



The Contribution of Livestock Production to Households' Food Security and Income in the Upper West Region of Ghana

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Abstract

This paper examined the contribution of livestock production to households' food security and income in the upper west region of Ghana. The researchers administered questionnaires to 622 household's heads. The probabilistic and ordinary least squares estimation techniques were used to analyze the dataset. The dependent variable was categorical hence the use of probabilistic regression. The paper discovered that livestock production contribute positively to household's food security as well as household's income. Thus livestock production is very essential as it contribute to food security, hence reduces hunger in the Upper West region of Ghana. The livestock contribution would have been higher if the latent contribution of livestock (nutritional content) was to be added. Based on this discovery, the study recommends that aggressive policy that enhances livestock production should be implemented.

Keywords: livestock production; food security; household income; Upper West region Ghana.

1. Introduction

The incidence of global warming poses a serious threat to agricultural activities especially crop production. Food crop production depends on amount of rainfall which is influenced by the climatic condition. Sudden changes in the climatic condition such as temperature and rainfall make agricultural land unsuitable for cultivation.

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According to [1], about 75% of the world Agriculturists and one-third of the developing world's population depend on rain-fed agriculture for their livelihood. These statistics imply that farmers depend on rain -fed agriculture for their income and food requirement, failure in food crop production poses a serious threat to their livelihood. Globally, about 826 million people are persistently famished while 2 billion people are food unsecured [2].

Food security is the condition in which there is continuity of food supply or the method by which this aim is accomplished. Thus, when people have access to sufficient, safe, nutritious food to maintain a healthy livelihood. And Livelihood encompasses the abilities, assets (including both material and social resources) and activities requisite for means of living [3, 4, 5].

Policy makers through expert knowledge and development partners have identified agricultural sector development as an important strategy for increasing rural incomes and ameliorating rural poverty [6]. Implementing a pro-active and sustainable farming system is paramount for sustainable economic development and reducing rural poverty. From past to present, agricultural sector policies have only centred on the food crop sub sectors to the neglect of the livestock sub sectors in Ghana.

Although recent statistics shows that Ghana has become service sector led economy with about 49.8% contribution to GDP, but the rural communities still depend heavily on agriculture for their livelihood [7]. Therefore agricultural growth still remain the key to advancement in rural livelihood and growth. The growth rate of Agricultural sector from 2007 to first quarter of 2015 grew between -1.7% and 7.4% [7]. Low Agricultural output gap in the North prevent Ghana from escaping poverty and becoming food secured [8]. This lower output gap is attributable to over reliance on the food crop sub sector [9].

Among all the regions in Ghana, the Northern, Upper West and Upper East are the most vulnerable regions in terms food insecurity and poverty incidence. This is mainly due to their dependence on agriculture for their income and food requirement. These regions experience long (6 months) dry season which make farming during this period nearly impossible due to the absence of irrigation (Ministry of Food and Agriculture [10].

However, livestock production has been identified as a diversification tool for farmers as it reduces farmers' vulnerability to unpredictability rainfall and volatility in goods market. Livestock production plays economic, social and cultural role through employment creation, prestige, income generation among others. A study by [11] on coconut-based households posit that livestock production plays a vital role in the lives of individuals in terms of ensuring food security, improved nutrition, provision of income, wealth creation among others. According to [12], due to the multi -faceted role livestock plays, lack of considerable attention to the livestock sector will mean a lack of attention to food security and improvement in the living standard of the rural populace. Therefore since Upper West region has been identified as one of the poverty endemic regions in Ghana with the main occupation being agriculture, this paper sought to investigate the contributions of livestock production to household income and food security in the upper west region of Ghana. Highlighting the essential role livestock play in the livelihood of the rural poor in terms of its contribution to household income and food security, this paper will help policy makers and government to develop agricultural sector policy holistically to

achieve its full benefit.

The paper is organized into four sections. Section one the introduction, problem statement, study objectives, research questions. The section two presents theoretical and empirical review. Section three presents the type and sources of data, sampling, data collection techniques, description of variables and the estimable technique. And the fourth section presents the empirical results, their interpretation and policy recommendation.

2. Literature review

This section presents the theoretical underpinning of the paper and a review of the relevant empirical literature on livestock production across the globe.

2.1 Theory of choice (Wald Criterion)

The Wald theory postulate that, when an action involves two strategies agents can make a choice that maximises the likelihood of success and minimise the probability of failure [13]. Due to the uncertainties in agriculture, there is always a pure strategy of either planting crops or rearing animals. Therefore farmers form expectations about nature (good rain or otherwise) by selecting a particular cause of action (crop production or animals rearing) with some degree of success or failure. However, this theory state that, farmers can choose a mixture of these alternatives (crop production and animal rearing) to optimise returns or minimise loses given the possibility that nature can do its best or its worst. Since farmers have imperfect knowledge about the true state of nature the Wald criterion offer the opportunity for farmers to select two strategies (crops and livestock production) which give them the maximum cum minimum expectations. This theory implies that farmers can integrate both crop farming and livestock production to minimise risk and optimise yield expectations.

2.2 Empirical review

Livestock production contribute positively and significantly to household income, family nutrition and manure to farmers [14, 15, 16]. The authors also found that Livestock production contribute to employment and reduces the uncertainties in the food crop sub sector.

Livestock production play a socio – cultural function. It also increase the nutritional content of the family diet and serve as a source of manure for crop production and prestige are attached to number of livestock owned [17, 18].

Livestock plays significant role in food security, wealth creation, capital accumulation, nutritional provision, traction, diversification, risk reduction and provision of regular income to small farmers and pastoralists [14, 19].

Livestock farming contribute about 60 percent to employment, 40 percent to GDP and 50 percent to Somalia's export earnings [20]. According to Organization for Economic Co-operation and Development (OECD) [21], keeping livestock is more profitable than investing in any other financial asset by poor household. This is

because it serves as cash buffer as well as a deterrent to inflation and therefore provides income sustaining ability for the farmer and household in general.

Livestock make a significant contribution to most economies [17]. Livestock produce food, Offer security, augment crop production, and create cash incomes for countryside and urban Populaces. It also generate energy and transport, and add value to goods which can have multiplier effects and create a need for services. Furthermore, livestock diversify food crop production and Income, offer year-round jobs, and diversify risk. Livestock also serve as important capital Backup for farming family unit.

The incorporation of crop and livestock schemes can offer some significant Sustainable benefits for the farmer through nutrient reutilization and adding economic worth to the structure by grazing on crop remains which would otherwise be under Utilized [22]. Furthermore, livestock also offer an enticement to plant nitrogen-fixing crops or Forages which function to increase soil fertility and reduce soil erosion. The significant contribution of livestock to the traditional sector adds to countryside standard of living and mainly the deprived are more - recognized [23, 12, 24].

According to Organization for Economic Co-operation and Development (OECD) [21;25;26], investments in the livestock sector can reduce poverty and increase food security as well as ignite economic growth through consumption and production spill-over effects. Livestock production has been well understood by Africans as a major venture that helps the poor individuals to improve their livelihood. In West African Countries where about two-third of the populace feed on less than US\$ 1.9 a day, it is asserted that about 60% of these deprived rely on livestock for their incomes [27].

3. Methodology

3.1 Data type, Variable description and model specification

This section of the paper is devoted to data type and acquisition procedure, the description of variables used in the study and finally the model specification for this paper.

The study used primary data which was obtained through questionnaires administration. The study administered questionnaires to six hundred and fifty (650) respondents who were household heads however, after careful sorting and purifying the questionnaires, six hundred and twenty two (622) became usable and therefore formed the sample size. The dependent variable was food security and it is measured by the continuity of food supply from one harvest season to the next. That is, whether households' farm produce is able to sustain household members at least from one harvesting season to the next harvesting season. The independent variables include income generated from livestock keeping (income from livestock), other sources of income to households, farm size, household size, demographic characteristics (sex, education, marital status). Again, study estimated the effect of livestock production on household's annual income from equation (3). The dependent variable in this case (annual household income) was regressed on the all the aforementioned independent variables.

3.2 Definition and measurement of variable and their expected signs

3.2.1 Variables

Food security (FS): is defined in this paper as the continuity of food supply or the means of achieving continuous food supply from one harvest period to the next harvest period. It was a binary variable that take the value of (1) if an individual household is food secured (the household has enough food to feed it members from one harvest to the next) and (0) if the individual is food unsecured. This follows the standard measurement used by the [28].

Sex: Refers to the gender of the household head (respondent). It was grouped into male and female categories. It assumed a value of one if the respondent is a male and 2 if the individual is female.

Age: The age of all the respondent was recorded in complete years disregarding fraction of months and days. Respondents who could not give age, the researcher estimated their ages using historical events. It was measured as a continuous variable. It was expected to be positively related to food security and household income

Education (Educ): this variable captures the level of formal education the respondent has attained. Education measured the intellectual capacity of the respondent. The respondent educational attainment was categorized into 1, 2, 3, 4 and 5 for primary, junior high school/ middle school, secondary education/ Ordinary level education, vocation and technical training and tertiary education respectively. The study expect education to correlate positively with household food security and income.

Livestock income (linc): refers to all the income generated from the sale of livestock and or their products. The study quantified on average the livestock respondent consumed direct as food supplement. It was measured in thousands of Ghana cedis. It was expected to be positively correlated with household food security and income.

Household size (HHSIZE): the household size refers to all persons who lived together in the same house or compound and share the same house keeping arrangement. In this paper, household does not related to only blood or marriage but include no relatives are under the care of the household head. Household size is expected to be negatively correlated with household food security but positively related with household income.

Other sources of income (OS): this refers to all the other incomes generated from other economic activities. For example income generated from petty trading, remittances, teaching among others. It was measured in thousands of Ghana cedis.

3.3 Model specification

The paper adapted the probabilistic (Probit) regression model to generate the empirical results. The probit model was used owing to the portmanteau nature of the dependent variable (food security). It classifies variables based on their predicted probabilities. The dependent variable has a binary response. Thus whether or not the household is food secured. The probit model is more ideal mode of estimating variables that are restricted while ensuring the variabilities in the independent variable. The probit model also ensure that there is no loss of

generality.

The probability of household head (respondent) being food secured:

$$P_i = P(Y=1)$$

The probability of the respondent not being food secured: $1 - P_i = P(Y=0)$

$$P(Y=1) = P_i = \frac{1}{1 + e^{\beta_0 + \beta_i X_i}} \dots\dots\dots(1)$$

$$P(Y=0) = 1 - P_i = \frac{1}{1 + e^{\beta_0 + \beta_i X_i}} \dots\dots\dots(2)$$

Substituting and taking natural logarithm, the binary probabilistic regression yields:

$$\ln\left(\frac{P(Y=1)}{P(Y=0)}\right) = \beta_0 + \sum \beta_i x_i \dots\dots\dots(3)$$

Where $x_i = f(\text{liveinc}, \text{Sex}, \text{Age}, \text{Edu}, \text{other income}, \text{Marital status}, \text{HSize})$

The second objective was to estimate the impact of livestock production on household income. The following equation was estimated

$$\text{Hhinc.} = \beta_0 + \sum \beta_i x_i \dots\dots\dots(4)$$

Where, Hhinc is total household income

And $X_i = f(\text{Linc}, \text{otherincome sources}, \text{farm size}, \text{HH size}, \text{age}, \text{gender}, \text{marital status}, \text{education})$

4. Results

4.1 Descriptive Statistic

The paper begins this section with the descriptive statistics on the study variables. The descriptive statistics shows that 89.23 percent of the household heads interviewed were males while 10.77 percent are females. This conforms to the exposition by [6] which projected a male dominated household head (84.5% male household heads as against 15.5%) in the Upper West region. It further reveals that 19.45 percent of the household heads interviewed had no formal education, 28.46 percent had attained primary education, 28.78 percent had junior high school/ middle school leaving Certificate, 16.72 had secondary/ Ordinary Level Qualification and 6.59 percent had attained tertiary level of education. The results also shows that 5.31 percent are single or never married, 5.14 percent were either widowed or divorced and 89.55 percent were married. This is a true reflection of the marriage pattern in the upper West region of Ghana [6].

The study presented the Mean, Maximum and Minimum values of variables which were continuous. The total

household income has a mean value of 90.7565. This suggest respondents who keep livestock have on average an annual income of 90.7565 thousand cedis. This is greater/lower according to [6]. On the average, the farm size of the respondent is estimated at 4.7018 acres. This is lower than the estimated mean of 9.88 acres for the three norther regions (Northern Upper West and Upper East) in Ghana. References [29, 18] estimated average farm size to be 6.69 while [30] estimated average farm size of 6.027 acres in the Northern region of Ghana.

The estimations further establish that the average value of household size is approximately 6 members. This means on average, each household head interviewed takes care of about 3 people. This household size is pretty lower compared to the national average of 4.5 in Ghana and similar study by [30] who found household size 9 for the people in the Northern region. The mean age of the respondent was 49.519 years. This figure is closer to 47.29 years reported on a simpler study by [30] in Yendi (Northern region). The maximum and minimum ages of the respondents are 20 years and 74 years respectively. The mean years of the respondents indicates that the respondents are within the economically labour force. However, the maximum age (74) of the respondents which is greater than the maximum age of 60 years suggest that those who are not considered less active can still make end meet by keeping livestock. The results are presented at the bottom of table 1.

Table 1: Descriptive statistics

Variable	Frequency	Percentages	Mean	Min. value	Max. value
Male	555	89.23			
Female	67	10.77			
No formal edu.	121	19.45			
Primary edu.	177	28.46			
Junior High/M.sch.	179	28.78			
Secondary/O'level	104	16.72			
Tertiary edu.	41	6.77			
Married	557	89.55			
Single	33	5.31			
Widowed/divorced	32	5.14			
Food unsecured	435	69.94			
Food secured	187	30.06			
Household size			6.0048	1	10
Age of household head			49.5193	20	74
Farm size (acre)			4.7018	0.3	60
Livestock income			70.1937	39.01	107.44
Other income sources			42.3342	23	59.5
Total household income			90.7564	61.425	114.7

Source: Authors' computation based on field survey data, 2018

4.2 Discussions

To provide empirical evidence on the contribution of livestock production to household food security and income, the paper estimated equation (3) specified in the presented in the previous section and the results are present in table 2. The second column of table 2 are the coefficients obtained from the probabilistic regression model and in the fifth column shows the average marginal effects. The fourth column presents the z- statistics with the corresponding p - values in parenthesis. The interpretations were done using the average marginal effects of the variables.

From the empirical results, the paper found a positive and statistically significant contribution of livestock production to household's food security. The result suggests that on average, increasing livestock production is more likely to increase food security by 0.0062 percentage point. This follows it's a priori expectation. Other empirical studies such [2, 31, 26, 32] also arrived at same conclusions in terms of signs and significance but differ in magnitude. The over whelming concerns is not only about food shortage or inadequate food distribution but rather households' inability to purchase addition food to sustain their livelihood. Therefore, livestock keeping provides the financial ability for the household to purchase additional food to smoothen their consumption. Apart the elimination of seasonal consumption deficits of households, livestock production could also provide latent benefits such nutritional needs of households, manure, animal power, prestige among other. However, these benefits are not accounted for in this paper. This means the value or contribution of livestock would have been higher.

The results further prove that there is a positive significant relationship between other sources of household income (excluding remittances and win fall gains) and food security. As income sources increase the household is able to purchase additional food to support their livelihood especially in case there is crop failure. The paper also uncovered that there is positive and statistically significant relationship between household education and food security. A better educated household head is more likely to achieve food security. The finding suggest that all the categories (primary, junior high, secondary vocation/technical training and tertiary) of education have positive effect on household food security. The higher one's level of education the higher the impact on household food security. This suggest that household heads who have higher education are more likely to remain food secured than those with lower or no education in periods of seasonal crop failure.

The study again found there is a negative relationship between age of respondent and food security. Increase in age has less likelihood of contributing to food security by 0.0022 percentage point. This depict diminishing labour productivity along the age ladder. As a person advances in age, his or her marginal productivity fall. This result is not suppressing as the descriptive statistics showed a maximum age of household heads to be 74 years which is above the active productive labour force of 60 years.

The study established that there is no significant relationship between farm size, household size and gender of the respondents. The insignificant impact of farm size on food security may due to the fact that farm lands are differentiated by land fertility. Thus the productive capacity of farm lands depend of its fertility. Meaning that, farm land may not be adequate to contribute to food. Unfortunately, Land fertility was outside the scope of this study due to lack of measuring rod.

Table 2: Estimated Probabilistic regression results

Variable	Coefficient	Std. Error	z- statistics	Marginal effects
Household size	0.0291	0.0303	0.96(0.34)	0.0101
AgeHH	-0.0078**	0.0035	-2.24(0.03)	0.0024**
Primary	1.5028**	0.7314	2.04(0.040)	0.9490**
Junior High/ middle sch	1.7097**	0.7316	2.34(0.019)	1.0017**
Secondary/O' Level.	2.0913**	0.7283	2.87(0.004)	1.1232**
Vocation edu.	2.2230***	0.7399	3.00(0.003)	1.1774***
Tertiary	2.5474***	0.7568	3.37(0.001)	1.2872***
Sex	0.2216	0.1898	1.17(0.243)	0.0693
Marital status	0.0336	0.1949	0.17(0.863)	0.0076
Livestock income	0.0189***	0.0038	4.95(0.000)	0.0062***
Other income sources	0.0797***	0.0147	5.41(0.000)	0.0253***
Farm size	0.0124	0.0010	1.25(0.212)	0.0039

*Note: *** and ** denote 1% and 5% statistical significance level respectively*

An equally important contribution of livestock production is its ability to contribute to household income in the Upper West region of Ghana. The results from the Ordinary least Square (OLS) estimator established a positive and statically significant relationship between livestock production and household annual income. The result suggest that, a relatives increase in livestock production could lead to 21.354 relative increase in household annul income. Household generate cash income from Livestock production through direct sales of livestock (live animals) and or their products (milk, eggs, meat, wool). The income generated from Livestock could serves a cash buffer and capital reserves increases financial stability to crop farmers. Income from livestock production could be used to purchase agricultural inputs such as fertilizer, improved seed weedicides and pesticides. Household heads who keep ruminants like cattle use the bullocks for ploughing instead of tractors. This reduces the cost of farming as it saves income which could have otherwise been used to hiring labour or hiring tractor to till the farm lands. This is an important contribution to crop production. This finding accords with that of [30, 2, 4, 19, 25] who found that livestock production contribute to household income and that livestock keeping minimizes the risk associated with the food crop sub sector (see table 3).

Household size in this case has a highly significant but surprisingly negative. The coefficient (0.6232) shows that a relative increase in household size will lead to 0.623 relative decrease in household income. The coefficient it is statistically significant at 1%. It being negative can be explained intuitively as some household dependant(s) may consume more than the income she or he generate. In this her or his contribution to household income will be negative. The paper also found a significant relationship between age (0.1549) of respondents and household income. There is also a statistically significant relationship between household size and annual income of household. The relationship is statistically significant at 1% (see table 3).

However, Farm size, marital status, gender (Sex) and education had no statistical significance with household annual income. Farm size being insignificant could be explained from the fact that the productivity of farm land dependence on the soil fertility which is outside the scope of this paper (see table 3).

Table 3: Estimated OLS regression results

Variable	Coefficient	robust Std. Error	t- statistics
Household size	0.00235	0.00204	1.15
AgeHH	0.0000934	0.00021	0.44
Educ.	0.0102	0.0075	1.34
Sex	0.0286***	0.0087	3.28
Marital status	0.0161	0.0100	1.61
Livestock income	0.041315**	0.01533	2.69
Other income sources	0.113666**	0.041601	2.73
Farm size	0.002721	0.003195	0.85
Constant	4.20504***	0.164984	25.49
Number of observation = 622		F(8, 614)	= 3.57
R- squared = 0.5383		P-value	= 0.0009

Note: *** and ** denote 1% and 5% significance level respectively

5. Conclusion

The ultimate aim of this paper was to empirically examine the contribution of livestock production to household income and food security in the Wa Municipality in upper West region of Ghana. Six hundred and twenty two questionnaires were administered household heads who keep livestock. The paper adapted the probabilistic (probit) model to achieve its first objectives. This model was used owing to the binary nature of the dependent variable (food security). The second objective was achieved using the Ordinary Least Squares (OLS) estimator. All continuous variable were logged. From the descriptive statistics, the study found that 89.23 percent were males while 10.77 percent were females. The study uncovered that, about 19.45 percent of the respondents had no formal level education, 28.46 percent had primary education, 28.78 percent had junior / middle education, 16.72 percent had secondary/ordinary level education and only 6.59 percent had attained tertiary level of education.

Furthermore, the paper found a positive and statistically significant contribution of livestock production to household's food security. Again, livestock production to household income is statistically significant and positive. Meaning the indeed livestock keeping contribute to household food security and income in the Upper West region of Ghana. The importance of livestock production in Ghana is under estimated. The results show that livestock production is very essential as it contribute to food security, hence reduces hunger in the Upper West region of Ghana. The findings suggest that with an increase in livestock production there is the likelihood

that household food security and income will also increase, *Ceteris paribus*. Moreover, other sources of income and education all had positive impact on food security. The livestock contribution would have been higher if the latent contribution of livestock was to be added.

The study has relevance policy implications for Ghana. This paper established that livestock production plays an important role in household food security and improvement in household income in the upper west region of Ghana. And therefore livestock production has the potentials if increasing food security and income among the people in the Upper West region. The contribution of livestock production would have even been higher if the latent contribution were added. However, the impact of this latent function is outside the scope of this paper. Hence future studies could incorporate the latent function to ascertain the full impact of livestock.

5.1 Recommendation

From the study, it was revealed that livestock production is a greater source of livelihood to the people in the Upper West Region of Ghana. This implies that livestock production could be a safety net for the people of Upper West region of Ghana. Based on the empirical findings, the paper recommend that government (agricultural planers) and non-governmental organization ought to pursue policies that could lead to improved breeds of livestock, availability of credit available to enhance large scale production of livestock, forage conservation among other interventions that will lead to the development of the livestock sub sector.

6. Limitation of the paper

The main short falls of this paper is its limited scope. The study covered only the Upper West region of Ghana hence the inability to generalize the findings to cover the entire Ghanaian economy. Again, the latent (nutritional) contribution of livestock production was outside the scope of this paper.

Model diagnostic test: To normalise the variances of the variables in the model and avoid the inherent Heteroscedasticity associated with primary data, the estimation was done using the robust standard errors. This was to ensure that the estimated standard errors are not either biased upward or downward. Therefore the results presented are free from the heteroscedasticity.

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