holding capacity, volume expansion and hydraulic conductivity did not show a defenite trend in all the directions with respect to cement kiln dust deposition.

Among the chemical properties, p^H and EC were comparatively higher for E_1 and E_2 pedons. This might be attributed to the release of Ca^{++}, Mg^{++}, Na^+ and OH^- ions from the cement kiln dust. This was in accordance with the results of Prasad *et al.* (1991). The cation exchange capacity of the surface horizons of E_1 and E_2 pedons was comparatively higher than the other pedons. This might be due to the enrichment of cations from the cement kiln dust. Oblisami *et al.* (1978) reported similar results. Among the exchangeable cations, Ca of E_1 was remarkably higher than other pedons. Apart from this, free $CaCO_3$, sesquioxides and acid insolubles were higher in E_1 and E_2 pedons when compared to all other pedons in all the four directions, which may be due to the nearness of these area to the cement dust transport which contained considerable amount of Ca, Fe, Al and SiO_2 in the cement kiln dust.

REFERENCES

DAKSHINAMOORTHY, C. and GUPTA, R.P. (1981). **Procedures for Physical Analysis of Soils and Collection of Agrometerological Data**. Division of Agricultural Physics, IARI, New Delhi, pp 53-55.

OBLISAMI, G., PADMANABHAN, G. and PADMANABHAN, C. (1978). Effect of particulate pollutants from cement kilns on cotton plants. **J. Air Pollut. Contr., 1**: 91-94.

PARTHASARATHY, S., ARUNACHALAM, N., NATARAJAN, K., OBLISAMI, G. and RANGASAMI, G. (1975). Effect of cement dust pollution on certain physical parameters of maize crop and soil. **Indian J. Environ. Hlth., 17**: 114-200.

PIPER, C.S. (1966). **Soil and Plant Analysis**. Bambay: Hans Publisher, 272 pp.

PRASAD, M.S.V., SUBRAMANIAN, R.B. and INAMDAR, J.A. (1991). Effect of cement kiln dust on (*Cajanus cajan* (L). Millsp. **Indian. J. Environ. Hlth., 33**: 11-20.

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COMPONENTS PRODUCTIVITY IN LOWLAND INTEGRATED FARMING SYSTEMS

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ABSTRACT

Field investigations were carried out under lowland farming at the Department of Agronomy. Tamil Nadu Agricultural University, Coimbatore for two years (1993-94 and 1994-95) to identify best mix from among poultry, pigeon, fish and mushroom components with cropping as base activity in comparision with cropping alone, Productivity of each component was recorded on their economic products and expressed as rice grain equivalent yield after conversion on the basis of unit price. Results indicated that integration of cropping with components like fish and mushroom as well as poultry and pigeon resulted in higher productivity than cropping alone under lowland integrated farming system.

KEY WORDS : Integrated farming System, component productivity, rice grain equivalent yield.

The average holding of farm in India has been declining and over 80 million out of 105 million operational holdings are below the size of one ha (Mahapatra and Bapat, 1992). Because of ever increasing population and decline in per capita availability of land in India, there is hardly any scope for horizontal expansion of land for food, feed and fibre production. Vertical expansion by integrating appropriate farming components requiring lesser space and time and ensuring higher total productivity of the system is the only alternate option left out. Aiming for increased total productivity per unit area in specified time is the ultimate way for sustainability of food production. Hence, the sustainable farming systems, economically viable and ecologically compatible encompassed with higher productivity to meet the present and future needs without jeopardizing the

potential, are to be optimized for specific agricultural domain. This could be possible through optimal crop and component link in accordance with the farm resources available in the farming system. Therefore, the present investigation on integrated farming system (IFS) was envisaged to identify an appropriate sustainable combination of components under lowland farming for the resource poor farmers.

MATERIALS AND METHODS

The components included in the IFS were cropping, fishery, poultry, pigeon and mushroom production. The components were selected bearing in mind their suitability to lowland situations of Tamil Nadu. Lowlands of Tamil Nadu possessing copious water supply at least for six to nine months have rice as dominant crop. This could very well provide opportunity for the linkage of fishery as component II in the programme. It has already been identified that droppings of poultry as a good source of feed for fish growth (Rangasamy *et al.*, 1995). Pigeon dropping with comparable composition as that of poultry dropping, not being tried earlier was also included to identify the feasibility to linkage in the lowland farming systems. Rice straw being a major input for the cultivation of edible mushroom and byproduct in the rice based system, mushroom component was added to explore its potentiality in generating income and employment on holistic approach.

Farming systems treatments

T_1	Conventional cropping systems with crop alone	0.40 ha
T_2	IFS with crop + fish (artificial feeding) + mushroom	0.40 ha
T_3	IFS with crop + fish + poultry + mushroom	0.40 ha
T_4	IFS with crop + fish + pigeon + mushroom	0.40 ha

Cropping

Conventional cropping systems **0.40 ha**

Sep.-Jan.	Feb.-Apr.	May-Aug.	
i Rice	- Green gram	- Maize	0.20 ha
ii Rice	- Sunhemp	- Maize	0.20 ha

Cropping systems in IFS **0.36 ha**

Sep.-Jan.	Feb.-Apr.	May-Aug.	
i Rice	- Soybean	- Sunflower	0.18 ha
ii Rice	- Gingelly	- Maize	0.18 ha

Fishery Fishpond 0.04 ha

Fingerlings belonging to six species were stocked at 400 number per 0.04 ha area of ponded water. Fish cultures were fed with three types of feed *viz.*, artificial feed. Poultary dropping and pigeon dropping in three different fish ponds. Grass carp in all the three feeding methods were fed with CO-1 Cumbu-Napier grass raised on the bunds of fish pond. Water level in all the ponds was maintained at 50 cm height initially at the time of release of fingerlings and subsequently raised to 60,70,80 and 90 cm at an interval of 30 days. From fourth month onwards, water level in the pond was maintained at 90 cm till the harvest of fish by pumping water every week.

Poultry

Twenty numbers of 18 week old Bapkok chicks were sheltered in a shed. The constituents of poultry feed used are:

Constituents	Composition (%)
Rice bran	35.0
Maize flour	25.0
Sunflower cake	9.5
Gingelly cake	9.5
Dried molasses	5.0
Alfalfa meal	3.0
Fish meal	6.0
Shell grit	4.5
Mineral mixture	2.5

Crop supplements constituted 87 per cent of poultry feed, which were worked out at production cost during the first year of the experiment. Recycling of farm wastes and produce from the crop component was used for the preparation of poultry feed in the second year. The alfalfa meal utilised in the poultry feed was obtained from alfalfa raised around the fish pond.

Pigeon

Forty pairs of pigeon were sheltered near the second fish pond. Birds were allowed to go for open grazing in the fields in and around the system and not been supplemented with any other material.

Mushroom

Mushroom cultivation was carried out with a capacity of 2 kg day^{-1} allowing recycling of paddy straw from the crop component. Five kg dried straw was cut into pieces of about 5 cm length and soaked in water for 6 to 8 hours and boiled for half an hour and after draining the water the chopped straw were shade dried for 20 minutes. The 100 gauge thick polythene tubes of size 30 cm x 60 cm were selected with perforation. Each polythene tube was tied with thread at base so as to make a bag. Three spawn bottles were used to prepare ten mushroom beds each with 500 g straw.

Productivity of components

Cropping : Productivity of the component crops in cropping in terms of grain yield was recorded and expressed as kg of rice grain equivalent yield (RGEY).

Fishery : In each species, five numbers were collected at random for measuring length and weight at monthly intervals and expressed the mean value in cm and g, respectively. Three staggered harvests of fish at 15 days interval from 315 days after stocking were done.

Poultry : Fowls started laying from 21st week onwards. Egg production from 20 birds was recorded every day and expressed as total number per month from the unit.

Pigeon : Prior to the commencement of the experiment, five productive pairs were thoroughly watched for one month for the purpose of quantifying the dropping and to identify the minimum pairs needed to provide voids to meet out 100 per cent feed requirement of the fingerlings proposed in 400 m^2 pond. Based on the mean weight of dropping from each bird in a day, it was worked out that 40 pairs were required to supply 2 per cent of the body weight of 400 fingerlings at all its growth phase up to one year when the harvest was completed in the contemplated programme. The growth rate of squab from the date of hatching to maturity was also studied to fix up best gain at which the same can be disposed for meat purpose. Accordingly the experiment was started with 40 productive pairs to satisfy the said need and the economics workout.

Table 1. Productivity (rice grain equivalent yield) of integrated farming systems (1993-94)

Farming systems		Component productivity (kg)					System Productivity (kg ha^{-1})
		Crop	Poultry	Pigeon	Fish	Mushroom	
FS_1	Cropping alone	10,131	-	-	-	-	10,131
FS_2	Crop (CPOM) + Poultry + Fish + Mushroom	12,226	3465	-	4803	10,746	31,240
FS_3	Crop (RPOM) + Poultry + Fish + Mushroom	12,590	3465	-	4803	10,746	31,604
FS_4	Crop (CPEM) + Pigeon + Fish + Mushroom	11,776	-	6281	4719	10,746	33,512
FS_5	Crop (RPEM) + Pigeon + Fish + Mushroom	11,643	-	6281	4719	10,746	33,389
FS_6	Crop (MSS) + Fish + Mushroom	11,045	-	-	5006	10,746	26,797

FS_1 ⟶ Rice - green gram - maize 0.50 ha
Rice - sunhemp - maize 0.50 ha

FS_2 to FS_6 ⟶ Rice - soybean - sunflower 0.45 ha
Rice - gingelly - maize 0.45 ha

CPOM : Composted poultry manure
RPOM : Recycled poultry manure
CPEM : Composted pigeon manure
RPEM : Recycled pigeon manure
MSS : Mushroom spent substrate

Mushroom : Daily mushroom production was recorded and expressed in kg.

The productivity of each component was converted into rice grain equivalent yield using the following formula and expressed in kg.

$$\text{Rice grain equivalents (kg)} = \frac{\text{Productivity of component (kg)} \times \text{Cost of component (Rs unit-1)}}{\text{Cost of rice (Rs kg}^{-1}\text{)}}$$

RESULTS AND DISCUSSION

The results on productivity have clearly brought out that integration of cropping with components like fish and mushroom as well as poultry and pigeon resulted in higher productivity than cropping alone during both year. In 1993-94 (Table 1), highest productivity (33512 kg) of RGEY was obtained by integrating pigeon + fish + mushroom and rice based cropping applied with composted pigeon manure to rice alone in the cropping system. The crop sequences under crop activity in the integrated farming systems tried *viz.*, rice-soybean-sunflower and rice-gingelly-maize contributed 35 per cent of the productivity followed by mushroom (32%), pigeon (19%) and fish (14%). Cropping with the application of either composted or recycled poultry manure integrating poultry + fish + mushroom resulted in 210 per cent higher productivity than cropping alone with a maximum share from crop (40%) followed by mushroom (34%).

Integration of crop received with composted or recycled pigeon manure + pigeon + fish + mushroom produced 230 per cent higher RGEY than cropping alone. However, only 165 per cent higher productivity was recorded by integration of cropping + fish + mushroom with maximum contribution from crop. (41%) and mushroom (40%) in the integration tried. There was a general increase in the mushroom (40%) in the integration tried. There was a general increase in the productivity of each farming system during 1994-95 (Table 2) with a similar trend of results as in 1993-94. However, the increase in productivity through integration of cropping with poultry + fish + mushroom, pigeon + fish + mushroom and fish-mushroom was respectively, 168, 188 and 129 per cent higher than cropping alone. The mean over two year (Table 3) also brought out similar trend of productivity response in each farming system.

Cropping as a base activity included in the IFS with rice-gingelly- maize and rice-soybean-sunflower resulted in higher productivity as a result of high grain yield produced by maize in the system. However, integration of allied activities

Table 2. Productivity (rice grain equivalent yield) of integrated farming systems (1994-95)

Farming systems		Component productivity (kg)					System Productivity (kg ha^{-1})
		Crop	Poultry	Pigeon	Fish	Mushroom	
FS_1	Cropping alone	11,787	-	-	-	-	11,787
FS_2	Crop (CPOM) + Poultry + Fish + Mushroom	12,942	3520	-	4550	10,465	31,477
FS_3	Crop (RPOM) + Poultry + Fish + Mushroom	13,177	3520	-	4550	10,465	31,712
FS_4	Crop (CPEM) + Pigeon + Fish + Mushroom	12,470	-	6637	4450	10,465	34,022
FS_5	Crop (RPEM) + Pigeon + Fish + Mushroom	12,310	-	6637	4450	10,465	33,862
FS_6	Crop (MSS) + Fish + Mushroom	11,692	-	-	4778	10,465	26,935

FS_1 ⟶ Rice - green gram - maize 0.50 ha
Rice - sunhemp - maize 0.50 ha

FS_2 to FS_6 ⟶ Rice - soybean - sunflower 0.45 ha
Rice - gingelly - maize 0.45 ha

CPOM Composted poultry manure
RPOM Recycled poultry manure
CPEM Composted pigeon manure
RPEM Recycled pigeon manure
MSS Mushroom spent substrate

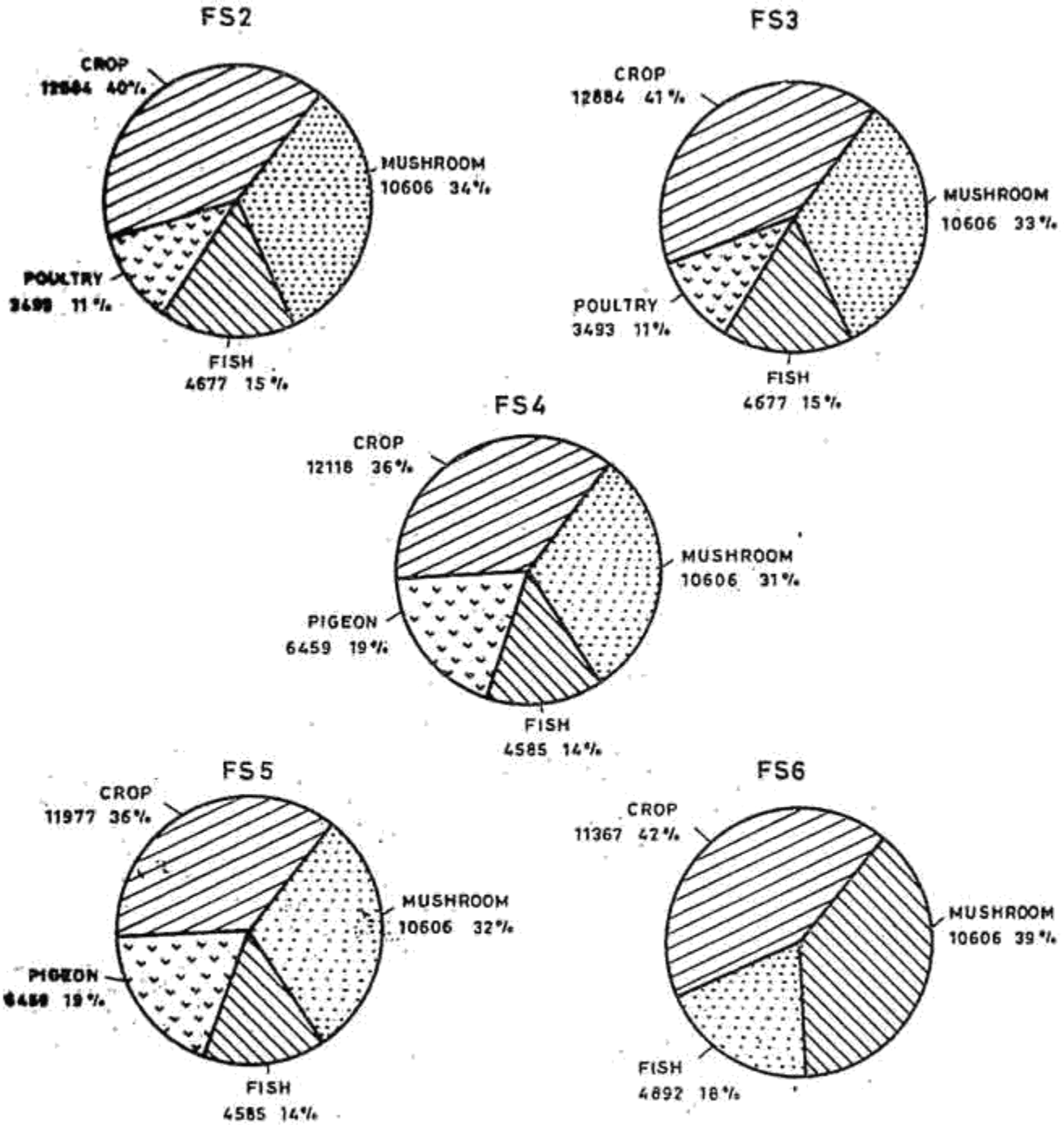

Fig.1 Component productivity in lawland integrated farming systems

such as pigeon/poultry rearing, fishery and mushroom cultivation contributed more to the total productivity of the farming system, as against cropping alone. Higher contribution of rice based cropping component in lowland IFS in Cauvery delta region was recorded by Govindan *et al.* (1990) and Western zone lowland farming system by Rangasamy *et al.* (1992) and Rangasamy *et al.* (1995). By virtue of inclusion of high yielding and nutrient responsive varieties in the study by replacing the local varieties popular among the farmers, and use of composted and recycled organic manures from allied enterprises linked would have helped in increasing the productivity of crops in integrated farming system. The efficiency of component linkage was evaluated predominantly

Table 3. Productivity (rice grain equivalent yield) of integrated farming systems (mean over two years)

Farming systems	Component productivity (kg)					System Productivity (kg ha^{-1})
	Crop	Poultry	Pigeon	Fish	Mushroom	
FS_1 Cropping alone	10,959	-	-	-	-	10,959
FS_2 Crop (CPOM) + Poultry + Fish + Mushroom	12,584	3493	-	4677	10,606	31,360
FS_3 Crop (RPOM) + Poultry + Fish + Mushroom	12,884	3493	-	4677	10,606	31,660
FS_4 Crop (CPEM) + Pigeon + Fish + Mushroom	12,118	-	6459	4585	10,606	33,768
FS_5 Crop (RPEM) + Pigeon + Fish + Mushroom	11,977	-	6459	4585	10,606	33,627
FS_6 Crop (MSS) + Fish + Mushroom	11,367	-	-	4892	10,606	26,865

FS_1 ⟶ Rice - green gram - maize 0.50 ha
Rice - sunhemp - maize 0.50 ha

FS_2 to FS_6 ⟶ Rice - soybean - sunflower 0.45 ha
Rice - gingelly - maize 0.45 ha

CPOM : Composted poultry manure
RPOM : Recycled poultry manure
CPEM : Composted pigeon manure
RPEM : Recycled pigeon manure
MSS : Mushroom spent substrate

on the basis of productivity of each component in the system. Stability of egg production with a productivity of 76 per cent (270 eggs per layer in a year), with least production cost and further its advantage as fish feed provided wider scope for inclusion of poultry/pigeon as a component in the lowland farming along with fish and mushroom associated with cropping (Fig.1). Similar increase in the total productivity of the IFS was reported by Devasenapathy *et al*(1995) by integrating cropping with dairy, fish, poultry and rabbit at Aliyar Nagar as compared to conventional cropping alone.

Experimental results on farming system for lowlands revealed that integration of cropping with components like fish, mushroom and poultry or pigeon resulted in higher productivity than cropping alone. Integration of 0.45 ha each of rice-soybean-sunflower and rice-gingelly-maize systems with pigeon (100 pairs), fish (0.1 ha pond with 1000 fingerlings) and mushroom (5 kg day^{-1})yielded higher RGE than the cropping alone with rice-green gram-maize (0.50ha) and rice - sunhemp - maize (0.50 ha) cropping in lowland farming systems.

REFERENCES

DEVASENAPATHY, P., MYLSWAMI,V., CHRISTOPHER LOURDURAJ, A., and RABINDRAN,R.(1995) Integrated farming systems for sustained productivity **Madras agric.J. 82**: 306-307.

GOVINDAN,R., CHINNASWAMI,K.N., CHANDRASEKARAN,B. BUDHAR,M.N. and PRICE,J.(1990). Poultry-fish culture in rice farming system in Cauvery delta region of Tamil Nadu. **Indian J. Agron. 35**: 23-29.

MAHAPATRA,I.C. and BAPAT.S.C.(1992). Farming systems research : Challenges and opportunities In:**Proc. XII National Symposium on Resource Management for Sustained Crop Production.** Indian Society of Agronomy, Bikaner, 25-28 Feb. 1992, pp. 382-390.

RANGASAMY,A., VENKITASAMY,R., PREMSEKAR,M and PALANIAPPAN,SP.(1992). Sustainable agriculture for rice based ecosystem. **Indian J. Agron., 37**: 215-219.

RANGASAMY,A., VENKITASAMY,R., PREMSEKAR,M. JAYANTHI,C., PURUSHOTHAMAN,S. and PALANIAPPAN,SP.(1995). Integrated farming system for rice based ecosystem. **Madras agric.J., 82**: 287-290.

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