Comparative Economic Analysis of Crop-Livestock Integration among Smallholder Maize Farmers in the Derived Savanna Zone of Southwestern Nigeria

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Abstract
Development objectives in most developing countries are moving towards the management and conservation of the land resource base, while striving for greater agricultural production. This paper examines the possible synergy of combining crop and livestock technologies on land quality and net returns among maize farmers in the derived savanna agro-ecological zone of Southwestern Nigeria. A three-stage sampling technique was used to select 100 respondents of equal numbers of maize farmers and maize-livestock farmers. Primary data on the farmers' socio-economic characteristics and the costs and returns to maize production were collected with a pre-tested structured questionnaire in the 2004 production season. The data were complemented with information from two focus group discussion (FGD) sessions and secondary data from the Ogbomosho north local government secretariat. The data were analysed using descriptive statistics, costs and return analysis and regression techniques. Mono-cropping farmers have higher level of farm education, farm size, more extension contact and longer fallow period. However, these farmers suffer from insects and pests infestations. The crop-livestock farmers on the other hand, have longer years of farming experience but suffer from bad odour emanating from animal wastes and did not have enough labour services. Regression results showed that cost of labour, choice of enterprise, level of education, farming experience, farm size and gender relations are factors that need to be considered in any policy strategy aimed at improving the livelihood of people in the study area. Budgetary analysis showed that the net return (₦34,853.6 per ha) to maize mono-cropping is statistically (5% level) lower than the net return (₦42,153.1 per ha) to crop-livestock farmers. This implied that maize-livestock integration is an economically preferable farming system in the study area. Extension services should focus more on the management of farm-level information.

Key words: Crop-livestock, Smallholder, Maize farming, Gross margin, Regression, Savanna.

INTRODUCTION

In Nigeria, the fixity of the land resource coupled with the increasing rate of population growth at about 3.0% per annum (CBN, 2003), and the competing economic, social, and industrial demands for land have led to increasing land pressure and a reduction in the available agricultural land. Hence, the average farmland available per capita has reduced from 1.77 ha in

1963 to a projected estimate of about 0.83 ha in 2003 (Olayemi and Ikpi, 1995; CBN, 2003). The resulting land fragmentation, coupled with the intensification of land use, with the same area being continuously cultivated overtime, have led to changing tenure arrangements that are associated with land degradation (Awe, 1997; Adebayo, 1997). This has led to a reduction in soil fertility, reduced farm yield and income levels.

Evidence from Olayide *et al.*, (1981) and Ogungbile *et al.*, (1999) showed that only 70 million ha or 73% of the 91.2 million ha total land area in Nigeria can be put under cultivation with just about 0.85 ha available per head, and this diminished progressively over time as population pressure mounted. This has made more difficult the traditional farming systems of shifting cultivation and bush fallow as evidenced by progressively shortened fallow periods and expansion into marginal lands (FAO, 1986; Lele and Stone, 1989; McIntire *et al.*, 1992; Hanson *et al.*, 2003). These changes have resulted in reduced productivity and the emergence of unsustainable farming systems with potentially disastrous consequences for resource-poor households, their food security status and on the environment.

Attempts have been made overtime in the use of soil improvement techniques such as crop rotation, and the application of organic and inorganic fertilizers. In the recent time, the use of inorganic fertilizer is common. However, the high price and scarcity of the fertilizers and the variation in net benefits across agroecological zones, call for the need to identify appropriate and affordable strategies and technologies. These will maximize farmer's benefits from limited input use without adverse effects on the natural resource base (Aduayi, 1985; Awe, 1997; Adepetu, 1997; Schiere *et al.*, 1997; Tarawali *et al.*, 1997; and Bamire 1999). Ogungbile *et. al.*, (1999) and Delve *et. al.*, (2000) claimed that the only alternative to these is the use of organic fertilizers. However, rather than resort to the traditional manure-transported mixed farming approach, Delve *et al.*, (2000) showed that as farmers gain knowledge of livestock production, the organic manure derived from the integration of crop and livestock becomes an important strategy to increase land productivity and optimize the biophysical input values. According to Williams et al., (1994), Hanson *et. al.*, (2003) and Butare (2003), the integration of crops and livestock is often considered as a step towards sustainable agricultural production because of the associated intensified organic matter and nutrient cycling, which increase the bioenergetic efficiency of agriculture and preserve the quality of farmland.

The presence of livestock on the farms also plays a vital role as capital assets for security and as a means of saving for cash income and in nutrient flows (De Haan *et al.,* 1997). The crop-livestock integrated systems are therefore believed to have the highest potential for increasing productivity in a sustainable manner among the farming systems in the West African sub-region, as it is closely associated with increasing agricultural intensification and higher productivity without jeopardizing the land resource base (ILRI, 2000). This is capable of increasing the net returns to farmers as well as better their livelihoods and standard of living (Hanson *et al.*, 2003).

ILCA report of 1979 and McIntire *et al.*, (1992) had shown that cereal-livestock integration is the most common practice in crop-livestock integration systems in developing countries' agriculture including Nigeria. Among the cereal crops cultivated, maize, which is a major food staple in these areas, is of interest to most farmers and most common, since it has a wide agro-climatic coverage, and has attained a commercial level on which many agro-based industries depend as source of raw materials. In Nigeria, it is used for producing corn flour, animal feed and a wide range of traditional meals ranging from snacks to soups.

Due to the diverse utility of maize and various uses of the products that could be obtained from it, demand for this crop has continuously risen over the years than its supply (Akpoko *et al.*, 1999). Hence, for the output of maize to increase proportionately to meet its growing demand, there is a need to consider crop-livestock integration as an approach to sustainable production, especially in agro-ecological zones suitable for livestock production. However, not all farmers practice crop-livestock integration, while most of those who practice it do not have sufficient livestock wastes to cover their farmland (ILRI, 2000; Hanson *et al.*, 2003). This invariably affects their expected yield and income levels. In addition, farmers are constrained by their localities as it affects their decisions in employing any practice (Butare, 2003).

Decisions as to whether or not to combine crops and livestock or grow crops alone as separate enterprises raise some pertinent questions on the economic benefits that could be derived from the use of resources in these enterprises. Thus, the central objective of this paper is to compare the economic benefits from crop-livestock integration systems and that of crop production alone. Specifically, the study compares the costs and returns to maize-livestock integration and maize mono-cropping; determines the effect of farmer's socio-economic characteristics on the net return to production in the two enterprises, and identify the peculiar problems to the two farming systems. The study tested the hypotheses that: maize-livestock integration is not economically preferable to the production of maize alone, and that farmer's socio-economic characteristics do not significantly influence their net returns to production in the derived savanna zone of Southwestern Nigeria.

METHODOLOGY

Study area and sampling technique: The study was conducted in Ogbomoso North Local Government Area (LGA) of Oyo State in Southwestern Nigeria. This area is situated in the derived savanna agro-ecological zone with a climate and vegetation distribution, which supports arable crops such as maize, millet, guinea corn, cassava, yam, cocoyam, plantain, while trees such as mango and cashew are also grown. The survey location is notable for crop and livestock production, with cereals, particularly maize, being the major crop grown and sometimes managed along with ruminant livestock as an integral component of the farming system. The livestock husbandry practices involved both free-range and intensive management systems in which farmers usually collect and carry livestock manure from the homesteads to farms for application to the maize fields.

The study adopted a three-stage sampling technique. In the first stage, Ogbomoso North LGA, noted for large crop-livestock farmers in Oyo State, was purposively selected. In the second stage, 10 communities in the LGA, obtained from the records of the State's Ministry of Agriculture, were selected using simple random sampling technique. In the third stage, farmers in each community were stratified into two: those who grow maize alone and those who practice maize-livestock production. Five respondents, each of maize mono-cropping farmers and maize-livestock farmers, were randomly selected in each of the communities. A total sample size of 100 respondents was selected for the study.

Sources of data and analytical techniques: Primary data were collected from the selected farmers, with the aid of a pre-tested structured questionnaire that contained questions on the 2004 production inputs and output costs and returns and farmer's socioeconomic characteristics. Two focus group discussion (FGD) sessions were held; one with farmers who cultivated maize alone, and the second with maize-livestock farmers in the LGA. This was to complement data obtained from the survey questionnaire and to gain better insight into crop-livestock interaction processes in the study area.

Data were analysed using descriptive statistics, costs and return analysis and regression techniques. Descriptive statistics was employed to describe and present the distribution of variables in the study using percentages, mean, and frequency counts. The t-distribution was used to test the differences between the mean estimates. Partial budget approach was used to compare the costs and returns to maize farms and maize-livestock farms through the computation of the gross margin (GM). The partial costs and returns analysis assumes that the farm is a complex structure of enterprises having basic fixed resources; hence enterprise sizes could be varied within limits, without affecting the costs of these basic resources. These basic resources could therefore be omitted from the budgeting computation (Olusi, 1990). The budgetary technique is mathematically expressed as:

$GM_i = TR_i - TVC_i$ ....(1)

(i = 1 for maize-livestock farmers, and 0 farmers who cultivated maize alone). GM is the gross margin in Naira (₦/ha), TR is the total revenue which is computed as: TR = price (p) in Naira x quantity of maize output (q) in kg/ha, and TVC is the total variable cost in Naira (₦). Tests of significance between sample means and proportions were used to compare variables in the two production systems.

The semi-log functional form of the regression technique was used to measure the effect of farmer's socio-economic characteristics on the net returns to farming operations. This was based on the values of R^2, the F-values, the significance of the regression parameters at the conventional levels of 1%, 5% and 10%, as well as the conformity of regression parameters with *a priori* expectations (Koutsoyiannis, 1998; Pindyck and Rubinfeld, 1998). The semi-log functional form of the regression equation was implicitly specified as: $Y = f(X_i, \mu)$; (i = 1,2,3,4,5,6 and 7), and explicitly expressed as:

$InY = \beta o + \beta_1X_1 + \beta_1X_1 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \mu$...............(2)

Where, Y = Gross margin or net return to production (₦/ha) is the dependent variable; In, is the natural logarithm; X_i are explanatory variables with X_1 = Age of farmer (in years); X_2 = Gender category of farmer (dummy: male = 1, female= 0); X_3

= Educational level (in years); X_4 = Farming experience (in years); X_5= Farm size (ha); X_6 = Cost of labour (₦); X_7 = Type of enterprise (dummy: crop-livestock farmers were scored 1, while farmers that cultivated maize only were scored zero. μ = stochastic error term; βo = Regression constant or intercept; and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ are regression coefficients. β_i is the change in the logarithm of net returns for any extra unit of the explanatory variable, while the magnitude of the coefficients of positively signed variables imply that any one more unit of that variable would lead to a higher net return proportional to the coefficients of that variable. On the other hand, negatively signed coefficients indicate that any additional unit of the variable would result into a reduction in the net return to production.

The *a priori* expectations of the explanatory variables showed that farmer's age (X_1) plays an important role in farm decision-making, and therefore affects their productivity and income levels (Feder *et al.*, 1985; Adesina and Zinnah, 1992). As an individual grows old, it is less likely that he will try scientific innovations. Therefore, age is expected to have a negative relationship with the net returns to production. Gender relations affect the adoption and use of new farm technologies (Gould *et al.*, 1989). Male farmers are perceived to face minimum constraints in the use of inputs on their farms as compared to females. This enhances their adoption of new ideas and technologies that could boost production. The variable, gender (X_2), is measured as a dummy, with male farmers scored 1, and female farmers scored zero. Farmer's level of education (X_3), either formal or informal, enhances his ability to read, interpret, understand and process research information for good farm decision making (Olayide, 1981). This is capable of increasing crop yield and income levels. The variable is therefore expected to have a positive sign with the dependent variable. Farming experience (X_4) in maize production is an important variable of interest. It represents the skill acquisition in the use of appropriate management practices, particularly in traditional agriculture where skill is essentially an outgrowth of practical experience accumulated over several years through trial and error methods (Feder *et al.*, 1985; Gould *et al.*, 1989). A positive relationship is hypothesized with the net returns to production.

It is expected that the larger the farm size (X_5), the higher is the tendency to adopt technological innovations because of the ability to experiment with part of the land.

Large farms also allow the farmer to utilize the available resources at his disposal for enhanced net income (Akinola, 1987). A positive relationship was hypothesized. Labour use for farm operations requires some expenditure. Cost of labour (X_6) is therefore expected to have a negative sign to net returns as it reduces the total revenue earned from production. The effect of animal manure on soil organic matter content, depicted by type of enterprise (X_7 = maize only or maize-livestock integration) practiced by a farmer will influence the soil fertility level, which invariably affects crop yield and the net return to production (Awe, 1997). A positive relationship was hypothesized for this variable. The summary of the expected signs of the coefficients of the explanatory variables, given the dependent variable, could be expressed as $\partial y/\partial x_i < 0$; where i = 1, 6 and $\partial y/\partial x_i > 0$ for i = 2, 3, 4, 5, 7.

RESULTS AND DISCUSSION

Socio-economic characteristics of the maize farmers

The selected socioeconomic characteristics of the respondents are presented in Table 1. The difference between the mean age of about 55 years and 43 years respectively for farmers that cultivated maize only and maize-livestock farmers was significant at the 5% level (Table 1). This showed that crop-livestock integration is predominant among older farmers in the study area. None of the maize-livestock farmers was below the age of 30 years when compared to the 14% of maize farmers who fall within this age bracket. About 7% of the maize farmers and 32% of maize-livestock farmers were over 60 years of age. This represented the aged and hence less active farmers who are incapable of vigorous farming operations, as supported by the findings of Adesina and Zinnah (1992).

More than 88% of the farmers in each of the two enterprises, and over 70% of the labour employed on the farm were male. This showed that male farmers dominated maize farming in the study area. According to FGDs, female farmers were limited by tenure arrangements to own farmland. Forty-five per cent and 12% respectively of maize farmers and maize-livestock farmers had no formal education, implying low level of literacy of respondents. A significant difference existed between the mean value of 5.1 years of education for maize farmers and 2.4 years for maize-livestock farmers at the 5% level. This suggests that maize farmers are more exposed to formal education than the maize-livestock farmers, and this is capable of affecting their use of new

Table 1: Summary of average statistics of farmer's socio-economic characteristics

Characteristics	Maize farmers	Maize-Livestock farmers	t-value
Age (years)	42.6	54.7	1.98**
Active labour force (%)	93.0	68.4	1.79
Gender: (% Male)	94.0	89.0	1.84
Labour (%):			
• Male	71.4	75.0	-
• Female	28.6	25.0	
Level of education (years)	5.1	2.4	2.61**
Farming experience (years)	11.3	19.8	1.85
Household size (Number)	6.2	4.7	2.14**
Total farm size (ha)	4.1	3.7	0.97
Cultivated farm size (ha)	2.4	1.3	2.01**
Duration of fallow (years)	5.7	2.5	3.21**
Extension contact (%)	11.0	7.0	0.73
Mode of land acquisition (%)			
Inheritance	38.0	46.0	-
Purchase	14.0	8.0	-
Borrowed	22.0	18.0	-
Leasehold	26.0	28.0	-
% of respondents keeping animals*:			
• Cattle	-	46.0	
• Goat	4.0	74.0	-
• Sheep	-	35.0	
• Fowl	10.0	100.0	
Sample size (n)	50	50	-

- means "Not Applicable"; * Multiple responses taken; ** means significant at 5%

technologies from research efforts and their income generating potential, as evidenced from Olayide (1981) and Akinola (1987).

The average farming experience of 19.8 years for maize-livestock farmers was significantly different from the 11.3 years for maize farmers. This showed that on the average, the maize-livestock farmers have longer years of farming experience. However, while about 12% of the maize farmers had more than 30 years experience in farming, none of the maize-livestock farmer's fall into this category. FGDs revealed that most farmers in the survey location usually incorporate livestock into their farming business after acquiring some experience in maize farming. The mean household size was 4.7 and 6.2 respectively for maize-livestock and maize farmers.

The difference between these two mean estimates was statistically significant at the 5% level, which showed that maize farmers had a larger household size than the maize-livestock farmers. About 11% of the maize farmers had a household size of more than 6, while maize livestock farmers had none within this range. Cultivable farm size varied between 0.2ha and 5.6ha with a mean of 2.4 ha for maize farmers and between 0.1 and 3.3ha with a mean of 1.3 ha for maize-livestock farmers. With a t-value of 2.01, the difference between the recorded mean values was found to be statistically significant at the 5% level. This showed that maize farmers cultivated more land than maize-livestock farmers. However, when compared with the total farmland area, maize-livestock farmers recorded an almost equal mean farm size as the maize farmers (Table 1). FGDs revealed that maize-livestock farmers usually provided some grazing areas for the animals.

A significant difference was found in the duration of fallow in the two production systems (Table 1). This suggests that maize farmers had longer fallow periods. It was further noted that about 10% of the maize farmers left their farmland to fallow for more than 8 years while none of the maize-livestock farmers left their land to fallow for this long. FGDs revealed that the soil fertility improving effect of animal manure on maize-livestock farmers' fields do not require leaving the land to fallow for too long, and this had given the farmers the opportunity for continuous cropping over a longer period.

The percentage of farmers who had contact with extension service was very low (11.0%) for those who cultivated maize only and 7.0% for maize-livestock farmers, supporting the findings of Onyibe *et al.*, (2006). FGDs revealed that farmers have had contact with extension agents for over one year from the time of survey. This implied that farmers in the study area rarely had access to new research ideas, particularly of modern agronomic practices that could enhance their net farm earnings. Four main ways of land acquisition were recorded. These included inheritance, purchase, borrow and leasehold. Almost equal proportion of the maize and maize-livestock farmers acquired their land through these methods; while more than 35% of the farmers inherited their farmland, less than 15% was by purchase. FGDs revealed that farmers that inherited and/or purchased their farmland were least constrained in cultivating different crops or in using new technologies on their farms whenever needed.

All the maize-livestock farmers kept poultry birds, about 74% kept goats, 35% kept sheep, while 46% kept cattle (Table 1). FGDs revealed that maize-livestock farmers usually buy and keep animals with the proceeds from the sales of their crops. From the average number of animals kept in the study area, poultry birds ranked highest, even though most respondents kept a combination of these animals. Thus, a larger proportion of the animal manure used on the farms was from poultry wastes. Some of the maize farmers also kept sheep, goat and poultry birds but did not use their wastes as manure on the farms. FGDs further revealed that most people in the study area are traditionally Muslims who usually require animals for their festivals. They therefore tend to keep these animals to prevent buying them at exorbitant prices from the market during the celebration of religious festivals.

Constraints to maize farming

The problems confronting maize farmers in the study area are shown in Table 2 for the two groups of enterprises. The high cost of inputs ranked highest among the problems facing maize farmers, followed by insect pests and diseases, lack of capital, labour scarcity, poor market prices of produce, and bad weather in order of dominance. For maize-livestock farmers, bad odour from animal wastes was the major constraint; others included labour scarcity, pests and diseases, lack of capital, high costs of inputs, poor market prices of produce, and bad weather condition in order of importance.

Table 2: Constraints to maize farming in the derived savanna zone of southwestern Nigeria in 2005

Constraints	Maize farmers* (%)	Maize-Livestock farmers* (%)
Insect pests and diseases	91.7	94.2
Lack of capital	85.9	90.7
Bad weather	62.0	41.0
Poor market prices of produce	68.4	63.0
Labour scarcity	71.0	95.0
High cost of inputs	92.5	76.4
Bad odour from animal wastes	-	97.8
Sample size (n)	50	50

*Multiple responses taken; - means "Not Applicable"

FGDs revealed that farmers respond to the high cost of purchased inputs by using them inadequately (i.e. below recommended quantities) or by applying the inputs to just a small portion of the land. In reacting to the scarcity of labour, farmers claimed that they reduce their cultivable land to manageable sizes, while selling only a small percentage of their produce to meet non-farm needs in response to poor market prices of their produce.

Farmers also resort to moneylenders, who charged very high interest rates of about 100% on loans, in response to the problem of lack of capital, as indicated in an earlier study by Butare (2003). This could reduce the quantity of input used (such as pesticides and herbicides), the type of technology used, the area of cultivable land, and their income levels. FGDs further revealed that the problem of bad weather condition was confronted with prayers since this was said to be beyond their control, while maize-livestock farmers had no cause to think through any specific control measure over the bad odour from animal wastes, as it enhances their level of output with the minimum external input use.

Average net returns per hectare to maize farming

Budgetary analysis of costs and return of maize farming in the study area is shown in Table 3. Significant differences were found at the 5% level between the estimates of mean yield, revenue earned, labour costs, total variable costs, and the computed gross margin for the two enterprises. These imply that maize-livestock farmers earn higher net return in their production operations per hectare as compared to farmers cultivating maize alone.

Labour constituted the largest cost component, and accounts for 62.5% and 55.9% respectively of the total cost incurred on maize and maize-livestock farms, while both local and improved seeds were used in maize farming. Results also showed that farmers used one or two forms of soil augmenting practices (such as inorganic or organic fertilizers). FGDs revealed that farmers apply inorganic fertilizers in small quantities because of its scarcity and high price, and this tends to affect their output level. In addition, though maize farmers who owned livestock could not have sufficient livestock wastes to cover their farmland, (supporting the findings of ILRI, 2000 and Hanson *et al.*, 2003), and had to spend an average of about ₦1,446 per hectare as cost of organic fertilizer, a higher gross margin was still obtained when compared to maize farms alone. These results showed that maize-livestock integration is an economically preferable practice in farming in the study area.

Table 3: Gross margin per hectare of maize farms in a crop-livestock farming system of the derived savanna agro-ecology of Southwestern Nigeria, 2005

S/No.	Item	Maize farms only	Maize-livestock integration	t-value
1.	Yield (kg/ha)	1,310.00	1,592.50	1.98**
2.	Price (₦/kg)	30.00	30.00	-
3.	Revenue (₦/ha) (= Items 1 x 2)	39,300.00	47,775.00	2.01**
	Variable Costs (₦/ha):			
4.	Labour	2,780.81	3,140.10	2.11**
5.	Inorganic fertilizer	875.20	357.50	1.83***
6.	Organic fertilizer	-	1,445.60	
7.	Improved seeds	578.74	431.40	0.86
8.	Local seeds	211.67	247.30	1.03
9.	Total variable costs (= Items 4+5+6+7+8)	4,446.42	5,621.90	2.03**
10.	Gross margin (₦/ha) (3-9)	34,853.58	42,153.10	2.14**

Source: Field Survey, 2005
1 US dollar ($) = 135 Nigerian Naira (₦) in 2005; - means "Not Applicable"

Regression estimates of the effect of farmer's socio-economic characteristics on the net returns to maize farming

From the regression results (equation 3), the estimates of the coefficient of determination (R^2) showed that 84.7% of the variability in the net returns to maize farming could be accounted for by variation in the explanatory variables included in the model. However, when corrected for possible sample bias, the proportion of explained variation was found to be 83.2 (R^2 = 0.8321). These measures, together with the correlation coefficient of 0.9205, indicate that the line of relationship is a good fit to the observed data. The F-value of 36.135 further reveals the significance of the regression relationship as a whole.

$$\ln Y = \underset{(0.371)}{5.42} - \underset{(0.004)}{7.33 \times 10^{-3}X_1} + \underset{(0.008)}{1.29 \times 10^{-2}X_2^{*}} - \underset{(0.014)}{3.86 \times 10^{-2}X_3^{*}} + \underset{(0.027)}{6.45 \times 10^{-2}X_4^{*}} + \underset{(0.018)}{3.69 \times 10^{-2}X_5^{*}} - \underset{(0.013)}{6.81 \times 10^{-2}X_6^{*}} + \underset{(0.095)}{3.79 \times 10^{-1}X_7} \quad \ldots(3)$$

$R^2 = 0.8470, R^2 = 0.8321, F^{**} = 36.135$

Figures in parentheses ( ) are standard errors; * means significant at 5%.

The significant and positive intercept of the regression estimates showed that the derived savanna agroecological zone of Southwestern Nigeria is suitable for maize farming. Except for age (X_1), the regression coefficients of all other explanatory variables in the model were significant at the conventional levels of probability

(1%, 5% and 10%). Cost of labour (X_6) and type of enterprise (maize-livestock integration or maize only, X_7) were significantly different from zero at the 1% level; education (X_3), farming experience (X_4), and farm size (X_5) were significant at 5%; while gender was the only significant variable at the 10% level of probability. Out of these variables, gender, farming experience, farm size, and type of enterprise recorded positive relationships with the percentage change in the net returns to maize production, while education and cost of labour had significantly negative estimates. Except for the coefficient of education, which was negative, the signs of all other explanatory variables in the model conformed to *a priori* expectations.

The magnitude of the coefficients of the variables showed that, for every additional male involvement in the cultivation of maize farms, a higher net return of ₦0.013 would be obtained, while increasing farm size by one hectare would lead to increased net returns by ₦0.037. On the other hand, the choice of maize-livestock integration was associated with 0.038 higher net returns, while the negatively signed coefficient of cost of labour implied that any additional cost incurred on hired labour would reduce farmer's net returns by ₦0.068. This was attributed to the scarcity of labour in the study area, as the few labour available for farm work charged exorbitant prices, which invariably reduced farmer's incomes. This supports the findings of Awe (1997). The finding is also supported by FGDs that attributed the significantly negative relationship of the coefficient of hired labour to the migration of youths in the locality to urban locations for white-collar jobs, while those left behind in the locality engaged in other activities believed to be much more lucrative than farming, particularly the use of motorcycles "*okada*" as means of transportation. The magnitude of the coefficient of education indicated that one more year of education reduces net returns by 0.039. This could be attributed to the generally low literacy level and respondents' non-contact with extension agents in the study area.

SUMMARY AND CONCLUSIONS

Crop-livestock integration increases diversity in farming systems and provide an opportunity for improving net returns to production through low, external input use, and in protecting the potentials of the land resource base. This study was undertaken to examine the economic benefits of maize-livestock farmers in Ogbomoso North (LGA) of Oyo State in Southwestern Nigeria, for enhanced crop yield and improvement in farmer's income and livelihood.

The socio-economic characteristics of the respondents showed that maize farming was male dominant, with crop-livestock integration most predominant among older farmers in the study area. The level of education of farmers was generally low, while only few had contact with extension service. Average cultivable farm size was 2.4 ha for maize farmers, while maize-livestock farmers cultivated 1.3 hectares. The inheritance and purchase mode of land acquisition provided farmers the opportunity to employ any new technology on their farmlands whenever required. The high cost of inputs ranked highest among the problems facing maize farmers, while bad odour from animal wastes was a major problem for maize-livestock farmers. Other constraints included lack of capital, labour scarcity in cropping and in tending the animals, pests and diseases, bad weather condition, and poor market prices of produce. Maize-livestock farmers earned higher net returns per hectare as compared to maize farmers. The budgetary analysis revealed that the net earning per hectare of maize-livestock farmers was about 1.20 of that for maize farmers. Labour constituted the largest cost component, and accounts for 62.5% and 55.9% respectively of maize and maize-livestock farms. These results showed that maize-livestock integration is an economically preferable practice in maize farming in the study area, while organic fertilizer obtained from the livestock could be used to replenish soil nutrient loss, thereby improving the land resource base for sustainable maize production. Regression results showed that cost of labour, type of enterprise (maize-livestock integration or maize only), level of education, farming experience, farm size, and gender had significant effects on the net returns to production at various levels of probability. These variables therefore need to be considered in any policy strategy aimed at improving the livelihood of farmers in the study area.

These findings imply that farmer's output and net returns to maize production could be increased to an appreciable extent if livestock production is added to their production activities. The integrated farms have better crop yields and generate better income all year round by sales of animals during the off-farm season, while the provision of quality feeds to animals from maize straws offer a synergistic advantage that should be further exploited. Researchers' efforts aimed at reducing the problems of maize-livestock integration, as well as providing extension services and education to train farmers on the appropriate use of this technology would help to improve farmers' productivity and income levels, while sustaining the potentials of the land resource base.

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