THE IMPACT OF EDUCATION ON PRODUCTIVITY IN THE COMMERCIAL POULTRY INDUSTRY IN THE GREATER ACCRA REGION (GHANA)

BY

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DECLARATION

I hereby affirm that except for references to work of other researchers, the study as presented in this dissertation: **The Impact of Education on Productivity in the Commercial Poultry Industry in the Greater Accra Region** was carried out by me in the Department of Agricultural Economy and Farm Management, University of Ghana, Legon, from January 2000 to June 2001.

I further assert that this work has not been presented to this University or elsewhere, either in part or fully for any other degree.

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This dissertation has been submitted for examination with our approval as supervisors.

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DEDICATION

TO

GOD Almighty, My Husband Kofi Larbi-Apau

and My Son Kofi Afriyie.

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Josephine A. Larbi-Apau

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LIST OF ABBREVIATIONS AND ACRONYMS

AMA	Accra Metropolitan Assembly
ASIP	Agricultural Sector Investment Project
CEPS	Customs, Excise and Preventive Services
CES	Constant Elasticity of Substitution
CPM	Coloured Progressive Matrices
EAP	Economic Active Population
FAO	Food and Agricultural Organization
FCR	Feed Conversion Ratio
GAPFA	Greater Accra Poultry Farmers Association
GAR	Greater Accra Region
GDP	Gross Domestic Product
GPFC	Ghana Poultry Farmers Council
IMF	International Monetary Fund
ISSER	Institute of Statistical, Social and Economic Research
JSS	Junior Secondary School
LPIU	Livestock Planning and Information Unit
MOFA	Ministry of Food and Agriculture
SAP	Structural Adjustment Programme
SSS	Senior Secondary School
USA	United States of America
VAT	Value Added-Tax

ABSTRACT

This study examines the impact of education on productivity (output) in the commercial poultry industry. Studies have focused on the role of production inputs including the human capital on agricultural productivity, with little emphasis on commercial poultry production.

A structured questionnaire was used to collect data from 60 production managers of the commercial poultry enterprises in the Greater Accra Region of Ghana for the production period of 1999.

The levels of education of the production managers of the enterprises were factored into the Cobb-Douglas Production Function together with other explanatory variables of day-old-chicks, purchased variable inputs, capital, feed consumed, influence of ownership to the enterprise, the enterprise as full-time employment (job) of the managers, extension visits and experience.

The estimate of the impact of education on productivity (output) in the commercial poultry industry in the study is positive and markedly higher at the secondary and tertiary levels with estimated coefficients of 2.4 and 1.5 respectively. The computed percentage in productivity (output) due to tertiary education relative to the lower (secondary) education is 10 percent. Tertiary education coefficient is significant at 10%, while secondary education coefficient is statistically insignificant. The interactive term of basic educational level of primary/middle/JSS, experience and extension education is positive, but statistically insignificant. Both capital (0.40) and labour (0.80) as other explanatory variables are positive and statistically significant at 0.05% and 0.01% respectively.

Financing for the commercial poultry enterprise and other government policies such as high interest rates, high cost of inputs and uncontrolled

liberalisation of the import of frozen poultry products are identified from the study as some of the main constraints to increased output and growth in the industry. Most of the operators are also under-utilising their installed capacities and are producing only when demand for the product is high.

It is recommended among others that, the level and quality of human capital (education and experience), be developed through improving quality of education, provision of in-service training and short courses to improve on the innovative, technical and management efficiency, together with an enabling economic environment, to encourage domestic investment in the quest to achieve self-sufficiency in meat production. Poultry managers with technical and management expertise can utilize available and transferable technology to permit efficiency in supplying good quality and inexpensive products to increase their sales. This can help them to compete with imported poultry products that have flooded the domestic market. There should be quality and quantity differentiation of poultry products for different segments of the domestic market.

CHAPTER 1
INTRODUCTION

1.1 Background

Over the last decade, agriculture's contribution to the gross domestic product (GDP) in Ghana at constant 1993 prices has been estimated at 40.7% with the service sector at 33.4% and industry at 23.4% on the average (ISSER, 1994; 2000). Ghana's economic growth and development has been closely linked with the performance of the Agricultural sector (MOFA, 1991). In addition, the agricultural sector serves as a source of employment. As at 1990, about 60% of the economically active population (EAP) are employed by the agricultural sector, however there is an increasing labour mobility to especially the service sector (ISSER, 1995).

The agricultural sector also contributes substantially to the countries foreign exchange earnings of about 40.7% and tax revenue of 10.6% on the average (ISSER, 1994; 2000). The relatively high performance of the foreign exchange earnings and the tax revenue contribution has been attributed to the cocoa sub-sector. Ghana's domestic agriculture is also expected to play a role of providing food for the populace however it seems it has not been able to play this role successfully as a result of unfavourable climatic conditions and the rapid growth of the population (Mulhall et al, 1998).

The sub-sectors in Ghana's agriculture are general agriculture, cocoa production and marketing, forestry and logging and fisheries. The general agricultural sub-sector includes food production, industrial and arable crops such

as oil palm, maize and cassava, as well as poultry and livestock. Production of crops and livestock employs about 70-80% of the EAP of the agricultural sector which is estimated at 60% (FAO, 1999), however, the sector's contribution to food supply for domestic consumption has continued to fall short of demand (ISSER, 1998).

Agricultural production in Ghana is generally characterised by small-scale farming with low productivity. Marfo, et al., (1991) indicates that about 80% of food crop farmers are mainly subsistence and the remaining 20% are for cash crop production. In the production of livestock, over the 1990s, it has been estimated that with the exception of pig whose population continued the decline started in 1990 (Table 1a), the other livestock numbers increased. On the basis of projection ISSER (2000) reported that the population of major livestock increased in 1997-9 as compared to 1996. Poultry population was also estimated to have increased by 4.8% and 8.9% percent in 1998 and 1999 respectively. The reason assigned to this increase in poultry production is the availability of reduced international feed cost, bearing in mind that the commercial poultry production in Ghana depends mainly on imported inputs such as feed ingredients, feed additives and supplements and veterinary drugs.

Table 1a: Livestock/Poultry Population 1990-1999 (million heads)

Year	Cattle		Sheep		Goat		Pigs		Poultry	
	popl.	% change	popl.	% change	popl.	% change	popl.	% change	popl.	% change
1990	1.15	0.9	2.22	0.5	2.02	14.4	0.47	-16.1	9.99	13.7
1991	1.20	4.3	2.16	-2.7	2.19	8.4	0.45	-4.3	10.57	5.6
1992	1.22	1.7	2.15	-0.5	2.22	1.4	0.44	-2.2	11.23	6.2
1993	1.17	-4.1	2.22	3.3	2.12	-4.5	0.41	-6.8	12.17	8.4
1994	1.22	4.3	2.22	0.0	2.20	3.8	0.37	-9.8	12.29	1.0
1995	1.12	-8.1	2.01	-9.5	2.16	-1.8	0.37	0.0	13.08	6.4
1996	1.25	11.6	2.42	20.4	2.53	17.1	0.36	-2.7	14.59	11.5
1997*	1.26	-3.2	2.50	-7.0	2.66	-4.7	0.35	-8.3	15.88	1.6
1998*	1.27	0.8	2.58	0.9	2.79	2.1	0.34	-6.1	17.28	4.8
1999*	1.29	1.6	2.66	3.1	2.93	5.0	0.33	-2.9	18.81	8.9

Source: ISSER (2000) * Projections

Despite the increasing growth in poultry production over 1990s, Adom-Boakye et al, (1999) based on a market survey, indicated that about 80% of the currently traded chicken is imported. Domestic production provides the remaining 20%. The per capita consumption of total traded chicken in Ghana, including imported chicken is estimated at 0.7kg/person/year, a figure far below the average for Africa at 3.1kg and that of the world at 7.9kg. Estimates for eggs consumption follow the same trend; Ghana at 0.74kg/person/year as compared to Africa's 1.9kg and the world 5.9kg (Darko, 2000). These trends in Ghana's low per capita consumption reflect in part weak production performance in the poultry sub-sector and weak purchasing power of consumers to buy high valued nutrient foods as the composition of the average diet in Ghana is heavily dependent on starchy staples and cereals (Levin, 1998).

Since 1996, poultry meat imports mostly frozen chicken and turkey meat parts has become the most important meat and animal products (excluding milk products) imported into the country (see Table 1b). This has been attributed to the period of 'mad cow' crises, high price competitiveness of domestic production and the availability of cheap exportable poultry cuts from other countries (LPIU, 1999). Frozen chicken has therefore continued to record significant growth to supplement domestic consumption requirements. For example the total monthly volume of chicken imports rose from 250Mt from January 1997 to about 1,050Mt in December 1998. The situation posses great competitive challenge to the sustenance of the local commercial poultry industry. On the other hand beef imports experienced drastic fall from 1996 also because of the 'mad cow' syndrome and the subsequent increase in beef prices on the world market.

Table 1b: Imports of Animal Products through Tema Port, 1992-1999 (MT)

Year	Beef	Chicken	Turkey	Pork	Others	Dairy Products
1992	16, 097	2, 314	2, 146	1, 404	282	2, 173
1993	19, 123	3, 085	1, 833	2, 048	481	2, 172
1994	7, 336	1, 848	954	1, 661	190	3, 874
1995	8, 241	3, 160	2, 268	2, 142	190	8, 505
1996	3, 384	3, 682	na	na	na	5, 640
1997	1, 687	1, 891	3, 048	741	363	6, 141
1998	1, 447	7, 291	2, 241	758	1, 215	10, 101
1999	2, 568	10, 766	1, 491	772	695	7, 407

Source: Ministry of Food and Agriculture, Veterinary Services Department (1999), Accra in ISSER (1994).

Over the last two decades, the Structural Adjustment Programme (SAP) initiated in 1983 established a policy environment for sustainable development with the support of IMF/World Bank loans. A policy on privatisation has been emphasised for the promotion of conducive and competitive macro-economic environment. The exchange rate, rates of inflation, lending rates and the stability of the local currency, were to be streamlined to promote investment in the economy. Structural changes were proposed and some implemented to develop the agricultural sector and encourage private participation in food production.

Overall, the agricultural sector has grown between 1-4.0% per annum with a population growth of 3.0-3.5% per annum. On the average, the agricultural sector has grown at par with population growth. To further improve the performance of the agricultural sector, the Medium-Term Development Programme of 1991-95 (MOFA, 1990) was developed. However, most of the policies were biased towards crop improvement, crop production and extension service in crop production. Running through the programme was detailed research in cereals and legumes improvement, coconut and oil palm rehabilitation and development of hybrid seed, promotion of good agronomic practices of root and tuber crops, post-harvest and management and improvement in soil fertility. Staff development was focused on crop production. Provision was also made towards increasing fish and fish products through the construction of fishponds to encourage aquaculture. A lot of infrastructural strategies were developed in this sector. The benefits of other projects such as Agricultural Sector Investment Project (ASIP) and the Irrigation project were all geared towards the development

of the crop sector. Very little was strategised towards the development of livestock and poultry industry.

In Ghana, agriculture is characterised by subsistence production using rudimentary technologies with few commercial enterprises. Some households produce partly for sale and partly for consumption. The poultry industry is no exception. Chicken and turkey dominate the poultry industry in Ghana even though the term refers to all domesticated birds including guinea fowls, pigeon, geese, ducks and peafowl. Poultry production has been undergoing several changes including vertical integration and sophistication such as automation in feeding and watering as well as effective health programmes to reduce morbidity and mortality in bird population in Ghana. There are two distinct poultry production systems in Ghana, the traditional family-poultry and commercial poultry production. The differences in these two lie basically in the scale of production, management, housing and marketing of output.

The traditional family-poultry is characterised by poor feeding regime (more of scavenging with little supplements from 'left-overs'), no or little housing units (birds may roost in trees on household compounds) and no or very little management practices. The family poultry producers are usually resource-poor women living in rural communities. A household may keep up to 50 local fowls, of which the hen broods and hatches the eggs which are laid in batches of 5 to 25 eggs per the laying period. Chicks follow the hen, feeding alongside the 'mother hen' till about two to three months when they are driven away. The young chicks fend for themselves till the pullets are ready to lay. The older birds may be

slaughtered for food when they are about one-and-half to two years old. The production contributes to family income, household nutrition and food security.

The largest source of growth in the poultry industry to help meet domestic demand in poultry products in Ghana is the commercial poultry production system. The commercial poultry production started in Ghana in the early fifties. The majority of eggs in the market were imported and broiler production was unknown since the traditional poultry that weigh about 800g on the average at maturity served as egg and meat producer. The industry picked up in the early 1970's and has since been producing on commercial basis alongside the family-poultry using the intensive management system of mainly the deep litter and the battery cage. Many of the enterprises are located in the urban and peri-urban areas where demand for the product is high. Some of the enterprises are vertically integrated companies with their own feedmill, parent stock farms (very few), hatcheries, broiler and layer farms, processing and packaging units. Marketing of the products is either at farm-gate or other retail outlets.

The commercial poultry industry has to be properly organised to make the required investments in capital and managerial skills necessary to compete with the various forms of imports. Some of the problematic issues that need to be addressed are the production of cost effective live bird population, operational processes and production inefficiencies, adoption of modern and appropriate technology to production, reduction in mortality rates, inefficient marketing strategies, market research and development. Solutions to these require a critical outlook at the managerial inputs in the production process and how it influences

productivity and the performance in the commercial poultry industry particularly. The level of education of the management is therefore crucial in enhancing productivity of the commercial poultry industry.

1.2 Problem Statement

The evidence that raising educational levels of the farmer enhances agricultural productivity comes primarily from Jamison and Lau (1982), supported by other empirical studies (Azhar, 1991; Phillips, 1994; and Pinckney, 1996).

Productivity measures have centred on the four main categories of labour, capital, variable inputs and services at the expense of entrepreneurship in general in the poultry industry. There is at present a paucity of direct evidence to quantify the magnitude of the effect of education on productivity in the poultry industry in general and the commercial poultry industry in particular in Ghana. However, the cognitive effect of the educated manager may increase the output in the industry by a given combination of inputs, the "worker effect" (Shultz, 1964; Cotlear, 1990; Appleton and Balihuta, 1996).

The ability of the educated manager to follow instructions for automation, use chemical inputs and other aspects of modern technology can be an asset to increase productivity in the industry. He also stands the advantage of using the numerative skill to calculate, measure, employ production techniques and engage himself informed in other planning decisions, thereby increasing the competitive edge of the commercial poultry unit and the industry.

Functional literacy of the production manager may change allocative efficiency by altering the selected combination of outputs and inputs, especially with the integration in the commercial poultry industry where prices and / or technology keep on changing. The propensity of the educated manager to adopt innovations, employ particular production mix, use alternatives to change attitude and practices and work towards achievement can be large and expected. These attributes are expected to increase the competitive edge of the industry and help increase production and thereby help decrease imported poultry products in the country.

The contention therefore is that for increased agricultural productivity especially in the poultry industry, commercial poultry farmers with enhanced human capital in terms of increased education would have the potential to be innovative, have access to and use production inputs more efficiently, adopt new and modern technologies and be more successful at managing the enterprises.

The focus of the study is on the commercial poultry industry and the questions that arise are: What are the types of commercial poultry enterprises in the economy? What are the levels of inputs available to the commercial poultry industry? What are the levels of production and the production capacities? Are these commercial poultry farmers able to utilise their capacities with the available inputs? What are the educational backgrounds of the managers in the commercial poultry industry? Does education increase productivity (output) in the commercial poultry industry?

Answers to these questions are relevant to the formulation and implementation of a sound industrial policy for commercial poultry in Ghana. This study is therefore aimed at finding answers to these questions.

1.3 Objectives of the Study

The main objective of the study is to estimate the impact of education on commercial poultry productivity (output) in Ghana, using the Greater Accra Region in Ghana as a primary focus. The study is focused on chicken as the popular species and of the largest population in Ghana.

The specific objectives of the study are:

1. to identify the types of commercial poultry enterprises in the Greater Accra Region (GAR);
2. to determine the levels of production inputs available for commercial poultry production in the Greater Accra Region;
3. to measure the production capacities in the enterprises relative to their potential capacities in the GAR;
4. to calculate the levels of productivity of the commercial poultry industry in the GAR;
5. to describe the patterns of the distribution of the educational background of the production managers in the commercial poultry industries located in the GAR;
6. to quantify empirically the impact of education on productivity (output) in the commercial poultry industry in the GAR; and

7. to ascertain the constraints to technological development and management capabilities in the commercial poultry industry.

1.4 Relevance of the Study

The World Bank's (1989), most recent perspective study on Africa states categorically "raising educational levels enhances agricultural productivity." Increase in the education of the rural labour force is expected to have a positive impact on agriculture. The study helps to ascertain the veracity of the "conclusive evidence" in the commercial poultry industry in Ghana. Since the commercial poultry industry has gone through series of technological changes, sophistication in production and capacity utilisation, people with low educational background are not likely to survive in such an enterprise. The educational background of the farmer in the poultry industry is therefore an important input, which must be studied and its effects analysed

Again, with a clearly defined role of agriculture in the Ghanaian economy, the commercial poultry industry as a sub-sector has an onerous task of providing animal protein source, enough to meet the country's demand and to achieve the policy of food sufficiency by the year 2020. The need to be competitive to cut down on the importation of poultry products in an attempt to encourage local production cannot be over-emphasised. The results of this study will be a valuable input into enhancing increased production as the types of the enterprises would be identified, the level of inputs assessed, and their capacities measured to help in management decision, policy formulation and implementation.

The expansion of commercial poultry production in developing countries has largely occurred outside the traditional agricultural sector (World Animal Review, 1984). In an attempt to build up the local commercial poultry industry in order to reduce imports of poultry meat and eggs, developing countries have not only become increasingly dependent on imported feeds (concentrates), but also on foreign technology, management and other production and processing requisites, thus, increasing the production costs. The results of this study are expected to highlight the constraints militating against the industry, and suggest alternative ways to solve some of these problems.

Operation managers are concerned with capacity for several reasons. First, they want sufficient capacity to provide the timing and quantity of output needed for meeting current and future customer demand. Notwithstanding, the acquisition of capacity is an investment by the enterprise. Since one seeks a good return on investment, both the costs and revenues of a capacity decision must be carefully analysed. It is also important to emphasise that managing capacity requires a good understanding of the environment within which the enterprise is operating. It very much requires an understanding of current demands of existing operations and a vision regarding future business conditions. Measurement of production capacity of the poultry enterprise, a parameter, which this study seeks to achieve, would be of an immense contribution to the industry as education and capacity-planning decisions of the production manager is

analysed. Moreover, a commercial poultry business entrepreneur of a sound educational background is expected to financially, economically and technologically evaluate alternative capacities and select the alternatives most suited to achieving strategic mission.

Furthermore, studies on the economics of education in the agricultural sector have been based largely on aggregates from developed countries (Jamison and Lau, 1982; Lin, 1991; and Phillips, 1994). Studies in developing countries have focused mainly on the non-agricultural sector, with a few studies on the agricultural sector by Chaudri (1969) in India, Haller (1972) in Columbia and Jamison and Lau (1982) in Thai. In Africa, south of the Sahara, with the exception of Pinckney (1996); Weir (1999), there is a paucity of studies on the effect of education in the agricultural sector, especially the poultry industry. This study is therefore one of the few that seeks to address issues of the impact of education on productivity (output) in the commercial poultry industry in Ghana. The study therefore adds to the empirical literature on education and productivity in the commercial industry in Ghana.

The result of the study will be a source of information to the Ministry of Food and Agriculture, especially to the Animal Production and Livestock Planning and Information Units (LPIU) to serve as a basis for further research work.

Finally, the study will provide the framework for further studies in the overall growth and development of the poultry industry. It must be

stated that new knowledge results in the creation of new inputs, which in turn results in increased efficiency if they are adopted.

1.5 Organisation of the Study

The study is organised into five chapters. Chapter 2 provides a review of literature on the impact of education on agricultural development. The chapter further reviews empirical models of education on productivity.

Chapter 3 is the outline of the study's methodology. It incorporates the study area, the sample size and the models used for measurement and analyses.

The empirical result their analyses and interpretations are presented in chapter 4. Chapter 5 concerns the summary, conclusion and recommendation derived from the study.

CHAPTER 2
REVIEW OF LITERATURE

2.1 Introduction

This chapter is a review of existing literature related to the commercial poultry industry and education and productivity in agriculture. The main issues addressed in this chapter are the commercial poultry industry in general, the commercial poultry industry in Ghana, valuation of agricultural output and inputs and measurement of productivity. Also included are reviews on production functions, education and productivity models, education, extension, research and technology adoption for increased productivity and studies on effect of education on agricultural productivity.

2.2 The Poultry Industry

Poultry meat and eggs are nutritious and relatively inexpensive animal products used by humans throughout the world. Chicken and turkeys dominate the world poultry industry. According to Roenigk (1998), globally poultry is the second most-consumed meat, having overtaken beef in 1996. Although pork is the leading meat, poultry is clearly the most dynamic in terms of gaining market share, adapting technology and being able to benefit from major consumer food trends. The application disease control, along with sound business practices has advanced the commercial poultry where eggs and meat can be produced efficiently.

China has emerged as a major player in the world poultry meat market for both export and import (World Poultry, 1998) as a result of its rapid growing domestic poultry industry. China is also USA's major competitor, surpassing the European Union (EU) as the second largest poultry producer in the world and second to Russia as a major importer (World Poultry, 1998).

World poultry meat consumption consists of three major segments; young meat chicken (broilers), turkeys and other poultry which include spent table egg layers, spent breeder hens/cocks, ducks, geese, guinea fowls, pheasants, quail, squab and ratites such as ostriches and emus (Roenigk, 1998). Broilers dominate the world poultry consumption, contributing about 70 percent of the world poultry market. Turkeys account for about 8 percent, and "other poultry" provides the balance of 22 percent of the global market.

In Africa, small-scale production is still the norm. Reports from the World Poultry (1999) estimated production levels of poultry meat in Egypt as 344,650Mt and Libya, 70,200Mt. In Ghana, poultry production is estimated at 14,000Mt (ISSER, 1998). In Morocco, half a dozen farms with 60,000 birds or more keep about 50% of the country's commercial broiler flock, and of this, 70% are situated around the main cities. In West Africa and for that matter Ghana, most of the poultry farms are also established in the peri-urban and urban areas. For example, in La Cote d'Ivoire, it is estimated that about 90% of its modern poultry production are sited around Abidjan. Some of these poultry enterprises are vertically integrated companies with their own parent stock farms, hatcheries, feed mills, broiler or layer sections, processing and packaging units (Ehui, 1996).

There has been an increase in the demand for poultry meat as a result of two major factors: population growth and increase in income. Demand for poultry has high-income elasticity, especially in developing countries. As income rises, poultry is often consumed in place of grain-based products (Roenigk, 1998). Poultry meat in developing countries, especially West Africa and for that matter Ghana is however consumed as luxury. Live poultry are slaughtered mostly for ceremonial and festival dishes and as a special meal for guests (Darko, 2000). The reason assigned to this is that poultry meat in these countries is relatively expensive, unaffordable and unavailable. On the other hand, poultry meat is viewed as having attributes that match with consumers preference in developed countries, because the meat is considered healthy and wholesome (Roenigk, 1998).

Production and Management efficiency is of utmost importance in the profitability and productivity of the poultry industry. For example, feed efficiency of the layer has a great impact on the returns of the poultry company, because more and large eggs with less feed, means a higher net yield. On the other hand, broiler standards depend on genetics, management practices, feeding programmes, health status and climatic factors. Under good biosecurity, housing and adequate nutrition, it is quite common to have broilers of more than 1.5 kg-2.0 kg at 35 days of age, even as high as 2.6 kg in just 4 weeks (Nilipur, 1998). A well-fed hen from a respected and known genetic line can easily produce more than 300 eggs in a 52-week production cycle. Nilipur (1998) recommended these standards to be used as a guide for production performance of birds.

Due to variations in management, it is commonly noted that for every 100 fertile eggs produced, only 50-70 percent eggs are actually converted to broiler meat, meaning 25-55 percent of the fertile broiler eggs produced are lost (Nilipur, 1998). This dramatic loss, according to Nilipur (1998) can be reduced if poultry growers pay close attention to management details in their operations. He further indicated that each egg must be converted to at least 2.0 kg (4.4 pounds) of meat within 40 days of age under normal conditions and each breeder should be able to produce at least 273 kg (600 pounds) of broiler meat during a 40-week production cycle. The inability to achieve these is attributed to inefficiency and poor management, and that the difference between poultry managers who know what to expect in performance, including limits and standards for each performance category versus managers who have no idea of what is going on in their operation is obvious (ibid). It has been suggested that the majority of egg production depression cases are caused by errors in management or nutrition rather than infectious diseases (World Poultry, 1997). Increasing production is the simplest way to meet the increasing demand for poultry products; however, improving the efficiency to get more out of ones flock is the utmost. Dramatic differences in performance therefore may be seen among enterprise in the poultry industry but the only major difference is the level of management skills among producers (Roenigk, 1998).

2.3 The Poultry Industry in Ghana

Commercial poultry production in Ghana started in the early 1950's. The majority of eggs on the market at that time were imported because local production was unappreciable and the eggs came from mainly hens kept on very few backyard farms (Annang, 1969). Annang (1969) indicates further that broiler production was unknown and the quality of eggs was also not given any serious consideration. Therefore historically, most commercial chicken farmers in Ghana entered the industry for egg production.

In most rural communities, village producers raise small poultry flocks. About 5-50 chickens per household are raised and human and poultry generally live within the same house/compound. Despite efforts to develop intensive poultry production, family poultry is still very important in low income, food deficient communities. Most hen eggs are allowed to incubate under the mother hen who may lay up to 20 eggs in a laying period. For example, in Northern Ghana, about 71% of the eggs laid are intended for hatching, 18% for sale, 5% for consumption and 5% for gifts (Guèle, 1998).

Family poultry is generally raised in free range and/or backyard systems that are traditionally extensive husbandry system. Since the system is maintained with very low level of inputs, poultry can be kept by even the poor (est) social class of the rural population (Guèle, 1998). The production system is considered as sustainable as it is socially and culturally accepted, financially economic and ecologically sound.

The late 1960's and the 1970's saw an active commercial poultry industry in Ghana. So successful was the industry that day-old-chicks and other poultry products were exported to other West African countries (Owusu-Acheampong, 2000). Again, in the early 1970's, many commercial poultry farms and hatcheries sprang up in Accra, Kumasi and most of the urban centers. Since these farmers did not have any dependable source of feed, most of them resorted to producing their own feed, though with great difficulty. According to Owusu-Acheampong (2000), the difficulty encountered in feed production, still persists today.

Egg production is the major poultry product in the commercial poultry industry in Ghana, widely consumed and easily distributed (Darko, 2000). Eggs in Ghana sell readily because of its relatively low unit price, its availability, relatively long shelf life and its non-substitutability in a multiplicity of dishes for mass consumption. The average Ghanaian commercial poultry farmer is said to consider broiler production as too capital intensive in terms of infrastructural requirements for processing, cold storage, marketing and distribution. Hence, the broiler production unit of the industry is basically avoided and remains under developed (Darko, 2000).

A market survey conducted in May 1999 in Ghana by Adom-Boakye, et al., (1999) indicated that Ghana produced 16.1 million poultry out of which 13.7 million were chicken. The study further stated that the total poultry product imports averaged 7,200Mt, giving a total traded chicken of 13,357Mt for an estimated 18 million people in 1999. Therefore in comparison to the USA of an annual per capita consumption of 39 kg per year, Africa 1.9 kg per year and the

world 5.9 kg per year, Ghana's per capaita consumption is estimated at 0.7 kg per year, Nigeria 0.5 kg, Benin 7.1 kg and Cote d'Ivoire 3.6 kg per year on the average respectively.

2.4 Imports of Poultry Products in Ghana

To increase the supply of poultry products to meet the shortage in demand resulting from low domestic production. The Customs, Excise and Preventive Services (CEPS) have listed three major chicken importers namely Amaadi Coldstores Ltd. (31.9% of total imports), Sotrec Ghana Ltd. (16.9% of total imports) and Diamonds Foods (16.8% of total imports), all together import about 60% of the total chicken imports to Ghana. They import mainly from France, Italy, the Netherlands and Belgium. These importers have no local production base (Adom-Boakye, et al., 1999).

2.5 Limitations to Increased Domestic Commercial Poultry Production in Ghana

Some of the major factors that have resulted in the uncompetitiveness, little integration and inadequate supply of poultry products in Ghana are listed as high cost of inputs, lack of subsidy on production inputs, the subsidization of imported poultry products and the high cost of capital (Somuah, 2000). The relatively high production cost is confirmed by the International Egg Commission (1999), which reported that Ghana has one of the highest production cost in both egg and broiler production (see Table 2a). In Table 2a, in comparison to Indonesia, the cost of

producing 1 kg of eggs in Ghana is about 53% higher, 65% and 50% more compared to USA and Brazil. Comparison to these countries is based on the fact that most of the imports of poultry products are from these countries especially France, Belgium and the Netherlands.

Table 2a: Cost of Production of 1kg of Eggs in Selected Countries (in USA cents)

COUNTRIES	USA CENTS
Indonesia	38.68
USA	43.56
Brazil	45.94
Canada	46.57
France	55.83
Ghana	72.85
Japan	90.69

Source: International Egg Commission (1999)

Table 2b compares the cost of production for live and dressed broilers. Again, the comparison to these countries, especially the Netherlands and France is important since imports of poultry products from these regions are subsidized and are sold at relatively cheaper prices in Ghana. The total cost of producing 2 kg live (1.3 kg dressed) is about 45% higher than the USA and 16% higher than France. However, the wholesale price of the same size broiler in Ghana is about 1.2% and 6.5% lower to that of the Netherlands and France respectively.

Table 2b: A comparison of production cost for broilers in Ghana, USA, the Netherlands and France for 2 kg broiler (live) or 1.3 kg (dressed) in Ghanaian cedis at an exchange rate of 2,500 cedis to US 1)

	GHANA	USA	NETHERLANDS	FRANCE
Day-Old-Chicks	2,800	780	1,495	1,549
Feed	5,280	3,309	7,144	5,920
Mortality Rate	224	39	75	78
Other Costs	1,400	1,223	1,216	590
Total Costs	9,704	5,351	9,930	8,137
Cost/Kg	7,465	4,116	7,638	6,260
Wholesale Price	9,000	5,781	9,118	9,635

Source: The International Egg Commission (1999)

Darko (2000) has also confirmed the high cost of inputs such as feed, vaccines and drugs, unreliable supply of utilities and uncertainties in the marketing of spent layers as problems in the commercial poultry industry. Somuah (2000) discussed among others small scale of operation and low consumption of poultry products in Ghana as additional distress in the enterprise. He indicated that the average size of a large-scale commercial layer farm in Ghana is of about 20,000 capacity. The situation is said to be worse with the commercial broiler production. A large number of such broiler farms are very small-scaled with less than 1,000 capacities even though they are commercially operated.

As of today, the rearing of commercial parent stock (breeders) and day-old-chicks have also suffered severe setbacks and most of the commercial feedmills have folded up (Owusu-Acheampong, 2000). Other constraints are high lending rates of between 27-47% over the last decade, high rates of inflation and rapid depreciation of the local currency.

2.6 Measurement of Productivity (output) and the Production Function

Productivity has been defined as a "ratio of output to a measure of some or all of the resources used to produce this output", however, the phrase "some or all of the resources" introduces an area of confusion into the definition corresponding to the multiplicity of the types of productivity (Teague and Eilon, 1973; Vonderembse and White, 1988).

Most studies on agricultural productivity have used output as the dependent variable. In Pinckney's (1996) study of "Does Education Increase Agriculture Productivity in Africa", the total value of output for both agriculture and livestock activities is assumed to be a function of labour inputs, land, other fixed inputs, purchased variable inputs and human capital. Pinckney (1996) used education of the agricultural household decision-makers in Kenya and Tanzania to estimate the effect of education on agricultural productivity (output) using dummy variables. The other variables used included labour which was measured as the actual total value (wages and salaries) using all the labour on the farm, whether adult, child or hired and land included all land operated by the household. The primary fixed inputs were dairy cattle, particularly in Kenya and purchased

variable inputs such as fertilizers and sprays for coffee. The human capital variables used included experience, which was estimated by subtracting years of education from age minus six (as is common in labour market studies) and years of schooling of household members other than the agricultural decision-makers. In addition to years of schooling, Pinckney measured the agricultural decision-makers' education by conducting Raven's Coloured Progressive Matrices (CPM), a 36- question test of reasoning ability; literacy is not an asset in taking the test (Raven, et al., 1991). He also included in the production function the extension variable, as in most cases; the specification is simply the number of recent extension visits. As agriculture and livestock in the areas surveyed are highly integrated, attempting to separate out one crop or product is likely to lead to a major measurement error. Secondly, Pinckney (1996) noted that one way that education should affect productivity is through the educated operator choosing a more appropriate crop mix. As with most of the previous studies, the Cobb-Douglas production function was used for the study.

Appleton and Balihuta (1996) on the effect of education and agricultural productivity used the value of the total agricultural output as the dependent variable. The educational variables were defined in reference to the education of the household head, measured as the total years of school. Four factors of production; labour, land, capital and purchased variable inputs (seeds and fertilizers) were also included. Labour was measured in terms of the number of adults working on the farm; two types of workers, adult household members aged 15-60 years of age whose main activity was working on household crop farms and

men permanently hired to work on the farm. Land was also measured as available cultivable land and capital as the value of capital goods. They noted that, for most enterprises, capital was largely in the form of hoes and tools. The number of farms using tractor was negligible. Purchased variable inputs were also measured by expenditure (in Ugandan shillings) on seeds, fertilizers and related items in the 30 days prior to the survey. To allow for flexibility in the effects of the factors of production on output, Appleton and Balihuta (1996) used the Translog production function, referring to Brendt and Christensen (1973).

To overcome the difficulty in interpreting the individual coefficients because of the second-order terms, they substituted (*In Xij-Xj**) for In *Xji,* where *Xj* is the sample mean of input *Xji,* reference to Jacoby (1992). It was explained that the transformation implies that the coefficients on the scaled factors of production (*In Xij-Xj**) are elasticities of production evaluated at the sample mean. Other explanatory variables include measures of farmer education and age, gender differences in productivity that is, the proportion of farmers who were women and for whether the farm manager was a woman.

In earlier studies to analyse empirically "Farmer Education and Farm Efficiency" Jamison and Lau (1982) used data from surveys of individual farms in Thailand, Korea and Malaysia. In the case of Thailand, prices of inputs and outputs of individual farms were used, indicating that these prices provided an opportunity to test the effects of education on farm efficiency. The educational level of the production unit was measured by either the education of the head of household, or farm workers, or family members or education of non-workers,

excluding the very young and the very old. As used by other studies, either the number of years of education or a dummy is used to represent the level of education. In Jamison and Lau's (1982) review, land, labour and capital were measured as quantity or value (actual market price or weighted price indices). Land was entered into the function as total area under cultivation or value (average or total rent paid). Labour was differentiated into family or hired and the variable was measured in terms of time or value. Capital was also entered as a single variable or differentiated into several factors including repairs and maintenance and depreciation. Other variable included the quantity, value or use of fertilizer, use of irrigation, types of seed and regional indicator variable.

To establish causality from education to input choice, Appleton and Balihuta (1996) run regressions with each input as the dependent variable and education and other regressors as explanatory variables in their research on Ugandan agricultural productivity. With education having a strong positive effect on capital and other purchased variable inputs, they concluded that the usual Cobb-Douglas production function, which includes other inputs explicitly, *ceteris paribus*, understates the importance of education in explaining the output. They then estimated the production function, without these inputs, as suggested by Welch (1970) to capture more fully the effect of schooling. Welch (1970) however emphasized that where there is adequate information about input and output prices, it is possible to investigate the full effects of schooling without omitting other inputs from the production.

To estimate the production frontier, Lovell (1993) noted that the Cobb-Douglas function is the most commonly used functional form because it has the advantage of easy estimation and interpretation of the coefficients. Christensen et al, (1971) in their work suggested the use of Cobb-Douglas function for the estimation of the production frontier, but added that the Constant Elasticity of Substitution (CES) and the Transcendental Logarithmic Production Function (Translog) are also most frequently used. The Translog is a more recent development. Each of these functions, however, restricts all Allen partial elasticities of substitution to be equal to one. Moreover, the CES function restricts the above elasticities to be constant and equal for any pair of inputs for all points of input space. In addition, both the Cobb-Douglas and the CES functions assume strong separability.

The Translog on the other hand does not restrict the value of elasticity of substitution at any point in input space, and it does not assume separabiblity. It is also very popular for its flexibility (Brendt and Christensen (1973; 1974); Burgess (1975); Denny and May (1977); and Brendt and Wood (1979)). The Translog also allows one to test for specific characteristics of technology (Carbo And Mellor, 1979). The usual estimation procedure has been to work with the side conditions for profit maximization in competitive products and factor market. Under this assumption, side conditions for profit maximization imply simple a system of semi-logarithmic equations with one equation for each input. Each of these equations gives the cost share of input as a linear function of the logs.

Education enters the aggregate production as an explicit input with its estimated coefficient as the only source of productivity (Griliches, 1963; 1964; Gisser, 1965; Lipton, 1985; and Philips, 1994). In this sense the marginal product of education captures the "worker effect" of education, reflecting the increase in output while holding physical resources constant. There is also substantial literature documenting the greater propensity of educated farmers to adopt agricultural innovations, the "allocative effect", for example, modern inputs or new crops (Feder, et al., 1985).

2.7 Valuation of Output and Factor Inputs in Agriculture

Enterprises output is the main measure of individual crops and livestock produced. It comprises the total value of crops or livestock produced by the farm other than losses in the field and in store. It also includes crop used for feed and seed of crops by the farmhouse and those consumed in the farmhouse and by farm labour. These are often valued at the market price (*www.defra.gov.uk*). Livestock enterprises output comprises the total sales of livestock and livestock products including direct livestock subsidies and production grants, consumed produce in the farmhouse, by farm labour and transfers between farm enterprises (ibid.). Total farm output therefore is the sum of crops and livestock enterprise output, general subsidies and miscellaneous revenue from the output sales, and the value is estimated by multiplying the unit sales price by the quantity of total output (Jolliffe, 1998).

Most studies on farm productivity use the value at the market price (Appleton and Balihuta, 1996; Pinckney, 1996) or the value or quantity as reviewed in the studies of Jamison and Lau (1982). Pinckney (1996) indicates that the value of output is used rather than quantity of output per se because agriculture and livestock activities in the area of study were highly integrated, usually in numerous ways in addition to the highly intercropping systems.

Agricultural inputs comprise payments and estimated value of non-cash inputs which are generally classified as variable or fixed (*www.defra.gov.uk*); *www.dardni.gov.uk*)). Total variable inputs are estimated as the total costs of feed, veterinary drugs and fees, medicines and chemicals, other livestock costs, seeds, fertilizers, crop protection, other crop costs, purchased feed concentrates and feed additives and other such inputs which can be changed in response to demand of their use in the short run (ibid). The total fixed costs are actual charges on farm machinery, farm structures and buildings, rental value on land, other farm charges including repair and maintenance costs of all property (farm building and fixed equipment) and depreciation, which is intended to reflect the degree of deterioration of the assets. It is suggested that for the estimation of depreciation, the diminishing balance method is the most appropriate for machinery and other fixed equipment, while the straight line method is recommended for glass houses and permanent crops (*www.defra.gov.uk*). Depreciation, repairs and maintenance were included in the valuation of fixed factor inputs (Olagoke, 1991; Phiri, 1991; and Pinckney, 1996).

Other general farm costs are valued at the expenditure incurred in acquiring the services of those inputs, for example expenditures on the use of utilities for farming purposes such as electricity, telephone services, heating fuel, water, insurance, bank charges and professional fees.

Labour employed on the farm are valued using wages, salaries, employees insurance contributions, unpaid family labour which is calculated at the appropriate rates for comparable paid labour and paid casual labour (*www.dardni.gov.uk*). Where family labour is split between enterprises (off-farm, on-farm and within on-farm enterprises), the costs allocated to the enterprise is related to the proportion of the hours/days spent on the enterprise relative to the total number of hours/days worked on all the other enterprises (ibid).

In most conventional approach to empirical estimation of farm household labour models in developing countries, total labour input on the farm is simply taken to be the sum of family and hired labour hours/days (Thapa, 2000). It is also widely assumed that the prevailing local market wage rate at which non-family labour can be hired is also the appropriate wage applicable to the labour/leisure consumption equilibrium for family labour. Such computation is made even if family labour is fully devoted to own farm work and does not supply any labour on the local hired labour market (Rosenzweig, et al., 1980). For example, in a study on "Efficiency of Resource Use in Rice Production Systems in Anambra State", Olagoke (1991) measured labour inputs in man-hours taking into account the total number of hours worked by household members and hired labour on the selected field on specific days. Man-hour was calculated according to the system

followed by Norman (1973) where adjustments were made according to the effectiveness of the tasks at hand relative to the effectiveness of a male adult under age of 65 years. The estimate was in monetary terms according to the current wage system. This is consistent with Jolliffe (1998) who used labour hours and estimated for wage worked over time.

Most estimation of human capital models in empirical studies use average number of years of schooling of household decision makers and/or members (Pinckney, 1996; Weir and Knight, 2000), the total years of schooling of the household head (Appleton and Balihuta, 1996) or the level of education of the household head, family members or education of non-family workers (Jamison and Lau, 1982). Other human capital variables include experience and extension visits (Pinckney, 1996; Jamison and Lau, 1982), and age (Pinckney, 1996).

2.8 Empirical Evidence of Effect of Education on Agricultural Productivity

Increasing labour and factor productivity in agriculture is widely acknowledged as one key to achieving growth and equity in Africa (Mellor, et al, 1987). The evidence that "raising educational levels enhances agricultural productivity" comes primarily from Jamison and Lau (1982) who compiled and analysed 37 earlier studies relating to agricultural productivity. They concluded from the study that, on the average, four years of education increase output by 72 percent, and that this percentage is higher in rapidly changing agricultural environment.

However, of the 37 studies cited, only two are from Africa (Hopcraft, (1974); and Moock, (1979; 1981), are both from Kenya.

The significant effects of education on productivity are mixed and varied. Hopcraft (1974) finds negative and significant effects of education on output while Jamison and Moock (1984) finds significant positive effect of four or more years of education, but a negative impact of fewer than four years of education on output. Bigsten (1994) results on livestock production however indicate mixed and significant results, while the combined effect of crop production and livestock was positive but insignificant.

In a similar work, Philips (1994) reviewed 12 studies using 22 data sets and also reported mixed and varied results. The average increase in output owing to an additional four years of schooling in the studies he considered was 10.5 percent, with the relevant figures fro traditional versus modern farming systems at 7.6 and 11.4 percent respectively. However, his survey was significantly geographically diverse to show that (under certain conditions) the effects of schooling are stronger in Asia than in Latin America, irrespective of the degree of modernization. This may have implications for the assumed applicability of Asian findings to Africa, though too few studies using African data were included to draw conclusion.

Interestingly, Appleton and Balihuta (1996) pointed out that, these surveys included only two African studies (both on Kenya) and that education was not found to be significant in either. They reviewed several additional African studies and found out that the effect of schooling on Agricultural output was usually not

significant, though in some cases it can be large, indicating that there is substantial variation in returns to schooling both within and between the areas surveyed. Other reasons assigned for the statistical insignificant results phenomenon are small sample size for a few of the studies, errors in measurement of farm production and wide variation in the actual effects of education on agricultural output in different areas and under different farming systems. These results combined with the slower pace of technological advancement in Africa casts considerable doubt on the relevance of results from Asia for Africa Agriculture.

According to Appleton and Balihuta (1996) and Cotlear (1990), education is suggested to have both cognitive and non-cognitive effects upon labour productivity. Cognitive outputs of schooling include the transmission of specific information as well as the formation of general skills and proficiency. Education also produces non-cognitive changes in attitude, beliefs and habits. Increased literacy and numeracy may help farmers to acquire and understand information and to calculate appropriate input quantities in a modernizing or rapidly changing environment. As is also emphasized by Rosenzweig (1995), education may either increase prior access to external sources of information or enhance the ability to acquire information through experience with new technology. Education may therefore influence agricultural productivity directly via one or more of the cognitive or non-cognitive effects through the production function.

2.9.1 Returns to Education in Agricultural Productivity

Investment in education in developing countries has been subjected to cost-benefit analysis for some 25 years. The social rate of return has also been estimated for over 40 countries. Perhaps the most influential stylized fact to emerge from these studies concerns the structure of returns to different levels of education (Knight, Sabot and Hovey, 1992).

In the first systematic overview of rate of return studies, Psacharopoulos (1973) concluded that the most profitable educational level in most countries is the primary education. In support of this assertion, the World Bank summarized evidence in its educational sector paper of 1980 indicating that the average social rate of return is significant higher in primary education (26.2%) than secondary (13.5%) and higher education (11.2%). Furthermore, Psacharopoulos (1985 and 1994) presented a consistent pattern of very large returns of 29% primary education in developing countries while the return to secondary and post secondary were 18% and 20% respectively. The result was a summary of the years of schooling for wage earners for more than 55 studies from Africa, Asia and Latin America.

The largest component of the workforce in most developing countries is engaged in self-employed farm work. Examining the returns to education for these labourers results in a more representative assessment of the primary value of education to the population. Jamison and Lau (1982) reviewed more than 35 studies that measured returns to education of farmers in Africa, Asia and Latin America and suggested that education has a positive effect on farm profit.

However, the statistical significance of these results is often weak. Pinckney (1996) results on education and productivity however did not imply that increase in cognitive skills always improves agricultural productivity. He stated that after achieving rather the rudimentary levels of literacy and numeracy, further advances did not improve productivity even in more technologically complex production environment in Kenya. Thus, investments on education beyond the basic literacy and numeracy cannot be justified by the potential impact of these investments on agriculture, even in high-potential areas.

2.9.2 Effects of Education on Wage Earnings

It is estimated that about 20 percent of working individuals in Ghana are wage earners, 15 percent in India, 19 percent in Haiti, 20 percent in Nigeria and 11 percent in Togo (World Bank, 1995). In the case of Ghana, 47 percent of the households were found to generate some self-employed, off-farm income, while 36 percent have at least one wage-earning member (Jolliffe, 1996). Vijverberg (1993) also note that urban self-employed men in Malaysia earn substantially more than wage earners with the same characteristics.

Boissiere, Knight and Sabot (1985; 1990) and Knight and Sabot (1987) used household survey data on wage earners from Kenya and Tanzania to estimate returns to cognate skills and other issues. Boissiere, Knight and Sabot (1985) found positive and significant return to cognitive skills and to school and indicated that these results refuted the screening and credential theories of

education. They confirmed that the years of schooling are important determinants of cognitive skills, and that cognitive skills are important determinants of wages.

Soon (1987) and Vijverberg (1993) have written two of the few papers on return to human capital that examined self-employed, off-farm work. They both found evidence that schooling for self-employed are significantly lower than for wage earner. Data from four districts on rural Pakistan indicated that cognitive skills had a significant effect on rural wage (Alderman et al, 1996).

The literature on measuring the returns to cognitive skills is however significantly more sparse than that on return-to-schooling. In view of this, most literature on return to human capital in developing countries focuses predominantly on returns to additional years of schooling for wage earners. The results of a study to examine winners and losers in Slovenia's transition by tracing out changes in return to education, experience, gender and change in wage inequality from 1987-1991, indicated a sharp contrast to those in East Germany, which have had decreasing returns to education and experience (Krueger and Pischke, 1992; Bird, Schwarze and Wagner, 1995). In contrast, Knight and Lin (1993) found greater return to education in the less institutionalised rural urban markets in China. Using group data, Flanagran (1993), confirmed Knight and Lin's results and indicated that returns to education rose in the Czech Republic during the transition, but that returns to experience fell.

Hanushek (1989) summary on the findings of 187 such attempts at linking school inputs and outputs in a production function framework found no strong or systematic relationship on school inputs and students performance. However,

Hanushek (1995) argued further that school quality is an important determinant of the returns to education and that quality varies dramatically within developing countries (and the United States). He further advocated that the focus of education policy should switch from access to schooling to improving the quality of schooling.

Other studies have confirmed the importance of school quality as important determinant of the returns to education. For example, Rizzito and Wachel (1980) and Card and Krueger (1992a; 1992b) found that school quality is an important determinant of the rate of return to education using US census data. Behrman and Birdsall (1983) also emphasized that ignoring differences in the quality of schools may bias the estimated returns to schooling.

The lack of a significant effect of schooling on farm profit has often been attributed to either the low technical level of production or the absence of technological change in Africa. Foster and Rosenzweig (1996) presented evidence that technological change increased the returns to schooling. The contrast therefore between the results of wage regressors and farm profit regressions suggest that it is inappropriate to use results from one or the other to make inferences about the effect of education on African workforce. Perhaps the most important inference that may be drawn from Micha's (1996) study on benefit-cost analysis of investment in schooling in rural areas is that more schooling affects favourably the process of agricultural production, a contrast to other studies. However, his study does not tell whether schooling is a vehicle for a higher degree of technological sophistication or a factor of production per se.

2.9.3 Education, Extension, Research and Technology Adoption for Increased Productivity

The continuous creation and introduction of new technology has been used as a standard for distinguishing a modern agricultural system from a traditional one (Shultz, 1964; Welch, 1970; Pudaisani, 1983 and Azhar, 1991). A new agricultural technology has also been found by many researchers to reflect high yield, low cost or other desirable traits. However, the changes in the production process involved in the adoption of a new technology may bring risks resulting from imperfect knowledge and the possibility of committing errors because education enhances one's ability to receive, decode and understand information.

Shultz (1964; 1975) and Lin (1991) among others have hypothesized that education may facilitate the diffusion of new technology. That is, farmers with relatively higher levels of education may have a higher possibility of adopting new technology than those with relatively little education.

The introduction of many new technologies has also met with only partial success as measured by observed rates of adoption. Feder, et al., (1985) attributes the constraints of the rapid diffusion of technology to many sources, some of which are enumerated as lack of credit, inadequate farm size, unsuitable supply of complementary inputs and inadequate knowledge in the sue of the technology. Peterson (1967) however attributed the positive returns to production research to a causative line, which is assumed to run from research to new knowledge to new inputs to increased efficiency. Khupse (1970) asserted that farmers' training improved significantly the knowledge, change in attitude and adoption behaviour

of the farmer, while Welch (1975) hypothesized that under technically dynamic conditions, growth advantages accrue to large farms, which along side rising operator education, imply scale of economies in the use of information. The idea therefore is that, the higher the research activities within the state, the more rapid the paces of technological change and on balance, the greater are the opportunities for using allocative skills. This is so because the added dimension of the effect of education on allocative efficiency in an uncertain environment is considered via a role of agricultural research.

Broomhall and Johnson (1994) have also argued that if scale economies provide incentives for farm size expansion, forces that result in increasing returns to scale supports the comparative advantage of large farms. Many of the economic benefits, particularly gains in capital productivity, favour large farms since they are more capital intensive in contrast to small farms. Moreover, technical advances have also resulted in cost reduction for additional outputs, thereby reducing the most profitable level of output for the firm (Shultz, 1976).

Interestingly, agricultural research and technology development in developing countries is increasingly turning to the small-scale farmers whose landholdings have less productive potential in terms of inherent physical and climatic properties. The concern here is that, on the distinction between agricultural research and technology development, Feldstein, et al., (1989) stated that the latter has no function outside a definable market or market potential, and that the process of meeting the needs of that market cannot be effective and profitable without the involvement of members of that market in the

determination of research criteria, design, testing and evaluation or without any consideration of promotion, sales and services (Feldstein, et al., 1989).

Kassimoto (1992) noted that in most African countries, the success of new technologies does not depend on high return and low cost of techniques, but on simplicity and similarities to a possibility of integration into traditional practices. Because technological change is the main force in agricultural development, the evidence in Lin's (1991) paper on education and adoption of new innovation in agriculture supports the argument fro increasing state investment in rural education in order to facilitate technological changes in agriculture. In addition, a farm's size has a positive effect on the decision to adopt innovation.

In Patrick and Kehrberg's (1973) work on cost and returns of education in five areas of Eastern Brazil, educational activities were generally not statistically significant in the value-added functions while farm supply resources were highly significant in all areas. These results also indicated that educational activities had limited direct impact on value-added, and returns to education turn to be lower in the modernised area studied. These findings explain the fact that numerous inputs supplied in the most modernised areas serve to replace the extension service as some of the information about new inputs and practices. They further argue that the extension service may be working with the "poorer" farmers in the more modernised areas, and that the statistical results may be reflecting the quality of the farmer assisted rather than returns to the extension activities per se.

There exists an immense literature on empirical evidence of impact of education on agricultural productivity, the rate of return to education and

schooling and farmer's education and technological efficiency. Some researchers like Pudaisani (1983) and Azhar (1991) have found positive relationships between education and productivity, others have indicated negative relationships (Hopcraft (1974), and yet others like Phillips (1994), and Appleton and Balihuta (1996) have emphasised on mixed results, and no relationships (Croppenstedt and Muller, 1998). The methodologies applied in this direction included the Human Capital Asset variable in the Cobb-Douglas production function (Foster and Rosenzweig (1996); Knight and Sabot, (1992) and Griliches (1964)); and the "worker effect" of schooling on output Chaudri (1979) and Welch (1970).

CHAPTER 3

METHODOLOGY

3.1 Introduction

To achieve the objectives of this study, different analytical methods and approaches are used. The chapter discusses these analytical methods, the study's setting, data source, method of sampling, and data collection. It also provides information on the theoretical model adopted for the study's objectives, the choice of variables, the hypothesis statement and procedures for validating the hypothesis.

3.2 The Choice of Study Area and Study Setting

The data for the study came from a cross-sectional survey of 60 commercial poultry enterprises in the Greater Accra Region in Ghana from April 2000-December 2000 after initial survey to identify the enterprises in operation. There are five districts in the study area. These are the Ga, Dangbe East, Dangbe West, Tema Metropolitan Assembly and Accra Metropolitan Assembly. The district capitals are Amasaman, Dodowa, Ada, Tema and Accra respectively. Most of the poultry enterprises are located within the city and the peri-urban areas of Accra, Tema and Amasaman districts. Figures for poultry census estimates from 1991 to 1999 indicated that the Greater Accra region has the highest poultry population (Table 3), hence, the choice of the study area.

Table 3: Poultry Population; From 1991 –1999 in Ghana

REGION	1991	1992	1993	1994	1995	1996	1997*	1998*	1999*
Ashanti	1,243,261	1,586,612	2,042,269	1,855,900	2,103,541	2,286,841	2,540,800	2,764,800	3,009,600
Brong-Ahafo	539,509	568,534	622,237	674,294	784,993	797,146	857,520	933,120	1,015,740
Central	483,065	631,472	667,026	658,912	673,826	684,778	730,480	864,000	996,930
Eastern	531,531	529,054	625,457	700,694	747,496	826,940	889,280	967,680	978,120
Greater-Accra	2,598,401	2,661,859	2,963,631	3,677,559	4,179,458	5,341,120	5,812,080	6,048,000	6,677,550
Northern	1,335,531	1,345,890	1,729,815	1,348,268	1,468,317	1,550,865	1,683,280	1,866,240	1,993,860
Upper East	985,519	903,025	923,693	890,777	802,706	811,925	889,280	1,036,800	1,166,220
Upper West	825,540	859,787	636,919	860,000	912,810	1,005,733	1,095,720	1,209,600	1,297,890
Volta	1,134,221	1,170,607	979,418	1,350,109	1,160,028	970,845	1,063,960	1,209,600	1,260,270
Western	911,885	954,734	974,058	272,598	247,377	304,110	317,600	380,160	413,820
TOTAL	**10,572,472**	**11,231,574**	**12,169,523**	**12,289,376**	**13,082,552**	**14,589,303**	**15,880,000**	**17,280,000**	**18,810,000**

Source: Livestock Production and Information Unit, MOFA (1999).
* Projections

Records have it that 8 hatcheries and 13 feedmills are in production and have registered with the Ghana Poultry Council. There are also 282 small and medium-scale producers who have registered with the Greater Accra Poultry Farmers Association (GAPFA) with an overall total of 739 known to the Accra Metropolitan Assembly. However, the survey conducted indicated otherwise. At the time of visit, most of the listed enterprises have folded up completely and

others were not in production but were waiting for the season when demand would be high to produce, that is at Christmas and festive occasions.

3.2.2 Measurement of Production Inputs

Production inputs considered and measured in the study included labour, capital, purchased variable inputs and the estimate for the human capital variable, education. The production inputs were therefore valued as follows:

- Labour variable as the actual total cost (wages and salaries) of all reported labour on the farm and in the enterprises, whether hired, casual, skilled or unskilled, including management. Household unpaid labour was negligible in the study.
- Capital variable included the total cost of repairs, maintenance and depreciation of fixed inputs and other variable cost on local heating devices such as charcoal and paper egg crates.
- Purchased variable inputs included actual payments and costs for/of utilities such as water, electricity, telephone services, carriage and transportation, day-old-chicks (for meat and eggs), cost of veterinary drugs and services, feed consumed by birds and feed ingredients for the feedmills and hatchery eggs.
- The education variables considered the levels of education of the production manager, the decision-maker; whether basic, secondary, tertiary, informal or non-formal in addition to experience. Experience was estimated as the number of years spent on the poultry enterprise. Influence

of the owner as the farm/production manager, the enterprise as the main job of the manager, and the number of extension visits was also measured. Except for experience, all the human capital variables entered the equation as dummy variables.

- Output variable was measured as the total value of all output from egg and meat production, day-old-chicks from the hatcheries and feed from the feedmills.

The costs and values were in the local currency, the Ghanaian cedi (¢).

3.3 Analytical Model

The main purpose of the study is to determine the impact of education on productivity in the poultry industry in the Greater Accra region. The aim was to analyse the farm/production manager's educational background in relation to decision- making, allocation of inputs to the various enterprises and the subsequent integration of the units on the general productivity of the enterprise. This section outlines the methods used to achieve each of the specific objectives.

3.3.1 Commercial Poultry Enterprises in the Greater Accra Region (GAR)

To achieve the specific objective one of identifying the types of commercial poultry enterprise in the Greater Accra Region (GAR), secondary source of information was used to tabulate the relative proportions of the different enterprises, namely egg and meat producers, hatcheries and feedmills in the GAR. In addition, the production enterprises in the GAR identified from the responses

were also analysed by using their frequencies and percentages and tabulated for qualitative and quantitative discussions.

3.3.2 Proportion of inputs available to the Enterprise

To achieve specific objective two, data on production input in the industry were collected. The proportion of the inputs was measured by calculating the cost of each factor input, relative to the total cost of inputs. The cost of inputs was used as a proxy for the proportions of inputs to avoid the variations that could exist as a result of the differences in especially physical capital inputs to various enterprises. The calculation is weighted according to the value of each firm's turnover as follows:

1. Proportion of labour inputs = $\sum(Lc_i/Tc_i)/n$ (1)
2. Proportion of Capital input = $\sum(Tcc_i/Tc_i)/n$ (2)
3. Proportion of Purchased variable inputs = $\sum(Tcvp_i/Tc_i)/n$ (3)
4. Proportion of Day-old-chicks inputs = $\sum(Tcdoc_i/Tc_i)/n$ (4)
5. Proportion of Hatchery eggs inputs = $\sum(Tche_i/c_i)/n$ (5)

   Proportion of Feed inputs = $\sum (Tcf_i/Tc_i)/n$ (6)

   where

   Tc = Total costs of all the enterprises inputs

   Lc = Total costs of labour inputs of all the enterprises

   Tcc = Total costs of capital of all the enterprises

   Tcdoc = Total costs of all the day old chicks of the enterprises

   Tcvi = Total costs of all the purchased variable inputs of the enterprises

Tche = Total costs of all the hatchery eggs of the enterprises

Tcf = Total costs of feed consumed by all the enterprises

The results are presented in a tabular format and analysed.

3.3.3 Production Capacity

Specific objective three measures the actual production capacities of the poultry enterprise relative to their potential capacities. The production capacity of the enterprise was calculated for the total capacity of bird production, the hatcheries and the feedmills. The production capacities was calculated as a ratio of the actual production to the potential production. The actual production is defined as the present production capacity, whilst the potential production is the maximum installation capacity of the existing physical structures for production, that is, for the production mix (birds, day-old chicks and feedmill, including labour).

Therefore, the total production capacity is calculated as the ratio of actual (present) production capacity to the potential production capacity,

that is,

$$TPC = Q / Qp, \quad (7)$$

The production capacity of the hatchery is the ratio of the actual (present) hatchery production capacity to the potential hatchery production capacity,

that is,

$$PCH = QH / QHp, \quad (8)$$

The production capacity of the feedmill is the ratio of the actual (present) production capacity to the potential capacity of feedmill production that is,

$$PCF = QF / QFp, \quad (9)$$

The capacity of labour is the ratio of the actual (present) labour employed to the potential labour requirement, that is,

$$PCL = QL / QLp, \quad (10)$$

where,

Q = Actual total production.

Qp = Potential total production.

QH = Actual hatchery production.

QHp = Potential hatchery production.

QF = Actual feed production.

QFp = Potential feed production.

QL = Actual labour employed.

QLp = Potential labour employed.

The results of this analysis are tabulated and discussed.

3.3.4 Productivity Measurement

Productivity is defined as a ratio of output to a measure of some or all the resources used to produce this output (Teague and Eilon, 1973; Vonderembse and White, 1988; Lovell, 1993).

To achieve specific objective four, the productivity of the various poultry enterprises were measured. The labour variable includes all the reported labour on the farm and/or enterprise, whether permanent, casual, skilled or unskilled. As a commercial enterprise all the labour employed at the poultry enterprises were paid

for in cash. Household unpaid labour was kept to a minimum level that could be neglected for the study. The fixed capital input considered included repairs, maintenance and depreciation of equipment such as incubators, energy (electrical) generators, feedmills, farm structures and hovers. Other variable capital structures include cost of repairs and maintenance of feeders, drinkers, lanterns and coal pots (heating devices) and any others specified.

Purchased variable inputs such as feed consumed, day-old chicks, fertile eggs for the hatchery, ingredients for feed production, veterinary drugs, electricity and water consumption, telephone bills, carriage and transportation costs were included in the productivity measurement. These entered as actual costs and expenditure (in Ghanaian cedis). It must be stated that inputs for production for the enterprises are purchased from the open market and from basically common sources.

The total value for the output was used rather than the quantity since some of the enterprises are integrated. Some of them produce their own feed, day-old chicks and are also into the production of layers and broilers. Attempting to separate the units was likely to lead to problems and errors in measurement.

These are outlined as follows:

The Total Productivity is calculated as:

$$[\sum_{i=1}^{n} (Tq_j / Tx_{ij})] \Rightarrow [\sum_{i=1}^{n} (Tq_j) / (\sum_{i=1}^{n} (Tx_j)] \qquad (11)$$

(where j = enterprise: bird, hatcheries, feedmill, etc.; and i = enterprise manager)

where,

ΣTQ is the total value of output by the enterprises, and

ΣTx is the sum of the total cost of the inputs for production and for each of the enterprise including cost of capital, cost of labour and cost of other purchased inputs.

b. Labour Productivity $= \sum_{i=1}^{n} TQ_i / \sum_{i=1}^{n} CL_i,$ (12)

where,

ΣCL is the sum of the total cost of labour for the production of birds, feedmill and hatchery for manager i.

Capital Productivity $= \sum_{i=1}^{n} TQ_i / \sum_{i=1}^{n} CK_i,$ (13)

where,

ΣCK is the sum of the total cost of capital for all the production mix i.

Productivity of Purchased Variable Inputs $= \sum_{i=1}^{n} TQ_i / \sum_{i=1}^{n} CPVI_i,$ (14)

where,

$\Sigma CPVI$ is the sum of the total cost of purchased variable inputs used for all the production processes i.

e. Productivity of feed $= \sum_{i=1}^{n} TQ_i / \sum_{i=1}^{n} CF_i,$ (15)

where,

ΣCF is the sum of the total cost of feed used for bird production i.

The productivity measures were calculated as total factor input productivity, labour productivity, capital productivity, productivity of purchased variable inputs and feed productivity (major variable input in the production process). The results were tabulated and discussed.

3.3.5 Educational Background of Farm / Production Managers

To achieve specific objective five respondents were asked to indicate the highest level of their educational background. Five levels of educational attainment were used. The parameters used were formal education, non-formal education, basic education of primary/middle/junior secondary school, secondary education of secondary/technical/vocational training, and tertiary education polytechnic /college and university.

The proportions of these educational levels are presented in the form of tables and analysed qualitatively and quantitatively.

3.3.6 Empirical Test of the Impact of Education on Productivity

In order to achieve specific objective six, the study tested empirically the impact of education on productivity in the industry. The theoretical framework for the empirical model is the integration of the Human Capital Asset model variables into the Cobb-Douglas production function (Griliches, 1963, 1964); Shultz (1964); Gisser (1965); Kislev (1965); Welch (1970); Christensen, et al., (1971);

Vansetti and Bressell (1972); Hopcraft (1974); Moock (1979, 1981); Jamison and Lau (1982); Cotlear (1990); Lovell (1993); Phillips (1994); Appleton and Balihuta (1996).

The human capital variables were measured, using the highest level of education attained by the production manager. These entered as dummy variables since there is no reason to believe that the relationship between level of education and productivity will be linear. Other variables that measured human capital were experience as years of experience in the poultry business and age of the production manager. Also included are owner's influence and the managers' performance as a full-time worker or otherwise. Dummy variables were included to indicate the owner's influence, job as the manager's full time employment and extension visits.

The assumption is that each enterprise has a set of feasible inputs and output from which the enterprise can choose from, that is a set of production possibilities. This set, using the production function can therefore be described as:

$$\mathbf{Y = F\,(X, Z, E)} \qquad (16)$$

where, Y is the quantity of output; X, the vector of quantities of the variable inputs such as day-old-chicks, drugs, hatchery eggs, water and electricity; Z, a vector of quantities of fixed inputs, and E, a vector of characteristic variables of production which include education, age, owner's influence, enterprise as full time job and availability of extension services.

As with most previous studies of education on agricultural productivity, Jamison and Lau (1982) reviewed studies that generally used variations of the

Cobb-Douglas production function in the logarithmic or the linear form to relate output Y, to the various inputs. The logarithmic form was specified in the following way:

$$\text{In } Y = \alpha_0 + \alpha_1 \text{In } T + \alpha_2 \text{ In } L + \beta \text{ In } E + \gamma \, EXT., \qquad (17)$$

where, Y = total output (in kilograms): T = area under cultivation (in hectares); L = labour input (in person-days); E = educational level of the household head (in years of formal schooling completed); and EXT = indicator of exposure to extension services (EXT = 1 if the farmer was exposed, EXT = 0 if he has not). The coefficients (α_0, α_1, α_2, β, γ,) on the input variables are estimated from the data and indicate how strong each input affects output. They further indicated that all the studies reviewed use production function of this general form, but include a normally distributed "error" term, the standard deviation of which is also estimated in the statistical analysis.

Weir (1999) measurement on the worker effects of education on farmer productivity in rural Ethiopia used a specified semi-log linear form of the Cobb-Douglas (C-D) production function, which is as follows:

$$\text{In Qi} = \alpha_0 + \alpha_1 \text{InLi} + \alpha_2 \text{In Ni} + \alpha_3 \text{In Ki} + \alpha_4 \text{In Fi} + \alpha_5 \text{In INi} + \alpha_6 \text{InOXi}$$

$$+ \beta \text{Si} + \Sigma \phi_{ki} X_{ki} + \varepsilon_1, \qquad (18)$$

where: InQi is the natural logarithm of farm output for household i; InLi is the natural logarithm of available cultivable land for household i; InNi is the natural logarithm of the number of adult household members who work on the farm in household i; InKi is the natural logarithm of the value of capital goods (hoes and

ploughs) used by household i; InFi is the quantity of fertiliser used by household i; InINi is the natural logarithm of other purchased inputs (seeds, plants, tools, transport, etc) by household i; InOXi is the natural logarithm of the number of bulls and oxen owned by household i; Si is a variable(s) representing education for household i; X_{ki} is the other farm characteristics such land quality for household I; and ε_1 is a stochastic error term.

Pinckney (1996) in his work, "Education and Agricultural Productivity in Africa (Kenya and Tanzania)", used a modified Cobb-Douglas production function;

$$\ln Q_i = \alpha_0 + \alpha_1 \ln L_i + \alpha_2 \ln Ld_i + \alpha_3 \ln AA_i + \alpha_4 \ln IN_i + \alpha_5 E_i + \alpha_6 CPM_i + \alpha_7 CS_i + \alpha_8 EXP_i + \alpha_9 EXT_i + \varepsilon_1 , \quad (19)$$

where, InQi = the dependent variable; gross value of output in natural logarithm; InL, is the natural logarithm of all reported labour on the farm i: InLdi, is the natural logarithm of all land operated by the household i; InAA, is the natural logarithm of agricultural assets; InIN, is the natural logarithm of purchased variable inputs such as fertilizers and sprays for coffee; E, as years of schooling of the decision-maker which entered as dummy variables; CPM, as the Raven CPM test which measures reasoning ability; CS, is the cognitive skills tests measure of numeracy and literacy; EXP, as approximated by subtracting years of education from age minus six; EXT, as the measure of number of recent contact with extension agents; ε is the error term.

The basic concept used in the analysis of productivity (with gross outpu as the dependent variable) therefore is the production function and the mos frequently used are the Cobb-Douglas, the Constant Elasticity of Substitutior (CES), and the Translogarithm (Translog) functions (Christensen, Jorgenson anc Lau, (1971)).

Following the work of Pinkney (1996), the total value of output of the commercial poultry enterprise is assumed to be a function of capital, othe purchased variable inputs such as the day-old-chicks, the feed consumed, the hatchery eggs, and the human capital variables of years of schooling anc experience.

The specific model estimated is

$$\ln Q_i = \alpha_0 + \beta_1 \ln KAP_i + \beta_2 \ln LAB_i + \beta_3 \ln OTH_i + \beta_4 \ln D_i + \beta_5 \ln F_i + \beta_6 ED2_i + \beta_7 ED3_i + \beta_8 ED4_i + \beta_9 ED5_i + \beta_{10} XPE_i + \beta_{11} XPE\hat{}2 + \beta_{12} OWN_i + \beta_{13} JOB_i + \beta_{14} EVIS_i + e_i \quad (20)$$

where,

Q_i	Value of total output of enterprise *i*.
KAP_i	Cost of capital (repairs, maintenance and depreciation of fixed inputs) of farm *i*.
OTH_i	Cost of purchased variable inputs (payments for electricity, water, drugs, carriage or transport charges and hatchery eggs).
D_i	Cost of day-old-chicks of farms *i*.

F*i*	Cost of feed consumed of farm *i*.
LAB*i*	Cost of labour (includes all reported farm or enterprise, whether management, supporting staff, production assistance, or watchmen)
PED2*i*	Primary Educational dummy variable = 1, if Primary/ JSS/ Middle, 0 Otherwise
SED3*i*	Secondary Education dummy variable = 1, if Secondary /Vocational /Technical, 0 Otherwise
TED4*i*	Tertiary Education dummy variable = 1, if Polytechnic /College/University, 0 Otherwise
NED5*i*	Non-formal Education dummy variable = 1, if Non-formal, 0 Otherwise
XPE*i*	Estimated as the number of years spent on the poultry enterprise
XPE^2	Experience squared
JOB*i*	The poultry enterprise as a full-time job = 1, 0 Otherwise
OWN*i*	Production manager as the owner of the enterprise *i*, Owner =1, 0 otherwise
EVIS*i*	Contact with the extension service. Extension visit =1, 0 otherwise
βi	Estimated coefficients.
ei	Error term.

To test whether different cost structures as a result of different enterprises (birds, feedmills and hatcheries) in the industry had effect on the model, the White Test (1980) was used to test for the null hypothesis that the error variances were constant.

The human capital asset model variables are in levels rather than in logarithms, implying that a unit change in these variables produces a constant change in the logarithmic value of the enterprise's production. XPE is estimated as the number of years of business experience, XPE^2 represents the squared-term for experience as it is hypothesised that the impact of experience decreases with increasing experience. OWN is the influence of ownership to the enterprise, the dummy equals 1 if the manager is the owner of the enterprise, otherwise 0; JOB is a dummy and equals 1 if the enterprise is the main job of the manager, otherwise 0; and EVIS is extension visits, a dummy equal 1 for visits by the extension service to the enterprise, otherwise 0. The βi's in the equation are estimated coefficients. However, the βn estimated coefficients for the dummy variables are interpreted as the expected differences in productivity (output) between different levels of education, managers as owners of the enterprise, enterprise as full-time job of the manager and extension visit. For example, if the productivity equation is semi-logarithmic and ED is measured in different levels of education:

$$\text{In}\,(Q) = \alpha + \beta_1 \text{In}\,K + \beta_2 ED + e \qquad (21)$$

then β_2 = percent change in productivity (output) for change from one level of education to the other, holding capital input constant. If we let output Q1 = In Qi when the educational level of the manager is at a higher level and output Q0 = In

Q0 when the educational level of the manager are level below, then g is the percentage change in output due to higher level of education which is given by g $= e^{Q_1} - e^{Q_0} / e^{Q_0}$ or equivalently log $(1+g) = Q_1 - Q_0 = \beta_2$, or that $g = e^{\beta_2} - 1$ (Baltagi, 1998). Therefore to account for the possibility that different levels of schooling have different effects upon productivity (output), primary schooling (basic), secondary schooling and tertiary education are all included in the equation as sets of dummy variables.

The hypotheses validated in this study on the production function are that, each of the physical inputs of production (including capital, day-old-chicks and others) and the Human Capital Asset model variables integrated into the Cobb-Douglas production function are expected to be positively associated with higher productivity, *ceteris paribus*.

This is expressed as:

$$\beta_2 = (\partial \mathbf{InQ}) / \partial \mathbf{EDi} > 0 \qquad (22)$$

where the β_2's have the interpretation as the percentage changes in the productivity (output) in response to one level of the EDi's, other inputs and characteristics variables held constant. That is, if the EDi variable is measured in terms of levels of, say, education, then β_2 is approximately the percentage change in output in response to an increase of one level of education at the margin, *ceteris paribus*.

The specific apriori expectations on the estimated parameters of equation (20) are:

$$\beta_1 - \beta_{10} > 0$$

$$\beta_{11} < 0$$

$$\beta_{12} - \beta_{14} > 0$$

The study tests the following hypotheses, where Ho is the null hypotheses and Ha, the alternative hypotheses.

(i) Ho : $\beta_{1\text{-}10} = 0$, Ha : $\beta_{1\text{-}10} > 0$

where,

H_0 : = there is no effect of capital on productivity (output) in commercial poultry industry

Ha : = there is a positive effect of capital on productivity (output) in the commercial poultry industry

H_0 : = there is no effect of labour on productivity (output) in the poultry industry

Ha : = there is a positive effect of labour on productivity (output) in the commercial poultry industry.

The hypotheses are repeated similarly for $\beta_3 - \beta_{10} > 0$

(ii) Ho : $\beta_{11} = 0$, Ha : $\beta_{11} < 0$

H_0 : = no effect of experience on productivity (output) in the commercial poultry industry.

Ha : = there is a negative effect of experience on productivity (output) the commercial poultry industry.

(iii) Ho : $\beta_{12} = 0$, Ha : $\beta_{12} > 0$

where,

H_0 : = there is no effect of owner's influence as a manager on the productivity in the poultry industry.

Ha : = there is a positive effect of owner's influence as a manager on the productivity in the poultry industry.

Similar hypotheses are repeated for β_{13-14}.

3.3.7 Constraints to the Technological Development and Management Capabilities.

In ascertaining the constraints to the technological development and management capabilities to the enterprises, a list of responses are included in the questionnaire. The list included finance, management, education, marketing, labour and availability of inputs and cost of inputs. Others are government policies on interest rates, high cost of available inputs and the liberalised importation of processed poultry products.

The Linkert Method of Summated Rating is used to scale the responses, that is, a list of statement is given to the subjects and respondents are asked to check the statement with which they agree. The Linket Scaling Technique assigns a scale value, 1-3, to each of the responses as regards these statements; Major constraints, Constraints and Less constraints respectively.

The opinions expressed in relation to the statements were analysed and described in frequencies and percentages. Respondents were also asked to suggest ways and methods they will adopt to deal with the suggested constraints.

3.8 Sources of Data and Data Collection

A sample of 60 commercial poultry enterprises was randomly selected from within the 5 districts of the Greater Accra Region of Ghana, 12 enterprises from each of the 5 districts. A formal pre -tested, close-ended questionnaire was used as a basis for data collection. This was designed and administered to the farm and production managers of poultry, namely, production of birds, hatcheries, and feedmills and for those enterprises that are engaged in two or more enterprises. The information was based on actual experience and records kept on the enterprise for the production period of 1999. Some of the information the questionnaire sought include, age, gender, level of educational background, experience in the poultry business and the type of poultry enterprise. Others are on production inputs, production costs, production capacities, input and output relationships and the constraints to the industry.

Further information was gathered from the Ministry of Food and Agriculture (MOFA), Livestock Production and Information Unit of MOFA, Accra Metropolitan Assembly (Agricultural Section) and Veterinary Service. Other sources are the Statistical Services, Customs, Excise and Preventive Service, Food and Drugs Board, Greater Accra Poultry Farmers Association (GAPFA).

Respondents with incomplete and obvious incorrect data were excluded for the purpose of analyzing this data. Of the 60 respondents, 40 enterprises were used for the study.

CHAPTER 4

EMPIRICAL RESULTS AND DISCUSSION

4.1 Introduction

This chapter reports the empirical results of the study. First the commercial poultry enterprises in the Ghana economy and in the Greater Accra Region (GAR) are presented and discussed. Secondly, the level of inputs available, the capacity utilisation and the productivity of the enterprise in the Greater Accra Region are provided. In addition, the educational and social backgrounds of the production and farm manager are described. The results of the econometric analyses are presented and discussed. Finally, the constraints to the management and technological development of the industry are recounted.

4.2 Commercial Poultry Enterprises in Ghana and in the Greater Accra Region

Table 4a shows the proportions of individual firms and corporations involved in the Ghanaian economy as a whole.

Table 4a: Types of Commercial Poultry Enterprises in Ghana

ENTERPRISE	FREQUENCY	PERCENT (%)
Producers of Poultry Products	1200	92.0
Suppliers of Veterinary Drugs	22	1.7
Importers of Poultry Products	37	2.8
Hatcheries	14	1.1
Feedmills	32	2.4
TOTAL	**1305**	**100.0**

Source: 1. Ghana Poultry Council.
2. The Veterinary Services.
3. The Statistical Service Department, Ghana.
4. The Greater Accra Poultry Farmers Association.

The largest proportions of commercial poultry enterprises are those involved in the production of meat (broilers), table eggs (layers) and hatchery or fertile eggs (breeders). The individuals and firms in this production enterprise represent 92.0%.

Other stakeholders identified in the study are producers, importers and suppliers of poultry meat and meat products, which represent about 2.8%. The feedmills form 2.4% of the total stakeholders and the producers and suppliers of veterinary drugs at 1.7%. The hatcheries represent 1.1%. There was however, no available data on the manufacturers and suppliers of poultry equipment and housing units.

Even though the poultry producers form the largest group, the supply of these products falls short of the demand for these products. The per capita consumption capacity of chicken meat and eggs in Ghana is estimated to be one of the lowest in Africa and the whole world. Whereas the average chicken meat consumption for the world is 7.9kg/person/year, that of Ghana is 1.2kg/person/year. It is further estimated that the average Ghanaian consumes one egg per month as compared to a world average of 13 eggs per month (Somuah, 2000).

As a result of the excess demand for poultry products, eggs and frozen poultry products are imported to supplement the local production. The importers of poultry products supply about 80% of the total poultry requirements in the country. However, the total chicken and turkey meat import in 1997 and 1998 amounted to 8939mt and 9532mt respectively, forming 50% and 42% of the total meat and animal products during the 1997and 1998 years respectively (LPIU, 1998). In spite of this, local production and imports do not meet the estimated

annual requirements of 300,000mt meaning Ghana is far from self-sufficiency in her meat requirements. The main countries of imports were identified as Italy, France, the Netherlands and Belgium.

Table 4b presents data on the producers of meat and eggs in the area of study. Available data indicate that there are 739 commercial poultry farms in the Greater Accra Region (AMA Agricultural Directorate, 1999). Out of this number, 11 farms representing 1.5% are large-scale, commercial producers, each producing on the average 15,000 birds per year, and a range between 50,000-120,000 birds per year. Together, they produce on the average 900,000 birds per year. This group has registered as members of the Ghana Poultry Farmers Council (GPFC).

The second group is the medium-scale producers who are also members of Greater Accra Poultry Farmers Association (GAPFA). They form 32.3%. This is made up of 239 individuals and corporate farms. Their production capacity ranges between 10,000-50,000 birds. The small-scale commercial producers form 66.2% of the total commercial poultry producers, which is made up of mainly 489 individuals. Most of them are backyard commercial producers. Some are functional only during festive occasions when demand is high, especially during Christmas, while others are non-functional and are no more in production.

Table 4b: Poultry Producers in the Greater Accra Region

PRODUCERS	FREQUENCY	PERCENT (%)	PRODUCTION RANGE
Large-scale Commercial	11	1.5	50,001-120,000
Medium-scale Commercial	239	32.3	10,001-50,000
Small-scale Commercial	489	66.2	200-10,000
TOTAL	**739**	**100.0**	

Source: 1. Ghana Poultry Council
2. The Accra Metropolitan Assembly (Agricultural Directorate (1997)
3. The Greater Accra Poultry Farmers Association (GAPFA)

The study survey however showed that most of the enterprises, especially with the production of eggs and meat have folded up and are no more in production. The need to conduct a fresh census of the enterprises would be most valuable to especially producers, researchers and policy planners and implementers. Commercial Poultry producers in the study sample are presented in Table 4c.

Table 4c: Poultry Producers in the Study Sample

PRODUCERS	FREQUENCY	PERCENT (%)	PRODUCTION RANGE
Large-scale Commercial	1	2.5	50,001-200,000
Medium-scale Commercial	10	25.0	10,001-50,000
Small-scale Commercial	29	72.5	200-10,000
TOTAL	**40**	**100.0**	

Source: Compiled from survey data.

Only 2.5% are producing over 50,000 birds, 25.0% are medium-scale producers (10,001-50,000) and 72.5% are small-scale commercial producers, producing

between 200-10,000 birds. These observations seem to agree with Somuah's (2000) assertion that the largest layer farm in Ghana produces about 110,000 birds and that other larger layer farms produce in the range of 10,000-40,000 birds. He further indicated that with the exception of five identified large-scale broiler farms producing more than 20,000 birds all others are small-scale producers producing below 10,000 birds. The total population of the top ten broiler farms is not up to 300,000 (ibid.).

The dominance of small-scale commercial poultry operation is seen as a constraint to the growth and development of the industry since small businesses tend to be risk-averse than larger businesses. Small businesses may have neither the managerial expertise nor the funds to diversify into other business operations. Moreover, investors recognise the higher risk of small businesses and will invest in them only if the potential for higher profitability outweigh the risk involved. Consequently, the cost of financing such businesses is generally higher than larger businesses. Such is most agricultural businesses in Ghana.

All the commercial poultry enterprises in the study are also using the intensive management system of production, that is, either the deep litter or the battery cage or a combination of the two. The structures for the battery cage are a modified version, made of wood and designed to suit the Ghanaian condition. Almost all the enterprises use these structures, which are also designed differently for layer and broiler production by a Ghanaian company. Some of the enterprises produce serially and throughout the year while others produce only when demand is high. Costs of inputs are dictated by market forces of demand and supply and are not within the control of the producers. Most of the inputs such as feed ingredients, especially concentrates, feed additives, soybean meal

and veterinary drugs are imported since local production is low and unavailable all year round.

Table 4d shows the extent of integration of the commercial poultry enterprises. One dramatic change in the poultry industry over the years has been the integration of all phases of the enterprise. This includes production processes such as hatcheries, feedmills, raising-phase (grower), dressing plants, services, marketing, and distribution. The importance of this is that, all the phases are synchronised so that the utmost efficiency will be achieved.

Table 4d: Integration of Enterprise in the Greater Accra Region

ENTERPRISE	FREQUENCY	PERCENT (%)
LAY (ONLY)	5	12.5
BROI (ONLY)	1	2.5
LAY / BROI (COMBINED)	12	30.0
LAY/BROI/FEEDML	5	12.5
LAY /HATCH/FEEDML	1	2.5
FEEDML (ONLY)	1	2.5
LAY / BROI / FEEDML/COCKEREL	2	5.0
LAY/COCKEREL	1	2.5
LAY/FEEDML	2	5.0
LAY/BROI/COCKEREL/OTH	1	2.5
LAY/BROI/HATCH/FEEDML/BREED/PPOC /OTH	2	5.0
HATCH/FEEDMILL/BREED	1	2.5
BREED/COCKEREL/OTH	1	2.5
LAY / BROI / COCKEREL	3	7.5
BROI / COCKEREL (COMBINED)	1	2.5
LAY/BROI/HATCH/FEEDML/COCKEREL/PROC	1	2.5
TOTAL	**40**	**100.0**

Source: Compiled from survey data.
Note: LAY = Layer, BROI = Broiler, HATCH = Hatchery, FEEDML = Feedmill, BREED = Breeder, PROC = Processed products, OTH =Other poultry.

From the sample survey, only 5% have integrated all the enterprises namely, bird production (layers and broilers), breeders, hatchery, feedmill, processed products and other poultry such as ducks and turkeys. A proportion of 12.5% are producing only layers, 2.5% are producing only broilers, and 30%, the highest proportions are into both layers and broilers (table eggs and meat). Ten percent of respondents are also into production of other enterprises such as ducks, turkeys and ostriches. Almost all the feedmills and the hatcheries have integrated other enterprises such as meat and egg production, except one. All the enterprises distribute and market their own products, mostly at the farm gate. In addition, most of the small-scale commercial producers are operating at very low capacities, which obviously do not merit high a level of integration and are also "occasional farmers" producing only as and when demand is high.

4.3 Level of Production Inputs in the Commercial Poultry Industry.

The inputs available for production were identified as labour, capital, purchased variable inputs such as day-old-chicks, feed for birds production, feed ingredients for the feedmills, hatchery eggs, drugs, water, electricity and similar. Table 5 indicates that the value of labour is the least of the inputs, representing 0.3% of the total value of inputs. This is about ¢2billion indicating that labour can be cheap. This is closely followed by capital, 0.4%, and representing ¢2.8 billion, day-old-chicks, 1.6% at about ¢11billion, and purchased variable inputs, 13.7% at ¢96 billion. The value of hatchery eggs and feed are the highest with 22.8% and 61.2% respectively.

Table 5: Proportion of Inputs Available to the Enterprise

INPUT	VALUE (¢) '000 000'	PERCENT (%)
Labour	2, 109	0.3
Capital	2, 812	0.4
Purchased Variable inputs	96, 311	13.7
Day-old –chicks	11, 248	1.6
Hatchery eggs	160, 284	22.8
Feed consumed	430, 236	61.2
TOTAL	**703, 000**	**100.0**

Source: Compiled from survey data.

The relatively low cost of labour could be attributed to the fact that there is general underpayment of unskilled labour in the industry, wages paid to these workers are relatively low, however, they form the bulk of the workers in the industry.

The high level of hatchery egg (22.8%), in terms of cost, could also be due to the fact that, a greater percentage of the fertile eggs supplied by the hatchery is imported, thus, attracting high import duty. The 5 hatchery enterprises are all producing on large scale (50,000-200,000 per year range), and are the main supplies of fertile eggs and day-old-chicks to the poultry industry in the GAR, including most of the enterprises surveyed. In addition to local production, these hatcheries import fertile eggs to augment the local supply, hence the enormous proportion of costs to the total costs. The enormous cost incurred in producing and importing fertile eggs could be a contributory factor to the close down of other large-scale producers such as Pomadze farms. Again according to the International Egg Commission (1999), the cost of producing 1kg of eggs in

Ghana is 53% higher than in Indonesia, 63%, and 50% more compared to USA and Brazil respectively (sources of most imports of poultry product to Ghana).

The level of day-old-chicks is 1.6% in cost. The figure presents a relatively low proportion of cost for this perishable input. The low proportion of this input could be attributed to lower cost of inputs from the countries of import, and subsidization of import of day-old-chicks in Ghana.

The current study and Portsmouth (1983) both confirm the larger percentage for feed which has been suggested by other authors like Kekeocha (1984) as representing up to 70%-75% for broilers and 50-70% for layers, out of the total production inputs.

4.4 Production Capacity Utilisation in the Commercial Poultry Industry

Interest in the production potential of the enterprise is of paramount concern for both domestic and international market. The production capacities for the individual enterprises the hatcheries and the feedmills are presented in Table 6.

Table 6: Capacity Utilisation

ENTERPRISE	BIRD CAPACITY (%)	HATCHERY CAPACITY (%)	FEEDMILL CAPACITY (%)
1	65	-	-
2	68	-	-
3	43	43	-
4	-	-	100
5	56	-	-
6	80	-	100
7	30	-	-
8	75	-	-
9	71	-	-
10	83	-	-
11	36	-	44
12	70	-	-
13	67	-	-
14	72	-	-
15	50	-	-
16	57	-	-
17	80	-	75
18	100	-	-
19	100	-	-
20	67	-	-
21	31	-	-
22	33	-	-
23	68	-	83
24	47	75	33
25	10	10	100
26	88	-	-
27	87	-	-
28	58	-	-
29	33	-	-
30	55	-	-
31	60	-	-
32	55	-	-
33	50	88	53
34	50	50	20
35	75	-	-
36	80	-	-
37	80	-	-
38	60	-	-
39	40	-	-
40	66	-	-
CURRENT T AVERAGE PRODUCTION CAPACITY	55.9%	30.2%	75.45
RANGE	30% - 100%	10% - 88%	20% - 100%

Source: Compiled from the survey data

The current average production capacity for birds (meat and eggs) is 55.9% with the individual firms producing at between 30%-100%. The hatcheries are producing at an average of 30.2% with some of the individual firms producing as low as 10%. The enterprises' highest capacity is at 88%. The feedmills seem to be doing better at an average capacity of 75.4%. Some are however, producing as low as 20% and others at full capacity of 100%.

In general, the commercial poultry industry is producing at about half of the installed capacity. The results from the study indicated that, most of the feedmills that were hitherto operating at full capacity in the 1970s have folded up leaving a few of them to operate commercially or producing to feed their own birds. The high cost of feed ingredients in the form of fish meal, soybean and maize has also led to the inability of these feedmills to produce to the optimum. The qualities of feed from some of the feedmills were compromised as a result of the high cost of inputs. Hence, most farmers prefer to prepare their own feed or purchase additives, in the form of minerals, vitamins, protein and carbohydrate concentrates to raise the level of quality of the feed from the feedmills to the required standard.

The installed capacity of the hatcheries is as low as 30.2%. In fact most of the hatcheries are un-operative and almost all of them are producing below their capacity. Hence, the imports of day-old-chicks and fertile eggs by some business enterprises such as REISS & CO., Afariwaa Farms, Glamour Farms Ltd., and most of the hatcheries to increase the supply of these inputs. An example of the low performance of the hatchery sector is the Pomadze Poultry Enterprises Ltd, which was estimated as the largest in West Africa with an installed hatchery capacity of 12 million day-old-chicks output/year. However, this enterprise is

virtually collapsed and has been put on divestiture. One other reason is the unavailability of parent stock, which is very expensive and cannot be produced by individual hatcheries locally. Almost all the hatcheries import breeder eggs to hatch in Ghana. Owusu-Acheampong (2000) has suggested the need for government's intervention since no individual enterprise can afford to produce breeder eggs/parent stock on its own.The production of birds is also estimated to operate at half capacity (55.9%).

Various reasons were assigned to this relatively low performance of the industry. First, financing the enterprise was identified as a major limiting factor in the production process. The cost of capital (borrowing) was very high and expensive at an average of 45% at the time of the study. Most of the respondents said they have been using owner's equity as a sole financier for the enterprise since credit facilities are unavailable, expensive and therefore unaffordable.

High cost of inputs and marketing of products was also identified as factors limiting the enterprises' ability to meet their operation objectives. For example, it has been reported by the International Eggs Commission (1999) that, whereas the USA produces 1kg of eggs at a cost of 43.56 cents, Ghana spends 72.85 cents to produce the same 1kg of eggs, meaning that, it costs 65% more to produce eggs in Ghana as compared to the USA. It is further reported by the same study that the cost of producing broilers shows similar proportion.

Other reasons assigned to the low capacity utilisation are the high and unstable prices of inputs. Available figures indicated that, at the beginning of the minor season, September 1999, the cost of maize, which is a major input in feed formulation, was quoted at 35,000 cedis/120kg, but by the beginning of June 2000, the price had changed to 125,000 cedis/120kg, an increase of about 280%.

The changes in price for wheat bran and fishmeal over the same period were 200% and 79% respectively (Gyane, 2000).

The effect of these factors therefore, was a very high increase in the cost of production and the difficulty to plan for long-term requirements. On the other hand, prices for the output remained either the same or slightly increased at a rate, which did not commensurate with the increase in production cost. The marginal cost was therefore far greater than the marginal revenue, a trend that has been reported by Gyane (2000) to persist for more than 5 years now.

4.5 Productivity Levels in the Enterprise

Productivity levels reflect the objectives and managerial goals of the enterprise concerned, in addition to controlling the performance of units within a firm. Table 7 shows the productivity of labour, capital, other variable inputs, feed and the total productivity.

Table 7: Estimates of Productivity

FACTOR	MEAN VALUES (%)
TOTAL FACTOR PRODUCTIVITY	1.9
LABOUR PRODUCTIVITY	82.6
CAPITAL PRODUCTIVITY	714.1
PURCHASED VARIABLE INPUT	30.4
FEED CONSUMED	16.7

Source: Compiled from the survey data.

The total factor productivity (static productivity ratio) was computed at an average of 1.9 of the industry for the year (1999). Partial productivities calculated showed that capital has the highest average value of 714.1, labour productivity at

82.6, and purchased variable inputs at 30.2 on the average. Feed as a major component of the enterprise was measured at an average value of 16.7 (refer, Table 7). Productivity measures the efficiency with which resources are utilized, or how efficient inputs are converted into outputs.

The poultry industry in the GAR has incremental gain in the value (volume) of ¢190 of what it is producing (output) as compared with the expenditure on measures (per ¢100 of all inputs) utilized. The inputs include paid labour, capital expenditure, purchased variable inputs and feed consumed. Management of the enterprises in the GAP achieved some level of efficiency and effectiveness with which resources were utilized in 1999. With the poultry industry in the GAP, efficiency means producing high-quality poultry products in the shortest possible time, while effectiveness could mean making profit and preserving future market share. This measure can provide management with a base for effective control that will produce corrective action to result in increased productivity in the future.

Reduction in wastage through efficient utilization or resources, lower operational costs, and advances in technology in the organization of production could be the driving force behind the increase in productivity of the poultry enterprise in the GAP. Management can however, reduce long-term liabilities, increase competitive advantage, and improve market share and profitability by producing more and better products and services if it has to maintain production efficiency. Factors to increasing the long-term productivity of the industry are organization of production (degree of integration, percentage of capacity utilization and adequate and reliable flow of materials), technological

development (size, quality and stability of production, and use of appropriate equipment), and human resources.

Labour productivity indicates an average measure of 82.6 per the production year (1999). The productivity of labour shows how efficiently labour inputs are converted into outputs. The measure explains an increase of ¢8,260 of the net value-added in output in the poultry industry per ¢100 value of all labour for production. The performance of labour could be attributed to relatively cheap and abundance of labour in a developing country such as Ghana. This observation agrees with Stonier and Hague (1980) that cheap labour has been identified as predominant in most developing countries and the agricultural sector as a whole though work output is high. They however, indicated that in most developing economies, it is difficult to increase output per man-hour by more than 3 to 4 percent per annum. The finding also supports Griggs (1991), that there is incomplete labour market in Ghana since the market is inactive. He estimated from his work on the predominance of agricultural labourers in developing countries that, the average farming household spends only 5 percent of farm income hiring outside labour.

Jolliffe (1996) indicates in more details that most of the small-scale units in the commercial poultry enterprises use household labour. This confirms earlier recommendation by Roberts (1979) that domestic labour should be used for small-scale units in the commercial poultry industry. By contrast, labour productivity for agriculture in the UK decreased by 17% In 2001, whist the total factor input productivity also decreased by 6.1% the same year. This was partly attributed to the impact of foot and mouth disease and the measures taken to eradicate the disease in cattle and sheep (DEFRA, 2002).

Greater worker participation, better quality of work, and its management and working conditions can improve the productivity of labour in the industry. There must be improvement in the methods of accomplishing work tasks, and increased morale and satisfaction on the part of employees.

The capital productivity is measured at 714.1%, indicating an increase in the value of output per unit of capital input by that margin. This could be attributed to quite efficient use of capital and technical progress in the industry as compared to other sectors of agriculture in Ghana. The poultry industry is quite capital intensive which is also evident from the fact that most of these enterprises are automated, or are using labour saving devices, even if it is locally manufactured as observed with some of the production processes.

The calculation of this ratio is very important, because it helps the production manager and the farmer to know how much to expect the employment of additional capital to add to the total revenue of the enterprise at each level of employment and productivity over time. It also gives an indication for the possibility of trade-offs between labour and capital for a possible increase in overall productivity of the enterprise.

The productivity of feed factor input was 16.7 indicating positive relationship of feed input to total output. That is, an increase in the value of output of ¢1,670 for every ¢100 value of feed input consumed. Feed productivity is affected by the feed conversion ratio of the type of poultry being produced. The feed conversion ratio (kg feed per kg weight gain) is an indicator of efficiency of feed utilization, and forms the basis for quick check on the profitability and productivity of the farm or enterprise. Indicators of feed conversion ratio are egg weight, feed intake and meat development. Feed wastage is very crucial to feed

conversion, profitability and productivity in poultry management since it is estimated that about 0.5% or more of feed is wasted per day per 100 layers in laying flock in Ghana. This is even expected to increase to 12%. Cumulatively, it can seriously distress the profitability and productivity of the enterprise (Somuah, 2000).

Feed conversion is important to production and to the producer, since the feed cost is more than 75% of the total cost (Kekeocha, 1984). Under controlled environment, Europe and the USA have been able to obtain values of 1.8 to 2.0 as feed conversion ratios (FCR) for 2.2kg bird (Somuah, 2000). It is also estimated that the world average FCR is 2.2 for hot climates. In Ghana, some of the small farms with bird populations of 100-500 birds have been able to achieve FCR of 1.8-2.0 and FCR of 2.0-2.4 for batch size of 2,000 or more under normal intensive management system respectively (Somuah, 2000). This is quite comparable to the world average. However, poor quality and inefficient use of feed as a result of high cost of feed inputs within the enterprise as well as disease outbreaks may result in very large feed conversion ratios of 3 and above (that is large feed consumed but less weight gain).

The efficient use of such factors as standardisation of feed and feed requirements for the type of poultry and production process, types of capital equipment used for feeding purposes which include tube feeders, automation and feed troughs that minimise feed wastage increases the productivity of the enterprise. Feed wastage is very crucial to feed conversion, profitability and productivity in poultry management since it is estimated that about 0.5% or more feed is wasted per day per 100 layers in laying flock in Ghana. This is even

expected to increase to 12%, which can seriously distress the profitability of the enterprise (Somuah, 2000).

In spite of all the emphasis on capital and labour productivity, most firms' find that other inputs account for more than 75% of the production cost (Vonderembse and White, 1988). The study therefore calculated the productivity of purchased variable inputs which included veterinary drugs, electricity, day-old chicks, water and similar. The productivity measure was positive at 30.4% for this factor. As was true for the other inputs, any decrease in the required variable inputs and services without decreasing the output should result in increase in productivity. Inefficiency in the allocation of these resources and effective utilisation of the inputs however can also contribute to low productivity.

Even though it is important to obtain productivity increases with or without increases in the inputs, it is most important to determine how those inputs are managed therefore productivity improvement lies in management of the production function and also in the employment of technological innovation.

4.6 Educational Background of the Production Managers in the Commercial Poultry Industry

Table 8a presents the educational background of the respondents. Twenty-six managers representing 65% of the respondents are graduates of the tertiary level. These are graduates of polytechnics, colleges and the universities. It is significant to note that, most of them are in medium- and large-scale production as employees of the enterprises and have also had formal training in agriculture. All managers and most managers in the commercial hatchery, and feedmills respectively are graduates of this level. Graduates of the second cycle institutions

(secondary, vocational and technical) represent 25% with a frequency of 10. Some of these are in full charge of the enterprise with supervision from the owners. They have been employed as mostly farm managers in the layer and broiler production. A few of them are in management positions in the feedmills as an integral part of the meat and eggs production process. 4 respondents representing 10% of the managers have completed the first (basic) cycle institution. They are managing some of the small-scale enterprises and are supervised by the owners. None of the managers is illiterate or has received exclusively non-formal education.

Table 8a: Educational Background of Farm/Production Manager

LEVEL OF EDUCATION	FREQUENCY	PERCENT (%)
No Formal Education	-	-
Primary/Middle/JSS (Basic)	4	10.0
Secondary/Vocational/Technical	10	25.0
Polytechnic/College/University	26	65.0
Non-Formal	-	-
TOTAL	**40**	**100.0**

Source: Compiled from the survey data.

It is worth noting that 75% of the respondents are males and 25% are females (Table 8b). Of the proportion of females, 80% are graduates of the tertiary level of education, and 57% of the male proportion has also achieved the same level of education.

Table 8b: Gender of Farm/ Production Manager

GENDER	FREQUENCY	PERCENT (%)
Female	10	25.0
Male	30	75.0
TOTAL	**40**	**100.0**

Source: Compiled from the survey data.

Table 8c expresses the proportion of formal and no formal training in agriculture or the poultry business.

Table 8c: Representation of Formal and No Formal Education in Agriculture or Poultry Business

AGRICULTURAL EDUCATION	FREQUENCY	PERCENT (%)
Formal Agricultural Education	20	50.0
No Formal Agricultural Education	20	50.0
TOTAL	**40**	**100.0**

Source: Compiled from the survey data.

As shown in Table 8c, fifty percent of the respondents indicated that they have had formal training in agriculture, and fifty percent indicated no formal training. Some of the later respondents expressed that working in the poultry industry is their first experience in agricultural enterprise, and are leaning on the job.

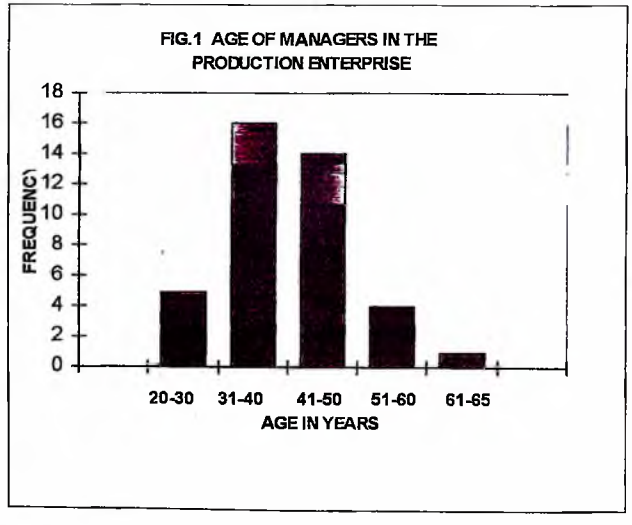
Table 8d: Representation of Managers as Full-time or Part-time Workers

MANAGER'S WORK STATUS	FREQUENCY	PERCENT (%)
Full-time Managers	24	60
Part-time Managers	16	40
TOTAL		**100.0**

Source: Complied from Data

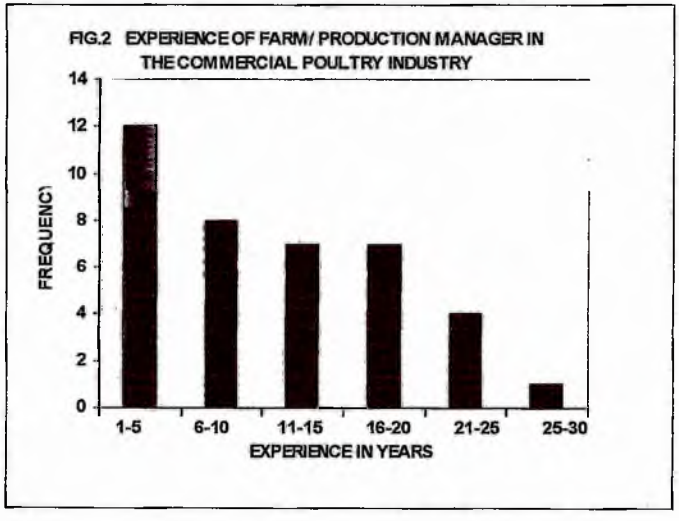
Table 8d shows the managers engaged in the enterprises as on full-time or on part-time basis. Sixty percent (60%) are in full-time business, while the remaining 40% are working on part-time. Most of the latter group are employees, either in the public or the civil service. They, on the average, spend up to two hours with the enterprise.

The ages of the respondents ranged between 23 to 61years with a mean value of 41.1 years. This has been presented in Figure. 1.



Source: Compiled from survey data

In Figure 2, the years of experience of the managers are presented. The mean-year of experience is 11.5 and the range is calculated as 1 to 30 years in the poultry enterprise. Whereas through experience, managers may be said to have acquired some skills and management expertise to deal with the day-to-day running of the business, it is also argued that, the more years the manager spends on the job, the more complacent he becomes, thus, leading to inefficiency and low productivity.



Source: Compiled from survey data

4.7 Effect of Education on Productivity (output) in the Commercial Poultry Industry

Table 9a summarises the regression results of the impact of education on productivity (output) in the commercial poultry industry in the Greater Accra Region. The study assumes that the effects of education are neutral. That is, education does not affect the productivity of capital, variable inputs or feed consumed differentially.

Except for the coefficients of experience XPE, experience-squared XPE*2, extension visits EVIS and secondary education (ED3), all the other variables have positive estimated coefficients. The coefficient (elasticity) of capital (KAP) is positive at 0.163 but statistically insignificant even at 10%. Purchased variable inputs (OTH) estimated coefficient (elasticity) is 0.448 and statistically significant at 1%. The coefficient of feed (FEED) has a positive coefficient of 0.361 and statistically significant.

The human capital variables are also statistically insignificant but positive, except secondary education whose coefficient is negative. The White Heteroskedasticity Test was conducted, and the results were insignificant, meaning there was no problem with non-constant variance of the error term (heteroskedasticity) (Refer Appendix 2). The insignificant coefficients in Table 9a may therefore be due in part to high correlation between variables. This high correlation among the variables therefore necessitated the elimination of some variables and aggregation of some into single variable (interactive terms) to avoid the estimation problems associated with high multicollinearity. (See Appendix 1 for the correlation matrix). Feed was highly correlated with total output, capital and other purchased variable inputs among others. Similarly, production manager (OWN) was highly correlated with manager as full time job (JOB).

A restricted equation (17) was therefore re-run by including interactive terms. Highly correlated variables such as feed and other variable inputs were therefore dropped from the equation.

Table 9a Regression Result of the Impact of Education on Productivity (Output) in the Poultry Industry

Dependent Variable is ln Q

VARIABLES	COEFFICIENT	t-STATS	PROBABILITIES
INTERCEPT	- 2.176	(-0.865)	0.397
lnKAP	0.164	(1.267)	0.220
lnLAB	0.298	(1.401)	0.177
lnOTH	0.449***	(4.052)	0.001
lnFEED	0.361**	(2.186)	0.041
ED3	- 0.160	(- 0.178)	0.861
ED4	0.202	(0.217)	0.831
XPE	- 0.015	(- 0.117)	0.908
XPE^2	- 0.000	(- 0.023)	0.982
OWN	0.205	(0.398)	0.695
JOB	0.045	(0.088)	0.931
EVIS	- 0.090	(- 0.208)	0.838

$R^2 = 0.923$	Adj. - $R^2 = 0.880$	F - Stats. = 21.719	N = 32.
White Heteroskedasticity Test:			
F-stat	1.436139	Prob. = 0.244457	
Obs* R-squared	19.36118	Prob. = 0.250379	

Source: Computed from the survey data.
Note: 1. Estimated t-values are in parenthesis.
2. Estimates of the model is derived from the data of the poultry enterprise in the Greater Accra Region
3. The asterisks indicate significant levels for one-tailed test, *** at 1%, ** at 5% and * at 10%

The model of best fit is therefore, presented in Table 9b. The study incorporated interactive term between education (ED2), extension visits and experience.

Table 9b. Regression Results of the Impact of Education on Productivity (output) in the Poultry Industry - Model of Best Fit

Dependent Variable is In Q

VARIABLES	COEFFICIENT	t-STAT	PROBABILTY
INTERCEPT	- 2.134	(- 0.737)	0.467
In KAP	0.400***	(2.834)	0.008
In LAB	0.803 ***	(3.673)	0.001
ED3	1.533	(1.204)	0.239
ED4	2.408 *	(1.241)	0.063
ED2*XPE*EVIS	0.451	(1.038)	0.301
JOB	0.609	(1.059)	0.299
$R^2 = 0.841$	Adj. - $R^2 = 0.804$	F - Stats. = 22.904***	N = 33
White Heteroskedasticity Test:			
F-Stats	0.963939	Prob. = 0.520140	
Obs*R-squared	14.13995	Prob. = 0.439338	

Notes:
1. Estimated t - statistics are in parentheses.
2. Estimate of the model is derived from the data of the poultry enterprises in the Greater Accra Region.
3. The asterisks indicate significant levels for one-tail test, *** at 1%, ** at 5% and * at 10%.

All the included variables have the a-priori expected signs and the human capital variables produce relatively high coefficient results.

The coefficient (elasticity) of capital is estimated at 0.400 and statistically significant at 1%. A percentage change in capital will lead to 0.4% change in output other factors held constant. The null hypothesis that capital does not impact on productivity is rejected and the alternative is accepted that capital impacts positively on productivity.

The estimated coefficient of labour is also statistically significant at the 1% level. The coefficient (elasticity) value is 0.8. This means that labour has a positive effect on output. All other things being equal, a 100% proportional increase in labour input used is able to produce a proportional 80% increase of output. The null hypothesis is rejected in favour of the alternative that, labour impacts positively on productivity.

The coefficient of the interactive term, ED2*EVIS*XPE is also positive but statistically insignificant but suggesting a possible complementary relationship between education at the basic level (primary/middle/JSS), extension visits and experience. This therefore means that managers with only the basic level of education may require some experience in the poultry business together with extension education to be efficient.

Education at the secondary level (ED3) is statistically insignificant but positively related to productivity (output). The coefficient (elasticity) is 1.533 and has a probability level of 0.299.

Education at the tertiary level also has a positive estimated coefficient of 2.4. It is statistically significant at 10%. The computed percentage change in productivity (output) due to ED4 (tertiary education) relative to the lower educational levels is 10.1 percent which ($e^{0.2408}$ - 1). This implies that, for the commercial poultry enterprises in the study area, a rise in educational level from the lower educational levels to the tertiary level increases productivity (output) by 10 percentage points. The findings seem to agree with Weir (1999), Appleton and Balihuta (1996) and Jamison and Lau (1982) that raising the educational level of the farm decision-maker increases agricultural productivity even though the results for these studies were varied.

The findings also agree with Moock's (1981) assertion that, there is an almost significant positive impact of four or more years of education, but a negative impact of fewer than four years. Out of 37 data sets reviewed by Jamison and Lau (1982), six had a negative and statistically insignificant effect, whilst in the remaining thirty-one, the effect was positive and usually significant. It is however interesting that complementing education at the secondary level with experience, increased output by 26% (ibid.).

The effect of quality education cannot be over-emphasised here since tertiary education increased output substantially than secondary education. This may be in contrast to Psacharopoulos (1994) that returns to primary education in developing countries (29%) is highest while the return to secondary and post secondary are 20% respectively. The positive impact of education on productivity (output) may be attributed to a reflection of the higher ability of more educated persons to manage not only the larger capacity enterprises, but also the relatively small and medium capacities. Sixty-five percent of the managers of the enterprises are highly qualified and educated mangers.

One expects owners of larger poultry enterprises to recruit more highly educated and qualified staff, however, the study indicates the presence of highly educated professionals of other establishments working as managers of small and medium-scale enterprises on part-time basis. They are using these enterprises to supplement family income and other financial commitments.

Appleton and Balihuta (1996) described the signs of the human capital variables as robust but with mixed values and significance. For example, 7 years of primary schooling was estimated to increase output by 13% (ibid). The results

further suggested that lower secondary schooling (which lasts four years) does not raise the agricultural productivity whereas upper secondary schooling may.

The positive impact of higher levels of education on productivity (output) may be attributed to a reflection of the higher ability of more educated persons present to manage the commercial poultry industry. It may also reflect the modernisation and technology, which characterises the medium and large-scale farms that are managed by this group of production managers.

JOB, referring to the production managers' influence as full-time operator in the poultry business is also positively but statistically insignificant even at 10%.

The R^2 value of 0.84 represents the percentage of variability in output which is explained by the explanatory variables. The performance may be said to be good since production is influenced by a number of unobserved variables such as access to credit, motivation and other factors, which could not be explained or considered in this specification. The R^2 - value also indicates strong positive relationships between the dependent and the independent variables.

The statistically significant F-statistics indicates that at least one of the explanatory variables significantly explained the changes in productivity (output) of the commercial poultry firms and that the estimated regression equation is useful for predicting or explaining the dependent variable.

4.8 Constraints to Technological Development and Management Capabilities in the Commercial Poultry Industry

The frequencies and the percentages of the respondents to the constraints militating against the enterprises are presented in Table 10. The major constraints

to the enterprise were identified as Government policies regarding interest rates and cost of inputs.

All respondents (100%) indicated that government policies related to interest rates and cost of inputs are major constraints to the poultry industry. As high as 84% also responded to the liberalised imports of frozen poultry and processed poultry products as a major problem to the industry.

Table 10: Constraints to the Enterprise

	MAJOR CONSTRAINTS (MC)		CONSTRAINTS (C)		LESS CONSTRAINTS (LC)			
SUBJECT	**FREQ.**	**%**	**FREQ.**	**%**	**FREQ.**	**%**	**TOTAL (%)**	**REMARKS**
Management	2	14	3	21	9	65	100	LC
Finance	24	86	3	11	1	3	100	MC
Land Tenure System	2	17	2	17	8	66	100	LC
Labour	3	14	9	41	10	45	100	LC
Technical & Machinery	3	23	7	54	3	23	100	C
Marketing	12	48	8	32	5	20	100	MC
Education	3	17	7	39	8	44	100	LC
Availability of Inputs	7	39	6	33	5	28	100	MC
GOVERNMENT POLICY								
- High Interest Rates	27	100	0	0	0	0	100	MC
-High Cost of Inputs	35	100	0	0	0	0	100	MC
-Imports of Poultry/ Poultry Products	27	84	4	13	1	3	100	MC

Source: Compiled from survey data.

Financing the production process was also found to be of major constraint by 86% of the respondents. Forty-eight percent (48%) responded to marketing as

a major constraint compared to 32% and 20% calculates for constraints and less constraints respectively for the same factor. Responding to constant breakdown, repairs and maintenance of machinery and the use of technology, 54% considered the subject as a constraint. Major constraint scored 23% and less constraint 23% respectively. Other factors such as management, land tenure system, labour and education were found to be less of a constraint to the enterprises.

The commercial poultry enterprise is a capital-intensive business in which the large-scale commercial farmers have to rely on the financial institutions to cope. Unfortunately, cost of capital in Ghana keeps increasing at such an increasing rate that most farm operators find it very difficult to borrow money from the financial institutions. It was estimated from a report presented on "Improving the Competitiveness of the Ghanaian Poultry Industry "(Darko, 2000), that, in 1996/1997, the average bank rate was 49% with a service charge of 1%, and a default rate of 52%. In 1998, it dropped to 39%-42% and to 36%-39% in 1999. The current rate as at year 2000 is 40%-41% for agriculture, which is even higher than 37% for the manufacturing company. Most of the enterprises are not able to afford and a few are able to service the loans. In fact, most of the entrepreneurs describe the interest rates as "guillotine" ready to come down at any time to "wipe them off".

The high cost of drugs and vaccines was described by the managers as prohibitive hence most of the small-scale farms are forced to treat their animals inadequately, leading to development of resistance to most of the drugs available and to low productivity.

The high cost and unstable prices of inputs was also described as "killing", a phenomenon that has resulted in very high cost of production and inefficient strategic planning of the industry.

In addition to the above, the production managers saw the liberalised import of poultry product as a serious problem to the enterprise. The relative cheaper price of 4,000cedis/kg of imported frozen chicken to 7,000cedis/kg for the locally produced chicken in 1999, they suggested has led to the collapse of the industry. Some of them have decided to produce only when the market is favourable. Firms could not compete under the various enumerated constraints.

On the question of financing the enterprises, the problems identified include unavailability of finances for operational purposes, unavailability of medium and long-term loans and credits, cost of finance and the impact of high inflationary rates. As high as 86% of the respondents indicate that financing the enterprise is a major constraint. In fact, most of the entrepreneurs indicated that the owners of the enterprises are financing their businesses themselves as sole financiers.

The supply of foreign exchange/currency in the system was also indicated as having a negative impact on the feedmills and the hatcheries as most of their inputs are import based.

Other constraints that were suggested include payment of 12.5% value-added tax, which is charged on some of the poultry production inputs, such as materials and equipment. This is because, the Customs, Excise and Preventive Services (CEPS) Harmonised Coding, does not clearly define and classify such materials as agricultural inputs. This in turn increases the cost of production, thus, reducing the profitability of the enterprise. Other factors militating against the

technological development and management capabilities were also listed as the energy factor, referring to the unpredictable power supply, availability of local raw materials, inflation, profitability, volumes of operation and capacity utilisation, cash flow problems and high cost of maintaining plant efficiency levels.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study has examined the impact of education on the productivity (output) of commercial poultry enterprises in the greater Accra Region using primary data collected from 40 commercial poultry enterprises.

The educational background of the managers, the decision-makers in the commercial poultry sector is relatively high. About 90% of the managers have received education beyond the basic level of primary, middle and junior secondary school. In fact, 65% of the managers in the sample have the tertiary level education in the study area. None of the managers was exclusively illiterate or has received only non-formal education.

The empirical test of the impact of education on productivity (output) in the commercial poultry industry for the interactive term of basic education, experience and extension service was positive but not statistically significant. The results however, suggest the complementarity of basic education, experience and extension services leading to an increase in productivity. The results also support the evidence from Jamison and Lau (1982) that "raising the educational level enhances agricultural productivity", and that increased education may improve the quality of labour and managerial inputs that is, a "worker effect" and "allocative effect" respectively. The education variable for secondary schooling was positive but not statistically significant. The result for the tertiary level of education was positive and statistically significant at 10% confidence level.

The study identified financing, high cost of production inputs and government policies as regards interest rates and liberalised imports of frozen poultry products as the major constraints to the enterprise.

5.2 Conclusion

The economic potential of the commercial poultry industry cannot be over-emphasised. The major stakeholders in the industry are the hatcheries, feedmills, production of table eggs, fertile eggs and meat, manufacturers and suppliers of drugs and additives and the importers and suppliers of frozen poultry products.

Out of the total of 739 commercial poultry producers in the Greater Accra Region, only 11 are large-scale commercial producers. The representations of the medium- and small-scale producers are 446 and 282 respectively. The levels of inputs available for production include labour (0.3%), capital (0.4%), purchased variable input (13.7%), day-old-chicks (1.6%), hatchery eggs (22.8%) and feed consumed (61.2%). The study also identified that only a few (7.5%) of the enterprises have integrated the various production processes. Large proportions of the producers (30%) are producing layers and broilers combined, 2.5% are into only broilers and 12.5% are producing layers only. There is only one feedmill, representing 2.5% that has no other production process.

The production capacity utilised by the producers of birds (meat and eggs) is 55.9%, hatcheries 32.2% and feedmills 75.4%. The measures of the factor inputs productivity were all positive at different levels: 82.6% for labour; capital, 714%; feed factor, 16.7%; and purchased variable input, 30.4%. The total factor input productivity was measured at 1.9%.

In describing the educational and social background of the managers, the study revealed that a greater percentage (65%) are graduates of the tertiary level, 25% have completed secondary education, while 10% are of the basic level. Whereas 25% of the respondents are females, 75% are males. The ages of the managers ranged between 23-61 years with a working experience in the industry of between 1-30 years. There was also an indication that, 60% of the managers are working in the businesses on full-time basis, while 40% are part-timers.

The impact of tertiary education on productivity (output) in the commercial poultry industry was positive with an estimated coefficient of 2.408. The estimated coefficient is significant at 10%. Impact of education at the secondary level is positively correlated to productivity (output) but statistically insignificant. The interactive terms of education at basic level, extension education and experience were positive and statistically insignificant suggesting the complementarity of basic education and experience to increase productivity (output). Both capital and labour as explanatory variables in increasing productivity (output) were positive and statistically significant at 5% and 1% respectively.

Finally, the study highlighted the major constraints to the industry. Among these were finance and government policy as regards the cost of capital, cost of inputs and import of frozen poultry products as a result of the liberalised market in the economy.

5.3 Recommendations

The following recommendations are derived from the study:

(1) It is recommended that highly and more qualified managers are employed to increase the efficiency and effectiveness of resource management in the industry.

Increase in productivity of the poultry industry is driven by advances in technology, organization of the production, reduction of wastage through efficient utilization of resources, lower operational costs, reduction of long-term liabilities, and increase on competitive advantage among others.

(2) The results indicate that we could expect the tertiary educated, especially agricultural graduates to permeate the poultry industry to have substantial impact on productivity in the commercial poultry industry. To the commercial poultry industry, investment in this type of education is very important. It is recommended, however, that financial support and organised market be encouraged to enhance the full potential of these graduates for increased technical and economic efficiency in the production of poultry and poultry products.

(3) Basic education combined with experience may shift the farmer to a higher production function as a result of raising the level of human capital, while simultaneously increasing the productivity of the available factor inputs. Therefore, emphasis may be placed on improving the quality and achievement of higher education for increased management efficiency and higher outputs in the commercial poultry industry. The managers can be provided with in-service training and short courses to improve on innovative and technical efficiency in order to cope with the dynamism of production in the industry.

(4) In as much as the macro environment is unfavourable for increase production and productivity of the enterprise, managers of these enterprises should not loose the fact that trade liberalization is associated with extension of consumer goods (including poultry products) to lower and middle-level class in urban and peri-urban areas at low prices. These increase flows will continue to influence the structure and conditions of agricultural food system. It is therefore recommended

that managers with technical and management expertise utilize available and transferable technology to permit efficiency in supplying good quality and inexpensive products to increase their sales if they are to compete with these foreign poultry products that have flooded the domestic market. There should be quality and quantity differentiation of poultry products for different segments of the domestic market. These can help to prevent the increasing marginalized domestic enterprises by these imports.

(5) Most of the entrepreneurs are sole financiers of their businesses due to the high cost of borrowed capital and lack of collateral and securities. It is recommended that the government should institute policies that preferentially lower the cost of capital to agriculture in order to support investment in the industry. In addition, payment of value-added tax (VAT) on agricultural equipment should be reduced or removed to encourage domestic investment in the hatcheries and feedmills as they are currently import based as well as to expand meat and eggs production.

(6) There should be an encouragement of both vertical and horizontal integration of the enterprise from both the private and public sector. For example, the production of poultry is dependent on the hatchery and the feedmill, likewise the hatchery on the production of the parent stock or breeders, or the feedmill on the production of poultry and capital equipment. The government can give support in the form of reduced tariffs on importation of production and processing plants and equipment and/or provision of subsidies to private entrepreneurs in the commercial poultry industry, improve the transportation, fuel and energy systems. This may result in the efficient utilisation of the factors of production, ready market and

distribution of products from the units and consumption outlets, thus, leading to efficiency in marketing, production expansion and maximum capacity utilisation.

(7) There is already a wealth of experience in family poultry development that can be utilised but all too often policy development initiate new programmes without taking this into account. This wastes both time and resource. It is therefore recommended that experiences in family poultry development is made part of the consultative process to review the experiences from various regions, organisations and countries in family poultry development from a technical, economic and policy perspective in order to formulate guidelines for the implementation projects for poverty alleviation and food security.

In general, poultry farmers need to supply larger volumes of poultry products than the 20% current domestic supply. Competing with the imports may require shifting from small-scale to medium or large-scale production, or aggregation of small poultry enterprises in the form of cooperatives (challenges to the ineffectiveness can be revisited) to meet the demands throughout the year. There is the need to create an enabling micro- and macro-economic environment to encourage domestic entrepreneurship in the industry for both the manufacture of poultry equipment and the commercial production process. Stabilizing the domestic currency, managing the negative aspect of liberalization, and keeping inflation to the best minimum level can ensure the supply of poultry products, and for achieving self-sufficiency in meat production by the year 2020.

The primary conclusion of this study is that investment in education has a positive impact on commercial poultry enterprises' productivity (output). This positive impact should be harnessed to make the commercial poultry enterprise competitive in the global market place.

5.4 Limitations and Suggestions for Future Research

The first limitation of the study is the focus on the chicken as the most popular species and of the largest population of poultry. There are other poultry species now springing up in the country such as ducks, turkeys and ostriches. Further research could include all these other species.

The study was unable to run separate analysis for hatcheries, feedmills and production of birds because of difficulty in separability of production and lack of large sample of these enterprises (hatcheries and feedmills). There is also lack of previous studies on Ghana commercial poultry enterprises that the study could compare its computed parameters.

Since there has not been any formal census and listing of poultry producers since 1997, there were difficulties in the collection of data as a result of inadequate information on the existing poultry enterprises especially, bird producers. Though most of these farmers have been registered and are members of GAPFA, available documents from the GAPFA indicated only the names and general postal addresses (non-residential or non-business) of these small- and medium-scale poultry farmers. There was no information as to where they could be located. Moreover, most of the enterprises listed (especially on the production of birds) are either non-functional or produce only during Christmas when demand is high, and so, there were only the structures with no production process as at the time of visits.

Most of the information provided by some of the respondents was inadequate and obviously incorrect. Such respondents were eliminated for the purpose of analysing this research.

The regression model employed aggregated data over birds, hatcheries and feedmills hence, several different measures of education may be used, and different

categories of labour may be considered (Weir, 1999). Again, different production functions apply to different farming systems. For example, the use of the entire pooled sample of farm household in rural Ethiopia constraints the coefficients on each explanatory variable to be same across different farming systems, which may present a mis-specification and result in biased estimated coefficient (Jamison and Lau, 1982). Thus, it may be necessary to estimate different production functions for different regions or different farming systems, (for example hatcheries, feedmills and bird production) (Appleton and Balihuta, 1996). Indeed, Cotlear (1990) found that education had different effects in different farming systems, in his study of farmers using traditional versus modern technologies in Peru. In the present study, a pooled data comprising the feedmills, hatcheries and bird production is used for the regression model as a result of the existence of few feedmill and hatchery enterprises in the study area, which cannot be analysed on their own merits. Secondly, some of the enterprises such as the feedmills and hatcheries are integrated and one way that education should affect productivity is through the educated operator choosing a more appropriate product mix.

It is therefore recommended that further work be carried out in the major commercial poultry producing areas in Ghana, outside the area of study, in order to ascertain the impact of education on productivity in the commercial poultry industry, and in the nation as a whole.

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Table 9a. APPENDIX 1

CORRELATION COEFFICIENT BETWEEN VARIABLES

	LTQ	LKAP	LLAB	LFEED	LOTH	ED3	ED4	XPE	XPE^2	OWN	JOB	EVIS
LTQ	1	0.832** (.000)	0.279 (110)	0.788** (0.000)	0.910** (0.000)	-0.208 (0.210)	0.233 (0.164)	0.136 (0.414)	0.133 (0.452)	-0.480** (0.002)	0.548** (0.000)	-0.184 (0.269)
LKAP	0.832** (0.000)	1	0.431* (0.012)	0.612** (0.000)	0.794** (0.000)	-0.128 (0.457)	0.099 (0.572)	0.090 (0.601)	0.125 (0.466)	-0.444** (0.007)	0.499** (0.002)	-0.226 (0.185)
LLAB	0.279 (0.110)	0.431* (0.012)	1	0.135 (447)	0.340* (0.043)	-0.105 (0.543)	0.124 (0.478)	-0.103 (0.550)	-0.114 (0.507)	-0.143 (0.406)	0.143 (0.406)	-0.127 (0.460)
LTFEED	0.788** (0.000)	0.612** (0.000)	0.135 (0.447)	1	0.629** (0.000)	-0.127 (0.453)	0.267 (0.110)	0.022 (0.895)	-0.008 (0.965)	-0.487** (0.002)	0.397* (0.015)	0.003 (0.988)
LOTH	0.910** (0.000)	0.794** (0.000)	0.340* (0043)	0.629** (0.000)	.1	-0.211 (0.197)	0.222 (0.181)	0.219 (0.181)	0.224 (0.1700	-0.458** (0.003)	0.491** (0.002)	-0.179 (0.277)
ED3	-0.208 (0.210)	-0.128 (0.457)	-0.105 (0.543)	-0.127 (0.453)	-0.211 (0.197)	1	-0.785** (0.000)	-0.239 (0.138)	-0.231 (0.152)	0.088 (0.591)	0.118 (0.469)	-0.182 (0.262)
ED4	0.233 (0.164)	0.099 (0.572)	0.124 (0.478)	0.267 (0.110)	0.222 (0.181)	0.785** (0.000)	1	0.269 (0.098)	0.167 (0.311)	0.011 (0.947)	-0.298 (0.065)	0.114 (0.488)
XPE	0.136 (0.414)	0.090 (0.601)	-0.103 (0.550)	0.022 (0.895)	0.219 (0.181)	-0.239 (0.138)	0.269 (0.098)	1	0.964** (0.000)	0.158 (0.332)	0.082 (0.614)	-0.012 (0.941)
XPE^2	0.133 (0.425)	0.125 (0.466)	-0.114 (0.507)	-0.008 (0.965)	0.224 (0.170)	-0.231 (0.152)	0.167 (0.311)	0.964** (0.000)	1	0.066 (0.684)	0.127 (0.435)	0.024 (0.882)
JOB	0.548** (0.000)	-0.499** (0.002)	-0.143 (0.406)	-0.397* (0.015)	0.491** (0.002)	0.118 (0.469)	-0.298 (0.065)	0.082 (0.614)	0.127 (0.435)	1	-0.434** (0.005)	-0.043 (0.793)
OWN	-0.480** (0.002)	-0.444** (0.007)	0-143 (0.406)	0.487** (0.002)	-0.458** (0.003)	0.088 (0.591)	0.011 (0.947)	0.158 (0.332)	0.066 (0.684)	-0.434** (0.005)	1	-0.313* (0.049)
EVIS	-0.184 (0.269)	-0.226 (0.185)	-0.127 (0.460)	0.003 (0.988)	-0.179 (0.277)	-0.182 (0.262)	0.114 (0.488)	-0.012 (0.941)	0.024 (0.882)	-0.313* (0.049)	-0.043 (0.793)	1

Source: Compiled form survey data.

Note: The asterisks indicate significant levels for two-tailed test, ** at 0.01 and * at 0.05 levels .

APPENDIX 2

White Heteroskedasticity Test on Table 9a

VARIABLES	COEFFICIENTS	T-STATS	PROBABILITY
INTERCEPT	-28.370	(-1.331)	0.203
InKAP	2.240	(1.785)	0.095
$InKAP^2$	-0.076	(- 0.191)	0.075
InLAB	1.034	(O.541)	0.596
$InLAB^2$	-0.020	(- 0.362)	0.722
In FEED	2.861	(1.737)	0.103
$InFEED^2$	-0.075	(- 0.166)	0.117
InOTH	-2.941	(- 3.279)	0.005
$InOTH^2$	0.0824	(3.373)	0.004
EVIS	0.148	(0.291)	0.775
XPE	0.1389	(0.558)	0.595
XPE^2	-0.010	(- 0.705)	0.492
$(XPE^2)^2$	5.910	(0.698)	0.496
ED4	0.141	(0.123)	0.903
ED3	-0.352	(- 0.335)	0.742
JOB	-0.712	(-1.248)	0.231
OWN	0.431	(0.767)	0.454
1. $R^2 = 0.605$	**Adj. - $R^2 = 0.184$**	**F - Stats. = 1.436139**	**Probability = 0.244457**
N = 32	**Obs.*$R^2 = 19.36118$**		**Probability = 0.250379**

Note: 1. Estimated t-values are in parenthesis

2. White Heteroskedasticity Test on Regression Results in Table (9a)

APPENDIX 3

White Heteroskedasticity Test on Table 9b

VARIABLES	COEFFICIENTS	t-STAT	PROBABILITY
INTERCEPT	0.039	(0.000)	0.999
lnKAP	6.643	(0.897)	0.381
$lnKAP^2$	0.031	(0.146)	0.885
lnLAB	-5.512	(- 0.476)	0.640
$lnLAB^2$	0.392	(0.623)	0.541
ln KAP*lnLAB	-0.662	(- 0.955)	0.352
lnKAP*(ED2*EVIS*XPE)	-0.065	(- 0.802)	0.433
lnKAP*ED4	2.366	(1.272)	0.220
lnKAP*ED3	2.528	(1,371)	0.187
lnKAP*JOB	0.411	(0.315)	0.757
lnLAB*ED4	2.466	(1.390)	0.181
lnLAB*JOB	2.127	(0.979)	0.341
ED4	-35.950	(- 0.1451)	0.164
ED4*JOB	-38.286	(- 1.3090)	0.207
ED3*JOB	-38.609	(- 0.395)	0.180
R^2 = 0.428	**Adj.- R^2 = -0.016**	**F - Stats. = 0.963**	**Probability = 0.520140**
N = 33	**0bs*R^2 = 14.13995**	**Probability = 0.439338**	

Note: 1. Estimated t-values are in parenthesis

2. White Heteroskedasticity Test on Regression Results in Table (9b).

EDUCATION AND PRODUCTIVITY IN THE POULTRY INDUSTRY IN THE GREATER ACCRA SAMPLE QUESTIONNAIRE FOR FARM MANAGER/PRODUCTION MANAGER FOR THE PRODUCTION YEAR 1999

NB. You are assured of the utmost confidentiality of all information given.

A. Identification

1. Questionnaire No.....
2. Name of Farm/Enterprise.....
.....
3. Location.....
4. Is the farm/production manager the owner of the enterprise

   1 = Yes 2 = No
5. Gender 1 = Male 2 = Female

B. Education

1. Highest Level of education

   1 = None 2 = Primary/Middle/JSS

   3 = Secondary/Technical/Vocational

   4 = Polytechnic/College/University 5 = Non-formal

Occupation

1. Is this poultry enterprise a full-time job

   1 = Yes 2 = No
2. If No, what is your major occupation

   1 = Public/Civil Employee 2 = Private Employee

   3 = Private Self employed 4 = Others (Specify).....

3. Any formal training in agriculture/poultry business

   1 = Yes 2 = No

4. Experience in the poultry industry / enterprise.....years

B. Type of Poultry Enterprise

1 = Layers 2 = Broilers 3 = Hatchery/Doc

4 = Feed 5 = Parent stock/Breeders

6 = Cockerels 7 = Processed poultry products

8 = Others (Specify).....

C. Production

Labour

1. How many employees are working on the farm/enterprise.....

2. How many of these workers are in

1 = Management..... 2 = Supporting/Office staff.....

3 = Production/Farm assistant.....

4 = Others (specify).....

3. What is the maximum labour requirement

1 = Management..... 2 = Office/supporting staff.....

3 = Farm Operations..... 4 =Other (specify).....

Land

4. What is the size of the land available for the enterprise.....

.....(in acres)

5. What is the land ownership contract

1 = Outright purchase 2 = Leasehold.

3 = Communal Ownership 4 = Inheritance

5 = Others(specify).....

6. What is the length of the lease period.....in years.

Capital Items.

7. What are the equipment and machines available for production and their life span.

Equipment/Machines	Quantity	Life span
1. Incubators	.....	.....
2. Generators	.....	.....
3. Feedmills	.....	.....
4. Trolley egg/egg crates	.....	.....
5. Feeders: Automatic	.....	.....
Plastic	.....	.....
Wooden	.....	.....
Metal	.....	.....
6. Drinkers: Automatic	.....	.....
Plastic	.....	.....
Metal	.....	.....
7. Hovers/Brooders	.....	.....
8. Lanterns	.....	.....
9. Coal pots	.....	.....
10. Others (specify).....	.....	.....
.....	.....	.....

Feed

8. How many bags of feed do you use per day per 1000 birds

   1. Day-old-chicks..... 2. Broilers.....

   3. Layers ..... 4. Parent stock.....

   5. Cockerel.....

9. Weight of bag of feed.

   1 = 45kg. 2 = 50kg.

10. Do you practice routine medication on your farm/unit.

    1 = Yes 2 = No.

    If No, why.....

11. Production cycle of the enterprise (please tick).

Weeks

Enterprise	4	6	8	10	12	52	75	90	104	other
1. Broiler										
2. Cockerel										
3. Layer										
4. Parent stock										
5. Feed										

12. How many batches of birds do you produce in a year.

    1. Broilers..... 2. Layers..... 3. Cockerels.....

13. Indicate the month(s) for peak production (please tick)

Enterprises	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct	Nov	Dec
1.Day-old-chicks												
2. Broiler												
3. Layer (eggs)												
4. Cockerels												
5. Feed												
6. Others (specify)												

14. What are the maximum, and present production capacities

Enterprise	**Maximum capacity**	**Present Production Capacity**
1. Hatchery	.....	.....
2. Housing/Structure for	.....	.....
birds	.....	.....
3. Feedmill	.....	.....

14. Are you able to produce to maximum capacity.

1 = Yes 2 = No.

15. If No, what are the constraints (can choose more than one in order of highest constraint).

1 = Finance 2 = Farm Structures 3 = Marketing

4 = Labour 5 = Inadequate capital equipment.

6 = Others (specify).....

Financing the Enterprise

16. What is / are the sources of finance

1 = Formal Bank 2 = Inheritance 3 = Money Lender.

4 = Informal Banks/NGO's/ "Susu"

5 = Others (specify).....

17. Give two reasons for the preference

1.....

2.....

Extension Services

18. How many times have you been visited by an extension agent

.....times.

19. Were the visits relevant.

1= Yes 2 = No

20. Would you recommend the services of the extension agents to the poultry enterprise.

1= Yes 2 = No

D. Enterprise Output (1999)*

1.

	Number Sold			Price per		
Enterprise	**Total Output**	**Dressed**	**Live**	**Dressed**	**Live**	**Kg/Dressed**
1.Broiler	.....	.....	.....	.....	.....	.....
2. Spent Layer	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	.....
3. Cockerel	.....	.....	.....	.....	.....	.....

* Seasonal production was captured in the production cycle (C. 11)

2.

Eggs	Total Output / day	Price / crate
1. Large	.....	.....
2. Standard	.....	.....
3. Small	.....	.....

3.

Hatchery	No. of Batches/year	Total Output/batch	Price/Doc (Cedis)
1. Broiler	.....	.....	.....
2. Cockerel	.....	.....	.....
3. Layer	.....	.....	.....

4.

Feed	Total Output in bags/day	45kg	50kg
1. Broiler Mash	.....	.....	.....
2. Broiler Finisher	.....	.....	.....
3. Chick Starter	.....	.....	.....
4. Grower Mash	.....	.....	.....
5. Layer Mash	.....	.....	.....

F. Farm Records.

1. What type of record(s) do you keep on the farm

   1 = Financial 2 = Production 3 = Inventory

G. Cost of Production (1999)*

1.

Labour	Hrs worked/day	Average wage/day	Wage/month
1. Management	.....	.....	.....
2.Office/Supporting staff	....	....	....
3. Production Staff	.....	.....	.....
4. Others (specify)	.....	.....	.....

2. Total labour expenditure per month ..... cedis.

3. Land

Enterprise	Acreage under production	Rent/acre/year	Total Cost of Repair and Maintenance
1. Farm Structures for birds	....	....	....
2. Feedmill	.....	.....	.....
3. Hatchery	.....	.....	.....

4. What is the cost of land available for the enterprise.....cedis

5. Cost of Capital Items

Equipment/Machines	Unit Cost	Cost of Repair and Maintenance/Depreciation
1. Incubators	.....	.....
2. Generators	.....	.....
3. Feedmills	.....	.....
4. Trolley/egg trays/crates	.....	.....
5. Feeders: Automatic	.....	.....
Plastic	.....	.....
Wooden	.....	.....
Metal	.....	.....
6. Drinkers: Automatic	.....	.....
Plastic	.....	.....
Metal	.....	.....
7. Hovers/Brooders	.....	.....
8. Lanterns	.....	.....
9. Coal pots	.....	.....
10. Others (specify.....		.....

Cost of Feed

6. What is the cost of a bag of feed.

Type of Feed	Unit Cost / 45kg.	Unit Cost / 50kg
1. Broiler Mash	.....	.....
2. Broiler Finisher	.....	.....
3. Chick Starter	.....	.....
4. Grower Mash	.....	.....
5. Layer Mash	.....	.....

7. Cost of Drugs, vaccines and other Inputs (cedis)

Enterprise	Drugs, disinfectants & vaccines	Electricity/month	Water/month.	Others
1. Hatchery	.....	.....	.....	.....
2. Broilers	.....	.....	.....	.....
3. Layers	.....	.....	.....	.....
4. Cockerel	.....	.....	.....	.....
5. Feedmill	.....	.....	.....	.....
6. Others (specify).....	.....	....	....	....

* Cost/Expenditure incurred for production period, 1999

Interest rates

8. What is the interest rate on loan/credit contracted from

1 = Formal Bank..... 2 = Informal Bank.....

3 = Money Lender..... 4 = Inheritance.....

5 = Family..... 6 = Others (specify).....

Transportation/ Fuel cost

9. What is the total transportation cost per production cycle

1. Poultry production.....cedis

2. Feed production.....cedis

H. Constraints to the Enterprise/Industry

(Rank from 1 - 3 in order of the highest to the lowest constraints)

1 = Major constraints 2 = Constraints 3 = Less constraints

Constraints	Ranking
1. Management	.....
2. Financial	.....
3. Land Tenure System	.....
4. Labour	.....
5. Technical and Machinery	.....
6. Marketing	.....
7. Education	.....
8. Availability of other Inputs	.....
9.Government Policy: - Interest rates - High cost of inputs - Liberalised imports of poultry products	....
10. Others (specify).....	.....

2. Measures undertaken to address the indicated constraints

Constraints	Measures
1. Management	.....
2. Financial	.....
3. Land Tenure System	.....
4. Labour	.....
5. Technical and Machinery	.....
6. Marketing	.....
7. Education	.....
8. Availability of other Inputs	.....
9.Government Policy: - Interest rates - High cost of inputs - Liberalised imports of poultry products	....
10. Others (specify).....	.....

3. Why are you in the poultry business (please tick)

1 = Income

2 = Profession/Occupation

3 = Home consumption

4 = Other (specify).....

THANK YOU MOST SINCERELY.