



Benefit cost ratio analysis of coconut based cropping systems

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Coconut is a crop of small and marginal farmers since 98 per cent of about 5 million coconut holdings in the country are less than 2 ha in extend. In Kerala, the palm is an essential component in the homestead system of farming. Coconut, a perennial crop which is committed to the land for decades, utilizes the natural resources like light, water and nutrients only to a very limited extent due to the peculiarities of its rooting pattern and canopy structure. The rooting pattern of coconut is such that only 25 per cent of land area is effectively utilized. A spacing of 7.5 meter in the square system is recommended for coconut (175 palms ha⁻¹) for optimum production. As canopy space utilization by coconut is very low, plenty of sunlight falling on the ground remain unutilized. Therefore, there is scope for exploiting the unutilized natural resources in a coconut garden so as to enhance the income of coconut farmer by introducing different cropping systems. A study was conducted at Vellayani, Kerala to find out the most economic cropping system in coconut garden.

A field experiment was conducted at the Instructional farm, College of Agriculture, Vellayani during the year 2004 - 05. The soil of the experimental site was red loam. The experimental area was lying under robusta banana intercropped with other annual crops during the previous years. The treatments consisted of ten cropping systems in coconut garden in the following combinations.

- T1 - 12 banana + 20 elephant foot yam (banana is planted at a spacing of 2 m apart and in the interspaces elephant foot yam is planted at 90 cm spacing.)
- T2 - 20 cassava + 20 elephant foot yam (cassava is planted at 90 cm spacing and elephant foot yam also at 90 cm spacing).

- T3 - 12 banana + 200 ginger (four inner corners of 2 meters bed) (banana - 2 m spacing, ginger 25 x 25 cm spacing in four inner corners of 2 m beds).
- T4 - 10 cassava + 10 elephant foot yam + 200 ginger (cassava 90 x 90 cm, elephant foot yam 90 x 90 cm, ginger 25 x 25 cm).
- T5 - 12 banana + 200 turmeric (4 inner corners of 2 m beds) (banana 2 x 2 m, turmeric 25 x 25 cm in four inner corners of 2 m beds).
- T6 - 10 cassava + 10 elephant foot yam + 200 turmeric (cassava 90 x 90 cm, elephant foot yam 90 x 90 cm, turmeric 25 x 25 cm in beds).
- T7 - 12 banana + 20 cassava (banana 2 x 2 m, cassava 90 x 90 cm).
- T8 - 12 banana + 10 cassava + 10 elephant foot yam (banana 2 x 2 m, elephant foot yam 90 x 90 cm, cassava 90 x 90 cm).
- T9 - 12 banana + 10 cassava + 100 ginger (banana 2 x 2 m, cassava 90 x 90 cm, ginger 25 x 25 cm in four corners of 1 meter beds).
- T10 - 12 banana + 10 cassava + 100 turmeric (banana 2 x 2 m, cassava 90 x 90 cm, turmeric 25 x 25 cm in the four corners of 1 meter beds).

Sole crops of banana, cassava, elephant foot yam, ginger and turmeric were raised separately and simultaneously in open.

The experiment was conducted in RBD having three replications. The fertilizers were applied as per package of practices recommended by Kerala Agricultural University for the respective crops. The population of individual crops in each

cropping system compared to sole cropping is given in Table 1.

(10.12 kg plant⁻¹) followed by banana in cropping systems T₃, T₁ and T₁₀ respectively, but not

Table 1. Population of coconut and intercrops in different treatments (ha⁻¹)

Treatment	Gross area basis					
	Coconut	Banana	Elephant foot yam	Ginger	Turmeric	Cassava
T1	175	2132	3555	-	-	-
T2	175	-	3555	-	-	3555
T3	175	2132	-	35555	-	-
T4	175	-	1777	35555	-	1777
T5	175	2132	-	-	35555	-
T6	175	-	1777	-	35555	1777
T7	175	2132	-	-	-	3555
T8	175	2132	1777	-	-	1777
T9	175	2132	-	17777	-	1777
T10	175	2132	-	-	17777	1777
Sole crop	175	2500	12345	100000	100000	12345

The yield data of all the crops tried in various cropping systems were statistically analysed and the results obtained are presented in Table 2. Economics of different cropping systems were worked out (Table 3) and the benefit cost ratio was calculated by dividing the gross income by the gross expenditure. The net returns were computed as the difference between the gross income and gross expenditure.

Table 2. Economic yield of banana, cassava, elephant foot yam, ginger and turmeric as influenced by cropping systems and sole cropping (kg plant⁻¹)

Treatment	Bunch yield of banana	Corm yield of elephant foot yam	Rhizome yield of ginger	Rhizome yield of turmeric	Tuber yield of cassava
T1	8.5 ^{ABC}	2.8 ^C	-	-	-
T2	-	4.1 ^{AB}	-	-	2.9 ^A
T3	9.1 ^{AB}	-	0.16 ^B	-	-
T4	-	3.5 ^{ABC}	0.11 ^C	-	3.4 ^A
T5	7.9 ^{BC}	-	-	0.08 ^A	-
T6	-	3.7 ^{ABC}	-	0.08 ^A	2.8 ^A
T7	7.7 ^{BC}	-	-	-	2.1 ^A
T8	7.7 ^{BC}	3.2 ^{BC}	-	-	2.3 ^A
T9	7.1 ^C	-	0.13 ^C	-	1.8 ^A
T10	8.4 ^{ABC}	-	-	0.11 ^A	2.1 ^A
Sole crop	10.1 ^A	4.3 ^A	0.19 ^A	0.12 ^A	3.8 ^A

(Means with the same letter are not significantly different)

The results of the study revealed that the bunch yield of banana var. Nendran was significantly influenced by treatments and the highest per plant yield was observed in sole crop banana

significantly different between treatments. Banana is a sun loving crop and the highest bunch yield in sole crop banana could be attributed to the highest incident radiation and hence the highest photosynthetically active radiation received by the sole crop banana without any shade.

Ginger, though a shade loving crop, the rhizome yield was found the lowest in coconut garden (Table 2). This might be due to the increased shade in cropping system in coconut garden compared to sole cropping. In ginger, various studies indicated that the rhizome yield increased upto 25 percent shade and thereafter declines.

There was no significant difference in corm yield of elephant foot yam between sole cropping and cropping systems. The highest tuber yield of 4.22 kg plant⁻¹ was recorded in cassava in cropping system T4, but on par with the tuber yield in other cropping systems and sole cropping. Eventhough cassava is a sun loving crop, the highest yield in cropping system in coconut garden could be attributed to the shade tolerant character of the new cassava variety 'Vellayani Hraswa' tried in the system.

In turmeric also there was no significant difference between cropping systems and sole cropping. Like ginger, turmeric is also a shade loving crop and performs well upto 25 per cent shaded situation. This might be the reason for the similar yield in cropping systems and sole cropping, wherein other cropping systems the shade levels were more

Table 3. Economics of different cropping systems in coconut garden (Rs ha⁻¹)

Cropping system	Intercrop	Expenditure (Rs)	Produce (t/ha) crop (Rs)	Value of individual (Rs)	Gross income (Rs)	Gross expenditure (Rs)	Net income	BC ratio																																																																																																																																				
T1	B (12)	1,90000	18.12	2,19464	3,08896	2,69000	39896	1.15																																																																																																																																				
	EFY (20)	54000	9.95	79632					T2	C (20)	25000	10.31	41240	1,69080	104000	65080	1.63	EFY (20)	54000	14.58	1,16640	T3	B (12)	1,90000	19.40	2,32812	3,66088	2,45000	1,21088	1.49	G (200)	30000	5.69	1,13776	T4	C (10)	12500	6.04	24160	1,63240	94000	69240	1.74	EFY (10)	27000	6.22	49760	G (200)	30000	3.91	78220	T5	B (12)	1,90000	16.84	2,02116	2,35680	2,30000	5680	1.02	T (200)	15000	2.84	17064	T6	C (10)	12500	4.98	19920	1,00124	79500	20624	1.26	EFY (10)	27000	6.58	52640	T (200)	15000	2.84	17064	T7	B (12)	1,90000	16.42	1,96992	2,43872	2,40000	3872	1.02	C (20)	25000	7.47	29880	T8	B (12)	1,90000	16.42	1,96992	2,65872	2,54500	11372	1.04	C (10)	12500	4.09	16360	EFY (10)	27000	5.69	45520	T9	B (12)	1,90000	15.12	1,81644	2,47164	2,42500	4664	1.02	C (10)	12500	3.20	12800	G (100)	15000	2.31	46220	T10	B (12)	1,90000	17.91	2,14896	2,48546	2,35000	13546	1.06	C (10)	12500	3.73
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than 25 per cent because of the presence of other taller plants. Eventhough the shade was more, the intercrop turmeric yields were on par with the sole crop yield showing the efficiency of the cropping systems with the particular planting pattern. The very low light intensities under shaded situation pose stress on plants because lack of irradiance limits photosynthesis and thus net carbon gain and plant growth (Lambers *et al.*, 1998).

Economic analysis of the study revealed the superiority of cropping systems by producing a benefit cost ratio of more than 1 (Table 3). The highest benefit cost ratio of 1.74 was in cropping system T4 involving cassava, elephant foot yam and ginger in coconut garden. The net income was the highest in cropping system T3 involving banana and ginger. When cassava was included in the system,

the net income decreased due to the low value of the crop (T4) when compared to the cropping system (T3). But when we take into consideration the food value/calorie value or energy value of the crop it is cassava the important. Similar results were obtained by Ravindran (1997) and Girijadevi and Wahab (2007). Cropping systems involving banana and cassava produced the lowest benefit cost ratio of 1.02, their net income were also the lowest among the systems (T7 and T9 respectively). Thus from the study it can be concluded that banana, ginger and elephant foot yam constitute ideal companion crops in coconut garden and thrive well as intercrops in coconut garden. The banana-cassava combination was not found remunerative with respect to the net income from the system as banana is high expensive crop and cassava is a low value crop.

The performance of different crops in suitable combination and population in coconut garden is economic than sole cropping of coconut. Inclusion of high value crops like ginger and banana increased the net income and inclusion of cassava, elephant foot yam and ginger increased the BC ratio. It was also observed that combination of banana and cassava in coconut garden is inferior to all other combinations with respect to net income and BC ratio.

References

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