GRIFFIN, J.L. and SAXTON, A.M. (1988). Reponse of solid-seeded soybean to flood irrigation.

JOHNSON, R.R. (1982). How high can crop yield go? **Better Crops With Plant Food 66** (winter) : 3-7.

RADHAKRISHNAN, R. MOHANDASS, S. and SIVANAPPAN, R.K. (1985). Influence of anti-transpirants on yield and water use of efficiency in grain sorghum. **Proc. National Seminar on Plant Phyiology.** pp. 101-104.

REDDY, P.S. (1985). Oilseeds-scope for big production rise. **Survey of Indian Agriculture.** pp. 71-76.

SINGARAM, S. 1990. **Irrigation Scheduling and Management Practices for Improving the Water Use Efficiency in Soybean.** M.Sc. (Ag) theis, Tamil Nadu Agricultural University, Coimbatore.

(Received : October 1996 Revised : May 1997)

Madras Agric. J., 84(8): 498-504 August 1997
https://doi.org/10.29321/MAJ.10.A00906

ECONOMIC EFFICIENCY OF COMPONENT LINKAGE IN LOWLAND INTEGRATED FARMING SYSTEM

C. JAYANTHI, A. RANGASAMY and C. CHINNUSAMY
Department of Agronomy
Agricultural College and Research Institute
Tamil Nadu Agricultural University
Coimbatore 641 003

ABSTRACT

Field experiments were conducted at the Department of Agronomy, Tamil Nadu Agriculturan University, Coimbatore to identify the best mix of components from among poultry, pigeon, fish, mushroom enterprises with cropping as base activity in comparison with cropping alone under marginal lowland farming condition for two years (1993-94, 1994-95). The economics of integrated farming systems was analysed interms of gross and net returns, returns per day and benefit cost ratio for the different combinations of components integrated in this programme. Results indicated that crop + pigeon + fish + mushroom integration was found to be superior in obtaining the highest net return to the tune of Rs. 90,252 ha^{-1} year^{-1} with higher per day return and benefit cost ratio of 2.44 in marginal lowland farming situation.

KEY WORDS : Integrated farming system, marginal lowland, returns, benefit cost ratio

Compounding the problem arising from the growing pressure of human population on the carrying capacity of the land and the productivity, the agricultural systems have encountered with various kinds of ecological and environmental problems. The ultimate goal of sustainable agriculture is to conserve the natural resource base, protect the environment, enhance the health and safety of human population over a longer period. This can be achieved by seeking the optimal use of internal production inputs in a way that provide acceptable levels of sustainable crop productity and livestock production resulting in economically profitable return. With a view to mitigate the risks and uncertainties of income from crop enterprises and to reduce the time lag between investment and returns, it is essential that the farmers include such of those enterprises in their production programme that yield regular and evenly distributed income throughout the year (Throve and Galgolikar, (1985).

More than 80 million farm holdings in India are below the size of 1.00 ha leaving no scope for expanding the individual farm size because of steady explosion of population with shrinkage of cultivated land due to urbanisation and industrialization (Mahapatra and Bapat, 1992). Therefore, the vertical expansion of agricultural production alone is possible by integrated appropriate farming components requiring lesser space and time and ensuring periodic income to the farmer. For assured regular income and decent living the farmer has to think of other allied enterprises with better complementarity to cropping activity. This is made possible through optimal crop and livestock mix, consistent with the farm resources immediately available. Hence, the present integrated farming system research was carried out to evolve an economically viable and sustainable farming system component integration for marginal lowland farming situations.

MATERIALS AND METHODS

The components included in the integrated farming system 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.,* 1990). Pigeon dropping with comparable composition as that of poultry dropping, not being tried earlier was also included to identify the feasibility of linkage in the lowland farming systems. Rice straw being a major input for the cultivation of edible mushroom and by product 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 alone0.40 ha
T_2	IFS with crop + fish (Artificial feeding) + mushroom0.40 ha
T_3	IFS with crop + fish + poultry + mushroom0.40 ha
T_4	IFS with crop + fish + pigeon + mushroom0.40 ha

Cropping

Conventional cropping systems 0.40 ha

Sep.-Jan.Feb.-Apr.May-Aug.

Rice-Greengram-Maize0.20 ha

Rice-Sunhemp-Maize0.20 ha

Cropping systems in IFS 0.36 ha

Sep.-Jan.Feb.-Apr.May-Aug.

Ric--Soybean-Sunflower0.18 ha

Rice-Gingelly-Maize0.18 ha

FisheryFishpond**0.04 ha**

Fingerlings belonging to six species were stocked at 400 numbers per 0.04 ha area of ponded water. Fish cultures were fed with three types of feed *viz.,* artificial feed, poultry 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 eighteen week old Bapkok chicks were sheltered in a shed. The constituents of poultry feed used are given below.

Constituents	Composition (%)	
Rice bran	35.0	
Maize flour	25.0	
Sunflower cake	9.5	87
Gingelly cake	9.5	
Dried molasses	5.0	
Alfalfa meal	3.0	
Fish meal	6.0	
Shell grit	4.5	13
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 utilized 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 guage 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.

The productivity of each component was recorded in their respective economic produce for analysing the economic returns. Economic analysis like cost of cultivation, gross and net returns and per day return were worked out and expressed in Rs. ha^{-1} for the components.

RESULTS AND DISCUSSION

The economics of integrated farming systems was analysed in terms of gross and net returns, return per day and benefit cost ratio for the component combinations tried in this study. The reality of integration could be achieved only by way of residue recycling from one component over the other and attaining maximum net return in a holistic approach. Resources like feed for poultry, fish and pigeon, substrate for mushroom production, organic manure from the wastes can be secured at least cost through proper integration in this system.

In 1993-94, highest gross return of Rs. 151666 was obtained by integrating pigeon + fish + mushroom + cropping applied with composted pigeon manure (Table 1). Cropping contributed 36 per cent of gross return followed by mushroom (31%), pigeon (19%), and fish (14%). Integration of cropping + pigeon + fish + mushroom resulted in 253 per cent higher net return than cropping alone. Highest return of Rs. 2.42 for every rupee invested was obtained by integration of pigeon + fish + mushroom with cropping applied with recycled pigeon manure. However, integration of fish and mushroom with cropping resulted in comparatively lesser net returns with the benefit-cost ratio of Rs. 2.12 as against Rs. 1.85 with cropping alone. The per day return was higher in cropping + pigeon + fish + mushroom activity than in cropping + poultry + fish + mushroom linkage.

The gross and net returns obtained during 1994-95 was higher than that of 1993-94 with highest gross return of Rs. 155092 obtained by integration of pigeon + fish + mushroom + cropping applied with composted pigeon manure (Table 2). Crop contributed 37 per cent of the gross return followed by 30 per cent with mushroom and 20 per cent in pigeon and 13 per cent from fish. Contribution of gross returns by cropping was to the tune of 42 per cent in crop + fish + poultry + mushroom combination followed by 33 per cent from mushroom. Increase in net returns by the integration of cropping + poultry + fish + mushroom and cropping + pigeon + fish + mushroom was 184 and 226 per cent, respectively, higher than the cropping alone. Whereas, integration of cropping + fish + mushroom resulted

Table 1. Economic analysis of integrated farming systems - (1993-94)

Farming systems	Cost of Production Rs ha^{-1}	Gross return Rs ha^{-1}	Net return Rs ha^{-1}	B-C. ratio	Per day return Rs ha^{-1}
FS_1 Cropping alone	29,559	54,670	25,111	1.85	150
FS_2 Crop (CPOM) + Poultry + Fish + Mushroom	64,111	1,41,171	77,560	2.21	388
FS_3 Crop (RPOM) + Poultry + Fish + Mushroom	63,883	1,42,939	79,056	2.24	392
FS_4 Crop (CPEM) + Pigeon + Fish + Mushroom	62,986	1,51,666	88,680	2.40	416
FS_5 Crop (RPEM) + Pigeon + Fish + Mushroom	62,758	1,51,449	88,691	2.42	415
FS_6 Crop (MSS) + Fish + Mushroom	57,152	1,20,871	63,719	2.12	331

FS_1 Rice - greengram - 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

Table 2. Economic analysis of integrated farming systems - (1994-95)

Farming systems	Cost of Production Rs ha^{-1}	Gross return Rs ha^{-1}	Net return Rs ha^{-1}	B-C. ratio	Per day return Rs ha^{-1}
FS_1 Cropping alone	29,559	57,898	28,339	1.96	159
FS_2 Crop (CPOM) + Poultry + Fish + Mushroom	64,111	1,44,019	79,908	2.25	395
FS_3 Crop (RPOM) + Poultry + Fish + Mushroom	63,883	1,44,681	80,798	2.27	396
FS_4 Crop (CPEM) + Pigeon + Fish + Mushroom	62,986	1,55,092	92,106	2.46	425
FS_5 Crop (RPEM) + Pigeon + Fish + Mushroom	62,758	1,54,287	92,529	2.46	423
FS_6 Crop (MSS) + Fish + Mushroom	57,152	1,22,603	65,451	2.15	336

FS_1 Rice - greengram - 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

in 131 per cent higher net returns than cropping alone with the distribution of income from various components being 43 per cent through crop activity, 40 per cent and 17 per cent through mushroom and fishery activity, respectively. Highest return of Rs. 2.46 was obtained by integration of cropping + pigeon + fish + mushroom for every rupee invested on cost of production. The per day return of the said integration was also higher (Rs. 424) than (Rs. 159) cropping alone.

The mean of two years (Table 3) found to be superior in crop + pigeon + fish + mushroom integration in obtaining the highest net return to the tune of Rs. 90252 ha^{-1} year^{-1} with higher per day return of Rs. 420 ha^{-1} and benefit-cost ratio of 2.44 than the benefit cost ratio of 1.90 with cropping alone. 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 resulting in higher net return, benefit - cost ratio and per day return. The

Table 3. Economic analysis of integrated farming systems - (Mean over two years)

Farming systems	Cost of Production Rs ha^{-1}	Gross return Rs ha^{-1}	Net return Rs ha^{-1}	B-C. ratio	Per day return Rs ha^{-1}
FS_1 Cropping alone	29,559	56,284	26,275	1.90	154
FS_2 Crop (CPOM) + Poultry + Fish + Mushroom	64,111	1,42,845	78,734	2.27	391
FS_3 Crop (RPOM) + Poultry + Fish + Mushroom	63,883	1,43,810	79,927	2.25	394
FS_4 Crop (CPEM) + Pigeon + Fish + Mushroom	62,986	1,53,379	90,393	2.43	420
FS_5 Crop (RPEM) + Pigeon + Fish + Mushroom	62,758	1,52,868	90,110	2.44	419
FS_6 Crop (MSS) + Fish + Mushroom	57,152	1,21,737	64,585	2.13	334

FS_1 Rice - greengram - 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 findings corroborate with the results of Govindan *et al.* (1990) and Rangasamy *et al.* (1995).

The process involved in the dynamic cycle comprising poultry, fish, mushroom along with crop as its base activity provided necessary resources for increased productivity of each component comparatively at cheaper costs. The constituents utilized for the preparation of poultry feed, to the tune of 87 per cent from the component crops like rice, maize, gingelly in the cropping system would help in reducing the production cost of egg in integrated farming systems. Rice cultivation even with best management technologies, could yield 8-10 per cent of illfilled and partly filled grains and this accounted for 35 per cent of poultry feed on hulling. Similarly, by using the grains of maize, gingelly and sunflower from the cropping component could result in reduced production cost of poultry, Rs. 0.53 egg^{-1}. as against Rs. 0.82 with commercial poultry farms. Economic advantage of poultry component in lowland integrated farming system was earlier reported by Sivaraj (1989) and Rangasamy and Jayanthi (1994) with better residue/waste recycling through allied components.

As an untapped component in terms of economics, pigeon added substantial amount of returns with minimum investment on its maintenance and production. Squabs produced by the pigeon component were disposed for meat purposes which has earned higher returns with minimum cost of production. It was identified that the squab attained its maximum weight on 10th week after hatching. However, highest meat recovery of 96 per cent was obtained at 30th day after hatching which was identified as ideal stage for disposal of squab. It was observed that pigeon moves out of its shelter for collecting shattered grains in the fields and it survived mainly on that as its economic value solely depends on the meat production which again helps the grower to maintain the unit at least cost. The results obtained in the study clearly indicated that pigeon is also a profitable component for linkage in the farming system programme (Fig.1).

The results on economic returns and residue recycling had clearly brought out the possibility of going in for inland fishery as a linked component in the lowland rice based farming system. Polyculture having the advantage of utilising the nutrient available in the entire water column maintained a higher productivity with lesser cost of production. Viability of fish component in lowland integrated farming system was earlier reported by many workers. Mushroom, a highly dependent component on rice based cropping provided greater share of income and employment under lowland integrated farming systems.

Integration of appropriate components in lowland farming system has resulted in enhanced income and employment generation as well provided the best opportunity for resource and residue recycling. Rice-soybean-sunflower and rice-gingelly-maize (0.90 ha) cropping integration with pigeon + fish (0.10 ha) and mushroom has resulted in higher net returns with major contributions from mushroom (30%) (Fig. 1). Economic efficiency by way of integration with mushroom was earlier reported by Loganathan (1989) in rice based integrated system for lowlands of Tanjore region by Govindan (1988) and Sivaraj (1989) and mushroom + poultry + fishery with rice based cropping system for lowlands by Rangasamy *et al.* (1992), and for Wstern Zone of Tamil Nadu. However, contribution of 32 per cent by rice-gingelly-maize and rice-soybean-sunflower cropping in pigeon + fish + mushroom integrated farming system has increased the net return considerably. Linkage of pigeon component with fish + mushroom and rice-gingelly-maize and rice-soybean-sunflower cropping recorded the highest net return of Rs. 90251 with proportionately higher contribution (20.8%) from pigeon than poultry (5.16%) in the place of pigeon in yet other system. Minimum cost of production encountered with pigeon component contributed for higher returns indicating the high productivity and efficiency of the linked components. Exclusion of the bird component either poultry or pigeon from the system linking rice-geingelly-maize and rice-soybean-sunflower cropping with fish and mushroom led to a considerable reduction of net returns (Fig. 1). Cost of production per kilogram of fish meat through artificial feed was Rs. 13.60 due to high cost of constituents of feed utilised in this treatment *viz.*, rice bran (40%), maize flour (40%) and gingelly cake (20%) as against the production cost of Rs.6.55 and Rs.6.68 with poultry and pigeon linked systems, respectively. The benefit-

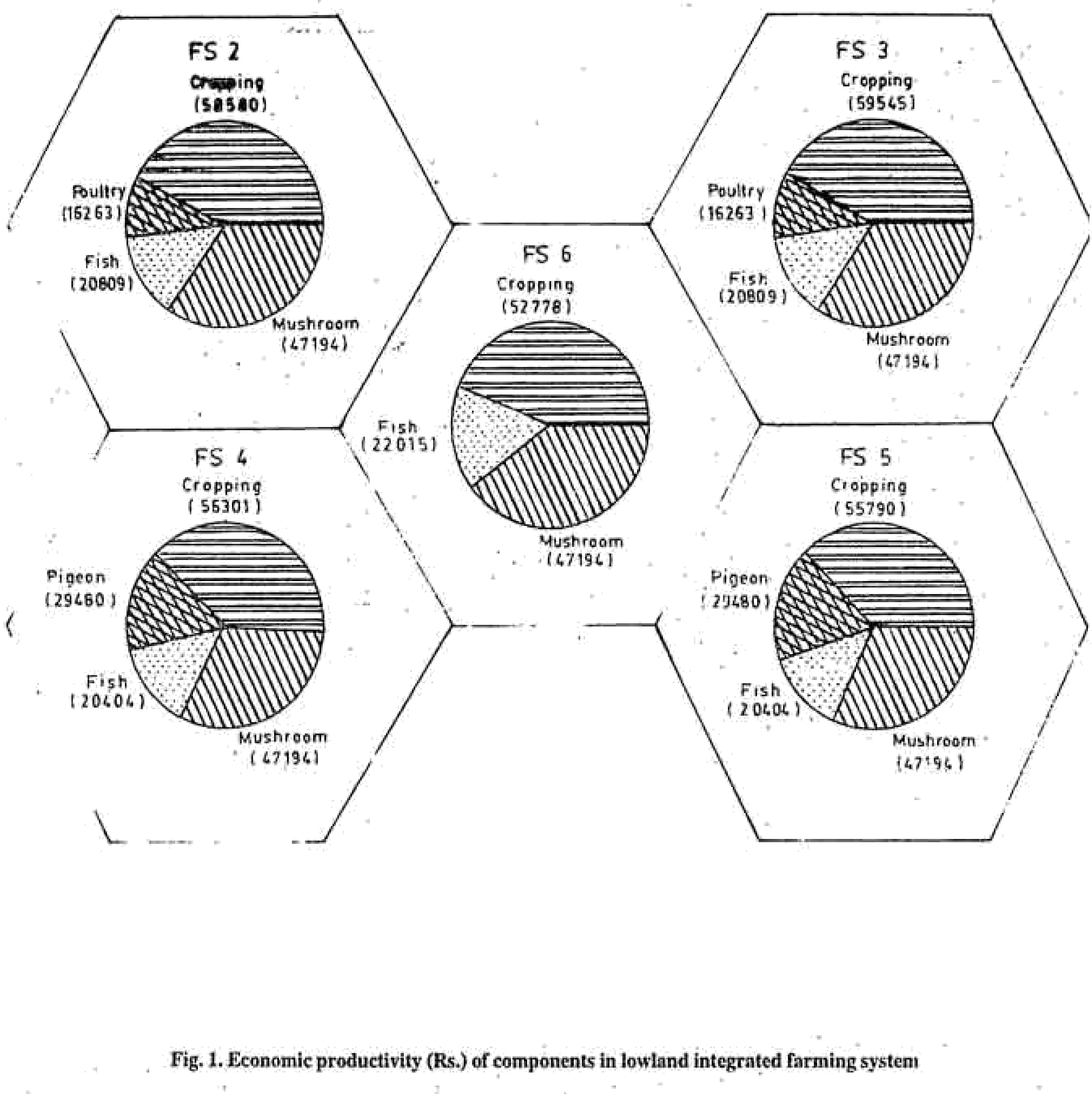

Fig. 1. Economic productivity (Rs.) of components in lowland integrated farming system

cost ratio realised with cropping + fish + mushroom has also clearly brought out the lower economic efficiency of the system.

Experiment of enterprise linkage for lowland farming systems revealed that rice - soybean - sunflower and rice - gingelly - maize cropping systems each in 0.18 ha with pigeon (40 pairs), fish (400 polyculture fingerlings in 0.04 ha of ponded water) and mushroom (2 kg day^{-1}) was the best in obtaining the highest gross and net returns with better per day returns and benefit - cost ratio under marginal and small farm situations.

REFERENCES

GOVINDAN, R. (1988), Role of Poultry cum Fish Culture on the Economics of Farming Systems in Thanjavur District of Cauvery Delta. M.Sc. (Ag.) Thesis Agricultural University, Coimbatore.

GOVINDAN, R., CHINNASWAMI, K.N., CHANDRASEKARAN, B. BUDHAR, M.N. and PRINCE, J. (1990). Poultry - fish culture in rice farming system in cauvery delta region of Tamil Nadu. Indian J. Agron., 35 [illegible]

LOGANATHA, P. (1989). Mushroom Cultivation as a Component in Integrated Farming System in Thanjavur District. M.Sc. (Ag.) Thesis. Coimbatore.

MAHAPATRA, I.C. and BEHERAPAT, 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. and JAYANTHI, C. (1994). Recycling of organic wastes in integrated farming systems. In: Proc. National Training on Organic Farming. GOI & Tamil Nadu Agricultural University. Coimbatore, 1-8 Sep., 1994., pp. 114-118.

RANGASAMY, A., SHANMUGASUNDARAM, V.S., SANKARAN, S. and SUBBARAYALU, M. (1990). Integrated farming system management : A viable approach. [illegible] Bulletin, [illegible] Agricultural University, [illegible]

RANGASAMY, A., VENKITASAMY, R., PREMSEKAR, M. and PALANIAPPAN, SP. (1992). Sustainable agriculture for rice based eco-system. 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.

SIVARAJ, S. (1989). Economics of Poultry and Fish Culture as a Component in the Farming Systems under Thanjavur District Condition. M.Sc. (Ag.) Thesis, Agricultural University, Coimbatore.

THROVE, P.V. and GALGOLIKAR, V.D. (1985). Economics of diversification of farming with dairy enterprise. Indian J. Agric. Econ., 11 : 717.

(Received : October 1996 Revised : February 1997).

Madras Agric. J., 84(8): 504-508 August 1997

SURGE IRRIGATION STUDIES IN SUNFLOWER

ARUNA RAJAGOPAL and R. DHANAPAL
Directorate of Publications
Tamil Nadu Agricultural University
Coimbatore 641 003

ABSTRACT

Surge irrigation was compared with continuous flow method of irrigation to find out the crop response, irrigation water requirement and water saving in sunflower crop. Sunflower hybrid MSFH 8 was grown in double row spacing of 120/2x30 cm (60 x 30 cm). There was no significant difference in yield between surge and continuous flow. However, there was 19.6 and 54.7 per cent saving of water in surge irrigation as compared to continuous flow and conventional farmers method respectively. It is due to the reduction in water front advance time in surge method particularly during the initial irrigation.

KEY WORDS : Surge flow, continuous flow, water front advance and recession

Sunflower is one of the important oilseed crops and often grown as rainfed crop. With the introduction of hybrids, it is imperative to go in for irrigation to maximise the production. A new method of irrigation, *viz.*, surge irrigation of delivering water in long furrows, with a series of 'ON' and 'OFF' modes with uniform time spans, was tested with the following objectives:

a) to find out the irrigation water requirement in surge compared to continuous flow for sunflower b) to study the response of sunflower to surge irrigation and c) to study the moisture distribution pattern.

MATERIALS AND METHODS

A replicated trial was carried out in black soil (FC-24%, [illegible], BD-1.45 Mgm^{-3}) at the Tamilnadu Agricultural University, Coimbatore during July, [illegible] to study the effect of surge and continuous [illegible] in 150 [illegible] furrows with a surge cycle [illegible] 0.5 (10 minutes ON and 10 minutes OFF) [illegible] in sunflower (MSFH. 8). Sunflower [illegible] 25 [illegible] both sides of the ridge [illegible] row [illegible] without altering the inter row [illegible] The [illegible] distance was 120 cm [illegible] and at [illegible] and it was 60 cm between [illegible] rows [illegible] rows on both sides [illegible] with [illegible] plant spacing in the row [illegible] cm). In [illegible] PVC 50 cm length with 7.5 cm diameter [illegible] provided at the head with [illegible] for easy [illegible] adopting Bulgarian [illegible] technique [illegible] *et al.* 1992). Considering [illegible] of 0.5 [illegible] flow rate of 1.5 lps was [illegible] Irrigation [illegible] scheduled at (IW/CPE [illegible] depth) all vegetative [illegible] During [illegible] productive phase irrigation was [illegible] at IW/CPE [illegible] 0.75 taking the actual [illegible] irrigation [illegible] that could be