Internat. J. Agric. Sci. Vol.3 No.2 June, 2007 : 127-129

Production potential and economics of rice-based cropping systems in hill zone of Karnataka, India

C. RAMACHANDRA*, M. SYED ANWARULLA, G. JANARDHAN AND PARASHIVA MURTHY
U.A.S., College of Horticulture, Mudigere, CHIKMAGALUR (KARNATAKA) INDIA

ABSTRACT

A field experiment was conducted during the year 2002-03 and 2003-04 on red sandy loam soil at Mudigere, hill zone of Karnataka, to study the productivity, profitability and energetic of different rice-based cropping systems under low land rice eco-system. Treatments comprised eight different cropping sequences with five varying fertility levels. Rice-soybean cropping sequence recorded the sustainable rice yield on long term basis. However, rice-bell pepper (181.0 q/ha) followed by rice-marigold (Rs.165.6 q/ha) registered the highest rice grain equivalent yield (RGEY). The highest net profit on per hectare investment was recorded with rice-marigold crop sequence (Rs.66573/ha). The production use efficiency (PUE) of rice-fodder maize was higher (111.0 kg/ha/day) than other cropping sequences. The highest land use efficiency (LUE)) was observed in rice-bell pepper cropping sequence (75.20%) over other treatments. Rice-rice or rice-fodder maize sequence had an adverse impact on yield sustainability as it decreased the yield. Rice-bell pepper and rice-marigold cropping sequences proved to be more remunerative over other cropping sequence.

Key words : Production potential, Profitability, Rice, Succeeding crops, RGEY, Net profit.

INTRODUCTION

Rice is the principal rainy season crop grown under rice-fallow in hill zone of Karnataka. The existing mono-rice cropping in low land is becoming less remunerative as only one crop of rice is being cultivated in a year. The need therefore, is to intensify agricultural production through increasing the cropping intensity that can be achieved through rice-based cropping system, as the rice being the main crop of the hill zone of Karnataka. The information on performance of different rice-based cropping sequences viz. cereal-cereal, cereal-legume, cereal-vegetable and cereal-flowers with regard to suitability, profitability and productivity are meagre. Hence, a study was carried out to assess the possibility of increasing the cropping intensity in low land rice by introducing short duration crops like, soybean, cowpea, radish, bell pepper, fodder maize and marigold in the cropping system to increase the productivity and profitability of the farmers of the zone through suitable cropping system.

MATERIALS AND METHODS

The field experiment was conducted for two years during rainy (*Kharif*) and post rainy (summer) seasons of 2002-03 and 2003-04 at Mudigere (Karnataka), situated in hill zone of Karnataka at a fixed site and layout. The soil of experimental site was red sandy loam soil having soil pH 5.50, organic carbon (1.57 %), available nitrogen, phosphorus and potassium 408.96, 20.85 and 248.96 kg/ha, respectively. The annual rainfall was 1875 and 1760 mm with mean maximum and minimum temperatures 26.53 and 17.43^{0}C, respectively during cropping years. The treatments comprised eight main plot treatments of cropping systems, *viz*. C_1: Rice-fallow; C_2: Rice- rice; C_3: Rice-soybean; C_4: Rice-cowpea; C_5: Rice-radish; C_6: Rice-bell pepper; C_7: Rice-fodder maize and C_8: Rice-marigold. Five sub plot treatments of fertility levels were F_1: Control; F_2: 50 per cent recommended dose of fertilizer; F_3: 75 per cent recommended dose of fertilizer; F_4: 100 per cent recommended dose of fertilizer and F_5: 50 per cent recommended dose of fertilizer + 5.0 tones of well decomposed *Chromoleana odorata* compost (on nutrient equivalent basis). The experiment was laid out in split-plot design with three replications. The crops included in different sequences were raised with recommended agronomic practices. Rice seedlings of 30 days were transplanted each year by the second week of July (*Kharif*) and crop was harvested during first week of December. The succeeding crops were sown after *Kharif* rice by the last week of December to second week of January during the post-rainy season. The details of varieties used, seed rate, fertilizer used and mean duration of crop sequence are given in Table 1. For comparison between crop sequences, the yields of all crops were converted into rice grain equivalent yield (RGEY) on prevailing prices (Yadav and Newaj, 1990). Land use efficiency (LUE) was calculated by dividing the total duration of crop sequences by 365 and expressed

* Author for correspondence.

Table 1 : Variety, seed rate, spacing, fertilizer dose used and mean duration of crops

Crop sequence	Variety	Seed rate (kg/ha)	Spacing (cm x cm)	Fertilizer dose (kg/ha)			Mean duration of crops (days)
				N	P_2O_5	K_2O	
Kharif crop							
Rice	Intan	62.00	20x10	60	75.00	90.0	160-170
Succeeding crops (summer)							
Rice	IR-20	62.00	15x10	75	75.00	90.0	110-120
Soybean	KHSB-2	62.50	30x10	25	60.00	25.0	90-100
Cowpea	C-152	20.00	45x10	25	50.00	25.0	90-100
Radish	Arka Nishant	12.50	30x15	75	37.50	37.5	45-50
Bell pepper	Arka Gaurav	0.32	60x45	150	75.00	50.0	110-120
Fodder maize	South African Tall	100.00	30x10	100	50.00	25.0	70-75
Marigold	African marigold	0.20	60x45	225	60.00	60.0	100-120

in percentage. Production use efficiency (PUE) value in terms of kg/ha/day was obtained by total production in a sequence divided by total duration of crop in that sequence (Tomar and Tiwari, 1990). An energy value for main produce (other than straw or green fodder) obtained from different sequences was computed as per Gopalan *et al*. (1971). Economics of various cropping sequences was calculated based on the prevailing local market prices.

RESULTS AND DISCUSSION

Performance of cropping sequences

The total productivity of rice based cropping sequence differed significantly due to cropping sequences and fertility levels (Table 2). Rice sequenced with fodder maize (27459 kg/ha) and rice-marigold (15719.0 kg/ha) produced the highest system productivity over other sequences. It may on account of higher yields of succeeding crops and confirms the findings of Raju and Reddy (2000). The results indicated that there was a decline in average rice yield with rice or fodder maize in sequence, whereas the rice yield remained more or less stable when sequenced with leguminous crops. The exhaustive nature of cereals included in the rice-based cropping sequence may be the reason for the decrease in rice yield (Jadhav, 1989), whereas inclusion of legumes or crops of lower biomass might have helped in maintaining soil nutrient status and intern the productivity or sustainability. The yield of succeeding crops in post-rainy season moderate. However, fodder maize, bell pepper and marigold recorded higher yield.

Rice Grain Equivalent Yield (RGEY)

Crop equivalent yield is an important index in assessing the performance of different crops under a given circumstances. The highest grain yield in terms of rice-equivalent yield (181.0 q/ha) was obtained by rice-bell pepper crop sequence, followed by rice-marigold (165.60 q/ha) and rice-rice (96.27 q/ha) cropping sequence. However, the lowest rice-grain equivalent yield was recorded with rice-rice (48.87 q/ha) and rice-fodder maize (57.15 q/ha) cropping sequences (Table 2). The highest rice-grain equivalent yield in rice-bell pepper and marigold based cropping systems was owing to higher yield potential and high market price and also efficient utilization

Table 2 : Grain yield of individual crop components, rice-grain equivalent yield and economics of different rice-based cropping systems (pooled data of 2 years)

Cropping sequence	Rainy season crop yield (kg/ha)	Post rainy season crop yield (kg/ha)	System productivity (kg/ha)	Rice grain equivalent yield (q/ha)	Economics	
					Gross returns (Rs./ha)	Net returns (Rs./ha)
Rice-fallow	4886.0	-	4886.00	48.87	36198	18088
Rice-rice	4237.0	5711.0	9948.00	96.27	73762	39343
Rice-soybean	5258.0	1127.0	6385.00	75.60	52194	26937
Rice-cowpea	4900.0	1066.0	5966.00	80.81	57974	30380
Rice-radish	4450.0	5895.0	10345.00	70.90	50250	22530
Rice-bell pepper	4199.0	8838.0	13037.00	181.00	119843	62283
Rice-fodder maize	3935.0	23524.0	27459.00	57.15	41295	15885
Rice-marigold	3933.0	11726.0	15719.00	165.60	127402	66573
CD (P=0.05)			779.03	10.44		

of time and space (Choudhary *et al*., 2000). The crops fertilized with recommended dose of fertilizer registered significantly higher equivalent yield. The interaction between cropping sequences and fertility level was found to be significant. Inclusion of soybean and cowpea in cropping sequence proved stable for increasing productivity and positive effect of legume crops on soil fertility was observed.

Table 3 : Biological efficiency and energy equivalents of different rice-based cropping system (pooled data of 2 years)

Cropping sequence	Mean biological efficiency			Energy equivalents (kg/ha)		
	Duration of crops sequence (days)	Production use efficiency (kg/ha/day)	Land use efficiency (%)	Digestible protein	Digestible carbohydrate	Digestible fat
Rice-fallow	166.0	29.21	45.40	332.00	3800.0	24.70
Rice-rice	282.5	34.12	74.60	676.80	7771.0	49.80
Rice-soybean	265.5	24.13	72.11	845.00	4338.0	246.40
Rice-cowpea	264.0	22.62	71.65	591.00	4435.0	35.50
Rice-radish	208.5	48.73	57.30	359.00	3656.0	28.30
Rice-bell pepper	277.0	45.14	75.20	407.20	3656.0	47.40
Rice-fodder maize	233.0	111.00	63.95	1372.00	8961.0	231.80
Rice-marigold	275.0	49.33	74.40	1069.00	12256.0	78.63

Biological efficiency of cropping sequences

The production use efficiency (kg/ha/day) was the highest in rice-fodder maize sequence(111.0 kg/ha/day), followed by rice-bell pepper (48.73) and rice-marigold (45.60) sequence, that might be due to higher yield of succeeding crops and was the lowest in rice-cowpea (24.13 kg/ha/day) crop sequence (Table 3). The highest land use efficiency (75.20%) was in rice-bell pepper, followed by rice-marigold (74.40%) and rice-soybean (72.11%) cropping sequences, because these sequences occupied the field for longest duration. It was the least in rice-fallow (45.40%) and rice-radish (57.30%) cropping sequences.

Energy equivalents (kg/ha).

The promising cropping systems in terms of energy equivalent of the crops, rice-sequences with fodder maize recorded the highest digestible protein (1372 kg/ha) and carbohydrate (8961.0 kg/ha) and rice-soybean crop sequence registered the highest digestible fat (246.40 kg/ha) than other cropping sequences (Table 3). Improvement in energy, protein and carbohydrate may be due to the highest grain production under the sequence.

Economics

Inclusion of vegetables and flowers in rice-based crop sequences gave higher net returns than other sequences as shown in Table 2. On pooled basis, rice-marigold crop sequence recorded the highest gross and net returns (Rs. 1,27,402 and 66,573/ha), followed by rice-bell pepper (Rs. 1,19,843 and Rs. 62,283/ha) and higher with other cropping sequences. Higher net return of these cropping systems was owing to the inclusion of vegetable and flower crops, which fetched high local market price and higher yield realized from the sequence. The study clearly indicates that rice-soybean sequence recorded sustainable rice yield on long term basis. However, inclusion of bell pepper and marigold in rice-based cropping system proved remunerative and more stable in comparison to other sequences. Therefore, rice-based cropping systems involving legumes, vegetable and flowers, viz. rice-soybean, rice-bell pepper or rice-marigold can be alternate suitable cropping sequences under low land rice-ecosystem of hill zone of Karnataka.

REFERENCES

Choudhary, J.B., Thakur, R.G., Bhargav, M. and Sood, R.D. (2000). Production potential and economics of maize (*Zee mays*)-based crop sequences on farmers field. *Indian J. Agron.*, **45(2) :** 232-235.

Gopalan, C., Ramasastri, B.V. and Balasubramanian, S.C. (1971). Nutritive value of Indian foods. *National Institute of Nutrition, ICAR, Hyderabad*, India.

Jadav, A.S. (1989). Nutrient balance with reference to fertilizer management under wheat based cropping system. *J. Maharastra Agric.Univ.*, **14 (3) :** 288-291.

Raju, R.A. and Reddy, M.N. (2000). Integrated management of green leaf compost, crop residues and inorganic fertilizers in rice (*Oryza sativa*)-rice system. *Indian J. Agron*., **45(4) :** 629-635.

Tomar and Tiwari, A.S. (1990). Production potential and economics of different crop sequences. *Indian J. Agron*., **35 (1/2) :** 30-35.

Yadav, D.S. and Newaj, R. (1990). Studies on increasing the utilization of natural resources through intensive cropping systems. *Indian J. Agron*., **35 (1/2) :** 50-55.

Received : June, 2006; Accepted : February, 2007