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Assessment of system productivity of rice-maize cropping system under irrigated ecosystem

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Abstract

Rice-Maize systems currently occupy approx. 3.5 million hectares in Asia. The highest acreage is in India followed by Nepal. Rice, wheat and maize are the major crops of India. Rice-based cropping systems, with wheat or maize as a secondary crop, are predominant in India. Rice and maize is the two principal cereals crop of Chhattisgarh state. The present study was examined assessment of system productivity (rice equivalent yield) of rice-maize cropping system of Durg district of Chhattisgarh state. Data was collected from rice-maize grower families that were selected randomly from each selected 12 villages to make a sample size of 120 rice-maize farm families, with the help of pre-tested interview schedule. The result reveals that the maximum of the respondents (47.50%) were adopted rice-maize/wheat-fallow cropping system, pertaining to average cropping intensity of the respondents was found to be 200.82 per cent. Results on average yield of major crops rice and maize was 39.03 q/ha and 49.71 q/ha respectively. Findings on system productivity (rice equivalent yield) of prevailing cropping system illuminate that higher percentage (5.83%) of the respondents obtained maximum productivity (rice equivalent yield) from rice-maize/wheat/vegetables system (128.2 q/ha).

Keywords: System productivity (Rice equivalent yield) and rice-maize cropping system

Introduction

Rice, maize, and wheat are major cereals contributing to food security and income in South Asia. These crops are grown either as a monoculture or in rotations in tropical and sub-tropical environments of South Asia. In the irrigated and favorable rain fed lowland areas, rice-rice (R-R), rice-wheat (R-W), and rice-maize (R-M) are the predominant cropping systems. Rice-maize systems, however, are less extensive as compared to R-W or R-R if total area under these cereal systems is considered. Rice (*Oryza sativa* L.) and maize (*Zea mays*) are grown in 3.5 million hectares (Mha) in Asia that includes 1.5 Mha in South Asia. These crops are grown in sequence on the same land in the same year either in double- or triple-crop systems to meet the rice demand of a rapidly expanding human population and maize demand of livestock and poultry. Rice-maize systems are emerging all around South Asia but in particular are developing quite rapidly in Bangladesh and South and North India. Yield potential of rice and maize, as estimated by ORYZA2000 and Hybrid Maize models, reaches up to 15 and 22 t ha⁻¹ respectively. However, data from several environments in India reveal gaps between potential and attainable yields of maize of up to 100% and between attainable and actual yields of up to 25–50%. Rice-maize systems are distributed all over South Asia but more particularly in Bangladesh, India, Nepal, and Pakistan. Excluding China and Pakistan for which exact data for rice-maize area are not available, rice-maize systems currently occupy approx. 3.5 million hectares in Asia (Timsina *et al.* 2010) [16]. Excluding Pakistan, area under rice-maize systems is 1.31 million hectares in South Asia. The highest acreage is in India followed by Nepal. The absolute area under rice-maize system is less in Bangladesh compared to other south Asian countries but it is increasing rapidly over the past 5-6 years (Ali *et al.* 2009). Rice-maize systems are practiced mostly in the south (Andhra Pradesh, Tamil Nadu, and Karnataka) and in the northeast (Bihar and West Bengal) parts of India with acreage of more than 0.5 Mha Andhra Pradesh has the highest acreage under rice-maize system in South India where this system is rapidly increasing under resource-conserving technologies, mostly zero tillage (Jat *et al.*, 2009). Maize crop is cultivated in Chhattisgarh in 1.51 lakh ha area and its productivity is 1.2 tonnes per ha which is very low compared to national productivity (1.6 tonnes per ha) (Dhruw 2008) [4].

Materials and Methods

The present study was undertaken in Durg district of Chhattisgarh state during 2016-17 in all three blocks namely Patan, Dhamdha and Durg.

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From each selected block four villages on the basis of area under rice-maize cropping system were considered for this study. The rice-maize cropping system adopted 10 farmers from each selected block were selected as respondents from all 12 villages, thus a total of 120 farmers (10 X 12 = 120) were selected for data collection. The data were collected by personal interview with the help of well prepared, structured and pretested interview schedule. Data were analyzed using frequency distribution, percentages, and correlation coefficient.

The system productivity of each cropping system the rice equivalent yield was work out for each cropping system with the help of following formula-

$$REY = \frac{(YMC + YSC) \times PSC}{PMC}$$

REY = Rice Equivalent yield (q/ha)
 YMC = Yield of main crop (q/ha)
 YSC = Yield of secondary crop (q/ha)
 PSC = Price of secondary crop (Rs/q)
 PMC = Price of main crop (Rs/q)

Result and Discussion

The findings on major crops grown by the respondents in the study area are presented in Table 1. The data reveals that rice and maize are grown by all selected respondents, followed by 36.67 per cent of respondents had grown wheat, 30.83 per cent of respondents had grown chickpea, 10 per cent of respondents had grown mustard and only 9.17 per cent of respondents had grown summer rice respectively.

Table 1: Major crops grown by the respondents

Sl. No.	Crops	Percentage of respondents
1.	Rice	100.0
2.	Maize	100.0
3.	Wheat	36.67
4.	Chickpea	30.83
5.	Mustard	10.00
6.	Summer rice	9.17

Cropping pattern is the order in which the crops are cultivated on a piece of land over fixed period of time. The findings pertaining to cropping systems adopted by the respondents during 2016-17 are presented in Table 2. The data shows that higher per cent (47.50%) of respondents were adopted rice-maize/wheat-fallow cropping system, followed by rice-maize/chickpea (30.33%), rice-maize (28.33%), rice-maize/vegetables (19.17%). Other cropping system was found as rice-maize/mustard (10%), rice-maize/wheat/vegetables, rice-maize-summer rice (9.17%) and rice-maize/wheat-vegetables (5.83%).

Table 2: Distribution of respondents according to adoption of cropping system

Sl. No.	Cropping systems	Frequency	Percentage
1.	Rice – Maize	34	28.33
2.	Rice – Maize / Chickpea	37	30.33
3.	Rice – Maize / Mustard	12	10.00
4.	Rice – Maize / Wheat	57	47.50
5.	Rice – Maize / Vegetable	23	19.17
6.	Rice – Maize – Summer rice	11	9.17
7.	Rice – Maize / Wheat –Vegetables	07	5.83
8.	Rice – Maize / Wheat / Vegetables	11	9.17

Cropping intensity is the ratio between total cropped area and net cultivated area expressed in percentage. The findings regarding cropping intensity are compiled and presented in Table 3. It was observed that (70.83%) of the respondents had more than 200 per cent cropping intensity and 29.17 per cent of the respondents had 101 to 200 per cent cropping intensity. None of the respondents had cropping intensity up to 100 per cent.

Table 3: Distribution of respondents according to their cropping intensity (CI) (n=120)

Sl. No.	Categories	Frequency	Percentage
1.	Up to 100%	00	00
2.	101 to 200%	35	29.17
3.	More than 200%	85	70.83
Average CI		200.82%	

It is clear from the data that respondents were growing more than 2 to 3 crops in the field may be due to assured irrigation facility or other production facility and the average cropping intensity of the respondents was found to be 200.82 per cent. The findings towards average yield of major crops are presented in Table 4. It is clear from the data that rice are grown by the respondents with average yield 39.03 q/ha.

Table 4: Distribution of respondents according to average yield of major crops

Sl. No.	Crops	Average yield (q/ha)
1.	Rice	39.03
2.	Maize	49.71
3.	Wheat	21.86
4.	Chickpea	14.24
5.	Mustard	15.73
6.	Summer rice	39.51

The data pertaining to average yield of maize crop, it was found that maize are grown by the selected respondents in *rabi* season with average yield in the study area was found 49.71 q/ha. Regarding average yield of wheat crop, it was observed that wheat was grown by respondents with average yield of 21.86 q/ha. It was observed that chickpea was grown by respondents and its average yield was 14.24 q/ha. Further it was found that mustard was grown by the respondents with average yield 15.73 q/ha. Regarding summer rice, it was found that summer rice was grown by respondents with average yield 39.51 q/ha.

The findings towards system productivity (rice equivalent yield) of different cropping systems are presented in Table 5. and Fig. 1. It was observed that, among all the prevailing cropping systems, 5.83 per cent of the respondents obtained maximum productivity (rice equivalent yield) from rice-maize/wheat/vegetables system (128.2 q/ha), followed by rice-maize-summer rice, followed by 9.17 per cent of the respondents and obtained rice equivalent productivity (119.9 q/ha), by adopting rice-maize/chickpea system, about 30 per cent of the respondents obtained system productivity 87.9 q/ha, and from rice-maize/vegetable system 19.17 per cent of the respondents obtained system productivity 87.6 q/ha. From rice-maize system, 28.33 per cent of the respondents obtained productivity 86.1 q/ha, from rice-maize/mustard system, 10.00 per cent of the respondents obtained productivity 82.2 q/ha, rice-maize/wheat/vegetables system, 8.33 per cent of the respondents obtained productivity 81.8 q/ha, and from rice-maize/wheat system, 47.50 per cent of the respondents obtained system productivity of 78.2 q/ha respectively.

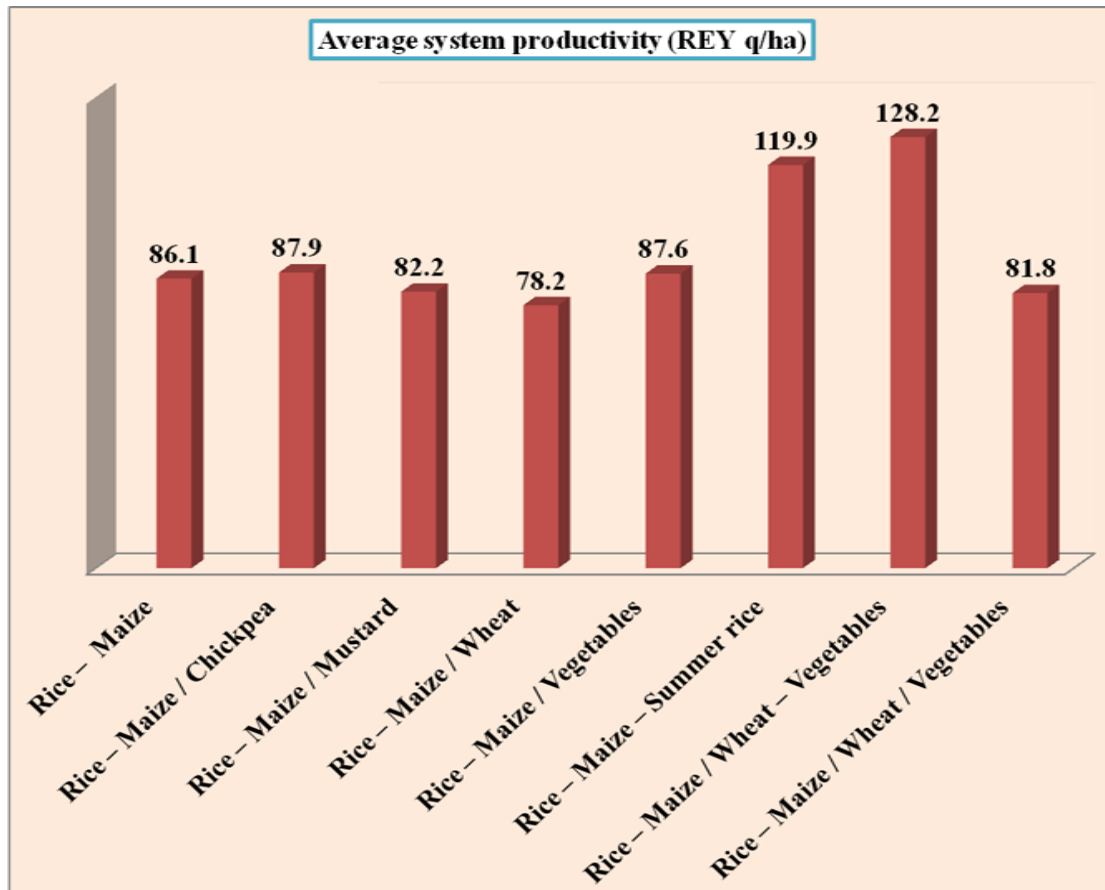
Table 5: Distribution of respondents according to system productivity (rice equivalent yield) of prevailing cropping system

Sl. No.	Cropping system	Percentage respondents	System productivity (REY q/ha)	Rank
1.	Rice – Maize	28.33	86.1	V
2.	Rice – Maize / Chickpea	30.33	87.9	III
3.	Rice – Maize / Mustard	10.00	82.2	VI
4.	Rice – Maize / Wheat	47.50	78.2	VIII
5.	Rice – Maize / Vegetables	19.17	87.6	IV
6.	Rice – Maize – Summer rice	9.17	119.9	II
7.	Rice – Maize / Wheat – Vegetables	5.83	128.2	I
8.	Rice – Maize / Wheat / Vegetables	8.33	81.8	VII

REY= Rice equivalent yield

The findings on system productivity of all cropping systems reveals that system productivity (rice equivalent yield) of rice-maize/wheat-vegetable system was found as highest (128.2

q/ha) among all the cropping systems and rice-maize/wheat was found as lowest system productivity (78.2 q/ha) among all the cropping systems.

**Fig 1:** System productivity (rice equivalent yield) of prevailing cropping system

Conclusion

This study reveals that the cropping systems adopted by the respondents during 2016-17 shows that higher per cent (47.50%) of respondents were adopted rice-maize/wheat-fallow cropping system. The majority (70.83%) of the respondents had more than 200 per cent cropping intensity because they were growing more than 2 to 3 crops in the field may be due to assured irrigation facility or other production facility and the average cropping intensity of the respondents was found to be 200.82 per cent. The findings towards average yield of major crops indicates that rice are grown by all the respondents with average yield 39.03 q/ha and pertaining to average yield of maize crop, it was found that maize are grown by all the selected respondents in *rabi* season with average yield in the study area was found 49.71 q/ha. The findings on system productivity (rice equivalent yield) of all cropping systems reveals that rice-maize/wheat-vegetable system was highest (128.2 q/ha) among all the cropping

systems and rice-maize/wheat was found as lowest system productivity (78.2 q/ha) among all the cropping systems.

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