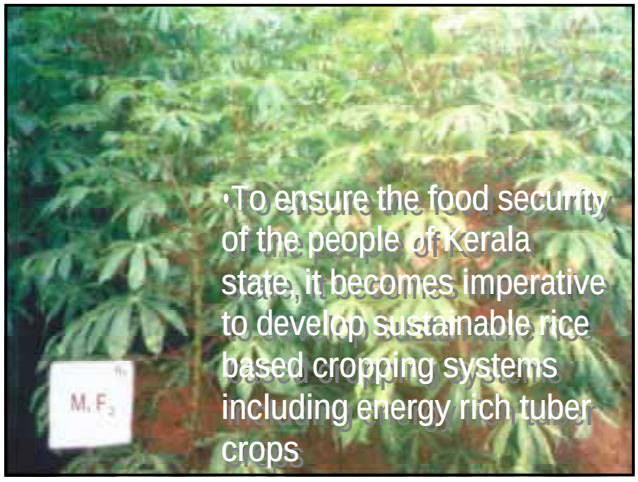
SUSTAINABILITY OF AN ALTERNATE CROPPING SYSTEM WITH RICE-CASSAVA-RICE IN SOUTHERN KER ALA

By

Dr.BABU MATHEW. P

- **The pre-requisite for a sustainable agriculture is the balanced supply of plant nutrients**
- **Achieved through the integrated nutrient management approach,**
- **Involves the use of high value organic manure such as vermicompost, biofertilizers along with inorganic nutrients**
- **Complementary use of organic, inorganic and microbial sources of plant nutrients can sustain the optimum crop yields and improve the soil health.**

- **The importance ascribed to sustainability at present is an appropriate attempt to promote organic manures, which can sustain soil health.**



MATERIALS AND METHODS

Two field experiments were conducted in farmer's field near College of Agriculture, Vellayani, Thiruvananthapuram, Kerala in three seasons, viz.,

Rabi (rice) 1998, 99
Summer 1999,2000 (cassava)
Kharif (rice)of 99,2000

Design - **Split -plot**

Main-plot treatments : (rabi rice)

M_1 - Vermicompost @ 3.33 t ha^{-1} + 75 per cent recommended NPK for Aiswarya + Azospirillum 2 per cent and Phosphobacteria 2 per cent sedling dip.

M_2- Vermicompost @ 3.33 t ha^{-1} + 50 per cent recommended NPK for Aiswarya + Azospirillum 2 per cent and Phosphobacteria 2 per cent Seedling dip.

M_3 - 75 per cent recommended NPK alone
M_4 - 50 per cent recommended NPK alone

(Recommended NPK for Aiswarya: 90 kg N, 45 kg P_2O_5 and 45 kg K_2O ha^{-1}.)

Subplot :
(Summer cassava)

F_1 - **No NPK fertilizers**

F_2 - **Recommended dose of NPK**

(50 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1})

Kharif rice cv Jyothi was raised after harvesting cassava without disturbing the plots. Recommended dose of NPK fertilizers (70 kg N, 35 kg P_2O_5 and 35 kg K_2O ha^{-1}) was given uniformly to all the plots.

- **Net return ha^{-1}**
- **Return per rupee invested**
- **Main Yield Equivalent (MYE)**
- **Per day Productivity**
- **Energy budgeting**

Return per rupee invested

The return rupee invested was calculated by the formula.

$$\frac{\text{Gross return (Rs.ha}^{-1})}{\text{Cost of cultivation (Rs. ha}^{-1})}$$

Main Yield Equivalent (MYE)

Main yield equivalent (rice) of the cropping system was calculated using the formula

$$\text{Main grain equivalent (rice)} = \text{Rice grain yield} + \frac{\text{tuber yield} \times \text{price of cassava}}{\text{Price kg}^{-1} \text{ of rice}}$$

Per day Productivity

Per day productivity of the cropping system was arrived at by using the formula

$$\text{Per day productivity} = \frac{\text{main yield equivalent (Rice grain)}}{\text{Total duration of the component crops in the system}}$$

Influence of INM on Main (rice) yield equivalent and per day productivity of the Cropping System

Treatment	Rice grain yield (Rabi and Kharif rice) kg ha^{-1} (a)	Cassava yield on the basis of rice yield equivalent kg ha^{-1} (b)	Main yield equivalent (MYE) kg ha^{-1} (a + b)	Per day productivity on the basis of MYE (kg ha^{-1} d^{-1})
M_1F_1	8260	3922	12182	34.31
M_1F_2	**8638**	**5014**	**13652**	**38.45**
M_2F_1	7613	3430	11043	31.10
M_2F_2	7889	4616	12505	35.22
M_3F_1	6842	3215	10057	28.32
M_3F_2	7097	4277	11374	32.04
M_4F_1	6208	3054	9262	26.09
M_4F_2	6583	3906	10489	29.54

Per day productivity

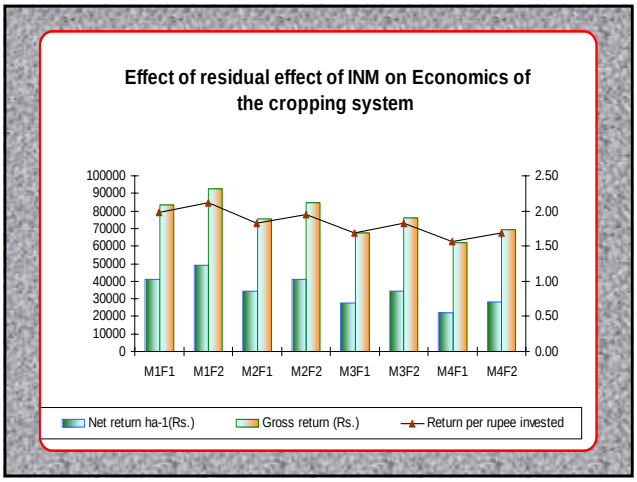
Highest per day productivity (38.45 kg ha^{-1}d^{-1}) and main yield equivalent (13652 kg ha^{-1}) was noticed in M_1F_2 (vermicompost +75 per cent NPK + biofertilizers in the first crop of rice and NPK fertilizers applied to the second crop, cassava),

Influence of residual effect of INM on system Economics of the cropping

Treatment	Cost of cultivation	Gross returns (Rs.)	Net Returns ha^{-1} (Rs.)	Return per Rupee invested
M_1F_1	41903	83255	41352	1.98
M_1F_2	43524	92335	**48811**	**2.12**
M_2F_1	41482	75540	34058	1.82
M_2F_2	43103	84380	41277	1.95
M_3F_1	40038	67530	27492	1.68
M_3F_2	41659	75905	34246	1.82
M_4F_1	39617	61965	22348	1.56
M_4F_2	412238	69420	28182	1.68

Economics of cropping system

In the cropping system of rice-cassava-rice, the highest net return ha^{-1} (Rs. 48,811) was obtained in INM treatment with vermicompost + 75 per cent NPK + biofertilizers) adopted in the first crop of rice and NPK fertilizers applied to the second crop of cassava (M_1F_2), followed by the treatment combination, M_1F_1



Energy budgeting

Energy budgeting was done using the every equivalents of productive inputs and outputs for each treatment as per the formula suggested by Baishyu and Sharma (1990).

$$\text{Energy ratio} = \frac{\text{Net energy returns } (Y - X)}{\text{Total input energy } (A + B)}$$

Where

A = Input energy excluding treatment (MJ)

B = Input energy for treatment (MJ)

A+B = Total input energy (X) in MJ

Y = Total output energy (MJ)

	Name	Energy equivalent per unit of input (MJ)
A.	Input	
1.	Rice seed	14.69 MJ kg^{-1}
2.	Farm yard manure	0.3 MJ kg^{-1} of dry matter
3.	Vermicompost	60.60 MJ kg^{-1} of nitrogen content
4.	Green manure	60.60 MJ kg^{-1} of nitrogen content
5.	Urea	60.60 MJ kg^{-1} of nitrogen content
6.	Mussorie rockphosphate	11.1 MJ kg^{-1} P_2O_5
7.	MOP	6.7 MJ kg^{-1} K_2O
8.	Plant protection chemicals	
	a. Fungicides	120 MJ kg^{-1}.
	b. Insecticides	120 MJ kg^{-1} or litre
9.	Labour	
	a. Man	15.68 MJ man day^{-1}
	b. Women	12.56 MJ woman day^{-1}

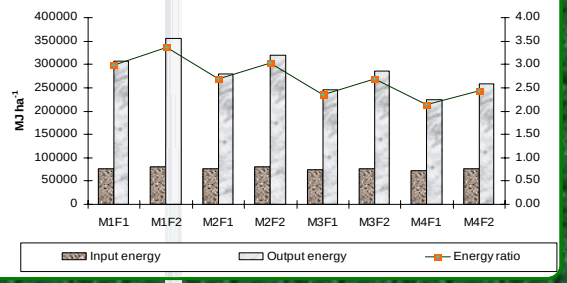
	Name	Energy equivalent per unit of input or output (MJ)
B.	Output	
1.	Plant biomass	10.00 MJ kg^{-1} of drymatter
2.	Paddy grain	14.69 MJ kg^{-1}
3.	Cassava tuber	5.6 MJ kg^{-1} fresh weight

Table 1 Influence of INM on Energetics of Rice

Treatment	Input energy Mj ha^{-1}	Output energy Mj ha^{-1}	Energy ratio
M_1F_1	26744	102397	2.80
M_1F_2	26744	111032	3.15
M_2F_1	26744	99328	2.71
M_2F_2	26744	105300	2.93
M_3F_1	26744	94540	2.53
M_3F_2	26744	102453	2.83
M_4F_1	26744	91902	2.43
M_4F_2	26744	98537	2.68

The highest energy ratio of 3.90 was recorded with the integration of vremicompost, 75 per cent NPK fertilizer and biofertilizer in first crop of rice and application of NPK fertilizer to the second crop cassava (M_1F_2).

. Effect of INM on Energetics of Rice- cassava-rice Cropping system



CONCLUTION

Studies evidently proved the suitability and sustainability of an alternate cropping system with rice-cassava-rice in southern Kerala with emphasis on INM in place of a traditionally followed cropping system of rice-rice fallow/blackgram-rice which in recent years, is becoming unattractive to the farmers due low benefit cost ratio and poor energy use efficiency