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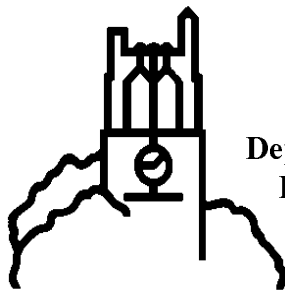
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Transforming Poultry Production and Marketing in Developing Countries: Lessons Learned with Implications for Sub-Saharan Africa

by

Laura L. Farrelly

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TRANSFORMING POULTRY PRODUCTION AND MARKETING IN DEVELOPING COUNTRIES: LESSONS LEARNED

by

Laura L. Farrelly

June 1996

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EXECUTIVE SUMMARY

BACKGROUND: Rapid technological progress in the modern poultry sector has resulted in a remarkable reduction in the costs of production and marketing of poultry meat and eggs. Falling retail prices of poultry products relative to those of other animal products due to this improved technology has resulted in increased consumption of poultry products worldwide. The development of confinement systems and controlled environment have broken agriculture's traditional ties to land and climate, making modern poultry production technology potentially transferable to almost anywhere in the world, including developing countries (Vocke, 1991). Successfully transforming the poultry sector, however, requires not only transferring the technology for poultry production, but also the institutions and coordinating mechanisms which facilitate the transfer of the system of intensive poultry production and marketing.

OBJECTIVE: The aim of this case study is to examine a few of the developing countries which have been particularly successful at developing their poultry sectors and to draw some lessons from these examples about the technologies, policies, and coordinating mechanisms that facilitated the transformation process.

EVOLUTION OF THE POULTRY SUBSECTOR: There are three discernable phases through which the poultry sector has evolved: (1) traditional systems, (2) semi-commercial systems, and (3) commercial systems. Each of these systems requires a unique set of technologies, policies, and coordinating mechanisms.

Traditional systems of poultry production are typically referred to as a "backyard business." Traditional poultry producers raise small numbers of domestic fowl for home consumption with small, mostly seasonal surpluses being sold at village markets. Farmers invest minimal resources in poultry production: they raise their own stock, the birds are left to scavenge for food and are occasionally given table scraps, they do not provide any type of vitamins or veterinary services, and often with no housing provided. Finally, there is no differentiation in the traditional system between birds used for eggs and those raised for meat.

The mortality rate for poultry in traditional systems is high due to a high incidence of disease as a result of poor or no veterinary care and their increased vulnerability to predators due to a lack of housing. Productivity of these birds is generally far below that of commercial growers because the amount and quality of feed is not monitored, and the genetic characteristics of the birds make them less efficient at converting quality feed to meat and eggs. There are, however, various benefits to the traditional system, including: domestic birds' adaptability to the climate and resistance to disease, and the important role of traditional systems in improved rural nutrition, income distribution, agricultural diversification, and as a source of liquidity (Wilson, 1986). Due to the low level of exchange, specialization, and investment in the traditional system, producers' risk and uncertainty are minimized. The traditional system is still the most common type of poultry production in the developing countries.

Between the two extremes of traditional and commercial poultry production are *semi-commercial systems* of medium-size family farms. In this system, farmers grow improved local breeds or cross-bred stock, although there still tends to be no differentiation between stock used as layers and stock used for meat. Semi-commercial farmers provide rudimentary housing structures, may purchase at least part of their feed, and use vaccines and veterinary services when available and accessible.

Semi-commercial growers sell most of their production to nearby urban centers, although no formalized system of marketing exists except, in a few cases, oral contracts. Where oral contracts do exist, they are typically made with hotels or restaurants and they have little or no effect on choice of technology, supply of inputs, or quality of the product. The purpose of these contracts is to give producers the right of first refusal with respect to a price offering and buyers the opportunity to make an offer to a known supplier (Billings, 1987). Moreover, independent semi-commercial poultry farming often seems to represent a transitional stage, with many of these farmers eventually being “integrated” into large companies in order to ensure regular supplies of inputs and to secure a market for their products at a guaranteed price (Krostitz, 1984).

Commercial systems are characterized by large-scale production using specialized and mechanized facilities which require low levels of labor. In this system, feed is the most important variable cost component, representing 70-75% of the production costs. For this reason, profitability in commercial systems relies heavily on the ability to secure stable supplies of low-cost feed.

Growers use genetically improved, specialized stock which are bred for their specific use as either layers for eggs or broilers for meat. These strains respond efficiently under commercially intense feeding systems, with broilers reaching a market-ready weight of approximately 1.8 kg in as little as six weeks. High productivity depends on well balanced rations and requires close nutritional supervision, thus requiring careful management. Additionally, these birds are extremely susceptible to feed changes, and any disruption in a feed supply can have severe economic consequences for producers (Kane, 1987). Along with improved nutrition and genetics, important advances in disease prevention and technology and management have facilitated the growth of commercial systems.

COORDINATION MECHANISMS, INSTITUTIONS, AND TECHNOLOGY

ADOPTION: Institutional innovations have led to more effective coordination in the subsector, thereby facilitating the transformation process from traditional to commercial systems. These institutional innovations include a formalized system of contracts associated with vertical integration and larger sized units capturing economies of scale.

Vertical coordination is motivated by the need to reduce transaction costs and to ensure technological complementarity between the stages of production and marketing (Minot, 1986). The poultry subsector lends itself to vertical integration because of the precise supply timing requirements (e.g., in chick production and in processing), the amount of specialized inputs, and the perishability of the product. The vertically integrated company can plan an optimum scale of production at each stage so that economies of scale can be achieved, while at the same time

achieving economies of information on quality and demand conditions which are articulated throughout the subsector. Although the grow-out stage of poultry production is not carried out by the large firm, the quality, timing, and quantity of poultry supplied can be integrated into the operations of the firm through *resource-providing contracts*.

Although the types of contracts vary among and within countries with commercial systems, the most common form of contract is one in which the producers are provided with an agreed number of chicks and the required amount of feed, drugs and veterinary services as well as technical services at no cost. Under this type of contract, growers basically rent their growing facilities and contract their labor, and at the end of the grow-out period they are paid a fixed amount per pound per marketable broiler. In many cases, a premium is paid for above average weight broilers as a reward for more efficient use of feed and better management practices.

For growers, contracts reduce risk and uncertainty because the intermediary -- the integrator -- links the growers with the input suppliers and markets. With a secured market outlet as well as an assured source of inputs and technical advice, growers are provided with both an incentive and an improved capacity to invest in specialized equipment and to adopt new technologies for more efficient production of poultry products (Jaffee, 1990). For the integrators, a contract provides tighter control over all the vertical stages of production including the inputs used, quality of the final product, and the timeliness of delivery of predetermined quantities (Glover, 1987).

The transition from traditional to commercial systems is increasingly dependent on the use of modern technology and commercial inputs, institutional and policy innovations, and internalized coordination mechanisms. Given the nature of the product and the required timeliness in the delivery of input supplies and processing as the scale of production and investment increase, these innovations serve to decrease transaction costs, manage risk, and achieve economies of scale throughout the different stages of the subsector.

TRANSFORMING THE POULTRY SECTOR: Experiences of Five Developing Countries:

This paper examines the experiences of five developing countries in developing their poultry sector: Bangladesh, Brazil, India, Nigeria and Thailand. Each of these countries are at different stages of transformation and have experienced different paths depending on their constraints and opportunities. Brazil and Thailand, for example, are the world's third and fourth largest exporters of value-added chicken meat products. The rapid transformation in the poultry sector of these countries is evident from the per capita consumption of poultry meat which in the last two decades has risen from 2.4 kg/year to 18.5 kg/year in Brazil and from 0.9 kg/year to 10 kg/year in Thailand.

The successful transfer of technology in the Brazilian and Thai poultry subsectors were very similar. The private sector played a leading role in developing new technologies through joint ventures with international (primarily US) companies. Technologies such as the development of improved breeding stock, hatching, vaccinations, and automated processing equipment were originally imported into the countries. However, domestic firms quickly developed the technology to produce these inputs locally, as well as the domestic human capital necessary to sustain the sector.

The integrators, originally pork processors in the case of Brazil and feed companies in the case of Thailand, maintained tight control over the vertical stages of production through integration and contracts. These coordinating mechanisms allowed integrators to achieve economies of scale, quality control, and timeliness of inputs in various stages of the subsector as well as provide incentives for participants in the subsector to increase productivity and adopt new techniques.

There are also some important differences between the experiences in Brazil and Thailand. While the objective of large-scale commercial poultry production in Thailand was conceived and implemented by the private sector, the government initiated this transformation in Brazil by providing the incentives for the initial private sector investment. The Thai government had very little involvement in the sector beyond the provision of basic quality and sanitary standards, an open policy on the import of essential inputs, low export taxes, and a few investment incentives in processing for exports. In Brazil, however, large amounts of public funds were invested in the sector, subsidies on feed grains were provided, very low interest loans were made available to subsector participants, and exchange rate adjustments were made.

The transformation initiatives undertaken in India and Nigeria differ from those of Brazil and Thailand, and have produced mixed results. The governments of both of these countries have played the leading role in transforming their poultry sectors to commercial systems. In the case of India, the government assumed primary responsibility for developing the technology and making it available and accessible to participants in the subsector. The government has taken on the task of identifying alternative feedstuffs (given that supply of feedgrains are limited), developing breeding programs for improved stocks, and providing the technical services and inputs such as training, veterinary care and vaccinations.

The Indian government's strategy has been largely successful because the plan included the institutional innovations necessary to create the incentives for improved performance and adoption of new techniques in the subsector. For instance, there is no formal system of contracts or vertical integration which would help growers to manage risk, however, the government's flock insurance program serves this function, thereby creating an incentive to invest in commercial scale grow out facilities. Also, the government established poultry estates (the 'cluster approach') which grouped a large number of growers in one area, facilitating economies in input supplies and health cover. Finally, the government licensed the import of breeding stocks, equipment and feed ingredients in order to control foreign exchange spending and to encourage local production of inputs. The shortcoming in the Indian initiative, however, is that there is no provision of a guaranteed market for chicken meat since there is not a system of contracts and because government cooperatives have not been successful. The lack of cold storage and a guaranteed future price for chicken meat has created a disincentive for potential investment in the sector (Panda et al., 1993).

Although the transformation in Nigeria was similar to that of India's, it has been less successful in transferring the system of commercial poultry production and marketing. The Nigerian government established state-run feedmills and hatcheries, however, the strategy did not develop the technology to sustain commercial systems at other stages in the subsector. For instance, vaccinations, technical services, processing facilities, and marketing services were either not

available or were not complementary to the scale of production at the grow out stage. Additionally, there was no plan for developing the human capital necessary to adopt and adapt new techniques. A lack of technological complementarity and the lack of tools for risk management created an important disincentive for investment and technology adoption in the sector (Bessei, 1993).

Government policy also led to adverse consequences for the poultry sector in Nigeria. Import taxes on maize, dependence on foreign exchange for the purchase of inputs, and a ban on poultry exports were some of the policies which resulted in a serious reduction in the production of poultry products (Sonaiya, 1990). Although Nigeria is still the largest producer of broilers in Sub-Saharan Africa, the government's strategy has not succeeded in transferring the poultry production and marketing system in the country.

The government of Bangladesh has taken a different approach to improving productivity in the sector. Faced with few raw materials for compound feed and a lack of foreign exchange for purchasing essential inputs for commercial systems, the government has pursued a plan based on small-scale rural poultry production. The government has attempted to improve existing small-holder production through the following measures: (1) providing vaccination against the country's most important disease (Newcastle disease) by government-trained village vaccinators; (2) improving protection of birds against predators; (3) introducing improved genetic stocks (dual purpose breeds); and (4) providing feed supplements to complement scavenging (Bessei, 1993). The government has devised various schemes to distribute birds to rural households along with the necessary inputs and marketing facilities.

To date, the Bangladesh strategy has been largely successful. Poultry production in the country represents approximately 37% of the total meat production and had a 24% annual growth rate of production during the 1980s (Panda, 1989). The strategy chosen by Bangladesh, however, relies heavily on the government for training of large numbers of village extension workers, distribution of vaccines at the village level, and overall coordination of input supplies and marketing facilities. The long-term sustainability of the institutional framework and training programs is still questionable.

LESSONS LEARNED AND IMPLICATIONS FOR SUB-SAHARAN AFRICA: There are several important lessons to be learned from these case studies with respect to the innovation and coordination necessary to transform the poultry sector. The first important lesson is that transformation of the poultry sector is not simply the transfer of a single technical innovation, but rather the transfer of a system. Development of the sector was not initiated and implemented under the discipline of atomistic competitive markets; due to the perishability of the product, the required timeliness of inputs, and the scale economies of the larger system, the same effectiveness of coordination could not have been achieved across spot markets. Furthermore, the transformation of the poultry sector was an iterative process in which the system was not transferred all at once, but followed a path of technological transformation. Changes were introduced in the subsector in close succession at different stages, but on a limited scale at any point in time, so that the whole subsector grew in an even, balanced manner. Inclusive and

important in following this technology path was the significant build-up of human capital to sustain the system.

The international market was an important source of technology in these case studies, and the formation of joint ventures between firms and agencies in developing countries and firms in industrialized countries (particularly the U.S.) has been an effective transfer mechanism. Those countries experiencing the greatest success in achieving commercial poultry industries, however, have included in their original objectives a long-run strategy for domestic adaptation of the necessary techniques. For instance, climatically adapted breeds were developed from imported stock.

Various coordination mechanisms were used to differing degrees in order to assure reliable input supplies, technical assistance, quality of production, and final markets. Contracts and vertical integration have been particularly effective in coordinating the poultry subsector, however, other coordinating mechanisms, such as the cluster approach used in India, have served this function as well.

Institutional innovations and the institutional environment played a pivotal role in transforming these countries' systems by providing incentives for participants throughout the subsector. Institutions and services which reduced the effects of price variability, dispersed risk, and lowered transaction costs, such as the provision of contracts, insurance, credit, etc., created an environment in which input suppliers, producers, and processors had an increased incentive to invest in the sector and to adopt new techniques.

Transforming the poultry sector in developing countries has the potential to improve nutrition and income as well as provide an important linkage in the process of structural transformation. A successful transformation to commercial systems offers gains from specialization and exchange, increases farm-level productivity through the use of new techniques and management practices, and benefits the long-run process of change in productivity gains from expanded use of land and labor to increased use of knowledge from outside the farm (i.e. the integration of agriculture with other sectors of the domestic and international economies). The extent to which countries succeed in transforming their poultry sectors will rely not only on transferring the techniques for commercial poultry production and marketing, but also an environment which enables the successful transformation of the *system*.

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1. INTRODUCTION

Rapid technological progress in the modern poultry sector has resulted in a remarkable reduction in the costs of production and marketing of poultry meat and eggs. Falling retail prices of poultry products relative to those of other animal products due to this improved technology has resulted in increased consumption of poultry products worldwide. The development of confinement systems and controlled environment have broken agriculture's traditional ties to land and climate, making modern poultry production technology potentially transferable to almost anywhere in the world, including developing countries (Vocke, 1991).

Of course, pineapples can be grown in Antarctica, given a particular set of incentives, resources, knowledge, and opportunities. The desirability of technology transfer for commercial poultry production to a developing country, likewise, will depend on those four criteria.

The possible government incentives for investing in commercial poultry production in developing countries include the ability to make widely available a low-cost source of animal protein, savings on foreign exchange spent on imports of meat and eggs, and the creation of a new source of demand for feed and feed grains. One could argue that all of these objectives could be satisfied by improved productivity of traditional systems of poultry production. Achieving these objectives through commercial systems, however, offers additional advantages: gains from specialization and exchange, increases in farm-level productivity through the use of new technologies and management practices, and, most important, benefits in the long-run process of change in productivity gains from expanded use of land and labor to increased use of knowledge from outside the farm (i.e. the integration of agriculture with other sectors of the domestic and international economies). In short, the transfer of commercial poultry production technology to developing countries can provide an important linkage in the process of structural transformation.¹

The second criterion, the right set of resources, refers to the availability or accessibility of a set of inputs to create a viable, efficient commercial system. This includes not only physical inputs (e.g., feed, equipment), but also the mechanisms required to provide for the optimal use of those inputs, including marketing channels and coordinating mechanisms.

A strong knowledge base and human capital capable of mobilizing resources and operationalizing the objectives is the third criterion. The technology of commercial poultry production may be transferred from the developed countries, but the knowledge necessary to sustain the industry and improve performance comes from the capacity of workers and managers to implement plans and modify technologies within the country.

¹ For a clearer description of the process of structural transformation, see Staatz (1994).

Finally, opportunities are all of those elements which induce rather than impede the transfer of commercial systems technology. Opportunities can be embodied in technologies, policies, information, rights and regulations, credit, institutions, tools for risk management, and so on.

Over the past few decades, the set of incentives for developing commercial poultry systems has been appealing to more than a few of the countries in Sub-Saharan Africa. Alignment of those incentives with the necessary resources, knowledge, and opportunities, however, has proven to be difficult -- even with the availability of new technologies like confinement systems and controlled environments. Despite the set backs in Sub-Saharan Africa, some developing countries are experiencing truly successful poultry sector transformation. The experiences of these countries hold some very important and promising lessons for Sub-Saharan Africa regarding the tools necessary to transfer this technology.

This paper examines the strategies used in developing countries which were successful in transforming their poultry sectors, with an emphasis on the technologies, policies, and institutions which were necessary to achieve this objective. This paper also draws some lessons from these countries which may be useful for the development and improved performance of poultry sectors in Sub-Saharan Africa.

An extensive review of the literature on poultry production in developing countries, undertaken for the purposes of this paper, describes the success stories in poultry sector transformation. Unfortunately, there is not a great wealth of literature on poultry in Sub-Saharan Africa, and that which exists tends to be lumpy, in the sense that the majority of literature on poultry tends to correspond with two periods: (1) the early to mid-1970s when commercial poultry production received a big push from the international community as a possible panacea for the animal protein deficit in developing countries; and (2) the mid-1980s reassessment of the feasibility and objectives of poultry production in the developing countries. For the purposes of this paper, however, the literature is sufficiently broad to capture at least the basic elements which have led to successes and shortcomings of development initiatives in the poultry sector.

This paper is divided into seven sections. The first section introduces the topic and describes the objectives of the paper. Section 2 describes the conceptual framework used to examine the transformation of poultry production in developing countries and describes the stages of the production-distribution-consumption chain in the poultry subsector. Section 3 defines the evolution of the poultry sector's technology frontier. Four case studies of successful transformation of the poultry sector in developing countries are presented in Section 4. Section 5 draws some lessons from those case studies. Section 6 examines the African experience and proposes some hypotheses regarding the transformation initiative in Sub-Saharan Africa which are then tested in the case of Nigeria. Section 7 summarizes the findings of this research and proposes a framework for the strategic planning of poultry systems in Sub-Saharan Africa.

2. A SUBSECTOR APPROACH

This study uses a subsector approach to analyze the transformation of poultry production and marketing. A subsector is a vertical set of activities that contribute to the flow of a commodity through the stages of production, distribution, and end use (Shaffer, 1973). The subsector analytical framework is a method for organizing the research of a particular commodity, with an emphasis on the vertical sequences in production and distribution as well as the coordinating mechanisms which link the interdependent stages of commodity flows. The subsector framework is a dynamic approach which traces the channels and transformations of a specific commodity, which examines not only the processes of physical transformation, but also the policies and institutions which structure the incentives for exchange, risk management, dissemination of information, and innovation.²

The subsector approach was selected for examining the transformation of poultry production and marketing in developing countries because coordination among the different stages from research to farm-level production to final consumption is crucial in achieving potential productivity gains. A farming systems approach, in contrast, which focuses on the relationships among different activities at the farm level, would not provide enough insights into relationships among the full set of activities involved in the production, processing, and distribution of poultry products. Although farming systems are an important stage in the subsector, this type of study does not provide any information on, for example, the incentives and transfer mechanisms for improved technology in inputs such as breeding stock or the institutions which facilitate distribution of poultry products once they have left the farm. A commodity subsector perspective provides a framework with which to examine the degree of specialization and exchange of a given commodity as well as the extent of coordination between agents and networks at different stages in a subsector. Furthermore, this approach provides insights into the technological, policy, and institutional innovations which facilitate preference articulation and communication of market opportunities throughout the stages of the subsector.

2.1 Elements of the Poultry Subsector

The vertical set of activities in the production, distribution, and consumption of poultry products can be broken down into six major components:³ feed preparation, animal husbandry, animal production, processing, distribution, and consumption (Willis, 1992). A brief description of each of these elements as well as the factors affecting their coordination will be instructive for the analysis which follows.

² For more information on the subsector approach, see Shaffer (1973), Boomgard et al. (1986), and Boughton et al. (1995).

³ This section is not meant to be an exhaustive listing of the agents, inputs, and processes involved in the production and marketing of a pound of chicken meat. The description which follows is intended to define some of the basic characteristics of the stages of the poultry subsector in order to facilitate a more in-depth analysis in later sections of this paper.

Depending on the type of system used for raising poultry, feed requirements may vary greatly. As scavengers, chickens are well adapted to an extensive production system, while more intensive production systems require a regular and nutritionally balanced feed ration. Maize is the primary ingredient, constituting up to 70% of the feed ration in intensive systems. The relative importance of maize in the ration as well as its relative price make it the determining factor in the cost of feed. The remainder of the ration is typically dependent upon the availability and cost of energy and protein sources, and may include elements such as soybeans, fish meal, cassava, oilseed cakes, and even slaughter waste.⁴ Compound (or pre-mixed) feeds typically include vitamin and mineral supplements.

In addition to the composition of feed, numerous technological, policy, institutional, and environmental factors determine the quality, availability and price of feed. Some of these factors include: domestic productivity of feed grains, competition for grains as food for human consumption, government policy and involvement in grain pricing and marketing, import policy and prices of feed grains, grain market information systems, facilities and technologies available for milling, storage capacity for feed and feed grains, transportation, and quality controls.

Animal husbandry includes all the processes and technologies involved in the breeding and hatching of birds. Breeding may involve natural reproduction of local fowl or, in more intensive systems, it may include the controlled breeding of parent stock to develop a strain of birds which possesses certain desired genetic characteristics. These genetic characteristics improve upon the performance of birds with respect to such attributes as the rate of feed conversion (the amount of feed required to produce a pound of meat or eggs), growing time required to reach maturity, and adaptability to climate and environment. With this technology, stocks can be bred as either broilers or layers to further increase productivity. Breeding and improvement of local strains is a lengthy process requiring high levels of technology and human capital. For this reason, countries tend to first obtain the technology and exotic breeds from the international community as a basis for developing a domestic breeding program (Poapongsakorn et al., 1986).

Once the breeding process has produced the fertilized eggs, hatching facilities are required. Capital investments are needed for specialized hatching equipment and basic infrastructure must be provided, such as a reliable source of electricity. As the hatching process must begin shortly after the fertilization of eggs, good coordination between the breeding, hatching, and grow out facilities must exist to ensure optimal hatching rates and the production of quality chicks (FAO, 1980).

Day-old chicks are delivered from the hatchery to the grow-out facility.⁵ Important factors at the grow-out stage include: availability, quality, and cost of feed; disease control, vaccinations and

⁴ Numerous papers presented at the *VI World Conference on Animal Production* identify possible alternative feed sources for poultry. (See Finnish Animal Breeding Association, 1988)

⁵ The types of farming systems are discussed in the following section on the evolution of the poultry sector. This section simply attempts to draw out some of the important processes and factors at this stage in the subsector.

veterinary care; quality and productivity of chicks supplied; types of materials and equipment available for construction of the grow-out facility; and management practices and technical services. The ability to coordinate delivery of these inputs at the farm level will influence the extent to which new technologies are adopted in response to opportunities and price incentives (Glover, 1987).

Processing options can range from slaughter at the point of sale in spot markets to fully mechanized processing plants. The cost of labor relative to the cost of capital as well as the availability of equipment will affect the scale and type of processing technology used. Economies of scale in processing are enhanced when by-products (e.g., feathers, carcasses) are used as protein sources in animal feeds. As the processing technology becomes more complex and specialized and amount of value-added to the product increases, institutions and policies play an increasingly important role, for instance, in the provision and enforcement of sanitary and quality standards.

Distribution may involve a number of coordinating arrangements, including spot markets, contracts, and vertical integration. The factors affecting the transformation process at the distribution stage will depend on the types of coordinating means used. As control of coordination shifts from spot markets to tighter forms of coordination, the effectiveness of distribution of poultry products will increasingly rely on the availability of transportation and infrastructure, cold storage, and information regarding supply and demand. Due to the perishability of poultry products, timely and reliable transportation and storage is necessary to avoid spoilage. A lack of information at the distribution stage can lead to simultaneous gluts and scarcities of poultry products in different regions or markets, leading to inefficiencies and increasing the risk of spoilage.

Animal protein generally has a positive income elasticity of demand, implying that consumption of poultry products increases with per capita income. The effective demand for poultry products, largely the result of increasing real income per capita and the degree of urbanization, is the primary force for structural transformation of the sector in developing countries.⁶ Demand for poultry products will also depend on their price relative to other sources of animal proteins. Efficient, intensive systems of poultry production are characterized by their ability to supply a low-cost source of animal protein relative to others (e.g., goat, sheep, and cattle), resulting in a substitution away from other animal proteins toward poultry products.⁷ Hence, unit costs are an

⁶ Virtually all of the literature on poultry in developing countries touches on the issue of increased effective demand for poultry products due to increasing real incomes and urbanization. None of the literature, however, attempts to determine by how much incomes and urban populations must increase to create an effective demand capable of sustaining the scale of commercial systems. Future research on these issues is much needed.

⁷ The rate of substitution away from other animal proteins toward poultry products may also depend on the type of system used to produce those meat substitutes. In developing countries, goats, sheep, and cattle are often fed almost no grains, relying on grazing land for feed. Additionally, the grazing land used for these animals may not have alternative uses, such that the economic cost of raising those animals is decreased relative to the cost of intensive poultry production.

important performance dimension or criterion when evaluating alternative production systems. Tastes and preferences of a society are also important determinants of demand. Preferences not only determine the consumption of chicken versus other meats, but also the demand for local fowl versus industrially-produced chicken. As incomes rise, demands for quality, specific attributes, and value-added poultry products also increase, influencing transformation and technology at every stage in the subsector. For example, both the domestic and international markets demand branded fresh, frozen, and value-added products (e.g., deboned).

Export markets also play an important role in the demand for poultry products. The quantity demanded in the export market depends on price (which depends on monetary and exchange rate policies), transportation costs, and the ability to meet market specifications, standards, and quality controls. The capacity to meet the (often times very strict) market specifications for the international market both depends on and influences performance and technology throughout the subsector (Jaffee, 1993).

The performance of the subsector -- the degree of vertical coordination and exchange, the transactional efficiency of the commodity flow, the role of participants in the stages of physical transformation, and the types of technology used -- is greatly influenced by the set of policies and institutions affecting the subsector. Government policy can facilitate or impede transactions by influencing the availability, accessibility, and values of inputs and outputs throughout the subsector. For instance, government taxes on imports of equipment, breeding stock, or drugs may undermine subsector participants' incentives to grow broilers or invest in processing facilities; while government subsidies on feed grains may act as an incentive for increased investment and participation in the subsector. Other government policies which affect the subsector include: price fixing, rules on competition, quality controls (and enforceability) on feed and poultry products, sanitary standards and food safety laws, enforceability of contracts, corporate/export/income tax laws, and exchange rate policy.

Institutions are the economic rules of the game which structure the incentives in the subsector (Shaffer et al., 1994). Institutions for managing risk, uncertainty and problems of asset specificity, and finance are important to facilitate coordination and minimize transaction costs in the subsector. Perishability of the product, the required timeliness of inputs and production, the threat of disease and mortality, and investment in specialized equipment (asset fixity) are all risks assumed by various participants in the subsector. A system of incentives which reduces or disperses risk and creates rights to resources (e.g., insurance, contracts, credit, cooperatives, information systems) has a positive effect on the level of participation in the subsector, the adoption of new technologies, and the effectiveness of coordination at every stage in the transformation process.

This section presented the reasons for use of the subsector approach as well as described some of the basic elements of the poultry subsector, including related policies and institutions, which shape the structure and performance of the subsector. The following section provides a description of the evolution of the poultry sector, the types of technologies used, and the important features which characterize each of the systems.

3. THE EVOLUTION OF THE POULTRY SECTOR

Transformation of the poultry sector began in the US in the 1940s with the emergence of confinement production systems and the development of new technologies and management practices. This transformation has led to dramatic increases in productivity and reductions in unit cost of production, and has benefited consumers by providing a reliable supply of low-cost of animal protein. There are three distinct phases through which the poultry sector has evolved: (1) traditional systems, (2) semi-commercial systems, and (3) commercial systems. Since the objective of this study is to determine how some developing countries have successfully transformed their poultry sectors from traditional systems to commercial ones, a description of the important features characterizing each of these systems will be instructive.

3.1 Traditional System

Traditional systems of poultry production are typically referred to as a “backyard business.” Traditional poultry producers raise small numbers of domestic fowl for home consumption with small, mostly seasonal surpluses being sold at village markets. The traditional system is a part-time endeavor for which women and children are often the chief decision makers with regard to feeding and care of the birds. Farmers invest minimal resources in poultry production: they raise their own stock, the birds are left to scavenge for food and are occasionally given table scraps, they do not provide any type of vitamins or veterinary services, and often with no housing provided. Finally, there is no differentiation in the traditional system between birds used for eggs and those raised for meat.

The mortality rate for poultry in traditional systems is high due to a high incidence of disease as a result of poor or no veterinary care and their increased vulnerability to predators due to a lack of housing. Productivity of these birds is generally far below that of commercial growers because the amount and quality of feed is not monitored, and the genetic characteristics of the birds make them less efficient at converting quality feed to meat and eggs.⁸

There are, however, various benefits to the traditional system. Traditional producers raise domestic fowl which are typically better suited to the climate and more resistant to disease than the imported, exotic breeds. Additionally, traditional poultry production can play an important role with respect to improved rural nutrition, income distribution, agricultural diversification, and as a source of liquidity (Wilson, 1986). Finally, due to the low level of exchange, specialization, and investment in the traditional system, producers’ risk and uncertainty are minimized. The

⁸ In the traditional system, the feed conversion ratio is estimated at about 4:1 (that is, four pounds of feed to produce one pound of broiler), while in commercial systems the ratio averages around 2:1. (However, “traditional” stock genetic characteristics may be more efficient at converting household waste and by-products and insects than “commercial” stock.) Also, layers grown in traditional systems produce around 60 eggs annually, while commercial layers can produce around 250 eggs per year (Billings, 1987).

traditional system is still the most common type of poultry production in the developing countries.⁹

3.2 Semi-Commercial

Between the two extremes of traditional and commercial poultry production are semi-commercial systems of medium-size family farms. In this system, farmers grow improved local breeds or cross-bred stock, although there still tends to be no differentiation between stock used as layers and stock used for meat. Semi-commercial farmers provide rudimentary housing structures, may purchase at least part of their feed, and use vaccines and veterinary services when available and accessible.

Semi-commercial growers sell most of their production to nearby urban centers, although no formalized system of marketing exists except, in a few cases, oral contracts. Where oral contracts do exist, they are typically made with hotels or restaurants and they have little or no effect on choice of technology, supply of inputs, or quality of the product. The purpose of these contracts is to give producers the right of first refusal with respect to a price offering and buyers the opportunity to make an offer to a known supplier (Billings, 1987)

In developing countries, semi-commercial poultry production has been mainly confined to the urban and peri-urban areas. Moreover, independent semi-commercial poultry farming often seems to represent a transitional stage, with many of these farmers eventually being “integrated” into large companies in order to ensure regular supplies of inputs and to secure a market for their products at a guaranteed price (Krostitz, 1984).

3.3 Commercial

Commercial systems of poultry production are the dominant production system in most industrialized countries as well as numerous developing countries. A commercial system is characterized by large-scale production using specialized and mechanized facilities which require low levels of labor.¹⁰ In this system, feed is the most important variable cost component,

⁹ Even in a developing country such as Thailand where commercial poultry systems are well-developed, over 70% of the population producing chickens raises fewer than 20 birds at a time (Poapongsakorn et al., 1986).

¹⁰ That which is considered large-scale production varies from country to country. Some countries classify large-scale production as holdings of as few as 1,000 birds at a time, while others classify large-scale holdings as 10,000 birds or more. Poapongsakorn et al. (1986) reports one grower raising 600,000 - 700,000 broilers at a time in Thailand. Labor requirements vary according to the type of technology used and the number of birds raised. While some countries report that it requires one man one day for six to eight weeks to raise 10,000 broilers, it is reported in the US that it takes only a half a day's labor for six weeks to raise 80,000 broilers (Vocke, 1991).

representing 70-75% of the production costs. For this reason, profitability in commercial systems relies heavily on the ability to secure stable supplies of low-cost feed.

Growers use genetically improved, specialized stock which are bred for their specific use as either layers for eggs or broilers for meat.¹¹ These strains respond efficiently under commercially intense feeding systems, with broilers reaching a market-ready weight of approximately 1.8 kg in as little as six weeks. High productivity depends on well balanced rations and requires close nutritional supervision, thus requiring careful management. Additionally, these birds are extremely susceptible to feed changes, and any disruption in a feed supply can have severe economic consequences for producers (Kane, 1987). Along with improved nutrition and genetics, important advances in disease prevention and technology and management have facilitated the growth of commercial systems.

3.4 Coordination Mechanisms, Institutions, and Technology Adoption

An important set of institutional innovations have led to better coordination in the subsector and have facilitated the technological advances in the transformation process from traditional to commercial systems. Institutional innovations which characterize the transformation to commercial poultry systems include a formalized system of contracts associated with vertical integration and larger sized units capturing economies of scale.

Vertical integration is a process in which different stages of the vertical production-processing-marketing chain are organized by the same firm (Minot, 1986). Vertical coordination is motivated by the need to reduce transaction costs and to ensure technological complementarity between the stages of production and marketing (Minot, 1986). The poultry subsector lends itself to vertical integration because of the precise supply timing requirements (e.g., in chick production and in processing), the amount of specialized inputs, and the perishability of the product. The vertically integrated company can plan an optimum scale of production at each stage so that economies of scale can be achieved, while at the same time achieving economies of information on quality and demand conditions which are articulated throughout the subsector. In general, the poultry subsector is not completely vertically integrated, however, because the scale requirements for efficiently sized processing and hatching plants do not tend to match that of the grow-out facility (Minot, 1986). Also, the strong incentives of owner-operated grow-out units contributes to a lower cost system than those relying on only hired management. Although the grow-out stage of poultry production is not carried out by the large firm, the quality, timing, and quantity of poultry supplied can be integrated into the operations of the firm through resource-providing contracts.

¹¹ Layers do not convert feed into meat as efficiently as broiler specialists. Since feed represents such a large portion of production costs in both commercial and semi-commercial systems, the use of dual purpose birds in semi-commercial systems which are raising birds exclusively for their meat represents an important inefficiency.

Contracts for poultry production were popularized in the US by feed mill operators who recognized the potential for economies of scale in the transportation of bulky feed. As the system of contracts evolved, feed mill operators became increasingly active in all the stages of production and processing, providing a tighter form of vertical coordination throughout the subsector.¹²

Although the types of contracts vary among and within countries with commercial systems, the most common form of contract is one in which the producers are provided with an agreed number of chicks and the required amount of feed, drugs and veterinary services as well as technical services at no cost. Under this type of contract, growers basically rent their growing facilities and contract their labor, and at the end of the grow-out period they are paid a fixed amount per pound per marketable broiler. In many cases, a premium is paid for above average weight broilers as a reward for more efficient use of feed and better management practices.

For growers, contracts reduce risk and uncertainty because the intermediary -- the integrator -- links the growers with the input suppliers and markets. With a secured market outlet as well as an assured source of inputs and technical advice, growers are provided with both an incentive and an improved capacity to invest in specialized equipment and to adopt new technologies for more efficient production of poultry products (Jaffee, 1990). For the integrators, a contract provides tighter control over all the vertical stages of production including the inputs used, quality of the final product, and the timeliness of delivery of predetermined quantities (Glover, 1987). This type of contract relationship provides strong incentives for both the integrator and the growers, and reduces opportunistic behavior which benefits one function at the expense of the other.

The amount of capital necessary to invest in this type of vertically integrated industry is very high. Also, efficiency gains due to economies of scale and the adoption of new technologies (especially improvements in feed conversion) create a highly competitive environment, at least initially, in which those firms operating below the average efficiency, which is constantly changing, will almost inevitably be eliminated (Freivalds, 1985). For these reasons, the industry tends to be highly concentrated, with generally between five and ten firms (i.e. integrators) controlling more than half of the market.

Table 1 summarizes the important features which characterize each of the systems in the evolution of the poultry sector. Table 1 reveals that the transition from traditional to commercial systems is increasingly dependent on the use of technology and inputs, institutional and policy innovation, and internalized coordination mechanisms. Given the nature of the product and the required timeliness in the delivery of input supplies and processing as the scale of production and investment increase, these innovations serve to decrease transaction costs, manage risk, and achieve economies of scale throughout the stages of the subsector.

¹² Tighter form of coordination refers to the control over the vertical stages of production and the linkages in the channels and transformation of poultry products. Control over the inputs and technologies used, the timeliness of input supplies and quantities produced, and the quality of the final product are some examples of how the firm can more “tightly” coordinate the activities in a subsector.

Table 1: Environment, Behavior, and Performance of the Chicken Meat Subsector

	<i>Traditional</i>	<i>Semi-Commercial</i>	<i>Commercial</i>
ENVIRONMENT			
Technologies	farmer breeding, scavenged feed, no special housing, small scale (\pm 1-20 birds)	imported chicks (dual purpose), local feedstuffs or imported feeds, rudimentary housing, few vaccinations, slaughter on the farm, medium scale production (\pm 50-500 birds)	proprietary technology, specialist birds, automated grow-out and slaughter facilities, compound feeds, private sector extension and health care services, large scale (\geq 10,000 birds)
Policies/Institutions	none or government-sponsored poultry distribution programs for rural households	limited public sector extension, import policies and taxes important	contracts, licensing, insurance, standards and quality controls, investment incentives, income tax incentives, exchange rate and import/export tax policy important
Markets	home consumption or spot markets, low real per capita consumer income	spot markets/ oral contracts, level of urbanization/ per capita consumer income important	vertically integrated, resource providing contracts, reaches rural and urban markets, real per capita consumer income important, export market expansion
BEHAVIOR			
Investment	little or none	low	high, joint ventures, high concentration ratio
Degree of Coordination	little or none	low, high risk at the grow-out stage	high, vertical integration, risk dispersion, strong incentives
Signaling	none	grower reputation	product differentiation, brand names, franchising, strong reputation effects in export markets
PERFORMANCE			
Broiler Productivity	low, high mortality rate	moderate, dual purpose birds less efficient in feed conversion, high mortality rate	high, efficient feed conversion, low mortality rate, mature quickly
Technology Adoption Rate	low	moderate, dependent upon import regulations and tax policies	high

The case studies examined in the next section describe in greater detail the issues and relationships highlighted in the table. These case studies reveal at least two of the dynamic aspects which help to describe the flow of the transformation process outlined in the table. First, in most cases, the evolution of the poultry sector is an iterative process in which the system is not transferred all at once, but rather it is the transfer a “technology path.” That is, changes are introduced in the subsector in close succession at different stages, but on a limited scale at any point in time, so that the whole subsector grows in a balanced way.¹³ The second important aspect in this dynamic process is that the impetus for transformation and increased integration may come from the public and/or the private sector, and their roles vary greatly from case to case. The government plays a significant role in each system and in the transformation process, however, the degree and type of government involvement in the sector as well as the incentives for greater private sector involvement are not easily generalizable within any system or transformation initiative. For this reason, it is difficult to extrapolate a general set of policy requirements or recommendations to accompany this table.

¹³ I am grateful to Duncan Boughton for his insights into this issue.

4. TECHNOLOGIES, POLICIES, AND INSTITUTIONS NEEDED FOR SUCCESSFUL TRANSFORMATION OF THE POULTRY SECTOR: FOUR CASE STUDIES FROM DEVELOPING COUNTRIES

Myriad attempts have been made by developing countries to transform their poultry sectors from traditional systems to commercial systems, or to improve productivity in existing systems. Despite Vocke's (1991) assumption of the ease of transferring confinement poultry production technology to anywhere in the world, the reality of transforming the subsector requires policies, incentives, and other coordinating mechanisms which facilitate the transfer of technology. Some firms and agencies in several developing countries have been highly successful in planning and developing a strategy for transferring this technology; their experiences provide important insights for Sub-Saharan Africa.¹⁴

4.1 Thailand

The growth of Thailand's broiler subsector has been nothing less than remarkable. In 1970, the pioneer of the Thai broiler industry, Charoen Pokphand (CP) group -- a leading feed company, began implementing plans to transform poultry meat production from an almost exclusively traditional production system to an intensive commercial system. In that year, less than 2% of the "commercial" growers raised over 5000 birds/year. By 1975, more than 96% of the commercial growers raised at least 5000 birds annually (Bishop, 1990). Today, Thailand has one of the most technically efficient, lowest cost systems in the world. Total production costs are estimated to be 26% lower than the US, and technical indicators such as feed conversion and mortality rate equal or exceed the performance of most national broiler subsectors (Jaffee, 1993). Due to this increased efficiency and subsequent low relative prices for chicken meat, per capita consumption of poultry increased from 2 lbs./ year in 1970 to approximately 22 lbs./ year in 1992 (Willis et al., p. 7). Additionally, Thailand has become the world's fourth largest poultry exporter and the largest exporter of value-added cuts (Jaffee, 1993, p. 89). The dramatic growth in Thailand's broiler sector can be attributed to a very clearly defined set of objectives, planned and implemented by the private sector with only minimal, albeit significant, support from the public sector.

Improved technologies were the leading force in the increase in production of low-cost poultry, helping to cut farm-level production costs drastically by improving the feed conversion ratio and

¹⁴ Traditional and semi-commercial systems lend themselves to the study of a poultry subsector which includes both meat and eggs because the same stock is used first for eggs, and then later for meat when layer productivity declines. Commercial systems are more specialized, and the examination of poultry meat and eggs actually become two subsectors: a broiler subsector and an egg subsector. Although the two subsectors are closely related, the remainder of this paper will focus primarily on the transformation of the broiler subsector.

reducing the grow-out time. Improvements of technology were planned and carried out at *every* stage in the subsector.

As described earlier, feed is the major variable cost component of poultry production. Decreasing the cost of feed grains was a leading objective for participants in the subsector. They placed emphasis was placed on improving productivity of feed grains through the development of new hybrid seeds. In order to achieve this objective, private feed companies in Thailand entered into joint ventures with companies such as DeKalb and Cargill.

An important institutional innovation at this stage was the use of contracts. Feed companies entered into contracts with maize producers, arranging to buy back the crops of farmers who used specified improved seed. These contracts provided an incentive for farmers to adopt the improved varieties. By 1992, average annual maize yields were only 400 kg/ rai for farmers using unimproved seed, compared to farmers using the new hybrid seed, who were achieving yields of 1.2 metric tons/ rai (1 acre = 2.5 rai) (Willis et al., 1992).

The breeding of improved stock was a four generation process. The CP Group initiated this breeding process in 1970 through an arrangement with Arbor Acres, a US based company. Initially, day-old broiler chicks were purchased from Arbor Acres and imported. Eventually, a joint venture was formed between the CP Group and Arbor Acres for the domestic development of parent stock, and then later grandparent stock, in Thailand. By the early 1980s, all aspects of the breeding process were taking place within the country (Poapongsakorn, 1982).

Feed companies initially constructed corporate farms to raise the imported chicks. The relatively small scale of production on the corporate farms was a constraint to achieving economies of scale in the production of feed and in processing. For this reason, the companies soon began poultry farming extension programs with the Thai farmers. Contracts to supply all the inputs (e.g., feed, chicks, medicines), provide technical assistance, and guarantee a price for the broilers at the end of the grow-out period, create an incentive for farmers to invest in the facilities for large-scale production. The feed companies (the integrators) also help the farmers to secure loans through commercial banks for the construction of grow-out facilities. They build housing units to company specifications which are typically large enough to raise a 10,000 bird flock. With the use of genetically improved stocks and modern facilities, a farmer can raise up to six flocks of 10,000 birds per year, earning more on each flock than s/he previously earned in an entire year (Willis et al., 1992). Leading contract farmers in Thailand have expanded their operations and are now raising 70,000 birds per flock.

Another innovation in broiler production created by the CP group was the agricultural village program.¹⁵ CP secured commercial loans for the construction of an agricultural village to be

¹⁵ This program played an important role in decreasing the barriers to entry in poultry farming because commercial loans under the original contract system were granted only to those farmers who owned their own land. The agricultural village program provided the opportunity for those landless farmers to become poultry growers and, eventually, to own their own land (Poapongsakorn, 1986).

inhabited by a group of families, each having a house, facilities for raising broilers, and 25 rai of land. The families are contract farmers with CP, and loans are repaid from their contract earnings. In seven to ten years, the farmers can pay back their loans and own their land and other property (Willis et al., 1992).

Integrators provide transportation of the broilers from the farm to the processing facilities. The gathering and transport takes place at night, when temperatures are cool, in order to decrease mortality and weight loss.

Integrators also carry out processing and distribution. Processing facilities are modern, efficient, highly mechanized, and built to meet the high standards for export. Processing takes place at night because dressed chicken for the domestic market must be delivered early in the morning. Since temperatures are still cool in the early morning, no cold storage is needed in the transport system, except for the shipment of frozen chicken for export. Fresh, frozen, and value-added products are sold domestically and internationally under brandnames. Some of the companies have also entered into retailing and/or have purchased franchises such as Kentucky Fried Chicken (KFC). The CP group not only owns a KFC franchise, but also supplies chicken to other KFCs throughout the region.

The export-oriented component of Thai broiler production has had a major impact on the entire industry by affecting the technologies adopted, the prices for birds and processed products, and the coordination of the subsector. Thailand has a competitive advantage in the export of value-added products, such as de-boned parts, due to its relatively low labor costs and its propinquity with Japan -- Thailand's primary export market. Thailand chicken faces a higher tariff in the Japanese market than US chicken, however, low labor and transportation costs have allowed Thailand to surpass the US in exports to the Japanese market. Since only a few parts of the chicken are exported, export-oriented firms have aggressively sought to further develop the local market for non-exported portions (Jaffee, 1993).

The fairly open market economy in Thailand has facilitated growth in the poultry sector. The government has offered investment incentives and research and quality control services, yet otherwise has intervened little in the emergent industry. The export tax on poultry products is small, increasing the country's comparative advantage in chicken meat in the international market. In addition, investment privileges, in the form of start-up capital, granted to modern slaughterhouses for exports have led to rapid expansion in the industry because large profits can be made in the export market. These incentives to export have permitted increased broiler production without lowering the prices received by the farmer (Poapongsakorn, 1982).

Perhaps the greatest institutional innovation has been the formalized system of contracts which provides incentives for producers and integrators, serves as a mechanism for risk management, and even helps secure credit for producers because commercial banks will generally accept a

contract as collateral (Glover, 1987).¹⁶ Contract farming has led to increased specialization and adoption of new technologies at all stages of the subsector. In the case of the agricultural villages constructed by the CP group, contracts served not only as a tool to manage risk and increase income at the farm level, but they also provided an opportunity for land ownership for farmers.

The tendency toward vertical integration has also been a key determinant in the transformation of the sector. Strong vertical coordination has permitted economies of scale to be realized throughout the subsector by providing stable and timely input supplies, ensuring a regular supply of chickens for the large processing facilities, and providing more control over the quality of production, thereby increasing demand (particularly in the export market). Vertical coordination has led to decreased production and marketing costs, ultimately benefiting all the participants in the subsector.

4.2 Brazil

Brazil is another developing country success story with respect to poultry sector transformation. Until the early 1960s, even urban households raised and processed their own chickens. Today, Brazil is the world's third largest poultry exporter after the US and France, producing more than three million tons of chicken in 1993 (Farina, 1994). Since the early 70s, the broiler sector has grown by approximately 12% per year, while average annual per capita consumption has increased from 2.4 kg in 1970 to 18.5 kg in 1993 (Farina, 1994). Although the transformation of the poultry sector in Brazil was very similar to that of Thailand, using many of the same technological advances and coordination mechanisms through private sector initiatives, the government has played a more active role in the evolution of poultry production and marketing in Brazil.

The 1970s were marked by strong growth in broiler production as a result of investments by companies that today are the leaders in the sector. These firms were originally pork processors that introduced poultry production as a diversification strategy. These processors are situated in the Southern region of the country because this is the traditional maize producing region. (In contrast to Thailand, no special incentives were needed to promote maize production.) Since the onset of the poultry industry initiative, soybean production in the area has expanded. Although poultry production was established in this area to decrease the cost of feed through proximity to domestic feed grain production, participants in the sector have had to pay higher prices for maize at times. This is due to the fact that maize has had to be imported occasionally, resulting in high transport costs from the port to the production area. Brazil is currently self-sufficient in feed grains, however.

¹⁶ None of the literature on contract farming in Thailand mentions the issue of enforceability. An important issue for further research could be whether there is an available and accessible legal forum for the resolution of contract disputes. If this forum exists, the study could offer some important lessons for operationalizing such a system in other developing countries.

Broilers are produced in intensive, commercial systems, and the production technology is similar to that of Thailand. Brazilian growers obtained extraordinary results in feed conversion, reaching a level of less than 2 kg of feed per 1 kg of bird, as the result of using genetically improved strains of broilers which were obtained in the international (primarily US) market (Farina, 1994). National poultry companies improved on this imported genetic base (e.g. by climatic adaptations), enabling further technical efficiencies of production to be captured. Other technical inputs (e.g., hatching equipment, vaccinations, medicines) were also originally imported. However, domestic companies quickly developed the technology to produce these inputs. As in Thailand, joint ventures in Brazil promoted the transfer of technology.

Only part of the operations at the processing stage are automated due to the low cost of labor relative to the cost of automatic equipment. Therefore, the potential scale economies of larger processing facilities have not been realized, making it possible for a number of smaller processors to remain in the industry (Farina, 1994).

All the stages of production and marketing are vertically integrated except for the grow-out stage which is coordinated through contracts similar to those described for Thailand. Vertical coordination is used to ensure quality standards and a timely flow of production throughout the subsector. These coordinating mechanisms offer a similar set of incentives to both integrators and producers as described in the case of Thailand, with the end result being lower production and marketing costs.

In Brazil, government policy played a much more active role in structuring the incentives for increased investment in the poultry sector than in Thailand. In the mid-1970s, the Brazilian government made large expenditures of public funds were made on new poultry hatching and processing facilities to encourage growth and private sector investment in the subsector. The program that disbursed these funds originally emphasized growth in the export market. Through 1988, exporters benefited from government subsidies equal on a gross basis to about 6% of the FOB price (Ahmed, 1990). Subsidies included low-interest loans (one third the level of the commercial rate), tax credits, and exchange rate adjustments (Krostitz, 1984). Producers and integrators also benefited from subsidies on maize that were provided by the government to compensate for the differential between the world price and the price of domestically produced maize.¹⁷ As of the end of 1988, these subsidies were no longer available.

In spite of the elimination of export incentives, the export market continues to be an important source of demand for the Brazilian poultry sector. Exports represent approximately 12% of production and serve as a revenue stabilizer for poultry products in times of recession -- a frequent occurrence in Brazil, a country with a highly unstable macroeconomic environment. Even with the elimination of export subsidies and strong competition from subsidized EEC

¹⁷ Although these subsidies created an incentive for increased poultry production, they served as a disincentive for improved productivity in maize production, which today performs well below international standards. Since these subsidies are no longer available, increased productivity in maize could drastically reduce the costs of poultry production in Brazil (Farina, 1994).

products, Brazil has remained competitive in the export markets due to a reduction in transportation costs by shipping their chickens in large quantities via reefer-ships rather than using containers. Brazil's major export market is the Middle East. Exporters tailor their production to meet the strict market specifications of those countries, giving them an additional competitive advantage in those markets.¹⁸

In short, the successful transfer of technology in the Brazilian poultry subsector was similar to that of Thailand. The private sector played a leading role in developing new technologies through joint ventures and maintained tight control over the vertical stages of production through integration and contracts. These coordinating mechanisms allowed integrators to achieve economies of scale, quality control, and timeliness of inputs in various stages of the subsector and provided incentives for production and the adoption of new technologies.

The experiences of Brazil and Thailand have, however, some important differences. While the objective of large-scale commercial poultry production in Thailand was conceived and implemented by the private sector, the government initiated this transformation in Brazil by providing the incentives for the initial private sector investment. Also, the Thai government had very little involvement in the sector beyond the provision of basic quality and sanitary standards, an open policy on the import of essential inputs, low export taxes, and a few investment incentives in processing for exports. In Brazil, however, large amounts of public funds were invested in the sector, subsidies on feed grains were provided, very low interest loans were made available to subsector participants, and exchange rate adjustments were made.

Whether the private sector in Brazil would have initiated the transformation without government incentives is impossible to determine. Given the level of investment required to achieve the scale economies of commercial systems and the level of macroeconomic instability in Brazil, integrators would have had to assume a great deal of risk to invest in the sector. It is also impossible to determine whether or not that risk would have been any greater than the risk assumed by the private sector in Thailand.

In considering the similarities and differences between the two cases, it is also interesting to note that, in the Thailand case, the integrators were the feed mill companies, while in the Brazilian case, pork processors began the integration process. The literature on poultry in these countries does not explicitly address the reasons why specific participants in these subsectors assumed the role of integrator nor it is apparent that integration from a particular stage in the subsector offers specific advantages over others. Future research on this topic would be useful.

4.3 India

¹⁸ Brazilian poultry has an added advantage in these markets because it uses so much labor at the processing stage, allowing processors to meet the strict specifications of Hallal kill (the Muslim method of slaughter which requires a specific manual labor process).

In 1971 India was producing 4 million broilers and 18 billion eggs annually; by 1991 India was producing 250 million broilers and 27 billion eggs. During this time, the poultry sector created employment for about 100,000 farm workers (Panda et al., 1993). While poultry production in India today is operating on a full-fledged commercial basis, the process of transforming poultry production was not due to a private sector initiative, but rather the result of a government program launched in the 1960s which put forth a clear set of objectives for attaining self-sufficiency in poultry products and then provided the investment and infrastructure necessary to reach those goals.

The technology or process used for transforming the industry has been largely initiated by the public sector, i.e., a government strategic plan. Maize imports are still required for poultry production, however, the All-India Coordinated Research Project has taken a leading role in identifying alternative, inexpensive protein and energy sources which can be found locally, such as cassava, cottonseed cakes, fish silage, and feather meal. These studies have helped develop economic and balanced poultry diets, contributing to improved productivity and growth in the sector (Panda et al., 1993). They have also helped the Bureau of Indian Standards to develop quality control specifications for feed.

With regard to breeding, the government decided that the easy availability of high performing commercial stocks has led to apathy in the private sector for systematic poultry breeding research, and, thus, has taken on the task of developing breeding stocks itself, with a goal of self-sufficiency by the year 2000. Demand for commercial stocks developed within the country is gradually increasing due to government research and in spite of stiff competition from private sector dealings with internationally reputed commercial stocks (Mohapatra, 1985).

Central and state governments have played an important role in improving infrastructural facilities and services for the supply of feed, provision of veterinary care including vaccination and medication of birds, provision of training to entrepreneurs, and technical know-how for poultry management. The government has set up corporations to provide all the facilities as well, making it possible to have standard equipment and feed manufactured in the country (Sathe, 1985). In other words, the government has assumed primary responsibility for developing the technology and making it available to participants in the subsector.

Government policy has also been extremely important in providing the incentives for intensive poultry production. Tax concessions on income derived from poultry production have been a driving force in increasing production at the farm level. Also, special credit lines for poultry development were established by the National Bank for Agriculture and Rural Development which cover breeding, grow-out, vaccine production, and marketing activities.

The government licensed imports of breeding stocks, equipment and feed ingredients in order to control foreign exchange. These licenses allow for importation of essential goods, yet at the same time encourage local production of inputs. Most of the equipment and vaccines are now locally produced, however, certain inputs still have to be imported. The government has created a list of materials permitted for import provided that, in exchange, the equivalent of foreign currency can be earned through export of certain products. For example, grandparent stocks may be imported

if the same amount of foreign currency can be earned by export of chicks or hatching eggs (Bessei, 1993).

An important institutional innovation is flock insurance. The government has made insurance available to protect poultry farmers against high losses due to epidemic diseases and other hazards. Since India has no formal system of contracts in Indian poultry production which would help to disperse risk, the provision of insurance provides an important incentive for producers to enter the poultry industry and invest in new technologies (Acharya, 1985).

The government initiated various other schemes to assist in socioeconomic development in rural areas by helping small-scale farmers, unemployed youth, and landless laborers to become poultry growers. One notable innovation is the cluster approach to poultry production. Some state governments have planned poultry estates on which land and poultry houses are provided by the government on a rental basis. Clusters of poultry producers make it possible to achieve economies of scale in transportation, provision of health cover, and the supply of feed. Additionally, the government assumes all of the marketing responsibilities for these poultry estates.

Although government policies designed to promote self-sufficiency and provide incentives for the poultry sector have been successful for the most part, there are at least two notable areas in which this has not been the case. As noted above, the government has taken the lead in establishing breeding programs to develop domestic parent and grandparent stocks. The government's initial goal, however, was to promote private sector breeding programs. A time schedule was used to set an expiration date for the importation of parent stocks, and then later grandparent stocks, which would allow the national poultry breeders time to develop competitive breeds. This objective was not achieved and the government decided to allow international breeding companies to enter into joint ventures with national companies. One prerequisite for the import of foreign breeds, however, is participation in a Random Sample Test (a test of performance characteristics such as feed conversion and mortality rates) conducted by the Ministry of Agriculture. The government still has a primary goal of achieving self-sufficiency in breeding stocks by the year 2000.

The second notable drawback to the government's approach is in the area of marketing. Although the government has taken responsibility for the marketing of poultry products from poultry estates, the remainder of poultry products marketed is in the hands of a few traders who have been able to use the market to their own advantage. Poultry products have been particularly susceptible to exploitation due to the perishable nature of the product, insufficient cold storage, and a lack of information on supply and demand in major consumption centers. Given these constraints (especially the lack of cold storage), poultry products from the poultry estates which are marketed by the government reach only a limited market area, thus decreasing the level of competition between the private traders and the government in many of the urban markets. Cooperative marketing attempts have been tried in some areas as well as coordination through quasi-government organizations, however they have not been able to influence existing marketing

systems or decrease the barriers to entry in the marketing of poultry products (Panda et al., 1993).¹⁹

Despite these drawbacks, the government-led Indian initiative has been successful in transforming the sector from traditional systems to intensive commercial ones. This success is due to a well-defined long-term poultry development plan with clear objectives for both the government and the private sector, as well as the government provision of a set of supporting policies, institutions, and technical services which created incentives for local production of inputs and poultry products.²⁰

4.4 Bangladesh

In contrast to the first three countries examined, where the objective was to develop commercial poultry sectors, Bangladesh has pursued a plan of development for the poultry subsector based on small-scale (traditional and semi-commercial) rural poultry production. The government chose this alternative approach because Bangladesh is not self-sufficient in feed grains and alternative sources of raw materials for a compound feed are scarce. The promotion of commercial poultry production would have depended on imported raw materials and would demand large amounts of foreign exchange.²¹ The government has attempted to improve existing small-holder production through the following measures: (1) providing vaccination against the country's most important disease (Newcastle disease) by government-trained village vaccinators; (2) improving protection of birds against predators; (3) introducing improved genetic stocks (dual purpose breeds); and (4) providing feed supplements to complement scavenging (Bessei, 1993). Poultry production in Bangladesh represents approximately 37% of the total meat production of the country and had a 24% annual growth rate of production during the 1980s (Panda, 1989).

In order to achieve the objective of increased rural poultry production, the government has taken on responsibility as sole provider of inputs and technology. The original strategy was to construct government poultry farms which produce day-old chicks of improved breeds. These chicks are then distributed to specialized growers to raise them for the first few weeks of life. Before these birds reach two months of age, they are distributed to rural households which keep flocks of about 10 improved hens for egg and chicken meat production.

¹⁹ The government has been trying to develop new processed poultry products which would have a longer shelf life while maintaining the low consumer prices for these products. See [Indian Farming](#) for a great recipe for pickled eggs.

²⁰ For the purposes of this paper, a success story is defined as a case in which firms or agents in a developing country have been able to transform the poultry sector to a commercial system. Although the case in India meets this criterion, further research into the social cost of a government-sponsored initiative for the transformation of the sector would be useful in determining whether the costs outweigh the benefits in this type of approach.

²¹ Apparently the government did not feel that increased production of feed grains was a viable alternative.

The government has initiated various other schemes including the construction of mini poultry farms which consist of 50-100 improved chickens and another scheme involving a total of 48,000 selected beneficiaries in 120 villages who are provided with all the necessary inputs, including marketing facilities (Panda, 1989).

The strategy chosen by Bangladesh relies heavily on the government for training of large numbers of village extension workers, distribution of vaccines at the village level, and overall coordination of input supplies and marketing facilities. Despite the encouraging initial results of the government program, it should be noted that these programs have been in place only a short time. The long-term sustainability of the institutional framework and training programs has yet to be confirmed.²² Potential constraints to long-term sustainability include the financial burden on the government in terms of input supplies and training, the degree of coordination and information necessary to successfully maintain this type of program, and the lack of a system of incentives within this framework for increased private sector involvement in the industry.

Although the Bangladesh strategy for increasing poultry production is not an example of a transformation to commercial systems, it is included in this study for two main reasons. First, this case study demonstrates that there are less intensive alternatives for quickly and substantially increasing the production of animal protein where the scarcity or cost of feed is prohibitive or where the high level of investment (and necessary foreign exchange) in commercial systems is beyond the means of public or private entrepreneurs. Second, the Bangladesh case demonstrates that, regardless of the scale of production, there is a need for a system in order to increase poultry production.²³ The Bangladesh government does not merely distribute birds to rural households which express an interest in raising poultry, but also provides the necessary inputs, technical services, vaccinations, and coordination and marketing services. In other words, the government plan is a strategy which involves the entire subsector, not simply the farm level production of poultry products.

²² There are no guidelines for discerning a dividing line between a short-term success and long-run sustainability. The government program was implemented in the early to mid-1980s, and it is largely responsible for the growth in rural poultry production. However, the poultry program in Bangladesh has been in existence only a short time relative to the other case studies presented in this paper. Perhaps it can be said that a decade of significant growth and successful implementation and expansion of the program are sufficient evidence of the sustainability of the strategy. There are those (including this author), however, who believe that it may still be too early to whole-heartedly endorse the Bangladesh strategy.

²³ In the mid-80s, when many African governments decided to change their emphasis from development of commercial systems to rural production, their strategies involved simply distributing birds to targeted households, without providing access to inputs, vaccinations, technical services, etc. See Safaloah (1992) for a description of the constraints and shortcomings of this type of approach undertaken in Malawi, for example.

4.5 Observations on Production and Exports

A closer examination of the production and exports of broilers in these case studies offers further insights into the sector. Table 2 reveals several important aspects of the growth of broiler production and export earnings in Thailand, Brazil, India, and Bangladesh.²⁴ This table demonstrates that all of the cases study countries have significantly increased their broiler stocks and production in the period between 1979-81 and 1991-93. The ratio of production to stocks is much higher in the cases of Brazil and Thailand than in India and Bangladesh. Two possible explanations for this are: (1) the stocks used in Brazil and Thailand have genetic characteristics which result in a higher dressing percentage (that is, more pounds of meat per bird) at maturity, and/or (2) a great deal of traditional production in India and Bangladesh still results in less poultry meat being exchanged in the market, while more birds are raised for home consumption.²⁵

An important distinction between Brazil and Thailand is demonstrated in this table in terms of export earnings per pound of broiler. As noted earlier in this paper, Thailand is the world's largest exporter of value-added poultry products, while Brazil exports mostly whole broilers. Brazil exports almost two and a half times as much poultry as Thailand, however Thailand earns almost five times as much per pound of broiler exported. The end result is that Thailand earned slightly less foreign exchange than Brazil for their broiler exports in 1991-93 although the total volume exported was only approximately 42% of Brazil's total exports.²⁶

²⁴ Since Bangladesh does not have a "broiler" sector, but rather a poultry sector with dual purpose birds, the data here refers to stocks of the dual purpose birds and the production of chicken meat from those birds.

²⁵ These possibilities are hypotheses put forward by the author, given the existing data and literature on productivity, breeding, and degree of exchange in different systems. These conclusions should be interpreted with caution. There are no comparisons made in the literature between production/stock ratios among these countries. Further research is warranted.

²⁶ The conclusions drawn in this paragraph are really comparing differentiated products and should, again, be interpreted with caution. The total volume exported by Brazil includes both meat and bones, while Thai exports are almost exclusively deboned meat. Therefore, these conclusions are not comparing the actual amount of broiler *meat* being exported, but rather the total volume of broiler products being exported. Relative factor prices (i.e. labor and capital) are determining factors in the amount of value-added to poultry products for export. Thailand's comparative advantage, due to the low cost of labor, offers an important lesson for developing countries and the potential for foreign exchange earnings in the sector.

Table 2: Broiler Stocks, Production, and Exports

	Thailand	Brazil	India	Bangladesh
Stocks (1,000,000)				
1979-81	60	426	160	59
1991-93	133	605	408	102
Production (1000MT)				
1979-81	373	1345	111	60
1991-93	741	2055	383	88
Exports (MT)				
1991-93	167672	322746	125	na
Exports as % of Production				
	23%	20%	<1%	na
Exports (\$1000)				
1991-93	402856	489355	108.5	na
Average Export \$US/lb.	.93	.19	.14	na

Source: FAO Production Yearbook, 1993 and FAO Trade Yearbook, 1993.

5. LESSONS LEARNED

As demonstrated by the case studies presented in the previous section, no single recipe is successful in the transformation of the poultry sector. Given differing resource constraints (e.g., feed, foreign exchange), each of these countries has developed a system for improving productivity in the poultry subsector based on a variety of initial conditions and objectives. Despite the differing levels of private and public sector involvement and the various combinations of transfer mechanisms used to reach their respective technology frontiers, some important lessons can be learned about the essential elements required to transform the poultry sector.

5.1 Defining the Objectives

The first important lesson from these cases is that a clearly defined objective was developed as the first step toward transformation of the poultry sector. Not only did the public and private entrepreneurs in these case studies define a vision for the poultry sector (e.g., increased availability of a low-cost animal protein, promotion of exports, rural development, etc.), but they devised a clear set of strategies for achieving those objectives.

More importantly, in all of these cases, development was not simply a transfer of a single technological innovation, but rather the transfer of a system. In no case was the development initiated and implemented under the discipline of atomistic competitive markets. For instance, a participant acting alone at any given stage of the subsector (e.g., individual growers) could not have achieved the same effectiveness of coordination across spot markets due to the nature of the product, the required timeliness of inputs, and the scale economies of the larger system. In order to achieve the coordination necessary for commercial poultry production, processing and marketing, a system which coordinates the entire vertical set of activities in the subsector is essential.

Finally, the cases of Brazil and Thailand are good examples of the sequential nature of the evolution of the poultry sector described in Section 3. In both cases, the transformation of the poultry sector was an iterative process in which the system was not transferred all at once, but followed a path of technological transformation. Changes were introduced in the subsector in close succession at different stages, but on a limited scale at any point in time, so that the whole subsector grew in an even, balanced manner. Inclusive and important in following this technology path was the significant build-up of human capital to sustain the system. This iterative process of transformation was important because it allowed these countries to capture economies of technology transfer by matching the types and scale of innovations with the given stage of economic development.

5.2 Technology

In regard to genetic resources, the initial commercial acquisition followed by domestic adaptation (either public sector, private sector or both) was a common approach. The international market

was an important source of technology in these case studies, and the formation of joint ventures between firms and agencies in developing countries and firms in industrialized countries (particularly the US) has been an effective transfer mechanism. Those countries experiencing the greatest success in achieving commercial poultry industries, however, have included in their original objectives a long-run strategy for domestic adaptation of the necessary technologies. Additionally, only one of the countries (Bangladesh) simply transferred technology from international sources without subsequently improving upon them to better suit their country's needs and environment. In the other countries, for instance, climatically adapted breeds were developed from imported stock. An important aspect of transferring technology in this way is that it requires investment in indigenous knowledge and incorporating that knowledge into the existing scientific knowledge base.

Improved productivity through technological innovation was a subsector phenomenon. In all of these cases, improvements on technology were made at *every stage* in the subsector. These improvements facilitated coordination through technological complementarity, making it possible to achieve economies of scale at each stage of physical transformation.

The quality, cost, and availability of feed are key factors in determining the success of a poultry sector transformation from traditional to commercial systems. Feed represents 70-75% of the variable costs of production, and its importance in the production of low-cost poultry products can be seen in each of the case studies. Whether a plan is devised for increasing domestic productivity of feed grains or whether an initiative is undertaken to find alternative feed sources, the lesson to be learned is that an economical and reliable source of feed must be identified or created.

Furthermore, not only does performance in the feed grain subsector affect the poultry subsector, but the reverse is also true. Development of a commercial poultry industry can serve as an important source of increased demand for feed grains. Moreover, the case of Thailand demonstrates that productivity in feed grains may be improved when participants in the poultry subsector recognize the potential to improve efficiency in the feed grain subsector as an essential element of improved performance in the poultry subsector. Conversely, the growth of productivity gains in feed grain production may not be affected, or may be negatively affected, by increased production in the poultry sector if subsidies undermine market signals in the purchase of feed grains, thereby decreasing the incentive for improved performance, as was the case with government subsidies of maize in Brazil.

Another lesson learned with respect to the adoption of new technologies is that progressiveness does not necessarily equal modernization (i.e. automation). This is especially true at the processing stage. Where labor is cheap relative to capital, labor intensive techniques will be more competitive. Countries with cheap labor can therefore have a comparative advantage in the export markets.

5.3 Institutions and Coordination Mechanisms

Tighter coordination than that provided by spot markets at all stages of the subsector was evident in all of these cases. Various coordination mechanisms were used to differing degrees in order to assure reliable input supplies, technical assistance, quality of production, and final markets. Contracts and vertical integration have been particularly effective in coordinating the poultry subsector, however, other coordinating mechanisms, such as the cluster approach used in India, have served this function as well.

Institutional innovations and the institutional environment played a pivotal role in transforming these countries' systems by providing incentives for participants throughout the subsector. Institutions and services which reduced the effects of price variability, dispersed risk, and lowered transaction costs, such as the provision of contracts, insurance, credit, etc., created an environment in which input suppliers, producers, and processors had an increased incentive to invest in the sector and to adopt new technologies.

At the grow-out stage, effective coordination mechanisms and institutions have played a particularly important role in improved nutrition and disease control. As described above, vertical coordination of the subsector has led to improvements in the quality, availability and cost of feed supplies, leading to improved nutrition at the grow-out stage. Additionally, losses due to disease have declined substantially (especially in Thailand and Brazil) with the improved technology available to producers, made possible through integrator coordination of the delivery mechanisms for veterinary care and input supplies. These cases also demonstrate that integrators have a strong incentive to provide this service. Investment decisions in these tightly coordinated subsectors are made based on a predictable set of expectations of future supply and demand. Provision of the necessary inputs for the well-being of the birds at the grow-out stage is one way for integrators to ensure that the supply of poultry products meets these expectations.²⁷

²⁷ A fundamental aspect of the types of contracts used in Brazil and Thailand may further explain the integrators' incentive to improve veterinary care, and, although the literature does not explicitly discuss this linkage, is worth noting. Contracts are commonly used by integrators (in these countries) which are devised such that the integrators actually maintain ownership of the birds throughout the grow-out stage. If there is an outbreak of disease in the flock, the grower will not receive payment for raising the birds to maturity, however, he/she has nothing invested in the input supplies (chicks and feed are provided by the integrators). The greatest burden from loss to disease would be borne by the integrators, thereby creating the incentive for them to invest in the well-being of the flock. Other types of contracts exist in these countries as well as other countries whereby growers buy the inputs from the integrators. At the end of the grow-out period, the producer sells the mature birds back to the integrator at a guaranteed price. By taking ownership of the birds, producers take on the risks associated with production during the grow-out period. Having drawn this distinction, it is still the case that the contracts have strong incentives for *both* parties to promote the health of the birds. Further examination of outbreaks of disease and their correlation with the types of contracts used would be instructive.

5.4 Marketing

Demand for poultry products is the determining factor which pulls the commodity through the channels of physical transformation. Higher productivity in commercial systems results in lower prices, thereby expanding the market and demand for poultry products. An important lesson learned from the cases of Brazil and Thailand is that the higher productivity from commercial systems may result in opportunities for expanding markets to include export markets. Additionally, in both of these cases, the marketing of poultry products abroad influenced the technologies used, the scale of production, and, ultimately, lowered prices in the domestic market. India also has plans in progress for exporting their poultry products.

The case of poultry in India demonstrates that without a reliable and stable market for poultry products, there will be fewer incentives for long-term investment in technology in the private sector. The government succeeded in creating incentives for domestic development of technologies, however, through policy innovations such as the licensing of inputs.²⁸

5.5 Policy

The degree and type of government involvement in the industry varied considerably according to the social and economic goals defined by the original objectives. In the cases of Thailand and Brazil, for instance, an important objective was to increase exports in order to boost foreign exchange earnings. These countries achieved this objective by removing the disincentives to export (e.g., export taxes) and offering incentives for exports such as tax credits.

The government offered investment incentives in all of the cases of transformation to commercial systems, although the level and types of incentives varied greatly. For example, in Brazil, the government offered numerous investment incentives to the private sector (e.g., very low interest loans, maize subsidies, and exchange rate adjustments); whereas in India, beyond the tax concessions offered, most of the investment incentives were implicit in the form of structural/policy incentives (e.g., licensing of imports). As noted earlier in this paper, a high level of investment is required for commercial poultry production and marketing. The risk associated with such an investment is great, especially with there is macroeconomic instability or a shortage of foreign exchange. There are no apparent guidelines in these case studies regarding the relative importance of government investment incentives and whether they are necessary for successful transformation of the poultry subsector; however, it can be noted that they did exist and the desired response from the private sector was observed.

A final lesson to be learned from these case studies is that all of the strategies, except for the Brazilian initiative, included some type of scheme which provided the opportunity for landless

²⁸ Although this policy innovation was successful at creating incentives for technology development, it is perhaps a second best solution in that it has done little to remedy the cause of the problem, namely poorly coordinated markets and information.

farmers to raise poultry. Although this may not have important implications for the technologies, policies, or institutions necessary to transform the poultry subsector, it may have important implications for income distribution and food security.²⁹

²⁹ The objective of this paper is not to examine the effects of commercial poultry production on income distribution, food security, or other social, economic, or policy objectives. The inclusion of landless farmers in the transformation process was noted here because, at least for this author, it was an unexpected positive externality which may offer some lessons for developing countries which have these objectives as a goal.

6. THE AFRICAN EXPERIENCE

In the 1970s, many African governments attempted to develop commercial poultry systems. By the mid- 1980s, the consensus among many of these governments was that the modern system of commercial poultry production was not a realizable goal, and that the focus should turn toward improving traditional, small-scale production (Wilson, 1986). Although small-scale and semi-commercial poultry production persist around the continent, the objectives of increased traditional poultry production (e.g., improved rural nutrition and income distribution) have not been sweeping successes either.³⁰ The reasons for the limited success in the poultry sector in Africa, under any production system, are not easily generalizable; nor is it true that poultry production and marketing have been a total failure throughout the continent.

The major difficulty in assessing the constraints and solutions to improved performance in the poultry subsector in Sub-Saharan Africa is the dearth of literature on the topic. The problems associated with this scarcity of literature are two-fold. First, the lack of documentation of studies undertaken at the planning stage of poultry sector transformation provides little evidence of the perceived constraints or proposed strategies undertaken by governments to transform the sector to commercial systems. Studies carried out by Udosen (1970) and Bollinger (1975) in Nigeria and the Ivory Coast, respectively, are notable exceptions. However, these studies focused mainly on farm-level production and consumption, with little examination of the constraints or proposed strategies for the system or the subsector as a whole. Second, the paucity of ex-poste literature on poultry sector initiatives in Sub-Saharan Africa provides researchers with few resources for analyzing the problems experienced with previous strategies and for assessing the prospects for future poultry sector strategies. For these reasons, it is difficult to systematically examine the countries on a case by case basis and apply the lessons learned in the previous sections of this paper to the poultry sector in Sub-Saharan Africa. The remainder of this section, therefore, will attempt to outline some of the potential problems cited in the existing literature and propose some hypotheses about the poultry sector in Sub-Saharan Africa that warrant thorough testing in future research. These hypotheses will then be used to test the case of the poultry sector in Nigeria, as it is the best documented case of poultry system transformation in Sub-Saharan Africa.

6.1 Potential Problems

One of the most frequently cited constraints to improved performance in the poultry sector found in the literature on Sub-Saharan Africa is the lack of stable, reliable sources of feed. Safaloah (1992) found that an inconsistent availability of raw materials, poor and uneven distribution of commercial feed, and high prices for feed were severe constraints to increased poultry production in Malawi. In Zaire, the raw materials are available to produce feed locally, however, seasonal

³⁰ For a description of the constraints to traditional poultry production in Sub-Saharan Africa, see Wilson (1986) and Sonaiya (1990).

fluctuations in supply and price were cited by growers as a primary concern (Ames, 1986). Dramatic fluctuations in the quality of feed available were found in Nigeria and Malawi (Ikpi, 1981 and Safaloah, 1992). Finally, Fusillier (1991) found that the low demand for poultry feed in the Ivory Coast has resulted in a high concentration ratio in the feed sector. In addition, feedmills in the Ivory Coast were using only one-third of their capacity in 1987, resulting in higher feed costs for growers (Fusillier, 1991). Regardless of the reasons for unreliable feed sources, Kane (1987) found that disruptions in feed supplies have had severe economic consequences for growers throughout Sub-Saharan Africa.

Other inputs in the production of poultry products have also been cited as major constraints to improved productivity and performance, including vaccinations and chick supplies. A lack of vaccinations and veterinary care have led to a great deal of morbidity and mortality in the region. In Mali, Kuit et al. (1986) found that growers did not know that vaccinations for poultry exist. In contrast, the Malian growers interviewed by Diarra (1992) were familiar with vaccinations and medicines, however, these inputs were not readily available or were generally very expensive. In some cases, veterinary care and medicines are supplied by the private sector, while in other cases these services remain the responsibility of the public sector. Although almost all of the literature addresses the need for improved veterinary care, none of the authors discusses the relative effectiveness of the public or private sector in providing this service.

Securing a timely and reliable supply of low cost, healthy day-old chicks is another potential problem. Nigeria was the only country reviewed in which domestic hatcheries had been established.³¹ The rest of the countries' growers rely on the supply of imported day-old chicks which are often unreliable (in terms of timeliness of delivery) and have a high mortality rate due to difficulties in transportation and climatic adaptability (Ames, 1986, Kuit et al., 1986, and Sonaiya, 1990). Although high losses and adaptability difficulties were not cited as major constraints in Senegal, Billings (1987) found that growers were importing day-old layer chicks for the sole purpose of chicken meat production (reason unknown). As a result, growers have to hold the slower-maturing birds up to six weeks longer than a broiler specialist and have a 3:1 rate of feed conversion, leading to higher costs for producers and higher prices for consumers.

A lack of technical training and extension services has limited growers' ability to manage large-scale, commercial systems. In most countries, training institutions do not offer training for large-scale production and the use of automated systems (Sonaiya, 1990). Additionally, most country studies refer to the lack of interest and motivation on the part of extension workers to become

³¹ A notable exception is the case of one poultry firm in Kenya, established by the British American Tobacco Company (BAT), which has developed a fully integrated broiler operation complete with its own breeding and hatching facilities. The BAT initiative deserves more consideration than what is given in this paper, however there is very little information on its development and its current status in the literature. The BAT invested in the poultry sector in Kenya in 1974 and relies mainly on broilers grown on a company farm, contracting a mere 20 growers to raise the remainder of their chickens. It is unclear why the company has not expanded its operation or if it intends to expand in the future. For more details see Kane (1987), p. 30.

involved in the commercial poultry sector.³² Poor management at the grow-out stage is often the result of scarce technical services, which subsequently leads to low levels of technical efficiency and increased mortality (Sonaiya, 1990). In a study of the poultry sector in Nigeria, the FAO (1980) found that 60-70% of early chick mortality was due to bad management. In Senegal, USAID sponsored a project in the 1970s to increase poultry production which included a considerable investment in an extension-training network. Once the project ended, however, the cost to the Senegalese government to continue operating the network was not sustainable (Billings, 1987).

Limited availability of credit to growers and feedmill operators is a key constraint to increased investment in the sector. In Mali, for example, growers have little access to credit and must rely on personal savings for investment in housing and equipment (Diarra, 1992). Malian growers' and feedmill operators' inability to purchase feed and feedgrains for storage during low price periods is also restricted by the limited access to credit. Krostitz (1984) notes that subsidies on inputs as well as subsidized credits are used by a number of countries. He further asserts that, although these subsidies are in principle neutral, the manner in which they have been distributed and the inadequate infrastructure in the more remote areas have excluded many rural producers from the benefits of such incentives, with landless owners, in particular, having great difficulties in obtaining credit (Krostitz, 1984).

Coordination and marketing are also potential problems for improved productivity in the sector. Most of the poultry products in Sub-Saharan Africa are marketed in spot markets. The risk assumed by growers who market their own products in the spot market is great due to the perishability of the product and the lack of cold storage (Wilson, 1986). Additionally, a lack of systematic planning and coordinated dissemination of information has led to simultaneous but localized gluts and scarcities of poultry products in countries such as Nigeria (Ikpi, 1981). In some countries, a system of oral contracts is used for marketing poultry products to hotels and restaurants in order to overcome some of these constraints. These oral contracts, however, have no effect on choice of technology, supply of inputs, or quality of the final product. Furthermore, Billings (1987) reports that, in Senegal, these contracts are likely to be broken if a better offer is found, even at the expense of a long-term relationship.

Cooperatives have been established in many countries as an alternative to oral contracts or spot markets. Cooperatives typically have facilities available for cold storage, however, a lack of control over the amount and timeliness of poultry products supplied, poorly coordinated information systems, and a lack of operating capital have been cited as major constraints to cooperative marketing in the region.³³

³² See, for example, Ikpi (1981), Sonaiya (1990), and Safaloah (1992).

³³ See, for example, Billings (1987), Ames (1986), and Jaffee (1992).

Marika Poultry Farm

An exception to the poultry marketing strategies typically found in the African countries is the approach taken by Marika poultry farm in Senegal. The operation provides weekly supplies of birds to individual households using written contracts. Marika employs salesmen who “function rather along the lines of an Amway agent,” going door-to-door selling purchasing agreements.

This marketing scheme has been so successful that the farm cannot supply all of the birds sold under contract. To meet the demand, Marika has arranged subcontracts with six other growers. The company helped these growers get into poultry production by providing credit to build housing facilities and purchase inputs as well as offering advice on technical and hygiene matters. At the end of the grow-out period, Marika buys the output from these growers at a guaranteed price. (See Billings, 1987, pp. 10-11)

The level of effective demand for poultry products is also a significant consideration for these countries. In many countries, it may be the case that, given the per capita real incomes, the national market demand is being met in quantity by traditional production systems (Kane, 1987). The case in Senegal reveals that growth in the sector is discouraged because the market is relatively stable with respect to demand, the consuming market is concentrated in the areas in and around Dakar, and consumers are indiscriminating as regards quality (Billings, 1987).

A final potential constraint to improved performance is the effect of government policies on the sector. Import and export policies have had a particularly significant effect on the poultry sector. In many countries, exportation of poultry products is banned, limiting the potential for expanding markets (Sonaiya, 1990). Furthermore, little or no protection against the dumping of subsidized poultry products from the EEC has resulted in substantially reduced investment and production in the sector in countries such as the Ivory Coast (Fusillier, 1991). High import taxes on essential inputs such as vaccines and medicines, equipment, and breeding stock have created a disincentive for investment in Zaire (Ames, 1986). Meanwhile, in Nigeria, overvalued exchange rates and liberal import policies on feed and feed grains have discouraged local maize production, and have ultimately led to unsustainable foreign exchange expenditures (Bessei, 1993).

Stocks, production, and amount of foreign exchange spent on imports of poultry meat for selected African countries are shown in Table 3. The table reveals that Nigeria is by far the largest producer of chicken meat among these countries, while Cameroon, Senegal, and especially Zaire are spending substantial amounts of foreign exchange on imported poultry meat. Two of these countries, Cameroon and Senegal, have undertaken strong poultry transformation initiatives in the recent past. This raises the question as to whether effective demand was actually the limiting factor in transforming the poultry sector in these countries.

Table 3: Poultry Stocks, Production, and Imports for Selected African Countries

	Stocks (1,000,000)		Production (1000MT)		Imports (MT)	Imports (\$1000)
	1979-81	1991-93	1979-81	1991-93	1991-93	1991-93
Cameroon	8	19	8	19	280	719
Ivory Coast	17	25	27	46	207	240
Kenya	17	25	32	48	na	na
Malawi	8	9	9	9	na	na
Mali	12	22	11	24	na	na
Nigeria	80	120	120	163	117	485
Senegal	8	29	12	44	833	1185
Zaire	14	34	13	30	19326	22333
Zimbabwe	8	12	8	17	7	10

Source: FAO Production Yearbook, 1993 and FAO Trade Yearbook, 1993

This section identifies some of the major constraints and potential problems to improved poultry production and marketing as described in the available literature on poultry systems in Sub-Saharan Africa. The scope of this section is limited not only by the number of studies, but also by the framework of analysis used in these studies. No *subsector* studies on poultry in Sub-Saharan Africa were found. This fact has led to great difficulties in piecing together a complete picture of the various systems and strategies attempted in these countries as well as the types of institutions and coordination mechanisms used to link the stages of the subsector. Given the evidence presented above, the following section proposes some hypotheses concerning the attempts to transform the poultry sector in Sub-Saharan Africa to commercial systems.

6.2 Hypotheses Regarding the Transformation of the Poultry Sector

The first hypothesis concerning transformation of the poultry sector in Sub-Saharan Africa is that firms and agencies did not devise a strategy for transferring the system of commercial poultry production and marketing. The evidence presented suggests that, while specific technological innovations were transferred, the system, which (among other things) requires more effective

coordination of the vertical set of activities in the subsector than what is achieved across spot markets, was not transferred.

The second hypothesis is that transformation of the technology system was undertaken as a single event rather than the transfer of a process of gradual technology adoption throughout the subsector. The focus of these initiatives seems to have been on large-scale transformation at the farm level rather than on a sequential approach to slowly transforming the stages of the subsector in parallel. The growth and scale of input supplies, technical services, and marketing facilities are noticeably different from the scale and technology used at the farm level.

Hypothesis number three is that only weak incentives for improved performance and productivity were provided in any of the stages of the subsector. There is no evidence of a system of (enforceable) contracts or other institutions (e.g., vertical integration, market information systems, insurance) providing the tools for risk management and creating a strong incentive structure for increased productivity and improved performance at all stages.

The fourth hypothesis is that a lack of coherent policies created a disincentive for investment in the sector. The evidence above regarding government tax policies, import/export regulations, a lack of standards and quality controls, and credit subsidies indicates that the policy environment has not provided the incentives for transformation, but instead has impeded development of commercial systems.

The final hypothesis is that effective demand in many of the Sub-Saharan countries is not large enough to take advantage of the economies of scale achieved in commercial systems. This hypothesis deserves careful consideration for testing in terms of future strategies for the poultry sector. In the introduction to almost every piece of literature reviewed for this study, some reference is made to increasing incomes and urbanization as an enabling force in the transformation to commercial systems. The evidence as to how much incomes must rise and what percentage of the population must live in urban areas in order to support the initial investment in commercial systems is inconclusive.

Table 4 shows the real per capita incomes, percent of urban population, and poultry meat consumption statistics for the success story countries described in Section 4 at the onset of their poultry sector transformation initiatives as compared with selected African countries in 1993 (the most recent data available). The table reveals that the initial conditions in terms of per capita real income and percent of urban population in the successful case studies vary greatly. While the data on Brazil would seem indicate that these African countries do not have a similar set of initial demand conditions conducive to the transformation to commercial systems, the data on Thailand seems to suggest that this may, in fact, not be the case. Real per capita incomes in Thailand at the

Table 4: Initial Demand Conditions for Successful Cases Compared with Selected African Countries

	Population (1000)	Real Per Capita Income	% Urban Population	Maize Production (1000MT)	Poultry Meat Consumption Per Capita (kg/year)
Thailand					
1970*	34152	540	15.1	1950	0.9
1993	56868	3986	25.4	2850	10
Brazil					
1970*	93204	1471	61.2	14216	2.4
1993	156649	4718	80.3	29967	18.5
India					
1970*	547367	247	21.3	7413	
1993	896567	1072	28.9	9700	0.2**
Bangladesh					
1980*	88221	142	13.7	1	
1993	122210	872	15.2	.3	1.3**
Cameroon					
1993	12547	1646	52.6	430	1.6
Ivory Coast					
1993	13397	1324	47.3	540	2.8
Kenya					
1993	26090	1058	29.1	1748	na
Malawi					
1993	8796	640	14.2	2034	1.3
Mali					
1993	10137	572	20.5	275	2.3
Nigeria					
1993	119328	1215	30.0	2300	2.8
Senegal					
1993	7948	1248	40.6	125	2.8
Zaire					
1993	38624	367	38.7	1201	1.1
Zimbabwe					
1993	10898	1484	32.1	2562	1.2

Sources: FAO Production Yearbook, 1993, FAO Balance Sheets, 1993, UNCTAD Handbook of International Trade and Development Statistics, World Bank Social Indicators of Development.

* Year on or just preceding the transformation initiative.

** 1984-86 average.

onset of the transformation initiative were lower than all of the real per capita incomes in Africa today excepting Zaire. Additionally, percent of population in urban areas in Thailand at that time was lower than any of those in the African countries selected, save Malawi. For these reasons, further research into the correlation between effective demand and commercial poultry systems is warranted.

Further research which tests the hypotheses proposed in this section is needed. Sufficient information on the transformation initiative undertaken in Nigeria begins to test some of these hypotheses. The remainder of this section reviews the strategy in Nigeria and draws some conclusions regarding the proposed hypotheses.

6.3 Poultry in Nigeria

In the 1950s the government of Nigeria began an advertising/information campaign to convince the general population that raising poultry was essential for both dietary and economic reasons. By the 1960s the government's encouragement began to take hold and poultry raising became a hobby if not a business. Profitability and quick returns on invested capital led to expansion and encouraged commercial banks to provide the necessary funds for further investment (Ikpi, 1981). In the 1970s, the government initiated commercial poultry development projects throughout Nigeria. Between 1972 - 76 and 1982 - 86 poultry meat production in the country doubled (Bessei, 1993).

The government played an active and facilitative role in coordinating the subsector and creating the incentives for increased investment. Specific policies in support of the sector included: (1) subsidized importation and supply of parent stocks and feed to both government and private farms; (2) a ban on poultry meat imports from 1971-73 and, later, customs duties on live and dead poultry imports; (3) availability of credit at preferential rates between 1978 and 1983; 4) an overvalued currency which made cheap imported maize even less expensive; and (5) establishment of federal and state facilities for breeding, hatching, and research (Bessei, 1993).

Despite active promotion and direct involvement in the sector, the government was unable to efficiently provide many of the services which it had undertaken as part of the development initiative. For instance, the government could not sustain breeding and hatching services, creating a gap between the demand and supply of day-old chicks. In a survey conducted by the FAO in late 1979, the outlook on state-owned hatcheries was bleak:

All states now have their own hatcheries but these seldom work at more than 25% capacity. Many incubators with an 8000 egg capacity were noted to operate with only 800-1000 eggs inside the unit. Other incubators were standing idle because they had no fertile eggs for hatching. Some incubators have remained crated for two years because no suitable building was available for housing in the unit (*sic*). Many smaller incubators have been abandoned and larger replacement units purchased because no technician was available to repair the breakdowns and in some cases replacement parts were not available. . . Informed sources estimated that only some 40-60% of eggs produced live chicks. . . The inability of the government hatcheries to operate at capacity is so serious that one government farm which had parent laying stock but no hatchery facilities was

actually selling fertile eggs as eating eggs to its staff and other local consumers. (FAO, 1980, p. 14)

During this same period, private hatcheries operated successfully for at least two reasons. First, the private hatcheries were well-managed. For instance, these hatcheries were well-staffed compared to the public hatcheries, which were so poorly staffed that frequently losses in production occurred simply because no one was on hand to start the auxiliary generators on the occasion of power outages. Second, private hatcheries were often able to extract rents from the sale of their chicks due to the instability of government chick supplies. Shortages in government supplies were not uncommon and producers were often willing to pay private hatcheries twice the government price for day-old chicks.³⁴ The government continued to operate their hatcheries, however, because they perceived the need to provide chicks at a lower cost (i.e. subsidized) to producers than what the private sector was capable of at that time (FAO, 1980). The lower priced government chicks, which were sold below cost, led to budget costs which were not sustainable.

Due to the variability of government supplies of day-old chicks, the aggregate supply of chicks varied greatly. For this reason, producers often turned to the international market to meet their demand. The government had no directives as to which sources of supply of imported chicks were acceptable for importation, a serious oversight on the part of the government. Major diseases such as Newcastle, Gumboro, and Marek's were introduced as a result of the importation of infected day-old chicks (Bessei, 1993).

Feed supply was also a constraint to improved performance in the subsector. Pfizer Feed Company began commercial feed production in Nigeria in 1968. State governments and private producers soon began to challenge Pfizer. The overall effect was an underutilization of the installed capacity of available feed mills, resulting in higher feed prices for producers. Other constraints in the feed industry included: (1) lack of information on composition and suitability of locally-available feedstuffs; (2) a shortage of micro-ingredients such as vitamin-mineral mixes and antibiotics; (3) quality of raw materials; and (4) lack of storage facilities (FAO, 1980). Additionally, Nigeria relied on imported maize which was used to mix feed locally. Import taxes on cereals and other essential feed components further penalized the sector. Finally, the poor quality of feed due to a lack of quality controls and standards for feed led to poor performance of birds at the grow-out stage.

At the farm level, the FAO (1980) reported that 60-70% of early chick mortality was due to bad management and environmental factors rather than to disease infections. Billings (1987) noted

³⁴ Commercial poultry production requires investment in highly specific assets, and a regular supply of chicks is necessary to use these assets and cover investment costs. Although producers were able to sustain their enterprise even though they incurred occasional losses due to higher input costs, many producers were eventually forced out of production due to prolonged periods of instability and increased prices of day-old chicks. At the same time, government hatcheries created a disincentive for private hatcheries to increase productivity due to the instability in the demand in the private sector for day-old chicks.

that hired overseers in Nigeria were frequently inattentive to their duties, often times leaving the birds without feed or water for extended periods of time. Additionally, training and technical services for improved management, nutrition, and health were not available.

Marketing services were provided by government agencies and cooperatives which had access, albeit limited, to cold storage. Poor marketing information and distribution facilities and infrastructure often times resulted in costly cross-hauling of poultry products and led to a great deal of spoilage (Ikpi, 1981).

Although the government's initiative created an incentive for producers to invest in the industry, the Nigerian strategy for transforming the sector was unsustainable. Even if the government had been able to improve the market information system and make more efficient use of government support centers for input supplies (or allow the private sector to provide these services without competition from the government), other factors contributed to the decline in the sector. First, the low prices for imported grain at the onset of the project discouraged local production of maize and other feedstuffs. Second, high local prices of poultry products limited the demand in the export markets (due in part to the overvalued exchange rate), and made foreign exchange (from oil exports) necessary to purchase inputs for the subsector. These two factors made the poultry sector highly dependent on the availability of foreign exchange and the prices of exports and imports. The downturn of oil prices, the structural reform programs which lowered the exchange rate, and the import prohibition on maize made feed supplies both expensive and unpredictable. The inability to replace imported feed supplies with products available locally led to a serious reduction in production (Bessei, 1993).

From this brief examination of the experience in Nigeria with poultry sector transformation, it appears that there is substantial evidence to prove hypotheses one through four. With regard to the first hypothesis, the Nigerian government's initiative did not seem to have a plan for transforming the system of poultry production and marketing. Lacking in the approach was an effective means for coordinating the entire subsector as a means for developing the system. For instance, growers acted as independent agents, securing their inputs and marketing their poultry meat in atomistic, competitive markets.

The Nigerian government largely based its strategy for transforming the poultry sector on introducing the technology for commercial scale production in a single event. The government introduced commercial-scale breeding and hatching equipment, grow-out facilities, and government-run feedmills all at once, without plans for gradually and sequentially building up the capacity and performance of the entire subsector. The consequences of this strategy are important because, from the evidence available, a significant shortage of human capital development in the transformation process lead to technical inefficiencies and poor performance at many stages in the subsector. These findings seem to prove the second hypothesis.

The third hypothesis also seems to hold in the Nigerian case. As long as the Nigerian government provided subsidies for inputs, credit, etc., the environment was conducive to investment in the sector, at least for growers. However, when the government was unable to sustain those subsidies or did not subsidize certain stages in the subsector, there was little investment in

commercial systems. Weak incentives for participants in the sector resulted in the lack of coordinating mechanisms such as contracts, with only weak institutions providing other tools for risk management.

The fourth hypothesis, a lack of coherence in policies creating an investment disincentive in the sector, is very apparent at the hatching stage. Additionally, policies imposing high import taxes on the import of essential inputs (e.g., maize) may have deterred investment in the sector, although there is not enough evidence from the literature to substantiate this assumption. Some evidence, however, shows that exchange rate policy adversely affected the local production of maize and the potential for expanding into export markets.

Not enough information is available to either prove or disprove the fifth hypothesis. The literature contains very little discussion on the Nigerian poultry sector concerning the consuming market or effective demand, and the subsequent effects on the sustainability of the scale of production. A careful examination of these factors in further research would be useful.

This section has provided an overview of the potential constraints to improved performance in the poultry sector in Sub-Saharan Africa. The greatest constraint, however, seems to be the lack of a systematic research effort to identify constraints at the national level and to reveal opportunities for future poultry sector strategies. Much work remains to be done both in the international community and in NARS if commercial poultry systems are to become a reality in Sub-Saharan Africa.

7. FUTURE STRATEGIES AND FURTHER RESEARCH

Every developing country considering investment in commercial poultry systems will face a unique set of incentives, resources, knowledge, and opportunities. Whether or not they are successful in transforming poultry production and marketing will depend critically on the objectives defined and the strategies devised for mobilizing resources. Important tasks for consideration in the planning of the poultry sector development include: (1) defining the role of the public and private sectors; (2) identifying the constraints to technology transfer; (3) providing the tools to effectively coordinate the stages of the subsector; and (4) establishing a set of incentives to encourage innovation and investment.

In the most basic sense, the role of the government is to facilitate the transfer of technology by providing a predictable set of rules and regulations and information within which the private sector can function. Beyond this very minimal role, a whole continuum of government policies and actions may help to further the development of more productive systems. The initial approach of the public sector is dependent upon the initial conditions and constraints in the subsector, and the public sector's capacity for overcoming those constraints relative to the private sector. The determining factor in the degree of success in the case studies, however, has proven to be the extent to which the public sector succeeds in defining a role for the private sector and then providing the incentives for increasingly greater private sector involvement in the sector.

Basic inputs, such as the availability of feed, equipment, human capital, and foreign exchange, may pose serious constraints to a cost effective transfer of technology. These constraints need to be identified at the onset of poultry sector development and a clear set of strategies for overcoming these constraints must be defined. The international community is an extremely important source of technology and know-how, but this technology must be combined with indigenous knowledge (i.e., human capital) in order to create an efficient, sustainable commercial system.

Tight coordination of the subsector is a necessary element of the production and marketing of poultry products on a commercial scale. The tools for planning and coordinating poultry at the subsector level will rely on innovation (e.g., vertical integration, cluster poultry estates) and an environment which makes the use of these coordinating mechanisms possible.

Incentives will determine the economic outcome of the transformation initiative. This study has brought to the fore a whole host of institutional innovations which have provided the incentives for investment, adoption and innovation of new technologies, and improved performance throughout the subsector. Innovations such as contracts, flock insurance, and agricultural villages have all led to an improved ability to manage risk, increased access to credit and investment opportunities, and improved productivity throughout the subsector. The lesson to be learned from these examples, as Shaffer and Wen (1994) so aptly put it, is to "get the institutions linking actions to consequences right" (Shaffer et al., 1994, p. 10).

While in theory these criterion for planning and development of a commercial poultry system seem quite simple, the reality of identifying and implementing them is another matter. How much

government involvement is enough (or too much)? What are the institutions which will create the necessary incentives and elicit the desired responses? These very big and important questions have no clear answers; yet the success of the project depends on finding answers and solutions to these questions and more. The hope is that this study will be useful in providing some guidance toward these ends.

The objective of this study has been to identify some of the elements necessary for successful transformation of traditional poultry sectors to highly productive ones. Many questions, however, remain unanswered. Further investigation is needed into the effects of commercial poultry systems on food security, income distribution, and other social and economic objectives. What are the trade-offs, if any, between equity and efficiency in commercial systems? Does commercial poultry production succeed in providing a low-cost source of animal protein for the population at large or does it merely transform a cheap source of grain into an expensive food source that only the urban wealthy can afford? What is the net effect on nutrition under different conditions?

Effective demand is the primary force for structural transformation in the sector. Further research is needed to determine the level of real income per capita and the degree of urbanization necessary to sustain the scale of commercial systems.

Additional research is also needed in the area of institutions and coordinating mechanisms and their effects on the overall performance of the subsector. Do the types of contracts used and the level of risk assumed by various participants in the subsector make a difference on overall performance? If vertical integration exists, does it matter who in the subsector serves the role as integrator?

Joint ventures have been the standard method for transferring technology to the developing countries. Are there other mechanisms available for transferring the technology which would offer some advantage over the joint venture approach? For instance, would franchising be an effective alternative to joint ventures?

Finally, the issue of the high level of investment required to develop the sector has been mentioned many times in this study. Is there a way of sharing this burden, say at a region level, which would make the possibility for transforming poultry systems more accessible financially? Mr. Dhanin, president of the CP group, has set up a regional network of capital and technology throughout Malaysia, Indonesia, Singapore, and China. The projects are at various stages in the transformation process. A regional pooling of resources and knowledge has put these countries on the fast track to commercial poultry production and marketing. Is there a potential for this type of cooperation at the regional level in Africa, and, if so, would this be largely a public or private sector initiative?

Commercial poultry production offers a unique set of opportunities and possibilities for Sub-Saharan Africa. Knowing that commercial systems have been successfully transferred to developing countries is half the battle. Learning from these experiences along with a strong dose of innovation in the implementation and development of the sector is the other half.

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