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Integrated Farming System and its Effect on Farm Cash Income in Awka South Agricultural Zone of Anambra State, Nigeria

[1]C.O.A. Ugwumba, [2]R.N. Okoh, [2]P.C. Ike, [3]E.L.C. Nnabuife and [4]E.C. Orji

[1]Department of Agricultural Economics and Extension, Anambra State University, Igbariam, Nigeria
[2]Department of Agricultural Economics and Extension, Delta State University, Asaba Campus, Nigeria
[3]Faculty of Agriculture, Anambra State University, Igbariam Campus, Nigeria
[4]Centre Manager, National Open University, Anambra State, Nigeria

Abstract: This study reviewed types of integrated farming system (IFS), profitability of IFS and its impact on farm cash income in Awka agricultural zone of Anambra State, Nigeria. Structured questionnaires were used to obtain information from 84 respondents selected by random sampling technique. Data obtained were analyzed by means of gross margin and net farm income, profit function and multiple regression methods. The highest net farm income of N1,156,730.00 or $7,462.77 was recorded by crop-livestock-fish partial integration which is closest to the full integration of crop-livestock-fish-processing-biogas. Output price parameter accounted for more of the maximum variable profit in profit function analysis. Farm cash income was significantly influenced by level of farmer's education, years of experience, type of integration and cost of farm inputs. Farm cash income could be increased through the provision of subsides for inputs to reduce cost of production and enlightenment campaigns to improve farmer's knowledge and technical skills.

Key words: Agricultural system, Profitability, Farm cash income, Econometrics

INTRODUCTION

Farming and agriculture are respectively defined as the practice of cultivating the land or raising stock and the production of agricultural goods through the growing of plants and the raising of domesticated animals [1]. In the developing countries (Nigeria inclusive) frantic efforts have been made through research and enlightenment campaigns to encourage farming and thus ensure significant increases in agricultural production in order to feed and sustain the population that is increasing at geometric proportion. However, the increases recorded have often fluctuated considerably due to improper coordination of measures that support increased productivity [2, 3].

The sustenance of increased productivity must emphasize on the development of strategies aimed at maintaining improved yields without depleting natural resources or destabilizing the environment. Such strategies abound in IFS. Integrated farming (or integrated agriculture) is a commonly and broadly used word to explain a more integrated approach to farming as compared to existing monoculture approaches. It refers to agricultural systems that integrated livestock and crop production. Integrated farming system has revolutionized conventional farming of livestock, aquaculture, horticulture, agro-industry and allied activities [4]. It could be crop-fish integration, livestock-fish integration, crop-fish-livestock integration or combinations of crop, livestock, fish and other enterprises [2, 4-6].

The benefits of IFS over those of Traditional farming system, [7], cannot be over emphasized. Though agricultural systems are better practised on large expanse of land, subsistence farmers notable for their small holdings can equally engage in them, especially those involving homestead fish ponds [8]. This is because IFS has been confirmed to reduce cost of production and thus increase farmer's productivity, income, nutrition and overall welfare [5]. If properly adopted with investment in agriculture, IFS improves the personal savings and health of farmers [9]. Othman,[3], summarized the multifaceted benefits of IFS to include economic benefits in terms of increased food production; social function in terms of provision of employment opportunities for excess labour force displaced from other sectors in the urban areas.

Corresponding Author: C.O.A. Ugwumba, Department of Agricultural Economics and Extension, Anambra State University, Igbariam, Nigeria

Integrated farming system can be complete integration encompassing crops, livestock, fisheries, processing and biogas units [4, 10] or partial integration involving different combinations of the later units [10, 11]. Which ever is the case, IFS can remove all the farming constraints (such as shortage and high cost of inputs and environmental pollution) by not only solving most of the existing economic and even ecological problems, but also provide the needed means of production such as fuel, fertilizer and feed, besides increasing productivity many-fold. It can turn all the existing disastrous farming systems, especially in the world's poor countries into economically viable and ecologically balanced systems that will not only alleviate poverty, but can even eradicate it completely [4].

There is dearth of information on the types, extent of adoption and benefits of IFS in Awka agricultural zone of Anambra State. This is evidenced by the observed subsistence nature of farming and poor levels of cash income realized by farmers in the area [7]. This study sets out to specifically identify types of IFS, determine the profitability of IFS and examine the impact of IFS on farm cash income in the study area. It is therefore justified because information generated there from will not only enrich literature on IFS but will inform policy on programmes that will encourage speedy adoption of full IFS in order to drastically reduce poverty and increase the standard of living of the farmers.

MATERIALS AND METHODS

The Study Area: Awka agricultural zone is one of the four agricultural zones operational in Anambra state. It comprises of five Local government areas (L.G.As) namely: Awka north, Awka south, Anaocha, Njikoka and Dunukofia L.G.As. The agricultural zone is within the derived savanna vegetative zone. The topography is hilly and in many parts flood erosion is a major problem. The soil is classified as deep porous ferralithic which is easy to till but subject to excessive leaching because it is formed from sandstone [12].

Farming Is the Predominant Occupation: It is carried out at the family level and it is mainly for subsistence. The little surplus production that may be generated is sold for money used to purchase non-farm commodities. Planting of food crops like maize, yam, cassava and others is largely determined by weather conditions. Animals such as goats, sheep, poultry and in limited cases cattle are kept, while homestead fish farming (especially catfish farming) is gaining grounds [8].

The agricultural zone was chosen because of the prevalence of various types of IFS and the location of Awka city, the capital of Anambra state, with its fast growing population and commercial activities. The Capital city serves as a viable market for farm products produced in the zone.

Sampling Procedure: The five L.G.As in the agricultural zone constitute the sample space. A total of 42 communities are found in the zone.Farmers operating various types of IFS were identified via the technical assistance provided by officers of Anambra state agricultural development programme (ASADEP) in charge of the zone. Random sampling technique was then used to select a total of 84 respondents (two from each community) for the study.

Data Collection: Data for the study were collected through primary sources. Primary sources of data, which were cross-sectional, comprise of the use of structured questionnaire items administered to the farmers. On the other hand, secondary data were obtained from relevant publications. The questionnaires were administered with the assistance of trained enumerators. Primary data collected include types of IFS, quantities of farm inputs and outputs and their prices and some socio-economic and demographic characteristics of the farmers.

Data Analysis: Whole farm budget, profit function and multiple regression techniques were used to analyze the data and achieve the objectives. To determine the profitability of IFS, gross margin and net farm income analysis were employed in the whole farm budget. Whole farm budget is a projection of the total production, income and expenses of a farm business for a whole farm plan [13]. It involves the establishment of revenue and cost items of the enterprises that constituted a particular farm. This is subsequently followed by the determination of farm gross margin and net farm income [14].

The mathematical expression for the gross margin analysis is presented below:

$$GM = P_i Y_i - r_i c_i \quad (I = 1, 2, ..., n)$$

Where:

GM= Gross margin

P_i= Farm gate price of the ith product

Y_i= Output of the ith enterprise producing ith product

r_i = Market price of variable cost

c_i = Variable cost

n= Number of the ith enterprise

The net farm income was calculated by deducting fixed cost from gross margin in each case as:

Net farm income = gross margin – fixed cost.

To obtain the worth of each of the fixed cost items, the straight line method of depreciation was used and it was assumed that the salvage value of the fixed cost items used in production is zero. The straight line depreciation method used thus becomes:

$$\text{Depreciation} = \frac{\text{Purchase price}}{\text{No. of years of useful life of the asset}}$$

Profit function analysis was employed to estimate the profitability levels of individual resource inputs on crop, livestock or catfish enterprises. These inputs include variable and fixed capital items deployed by the enterprises in producing the various products. The profit function was used because of its importance in diagnostic analysis reflecting marginal resource profitability at mean levels of input price [15]. The profit function model is specified as follows:

$$\Pi^* = \Pi^* (P_y, P_1, P_2, P_3, P_4, Z_1, Z_2, Z_3)$$

Where:

Π^*= Amount of maximum variable profit (N)
P_y= Price of output (N)
P_1= Per unit price of planting materials (N)
P_2= Per unit price of livestock feed (N)
P_3= Per unit price of fish feed (N)
P_4= Per unit price of labour (N)
Z_1= Value of farm land (N)
Z_2= Value of matchet, wheel barrow, basin, etc. (N)
Z_3= Value of fish pond, livestock pen (N)

Note: Z_1, Z_2 and Z_3 are fixed cost items. They are not included in the analysis since the analysis is based on the short-run effect of input prices.

Multiple regression analysis following Koutsoyiannis, [16],was used to determine the effect of IFS on farm cash income. The multiple regression model is specified explicitly as follows:

$$Y = B_0+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+B_7X_7+ e$$

Where:

Y= Farm cash income (dependent variable) $X_1, X_2, \ldots\ldots, X_7$ (independent variables) and X_1 = age of farmer (years)
X_2= Household size
X_3= Level of farmer's education
X_4= Years of experience
X_5= Type of IFS (Dummy: partial integration = 1, full-integration = 0)
X_6= Cost of farm imputs (especially cost of poultry and fish feeds)
X_7= Gender (Dummy: male = 1, female = 0) $B_0 – B_{10}$ are regression coefficients

$$Fcal = \frac{MSR}{msr}$$

Where:

F_{cal}= Calculated F-statistic
MSR= Regression mean square
msr= Residual mean square

Degree of freedom (df) for variation due to regression = 7.
Degree of freedom for deviation from regression =(n-8)=76

There is a significant relationship between X_i and Y if $F_{cal} > F_{tab}$. F_{tab} is the value of F in the statistical table at the level of probability chosen. In this analysis the level of probability is at 0.05 or 5%.

RESULTS AND DISCUSSION

Types of Integrated Farming System (IFS): Integrated farming system in the study area involves such agricultural systems as shown in Table 1 below. None of the farmers engaged in full integration of crop-livestock-fish-processing-biogas production. Rather, all the farmers practised one form of partial integration, with majority (47.6%) engaging in crop-livestock integration.

About 29.76% of the farmers had incorporated catfish farming into their agricultural systems and are thus practising crop-fish-livestock integration. Other types of partial integration patronized by the remaining farmers include: Livestock-fish integration (11.90%); crop-fish integration (9.52%) and crop-livestock-agro-

Table 1: Types of integrated farming system

Type of IFS	Percentage
Crop-livestock	47.62
Crop-fish (catfish)	9.52
Crop-fish-livestock	29.76
Livestock-fish	11.90
Crop-livestock-agro processing	1.19
Total	100.00

Source: Field survey, 2008

Note: Livestock includes sheep, goat and broiler poultry while agro-processing mill refers to cassava tuber processing mill

processing (1.19%). The common feature of most integrated agricultural systems is that livestock and fisheries wastes are used as fertilizer for livestock and fish production; and livestock waste is also used to fertile the growth of various natural planktons in the ponds as fish feed.

Profitability of Integrated Farming System: Gross margin and net farm income: Gross margin and net farm income techniques employed in whole farm budget analysis were used as a measure of profitability of the various types of IFS in the study area. Results of the analysis are presented in Table 2. The results show that IFS is a viable system in the area. This is exemplified in the net farm incomes (NFIs) realized by the different types of partial IFS in the study area viz: livestock-fish integration (N719,580.00 or $4,642.45), crop-livestock integration (N785,830.00 or $5,066.65), crop-fish integration (N808,050.00 or $ 5,210.00), an crop-livestock-fish integration (N1,156,730.00 or $ 7,462.77). The highest NFI was recorded by the IFS with the highest number of enterprises. This suggests that the highest the number of viable enterprises integrated into an agricultural system the highest the expected profit. Results of this analysis

Table 2: Gross margin and net farm income estimates in whole farm budgets

			Revenue/variable cost			
Item	Qty/ha/enterprise	Price/unity (N)	Livestock-fish	Crop-livestock	Crop-fish	Crop-livestock-fish
Revenue						
Yam	1500 tubers	150	_	225,000	225,000	225,000
Maize	2000 kg	120	_	240,000	240,000	240,000
Cassava	15,000 kg	10	_	150,000	150,000	150,000
Sheep	10	8,000	80,000	80,000	_	80,000
Goat	10	10,000	100,000	100,000	_	100,000
Poultry (broiler)	200	1,500	300,000	300,000	_	300,000
Fish (live-catfish)	5,000 kg	300	1,500,000		1,500,000	1,500,000
Total Revenue (TR)						
Variable cost						
Yam set	1,200	80	_	96,000	96,000	96,000
Maize seeds	25 kg	150	_	3,750	3,750	3,750
Cassava cuttings	30 bundles	200	_	6,000	6,000	6,000
Labour (crops)				50,000	50,000	50,000
Fertilizer (crops)	13 bags	1,700	_	22,100	22,100	22,100
Goat (kids)	10	500	5,000	5,000	_	5,000
Sheep (lamps)	10	800	8,000	8,000	_	8,000
Poultry (chicks)	210	100	21,000	21,000	_	21,000
Feeds (goat, sheep and poultry)	400 bags	2,100	84,000	84,000		84,000
Medication/vet. Ser.			2,120	2,120		2,120
Miscellaneous (water, wood shaving electricity etc)	_	_	4,000	4,000	_	4,000
Labour (livestock)	_	_	3,800	3,800	_	3,800
First (Fingerlings)	5,200	10	52,000	_	52,000	52,000
Feeds (fish)	7,000 kg	150	1,050,000	_	1,050,000	1,050,000
Labour (fish)	_	_	15,000	_	15,000	15,000
Miscellaneous (water, electricity, etc)	_	_	10,000	_	10,000	10,000
Total variable cost (TVC)			1,254,920	305,770	1,304,850	1,432,770
Fixed cost (FC)						
(livestock and fish)			5,500	3,400	2,100	5,500
Gross margin[GM] =TR –TVC			725,080	789,230	810,150	1,162,230
Net farm income[NFI] = GM – FC			719,580	785,830	808,050	1,156,730

Source: Field survey, 2008

Note: One US Dollar ($) – N155.00

Table 3: Profit function estimation

Parameter	Coefficient	Standard error	t-value
Price of output	3.142	0.170	17.751**
Price of labour	-8.230	0.047	0.029
Price of feeds	-16.671	0.095	5.632**
Price of planting materials	11.530	0.041	0.004
Price of livestock/Catfish seeds	-4.715	0.048	0.015
Intercept	-3.492	0.519	0.00041
R^2	0.812		
F-statistics	47.630*		

Source: Field survey, 2008 *Significant at 10% **Significant at 5%

Table 4: Multiple regression results for effect of IFS on farm cash income

Independent variables	Coefficients	t – values
Constant	52,700	15.942**
Age of farmer	4.166	0.562
Household size	-9.154	-1.146
Level of farmer's education	8.671	3.781**
Years of experience	11.231	4.563**
Type of IFS	41.269	7.129**
Cost of farm inputs	-25.685	-2.784*
Gender of farmer	-3.712	-1.694
R^2	0.781	
F-statistic	27.126	

Source:Field survey, 2008 *Significant at 5% **Significant at 1%

lend credence to the conclusion that IFS is the key to poverty eradication because it drastically reduces cost of production thus engineering economic viability and ecological sustainability [4].

Profit Function Analysis: The profit function analysis was deployed to determine the effect of the prices of output an variable inputs and the fixed input quantities on the amount of maximum variable profits. The result of the profit function analysis is presented in Table 3.

The results shows that the overall model is statistically significant implying that the variable price items contributed significantly to profit. Again, the R^2 figure of 0.812 indicates that the combined effects of the variable price items in the function explained about 81% of the variation in maximum variable profit. This situation is also confirmed by the F-statistics significant value of 47.630. Price of feeds especially catfish and poultry feeds is negatively correlated with profit implying that farmers who adopt systems that reduce cost of feeds will make more profit. The t-statistic shows that the price parameters for planting materials, labour and livestock /fish seeds have no significant effect on profit, while the output price parameter accounts for more. This suggests that high output price enhances income and profit of IFS.

Impact of IFS on Farm Cash Income: It is hypothesized that farm cash income of the survey farmers was influenced by certain variables including age of farmer; household size; level of farmer's education; years of experience; type of IFS; cost of farm inputs; and gender of farmer. These variables were analyzed using the multiple regression method to find their effects on farm cash income. The result is shown in Table 4.

The coefficients of level of farmer's education, years of experience and type of IFS are positively signed as expected. This implies that farmers who are educated, have more years of experience and can combine many viable enterprises tend to be more efficient in production and consequently will realize more income. This agrees with respective findings of Adeoti,[17] and Chan, [4], that years of experience and type of IFS reduce farmer's inefficiency and thus increase productivity and income.

The coefficient of household size is negative and statistically insignificant. This means that the agricultural systems depend more on hired labour. Most family labour are more likely to be engaged in non-farm activities. Farmer's age has no significant effect on farm cash income but it is positively correlated with it, implying that older farmers earn more cash income from IFS than younger ones. The reason could be that they are more experienced and have over the years accumulated resources to invest in IFS.

The dummy coefficient of type of IFS is positive and significant. This suggests that, though most of the farmers practise partial integration, those who combine more viable enterprises (catfish farms inclusive) will realize higher income. Dummy coefficient for gender is negatively signed and insignificant. Implying that farm cash income does not increase with more participation of men. This is however, contrary to the finding of Yusuf and Malomo,[18], that poultry farmers' technical efficiency increases with more participation of men.

Cost of farm inputs has negative relationship with farm cash income but significant at 5% level. This is in line with a prior expectation and implies that any measures that can reduce cost of livestock or catfish feed, while maintaining high quality will lead to increase in farm cash income.

CONCLUSION

The study highlighted the impact of IFS on farm cash income. Majority of the farmers in the study area practised partial integration. Results revealed that all types of IFS are on the average profitable. Net farm income realized by farmers who maintained crop-livestock-fish integration was the highest. Implying that farmers who want to achieve full integration and thus earn more income and escape from poverty will target the combination of more enterprises including crops, livestock, fisheries, processing and even biogas.

Farm cash income was positively influenced by farmer's age, level of education, years of experience and type of integration. It was, however, negatively influenced by household size, cost of farm inputs and gender of farmer. Farm cash income can be improved by directing policy towards measures that will reduce cost of inputs and increase farmers knowledge and technical skills. Such measures may include subsidization of inputs and enlightenment campaigns in form of trainings, workshops and seminars.

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