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Economic Analysis of Crop-Livestock Integration in the Northern Guinea Savannah of Nigeria

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Abstract

Research was undertaken on the economics of crop-livestock integration in the Northern Guinea Savannah of Nigeria. The aim of the study was to quantify the reciprocal contributions of crops and livestock and also the factors affecting the integration of crops and livestock production in the area. Field data were collected during the 1996/97 farming season from 150 respondents randomly selected at two locations (Zaria and Bauchi) and classified into crop farmers (CF) and crop-livestock fanners (C-LF). The two locations represent different levels of market opportunities. The Zaria area is hypothesized to follow a market-driven path of agricultural intensification while the Bauchi area follows a population-driven path of agricultural intensification. Results of the study showed that the CF in the Zaria area recorded a gross margin (GM) of ₦62,035. This was about three and a half times the GM in Bauchi (₦17,262). Similarly, the C-LF in the Zaria area recorded a much higher GM (₦145,334) over that recorded by the C-LF in the Bauchi area (34,367). Among the general factors affecting crop-livestock integration are land, labour, availability of feed, availability of organic and inorganic fertilizer, age and level of education of the farmers. The study concluded that by integrating and using crop-livestock farm linkages, farmers can improve their economic gains more substantially especially in areas with better market opportunities (Zaria). Therefore efforts should be made to substantially improve the market infrastructure and solve some of the problems affecting crop-livestock integration in the NGS of Nigeria.

1 Introduction

The integration of crops and livestock as a viable enterprise is an important area for scientific investigation. According to FAO (1982), livestock and crop farm systems are major components of agricultural production in the semi-arid West Africa. However, they have not yet been well integrated so that the livestock farm system can benefit the crops with draught power for ploughing, planting, weeding and other benefits from livestock (DELGADO AND MCLNTIRE, 1982; MCLNTIRE & GRYSEELS, 1987; POWEL AND MOHAMMED-SALEERN, 1987; PANNEL AND FALCONER, 1988; JAEGER AND MALTON, 1990).

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However, the demand for soil fertility inputs is weak at low population densities because fallow is available. The high labour and Transport costs per unit of manure make it expensive per unit of nutrient. Weak crop responses to fertilizer (due in part to sparse rainfall, poor soil quality, an absence of irrigation and lack of improved cultivars) mean that it is profitable only in relatively small doses. Supply restrictions and other government policies sometimes depress the use of fertilizer. High levels of manure application would have positive effects on crop productivity and soil quality (MCLNTIRE & GRYSEELS, 1987; SALAM et al., 1990). However, providing such quantities could cause an inherent conflict in the farming system. Raising the stock rate to produce more manure ultimately reduces the amount of crop land because of competition between fodder and human food production. Because of different transport and application costs, the choice between fertilizers will almost always be resolved in favour of the latter, where it is available. Constraints in the supply of chemical fertilizer are a serious barrier to its use (MCLNTIRE *et al.*, 1992).

The majority of past studies on crop-livestock integration in Nigeria have concentrated mainly on the sub-humid zone of the country. Also most of the studies have been rather qualitative and descriptive in nature. Quantitative attempts at describing this type of farming system (SCHLEICH, K. 1985; COMPERE *et al.;* 1990, BANDARA AND RAJAGURU, 1992) focused mainly on the estimation of the nutritional value and quality of crop residue, effect of manure on soil fertility and crop yield and general interactions between crops and livestock. The purpose of this study, therefore, is to assess and quantify the contributions of crop and livestock and determine the factors affecting the integrated production system.

2 Methodology

2.1 The study area

The study was conducted in two locations. These locations are the Zaria area of Kaduna State and the Bauchi area of Bauchi State, Nigeria. The Zarai area is hypothesized to follow a market-driven path of agricultural intensification while the Bauchi area follows a population-driven path of agricultural intensification. Similarly, the Zaria area has better market opportunities than Bauchi. This is shown by the level of infrastructural development which is better in Zaria than Bauchi (MANYONG et al., 1996). Both locations are within the geographical location referred to as the Northem Guinea Savannah (NGS) of Nigeria. The NGS of Nigeria is characterised by a growing period of 151 - 180 days, a daily mean temperature during the growing period of more than 20° and an altitude not exceeding 800m above sea level (IITA, 1994 quoted in MANYONG AND CARSKY, 1995). The survey was conducted in the 1996/97 farming season.

2.2 *Data source and analysis*

Primary sources of information were mainly used in this study. The primary data were collected by the use of structured questionnaires. Information was collected on various aspects of crop and livestock production. The method of simple random sampling was used to estimate the sample size. A total of three villages from each of the areas were purposively selected from both Zaria and Bauchi areas. However, 25 respondents were randomly selected from each of the study villages using the Random Number Table. This gave a total of 150 respondents for the two study areas. Descriptive statistics such as means, percentages etc. were used to describe the general farming conditions in the area. Partial budget and regression models were also used to determine the profitability of crop-livestock integration and also determine the factors affecting the production system. In doing this, the respondents were stratified into crop farmers and crop-livestock farmers using livestock unit (LU) as a bases for stratification. The respondents who owned less than or equal to three LU were regarded as crop farmers and those having more than three were classified as crop-livestock farmers. The reason for this classification is that it is very difficult to find farmers who are producing only crops without some level of livestock ownership.

In order to obtain the gross revenue accruing to the respondents from livestock sales, calculated rate of removal of livestock was used. In the Zaria, an average of 30 per cent removal was recorded for cattle and 28.5 per cent for sheep and goats. The level of removal was 10 per cent for cattle and 28.5 per cent for sheep and goats in the Bauchi area.

3 Results and Discussion

3.1 *Manure utilisation*

The value of livestock droppings for soil fertility is recognised by the respondents in the study area. The agronomic value of manure lies in its content of organic matter and of nutrients (JAHNKE, 1982). It has been shown that manure provides soil nutrients, raises soil pH and provides the basis for the intensification of cropping systems (MOKWUNYE, 1980; PADWICK, 1983). According to Jones (1971, 1976), manure improves soil organic matter and consequently raises crop yield. The respondents used such methods as strategic herding, night kraaling, stabling, etc. to introduce animal manure to the farm sites. To this end, there exists an agreement between farmers and herders to have animals graze on crop residues on farmers' farms after harvest and in return receive some quantity of livestock droppings to improve the soil fertility. Some of the integrated crop-livestock farmers practise this method instead of stocking the crop residue at home. The respondents who transported manure to the farms used jute bags *(mangala)*. The *mangala* are placed on donkeys for transportation to the farm site. Some farmers use bicycles to carry out the same operation.

3.2 *Draught Animal Power (DAP) utilisation*

DAP is used mainly for ploughing, harrowing, ridging and transportation. In some cases, animals are used for off-farm transportation for instance trade and marketing. About 60 per cent of the respondents indicated having animals and implements for work. About 30 per cent did not have this facility but depended on other farmers for the use of DAP. The payment for renting a unit of DAP is either in cash or in kind. The remainder of the respondents (10%) did not respond to this questionnaire item.

Work animals and implements were either bought or inherited. About one to two pairs of animals were generally used per operation. The acquisition of the DAP set in most cases had a long history which dates to as far back as 10 to 20 years. Only very few of the respondents acquired their animals and implement less than 1 0 years ago. When bought, the implements are usually from Emcot (the major source of animal traction implements in the Zaria area) or from the local blacksmiths. The implements from the local blacksmiths, although cheaper, wear out faster than those from Emcot.

Work duration is usually 6 hours per day. This is divided into two. The animals are allowed to work 4 hours in the morning, that is from 6.00 a.m. to 10.00 a.m., and two hours in the evening from 4.00 p.m. - 6.00 p.m.. The most important species of animals used for DAP in the study area are *Bunaji (White Fulani)* and donkeys (mainly for Transport of crop residue and manure).

3.3 *Crop residue disposal*

From the figure below, it can be seen that a greater quantity of the crop residue (94%) produced by the respondents in the Zaria area was fed to livestock. There was no indication of commercialisation of crop residue among the respondents during the study period (Fig. 1). This, however, was the case with the C-LF.

In the Bauchi area, 57 per cent of crop residue produced is fed to livestock; 14 per cent and 29 per cent are respectively is given away and sold (Fig. 2).

3.4 *Livestock removal*

Removal of the animals was calculated as sales plus slaughter plus gifts. The percentage removed was calculated as follows:

$$\% \text{ Removed} = \frac{\text{Total removal}}{\text{Total no. of animals}} \times 100$$

This was found to be about 33 per cent for cattle, 43 per cent for sheep and 41 per cent for goats. The distribution of the removal in the Zaria area is presented in Figure 3. This removal rate is clearly higher than those reported by Ndubuisi (1994). This is an effect

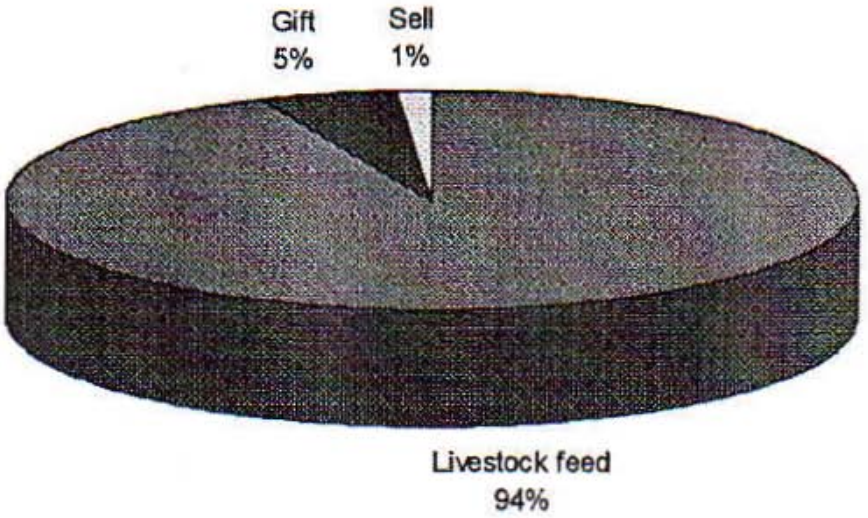

Figure 1: Methods of crop residue disposal in the Zaria area

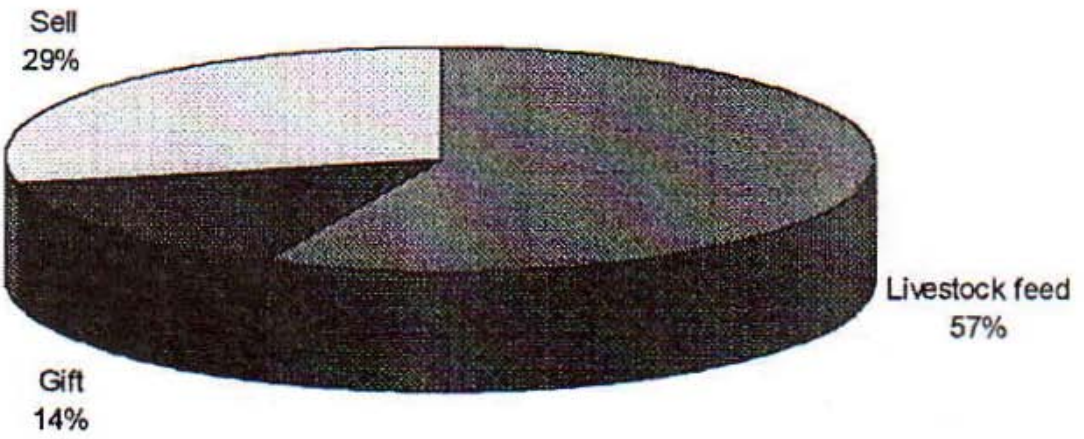

Figure 2: Methods of crop residue disposal in the Bauchi area

of a market in the area thereby disproving the claims of Doran, Low and Kemp (1979).

The implication of this removal rate is that in the long-run the danger of overgrazing would be kept to a minimum. This would therefore have implications for agricultural development. Concerning livestock removal in the Bauchi area, the respondents presented a slightly different view. The removal rate was about 12 per cent for cattle - made up of 10 per cent sold, two per cent consumed and 0.35 per cent given away; 30 per cent and 27 per cent of sheep and goats respectively were also sold. The distribution of removal according to the various components is presented in Figure 4. This distribution shows a relatively lower level of livestock being taken to market in the Bauchi area. Sales of livestock in this area concentrated more on small ruminants.

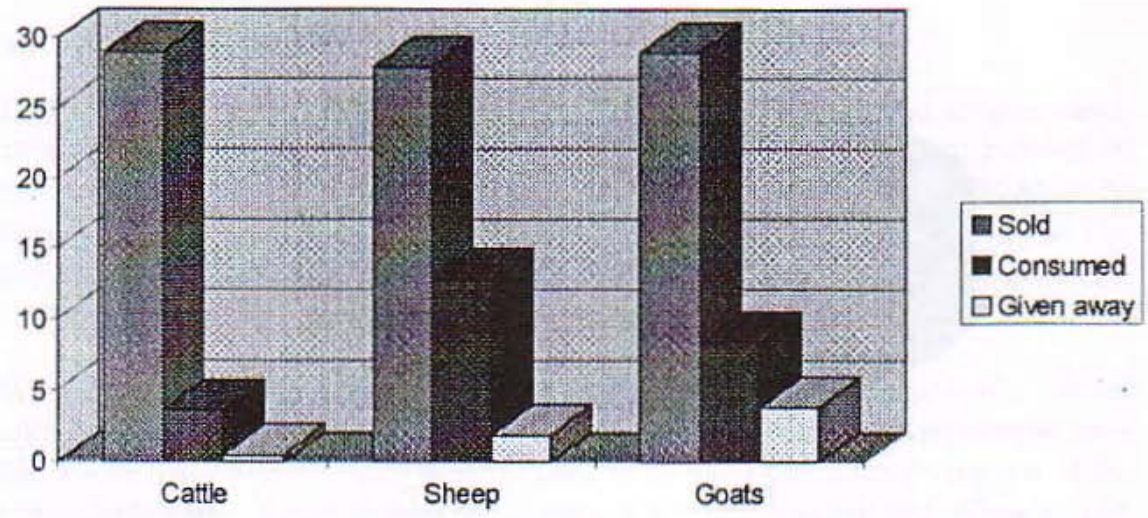

Figure 3: Livestock removal in the Zaria area

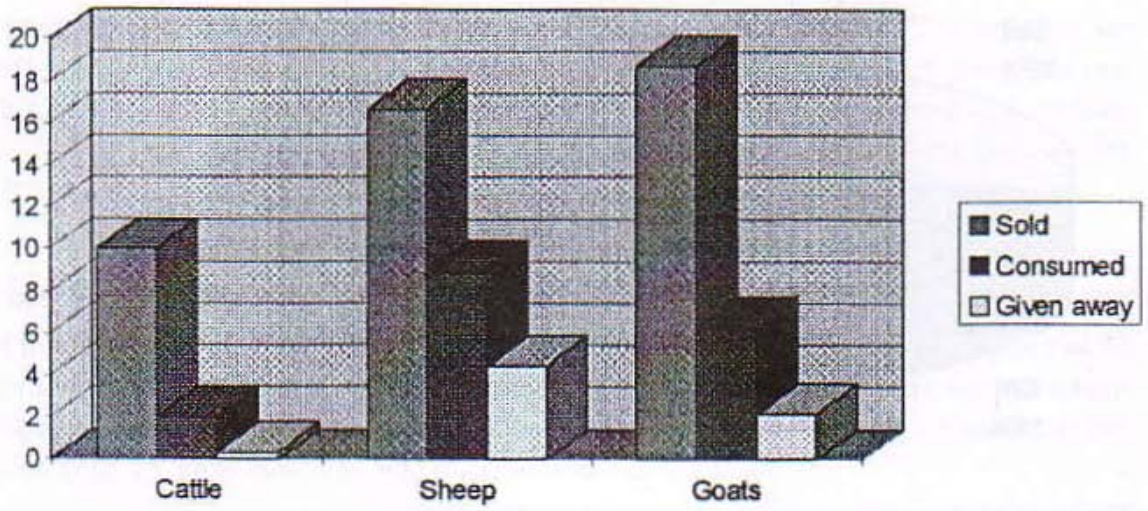

Figure 4: Livestock off-take in the Bauchi area

3.5 Resource utilisation in the study areas

3.5.1 Land

Land is the most valuable asset of the agricultural population. Unfortunately land has become a scarce resource within the last few years. The reasons for this are (1) the growing population which requires more land for cultivation and (2) the land tenure system inherent in the traditional system and (3) the constant degradation of agricultural land due to over-grazing in some of the areas. In the NGS, land is communally owned by the Hausa. Individuals only possess rights to the piece of land they own. The average size of land cultivated by the crop farmers in the Zaria area was 4.94 ha while it was 2.92

ha in the Bauchi area. Similarly, the integrated crop-livestock farmers in the Zaria region used an average land size of 4.36 ha while it was 6.64 for the crop-livestock farmers in the Bauchi region. The reason for the low hectare cultivated by the Zaria farmers could be attributable to the high number of LUs owned by the Zaria farmers and this may have reduced the area of land available for crop production.

3.5.2 Capital assets

The inputs used for the farm enterprise are both durable and non-durable. The durable assets are defined as lasting for more than one year and include the farm equipment: ploughs and cultivators for animal traction, hoes, matchets, carts, etc.. The non-durable assets include seeds, fertiliser and agrochemicals, supplementary feed for livestock feeding and veterinary drugs and mineral lick *(kanwa)*. Income from sales of crops (53%) and livestock (41%) were the major sources of funds for buying farm inputs in the Zaria area. Only four per cent of the respondents obtained funds from off-farm sources and two per cent of the respondents obtained funds from family contributions. In the Bauchi area, 49.10 per cent of the respondents obtained funds for their farm operations from sale of crops while 48 per cent obtained funds from sale of livestock and livestock products. Only 2.68 per cent obtained funds through family contributions. None of the respondents indicated having borrowed money from institutional sources during the study period.

3.5.3 General herd management

Herd size among the respondents in the Zaria area averaged 27 head for cattle, 10 head for sheep and 23 head for goats. In the Bauchi area, the average herd size was much lower than that of the Zaria area. It was three head for cattle, 4 head for sheep and 10 head for goats. Usually, calves are restricted at night by tying them with neck loops which are then tied to a single rope stretched between two posts *(dangwali)* to prevent them from suckling their dam. The adult cattle are confined during the night in single enclosures. Weaning is always by natural methods and usually takes place when the calves are about one year old. Milking is done once or twice daily. During the wet season, *kanwa,* a local mineral supplement, is given to enhance the appetite of the animals. Traditionally, sheep are reared together with cattle while goats are tethered and fed fresh grass during the planting season to avoid crop damage. Milking and milk processing is usually done by women. Veterinary services were privately provided by the veterinarians coupled with the farmers' indigenous knowledge in handling some livestock health matters.

3.6 Partial budget analysis for crop farmers

Table 1 presents the results of the partial budget analysis for the crop farmers in the study area. An average of 375 man-days of labour was used by the Zaria farmers during the period. Family labour accounted for about 41 per cent of the total labour while hired

Table 1: Partial budget analysis for crop farmers

Revenues (N per farmer)	Zaria	Bauchi
GR Crops		
Sale of crops	₦93,336.00	₦I5,512.00
Sale of crop residue	₦446.00	₦203.00
GR Livestock		
Sale of animals	₦6,500.00	₦2,953.00
Sale of manure	₦I,756.00	₦0.00
Sale of milk	₦I66.00	₦550.00
Total GR	**₦81,422.00**	**-₦19,218.00**
Variable Costs (VC) (N/farmer)		
Crops		
Labour	₦9,008.00	₦I,733.00
Fertilizer	₦22,949.00	₦4 1. 00
Agro-chemicals	₦1,495.00	₦5.00
Livestock		
Labour	₦96.00	₦33.00
Supplementary feed	₦4,573.00	₦I3.00
Veterinary service	₦I,048.00	₦I31.00
Total variable costs (TVC)	**₦39,387.00**	**₦I,956.00**
Gross Margin (GM) (N/farmer)	**₦62,035.00**	**₦17,262.00**
GM/ha	₦5,590.00	₦5,952.41
GM/man-day	₦I 12.00	₦I06.56

₦ = Nigerian Naira $1.00 = ₦75.00

labour accounted for about 59 per cent. The average land holding was 7.52 ha for crop farmers. Labour for both crop and livestock production accounted for about 24 per cent of total labour. The use of fertilizer in this area has increased tremendously. The cost of fertilizer was 58 per cent of TVC. This shows that crop production activity is very important among this group of farmers.

The gross income (GI) was ₦93,336.00 and the contribution of livestock to the GI was about 10.34 per cent. The implication is that this group of farmers depends more on crop production than livestock production. The gross margin was ₦62,035.00. The returns to land and labour were ₦5,590.00,349 and ₦112.00, respectively. The fairly high gross margin for this group of farmers in the Zaria area is a further confirmation of the hypothesis of Manyong *et al.* (1996).

The crop farmers in the Bauchi area owned an average of 0.704 LU. The cost items included mostly labour and veterinary service. An average of 162 man-days of labour was used during the study period. Family labour accounted for about 49 per cent of the total labour while hired labour accounted for about 51 per cent. The majority of the

hired labour was communal in nature and costs were put in for the farmers who did not pay cash. The total variable cost (TVC) was ₦1956. Out of this, cost of labour for both crop and livestock production accounted for about 90 per cent of the TVC while fertilizer accounted for only about two per cent and veterinary service accounted for about seven per cent of the TVC. The gross margin for this group of fanners amounted to ₦ 17,262. The contribution of livestock to the gross income (GI) was about 18 per cent. Returns to land and labour were ₦5,911.00 and ₦106.00, respectively.

3.7 Results of the farm budget analysis for crop-livestock farmers

In Table 2, the result of the partial budget analysis for the crop-livestock farmers in the study areas is presented. The respondents in the Zaria area used an average labour of 554 man-days. Family labour accounted for about 68 per cent of total labour while 32 per cent was accounted for by hired labour.

The TVC was ₦81,022. Labour for both crop and livestock production accounted for about 52 per cent of the TVC. Fertilizer is also an important input among this category of respondents as this accounted for about 22 per cent of the TVC. The gross income was ₦226,356 and the contribution of livestock to gross income was about 56 per cent.

Table 2: Partial budget analysis for crop-livestock farmers

Revenues (N/farmer)		
GR Crops	**Zaria**	**Bauchi**
Sale of crops	₦99,602.00	₦I9,216.00
Sale of crop residue		₦33. 00
GR Livestock		
Sale of animals	₦120,000.00	₦15,459.00
Sale of manure	₦3,254.00	₦73.00
Sale of milk	₦3,500.00	₦1,038.00
Total GR	₦226,356.00	₦35,819.00
Variable Costs (VC) N/farmer		
Crops		
Labour	- ₦41,432.00	₦625.00
Fertilizer	₦17,715.00	₦145.00
Agro-chemicals	₦1,179.00	₦14.00
Livestock		
Labour	₦471.00	₦78.00
Supplementary feed	₦I3,846.00	₦5.00
Veterinary service	₦6,379.00	₦585.00
Total variable costs (TVC)	₦81,022.00	₦l,452.00
Gross Margin (GM) (N/farmer)	₦145,334.00	₦34,367.00
GM/ha	₦23,442.00	₦16,847.00
GNYman-day	₦262.00	₦117.00

₦ = Nigerian Naira, $1.00 ₦75.00

The gross returns to land and labour were ₦14,248 and ₦222, respectively. These results further support the fact that there are better market opportunities in the Zaria area which then favours the sale of more animals than in the Bauchi area.

In the Bauchi area, labour used during the study period averaged 292 man-days. Family labour accounted for about 68 per cent of the total labour while hired labour was only 32 per cent. The TVC was ₦1452 (Table 2). Labour cost for both crop and livestock production accounted for about 48 per cent of the TVC. At this stage, the cost of veterinary service became more important as this accounted for about 40 per cent of the TVC. This could probably be because this group of respondents kept more head of livestock than the previous group hence they are classified as integrated crop-livestock farmers. The gross margin was ₦34,367. This is clearly three times that of the crop farmers.

When compared with the GM for the Bauchi area, it was found that the GM for the Zaria area was about 4 times that of the crop-livestock farmers in the Bauchi area. The reason for the higher GM for the Zaria area could have stemmed from the better market opportunities that allowed the farmers to make better income from the sale of their produce. This indicates that the Zaria area follows a market-driven path of agricultural intensification while the Bauchi area follows a population-driven path of agricultural intensification (MANYONG *et al.* 1996).

3.8 Multiple regression analyses

The purpose of multiple regression analysis in this study is to determine the factors that influence crop-livestock integration. A determination of such important factors would assist the policy makers in designing interventions to improve the production process. To overcome the difficulties envisaged in interpreting the regression results, the value of the output from both crops and livestock was calculated on a per farmer basis. This method enabled the establishment of a uniform unit of measure for the revenue and costs to be pooled together wherever necessary.

The respondents in both the Zaria and Bauchi areas were stratified into two, crop farmers and crop-livestock farmers. The basis of this stratification is the livestock unit (LU). One LU is defined as an animal of 250 kg live-weight for cattle or 10 sheep/goats of 25 kg live-weight each. In converting the animals to LU, the methods of ILCA (1993) and Jahnke (1982) were used. In both the Zaria and Bauchi areas, the respondents with less than or equal to 3 LU were classified as crop farmers, and those having more than 3 LU were regarded as integrated crop-livestock farmers. The essence of this stratification was simply to observe how the explanatory variables behave for the different groups of farmers under the same management condition. The same functional forms were therefore fitted to two sets of data corresponding to two groups of farmers in both the Zaria and Bauchi areas. The groups are: Crop farmers and Crop-livestock farmers. The results of the analyses are presented below.

3.9 Multiple regression analysis for the crop farmers in the Zaria area

The explanatory variables included in the model explained about 80 per cent and 49 per cent of the variation in dependent variable for both the linear regression (LR) and Cobb-Douglas (C-D) functions. This is indicated by the values of the R2. All the explanatory variables included in the model were significant in the case of the linear function while only three variables were significant for the Cobb-Douglas function. This is shown by the values of the various t-ratios (Table 3). Within this group, cost of supplementary feeding, cost of labour for crop production, cost of fertiliser cost of manure and cost of agrochemicals have positive interaction with the dependent variable.

The positive sign of cost of supplementary feeding could be due to the fact that the respondents engaged more into crop production and would expectedly produce more crop residue for feeding livestock. In the long-run, this would promote crop-livestock integration. The net effect of this would be an increase in the income of the respondents. The reason for the positive sign of the cost of fertiliser could be because the respondents are currently operating at a low level of fertiliser use. Finally, it is expected that as the total livestock unit increases, there would be a corresponding need for more grazing area. This may eventually lead to a competition between crop and livestock production resulting in a drop in revenue accruing to the farmers from crop sales. This is evident from the negative sign of the number of livestock units in the linear function.

Table 3: Regression summary for crop farmers in the Zaria area

Variable	Regression coefficient	
	Linear	Cobb-Douglas
Intercept	221.394	-5.079
Cost of supplementary feed	.217(4.917)***	.686(4.089)***
Cost of labour for crop production	.044(1.887)*	.287(2.853)***
Cost of fertilizer	.039(4.480)***	
Cost of labour for livestock prod. prod.	-3.839(-2-722)**	
Cost of crop residue	-1.143(-2.371)**	
No. of livestock units	-205.461(-2.227)**	
Cost of manure		.432(2.972)***
Cost of veterinary service		-.279(-1.436^{ns}
Cost of agrochemicals		.323(1.267^{ns}
R^2	.80	.49
Adj. R^2	.76	.43
F-ratio	19***	7.56***
n	35	45
DW	2.07	1.73

*= Significant at 0.1 level ** = significant at.05 level *** = Significant at. 0 1 level
n = No. of respondents Figures in parenthesis are t-values

3.10 Multiple regression analysis for the crop farmers in the Bauchi area

The result of the multiple regression analysis for crop farmers in the Bauchi area is presented in Tables 4. The relevant explanatory variables in this group are positive for both LR and C-D functions except for cost of veterinary service that has a negative sign. All the parameters that appeared in the regression equation are important in explaining variations in the dependent variable considering the significance of the various t-ratios. Education became important at this stage. This shows that for crop and livestock to be integrated appropriately, a certain level of education is important. R^2 was .57 and .22 while F-ratio was 12 and 4.47 for LR and C-D functions, respectively.

Table 4: Regression summary for crop farmers in the Bauchi area

Variable	Coefficient	
	Linear	Cobb-Douglas
Intercept	- 31.68	3.100
No. of livestock units	171.311(5.957)***	.440(1.744)*
Cost of labour for crop production	.027(3.600)***	.154(1.644)ns
Cost of veterinary service	-.523(- 3.943)***	
Years of education	.468(2.079)**	
Size of land cultivated	21.374(1.898)*	.511(2.421)**
w	.57	.22
Adj.	.52	.17
F-ratio	12***	4.47***
n	52	52
DW	1.81	1.74

Significant at 0. 1 level **= Significant at .05 level *** = Significant at . 0 1 level
n = No. of respondents Figures in parenthesis are t-values

3.11 Regression summary for crop-livestock farmers in the Zaria area

For this group of farmers, all the explanatory variables included in the linear model have positive interaction with the dependent variable while only four parameters have positive interaction with the dependent variable in the Cobb-Douglas function. The percentage of variation explained by the regression equation was 98 for the linear function and 59 for the Cobb-Douglas function. Education and cost of agro-chemicals became important and entered the linear regression equation. The rest of the regression results are presented in Table 5.

3.12 Multiple regression analysis for crop-livestock farmers in the Bauchi area

Table 6 presents the results of the multiple regression analysis for the integrated crop-livestock farmers in the Bauchi area. $R^2$was .98 and F-ratio was 123 for the LR The C-D function showed R2 value of .77 F-ratio of 12. The regression coefficients have signs almost similar to those of the crop farmers. In this group, age became an important

Table 5: Regression summary for crop-livestock farmers in the Zaria area

Variable	Regression coefficient	
	Linear	Cobb-Douglas
Intercept	-746.354	-4.209
Size of land cultivated	194.324(22.807)***	
Cost of crop residue	.102(11.887)***	
Cost of agro-chemicals	.291(4.359)***	-516(-I.301)ns
Cost of labour for livestock	.471(3.625)***	
production		
Years of education	19.747(2.325)**	
Cost of Fertiliser		.647(2.675)**
Cost of manure		-642(-2.570)**
Cost of labour for crop prod.		.489(2.592)**
Age		1.680(1.527ns
Cost of supplementary feed		337(1.141)ns
R2	.98	.59
Adj.	.97	48
F-ratio	140.75***	5.44***
n	21	30
DW	2.09	1.61

* = Significant at.1 level ** = Significant at.05 level *** = Significant at.01 level
n = No. of respondents Figures in parenthesis are t-values

Table 6: Regression summary for crop-livestock farmers in the Bauchi area

Variable	Coefficient	
	Linear	Cobb-Douglas
Intercept	353.27	2.568
Cost of manure	6.117(11.027)***	
Cost of fertilizer	-2.069(-6.746)***	.486(1.771)*
No. of livestock units	154.339(7.094)**	1. 1 14(3.769)***
Age	-20.331(-I.993)*	-.735(-I.974)*
Cost of labour for crop production	.058(1.599)*	
Cost of supplementary feed	29.394(1.903)*	.896(3.126)***
Cost of veterinary service	-. 146(-I.790)*	-.229(-I.523)ns
R2	.98	.77
Adj. R2	97	.71
F-ratio	123***	12***
DW	2.00	1.77
n	23	24

* = Significant at 0.1 level **=Significant at 0.01 level ns=not significant
n = No. of respondents Figures in parenthesis are t-values

explanatory variable as this appeared in both models. The negative sign of this variable infers that as the age of the respondents increases, the farmers' ability to handle integrated crop and livestock production also decreases. This has implicationsfor the level of income derivable from agriculture.

4 Summary and Conclusion

The aim of this study was to quantify the reciprocal benefits of crop-livestock integration in the Northern Guinea Savannah of Nigeria. One hundred and fifty respondents randomly selected and stratified into crop farmers (CF) and crop-livestock farmers (C-LF) were used. The basis of the stratification was the livestock unit (LU). The results of the study indicated that the CF in the Zaria area recorded a gross margin (GM) of N62,035. This was about three and a half times the GM in Bauchi (₦17,262). Similarly, the C-LF in the Zaria area recorded a much higher GM (N145,334) over that recorded by the C-LF in the Bauchi area (N34,367). In addition among the General factors affecting crop-livestock integration are land, labour, availability of feed, availability of organic and inorganic fertiliser, age and level of education of the farmers. The paper concludes that since the crop-livestock farmers made higher gross margins in both Zaria and Bauchi than the crop farmers, it then follows that this type of production system is more profitable. Therefore efforts should be made to address the bottlenecks in crop-livestock integration and also in improving market infrastructure in the NGS of Nigeria. Given the levels of significance of the various explanatory variables considered in the regression model, it becomes imperative to address some input problems especially in the case of land and labour. Land and labour are the major areas of competition between crop and livestock enterprise.

Zusammenfassung

Das Ziel dieser Studie war die Quantifizierung der gegenseitigem Vorteile der Integration von Getreide und Viehzucht in der Nordguineischen Savanne Nigerias. 150 Betriebsleiter wurden zufällig ausgewählt und in Marktfruchtbetriebe (M) und Marktfrucht-Futterbaubetriebe (Mf). Als Basis für die Schichtung wurden Großvieheinheiten gewählt. Die Ergebnisse der Studie zeigen im Gebiet Zaria einen Deckungsbeitrag (DB) für M-Betriebe von N 62,035, was ungefähr 3,5 mal höher ist als in Bauchi (N 17,262). Der DB für NW-Betriebe in der Region Zaria ist ebenfalls beträchtlich höher (N 145,334) als der in der Region Bauchi (N 34,367). Von den allgemeinen Faktoren, die die Integration von Marktfrucht und Futterbau beeinflussen sind zu nennen: Boden, Arbeit, Futterverfügbarkeit, Verfügbarkeit von organischem und anorganischem Dünger, Alter und Ausbildung der Betriebsleiter. Die Studie kommt folglich zu folgendem Schluss: Da die W-Betriebe in den Regionen Zaria und Bauchi einen höheren DB als die reinen M-Betriebe erwirtschaften konnten folgt daraus, dass das erstere Produktionssystem das profitablere ist. Deshalb sollten Anstrengungen unternommen werden, die Engpässe bei der Integration von Marktfrucht und Futterbau

herauszustellen und die Infrastruktur in der Nordguineischen Savanne Nigerias zu verbessern. Bei einer gegebenen Signifikanz der erklärenden Variablen des Regressionsmodells ist es unausweichlich, die Input Probleme bezüglich Boden und Arbeit besonders herauszustellen. M- und NW-Betriebe konkurrieren gerade um die Faktoren Boden und Arbeit.

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