



Alternative institutional arrangements for contract farming in poultry production in Bangladesh and their impacts on equity



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Table of Contents

List of Tables	v	
List of Figures	vii	
Abbreviations	viii	
Acknowledgements	ix	
1	Background and objectives	1
	1.1 Introduction	1
	1.2 Poultry farming systems in Bangladesh	2
	1.3 The emergence of contract farming and its pros and cons	3
	1.4 Objectives of the study	6
2	Sources of data and study methodology	9
	2.1 Identification of contract farming arrangements and market actors	9
	2.2 Selection of study areas and sampling of contract farming enterprises	10
3	Types of contract farming and other institutional arrangements in poultry production and marketing	14
	3.1 Formal production-marketing contracts	14
	3.2 Formal input marketing contracts	25
	3.3 Informal output marketing contracts	26
4	Structure and conduct of poultry input and output markets	28
	4.1 Structure and conduct of hatcheries and feed mills	29
	4.2 Trading practices and performance of feed traders	34
	4.3 Trading practices and performance of veterinary drug traders	37
	4.4 Trading practices and performance of poultry equipment traders	39
	4.5 Trading practices and performance of broiler and egg traders	40
5	Determinants of participation in commercial and contract poultry farming	48
	5.1 Choice of models to explain market participation	48
	5.2 Factors hypothesized to have influence on participation	50
	5.3 Factors influencing participation in commercial poultry farming	56
	5.4 Factors influencing participation in contract poultry farming	58
6	Technical and economic performance of sampled poultry farms	62
	6.1 Characteristics of meat and egg production in sampled farms	62
	6.2 Input and output marketing and prices	64

6.3	Disposal and use of poultry excreta	67
6.4	Costs and returns of broiler farms	68
6.5	Costs and returns of layer farms	72
6.6	Costs and returns of breeder stock farms	74
6.7	Overall income difference between farm types	74
6.8	Reasons for discontinuing the poultry business	76
7	Conclusion and policy implications	79
7.1	Forms of contract poultry farming	79
7.2	Structure and performance of input and output markets	79
7.3	Factors influencing participation in commercial poultry farming	80
7.4	Performance of contract and independent poultry farms	81
7.5	Policy implications	82
	References	85

List of Tables

Table 1. Meat and egg consumption in Bangladesh in selected years	1
Table 2. Incentives for contract farming	5
Table 3. Sample of input and output traders	11
Table 4. Distribution of sampled poultry farmers by farm type and district	12
Table 5. Summary of main features of contract arrangements of selected integrators in the poultry sector of Bangladesh	15
Table 6. Sharing of responsibility in broiler production between the contract farmer and ABFL	20
Table 7. Sharing of responsibility of the contract farms and contractor (ABFL) in breeder stock farming	22
Table 8. Distribution of hatcheries and feed mills by district	30
Table 9. Number and percentage of poultry farmers using different strains of broiler birds by farm type and district	32
Table 10. Number and percentage of farmers using different strains of layer birds by farm type in Gazipur district	32
Table 11. Wholesalers' and retailers' marketing costs and margins of feed trade	36
Table 12. Average buying and selling prices (BDT/t) of wholesalers and retailers of selected brands of feeds	37
Table 13. Marketing margins of equipment wholesalers by type of equipment (BDT per unit of equipment)	39
Table 14. Daily costs and margins of broiler <i>aratdars</i> and wholesalers in Mawna and Dhaka markets	44
Table 15. <i>Aratdar's</i> daily marketing costs and margins per 1000 eggs in Mawna and Tejgaon markets	45
Table 16. General characteristics of sample households by farm type and district	54
Table 17. Average annual gross income of farmers and percentage share of income sources by farm type and district	55
Table 18. Proportion of farmers who took loans from different sources and average amount borrowed (BDT) by farm type and district	56
Table 19. Estimated coefficients and related statistics of probit regression on participation of farms in commercial poultry production by district	57
Table 20. Estimated coefficients and related statistics of probit regression on participation of farms in contract poultry farming by district	58
Table 21. Estimated coefficients and related statistics of probit regression on participation of farms in contract broiler and breeder stock production in Kishoreganj	59

Table 22. Estimated coefficients of multinomial logit model fitted to the sampled non-poultry, independent and contract poultry farms	60
Table 23. Estimated coefficients of multinomial logit model fitted to sampled independent, informal and formal contract poultry farmers	61
Table 24. Average meat production (live weight) characteristics of broiler farms by farm type and district	63
Table 25. Average egg production characteristics of layer farms in Gazipur by farm type	63
Table 26. Average characteristics of contract breeder stock farms in Kishoreganj	64
Table 27. Factors influencing number of fertile eggs produced per bird in breeder stock farms in Kishoreganj	64
Table 28. Quantity of industrial feed used per production cycle and prices paid by broiler farms in 2005	65
Table 29. Sales outlet for broiler and eggs by farm type and district	66
Table 30. Highest and lowest prices received per unit output by farmers in 2005	67
Table 31. Percentage of farmers reporting method and location of storage of poultry excreta	68
Table 32. Percentage of farmers reporting pattern of use of poultry excreta	69
Table 33. Cost structure of contract and independent broiler farms by district	70
Table 34. Estimated coefficients of cost function for broiler farms	71
Table 35. Costs and returns per 100 birds in broiler farms	72
Table 36. Cost structure of contract and independent layer farms in Gazipur	73
Table 37. Estimated coefficients of cost function for layer farms in Gazipur	73
Table 38. Costs and returns per 100 eggs in contract and independent layer farms in Gazipur	74
Table 39. Costs and returns per cycle of contract breeder farms in Kishoreganj	75
Table 40. Estimated coefficients of cost function for breeder stock farms	76
Table 41. Factors influencing per capita income of the sample farms	76
Table 42. Percentage of broiler and layer farms operating before dropping out	77
Table 43. Proportion of farmers citing reasons for dropping out of poultry farming	77

List of Figures

Figure 1. Structure of the broiler component of ABFL	19
Figure 2. Marketing chains used for distribution of poultry feeds	31
Figure 3. Main marketing channels for broiler producers in Gazipur and Kishoreganj districts	41
Figure 4. Sale prices of broilers (BDT/kg) at different points in the market chains in Gazipur and Kishoreganj	46
Figure 5. Sale prices of eggs (BDT/100 eggs) at different points in the market chains in Gazipur	47

Abbreviations

ABFL	Aftab Bahumukhi Farms Limited
BBS	Bangladesh Bureau of Statistics
BCR	benefit cost ratio
BDT	Bangladesh Taka
BPC	Biman Poultry Complex
BRAC	Bangladesh Rural Advancement Committee
DLS	Department of Livestock Services
ECNEC	Executive Committee of the National Economic Council
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
NGO	non-governmental organization
OLS	Ordinary Least Squares

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1 Background and objectives

1.1 Introduction

Poultry meat and egg production account for more than 30% of all animal protein worldwide and the share is increasing. By 2015, poultry will account for 40% of all animal protein (IFPRI 2000). In Bangladesh, total meat consumption increased by 54% from 305,400 t in 1990 to 469,100 t in 2005. Per capita consumption of meat increased from 7.4 grams per day in 1990 to 8.2 grams per day in 1995 then marginally to 8.4 grams by 2005 (Table 1). The share of chicken meat in total meat consumption increased from 21.5% in 1990 to 24.2% in 2005 while the share of duck meat decreased from 4.5 to 2.9% in the same period. Egg consumption increased by 132% from 67,300 tonnes to 156 thousand tonnes in the same period, and per capita consumption of eggs increased by 75% from 1.6 to 2.8 grams per day. Thus, although total consumption increased substantially, per capita consumption of meat and eggs increased only marginally and these rates are very low by international standards.

Table 1. *Meat and egg consumption in Bangladesh in selected years*

	1990	1995	2000	2005
Meat				
Total meat ($\times 10^3$ t)	305.4	373.8	423.5	469.1
Per capita/day (grams)	7.4	8.2	8.4	8.4
Percent share of chicken meat	21.5	24.5	23.1	24.2
Percent share of duck meat	4.5	3.7	3.2	2.9
Eggs				
Total ($\times 10^3$ t)	67.3	97.4	133.1	156
Per capita/day (grams)	1.6	2.1	2.6	2.8

Source: <http://faostat.fao.org/site/573/Desktop Default.aspx>.

In the past, inland open water fish was the major source of protein in the country but open water fishery has declined drastically. Efforts to meet protein deficiency by increasing ruminant livestock production are constrained by grazing land and the high cost of imported feeds (Ahmed et al. 1990; Haque 1992). Increased poultry production may be a good option to meet protein supply requirements since poultry can be produced within a short time as compared to other ruminant animals. Agricultural occupations presently absorb about 57% of the labour force (Bangladesh Bureau of Statistics [BBS] 2002) and opportunities to expand employment in this sector are rather limited.

The livestock subsector contributes 4% to the Gross Domestic Product (GDP) and 17% to agricultural GDP. The subsector also provides full-time employment to 20% of the labour

force and part-time employment to another 50% (Executive Committee of National Economic Council [ECNEC] 1999). Commercial small-scale poultry production and related backward and forward linkage activities in marketing, input supply etc. have the potential to generate employment and alleviate poverty by creating more jobs per unit of added value compared to other livestock and agricultural activities. The challenges have been, and still are, to increase market participation of small poultry producers, increase productivity of poultry products and provide access to markets for inputs, services and outputs at remunerative costs and prices.

1.2 Poultry farming systems in Bangladesh

The present farming systems of poultry in Bangladesh can be broadly divided into two categories: traditional rural backyard or scavenging/semi-scavenging system and commercial farming system. Traditional poultry production is an essential part of rural farm household activities; a few birds are reared with little or no feed supplement to produce eggs and meat for home consumption and any surplus is sold. Commercial poultry farms are defined as those that raise birds in confined conditions based on high yielding breeds, commercial feeds and management practices (Ali 1993). However, the Department of Livestock Services (DLS) and a non-governmental organization (NGO), Bangladesh Rural Advancement Committee (BRAC), have promoted a small-scale semi-scavenging commercial poultry model using local or crossbreeds and partial supplementation with concentrate feeds (Saleque 2000; Islam and Jabbar 2005). In this study, the focus is on the first type of commercial poultry though some references to the second will be made where appropriate.

In response to rapidly increasing demand for animal products and expanding market opportunity in the early 1990s, a commercial broiler and layer sector has emerged in Bangladesh. The sector is characterized by intensive production techniques (exotic and crossbred birds, concentrate feeds and drugs) and technical and policy support (subsidized credit, local production and import of day-old chicks, drugs etc). The traditional poultry sector, where poor smallholder producers dominate, still remains the major supplier of poultry meat and eggs in the rural areas. However, the rural poor have been unable to capture any significant share of the rapidly expanding urban market (Islam and Jabbar 2005).

The total poultry population in the country increased from 91 million in 1990 to 123 million in 1995 and 153 million in 1997; this increase was almost entirely in the commercial poultry sector. In 1998, poultry population dropped sharply to 138 million due to a severe flood then stabilized at 140 million in 2006 (<http://faostat.fao.org/site/573/DesktopDefault.aspx>).

Most commercial poultry farms in Bangladesh are small-scale (less than 5000 birds per batch). In 1995, large- and small-scale commercial poultry farms respectively accounted

for 12 and 2% of total poultry meat production in the country with the scavenging system accounting for the rest (Alam 1995). The newly established commercial poultry farms were fairly small in the early 1990s. Most farms still rear between 1000 and 2500 birds but the average size of farm has been increasing slowly over time. A recent study showed economies of scale in poultry farming, part of which arose from hidden subsidies such as cheap credit and inputs which generally are not accessible to smallholder poor farmers. Rapid industrialization of poultry production could wrongly harm the mechanism of income generation for the poor in the country (Jabbar et al. 2005b).

There are presently two types of commercial poultry farms in the country: independent farms (the majority) and a few contract farms. Contract farming was first introduced in 1994 by Aftab Bahumukhi Farms Limited (ABFL), a private sector company.

1.3 The emergence of contract farming and its pros and cons

In recent decades, demand for livestock products in developing countries like Bangladesh has been increasing rapidly, propelled by income, population and urban growth. Large-scale urban and peri-urban production principally met the demand. Although the growth in demand for livestock products should, in principle, bring opportunities for many livestock-dependent poor who have traditionally dominated developing country markets, such producers have generally faced hard competition in these rapidly expanding markets. Small-scale or poor producers captured only a tiny share of the expanding markets due to their inability to produce high quality products at competitive costs, and lack of access to information, skills, technologies and other infrastructure to reach urban markets, all of which increase transaction costs. Further, in the absence of adequate preservation and marketing infrastructure in most rural areas, individual market-entry investments to fulfil production and sanitary standards are prohibitively high in light of the quantities of marketable products produced. Lack of access to market information further reduces the negotiating position of small production units (Delgado et al. 1999). Government policies often support and subsidize industrial livestock production thereby promoting economies of scale. However, equity, environment and health consequences are most often overlooked. Discussions among stakeholders worldwide on the impacts of market reform and globalization on the poor and the environment have brought these issues into focus. It is generally agreed that policies and organizational arrangements are required for smallholders to effectively participate in the market and to minimize the negative environmental impacts of livestock (de Hann et al. 1997).

To overcome these constraints, organizational arrangements that allow small production units to benefit from various forms of collective action—such as producer groups, input and output

marketing cooperatives and product collection schemes—have been supported in a number of countries by government organizations and NGOs with varying degrees of success.

Contract farming is one such institutional organization that is considered to be useful in facilitating market access of smallholders in high-value supply chains that require specialized inputs to produce and sell to markets for specialized outputs. Strengthening the supply chain through contracting as an instrument has long been used in various economic activities with varying degrees of success and impacts (Glover 1987; Farrelly 1996; Runsten and Key 1996; Eaton and Shephard 2001; Binh et al. 2005).

Contract farming is emerging as a market institution for high-value agriculture in developing countries and in the production and marketing of livestock commodities. A recently concluded project on livestock industrialization, trade and social-health-environment impacts in developing countries, conducted jointly by the Food and Agriculture Organization of the United Nations (FAO) and IFPRI with national collaborators in India, the Philippines, Thailand and Brazil, provided a controlled baseline study of the cost structures and relative competitiveness of independent and dairy cooperative smallholder and medium-scale dairy and poultry operations, compared to some farmers undertaking contract farming (Delgado et al. 2004).

Contract production is the production of goods and services for future delivery. Before completing production, a producer commits to deliver a particular buyer. Typically, farmers have one contract that includes terms of production (e.g. specifying production methods, input and services provision or scale of production) and marketing (e.g. fixing the quantity and selling price of transaction or mode of payment) (Economic Research Service 1997). A marketing contract refers to a verbal or written agreement between a farmer and a buyer (food processing or marketing company) which sets the price and provides an outlet for a specified quantity of a commodity before the farmer sells the commodity. Most management decisions remain with the farmer, who retains product ownership during the production process. The person contracted assumes all production risks but shares the price risk with the contractor.

Conversely, production contracts involve paying the farmer to provide management, labour and facilities while assigning ownership of the product to the contractor. The contract specifies in detail the production inputs supplied by the contracted farmer and the contractor, who may be a processor, feed mill or another farm operator or business. The contract also specifies the quality and quantity of the commodity to be produced and delivered. Because the contractor often controls the amount produced and the production practices, the contractor often dominates the terms of the contract. Advantages of production contracts for farmers include the sharing of production and marketing risks with the contractor and the availability of financing either directly from the contractor or indirectly through other lenders who are more assured of loan repayment under this arrangement.

Vertical integration occurs when a single firm can perform all or most aspects of production and marketing. When a single firm can produce complementary products and services, it can do so more profitably than a number of firms. When carried out as part of a set of interlinked activities, a complementary activity can reduce cost (Berlin 2001). A vertically integrated poultry firm enters a contract arrangement with producers to produce poultry meat and/or eggs. It may own a feed mill to manufacture poultry feed, a hatchery for hatching eggs or producing day-old chicks, a processing plant to process products or retail outlets to sell the products. Thus, integrated large firms control all levels of the value chain from feed milling to sale of output at the retail level. Such farm activities may also be defined in terms of the principal-agent theory where the principal (firm) anticipates how the agent (farmer) will respond to each strategy it proposes. The firm maximizes profit subject to two constraints: growers will accept the contract and abide by its terms (it must give them greater profits than they can derive from the next best alternative). Potential benefits of contract farming to producers and integrators are outlined in Table 2.

Table 2. *Incentives for contract farming*

Risks/hazards in livestock	Benefits of contract farming	
	Integrator, buyer or trader	Contract grower
No capital	Access to investment opportunities in livestock; facilities construction	Access to capital
Loss of capital	Incentive to contract grower to renew capital	Protect against systematic loss
Loss of animal	Protection against careless labour	Protection against diseases
Quality of animal	Assurance of product	Access to better stock
Reliability of output price	Reliability of supply	Reliability of outlet
Quality and price of inputs	Quality gain for integrators	Quality assurance, availability, credit
Timing/availability of outputs		Timing and availability of management
Timing of output sales		Timely outlet
Labour supervision	Absence of issue	Absence of daily supervision
Land tenure	Access to land	
Environmental regulation	Avoid legal responsibility for pollution	
Knowledge deficiency		Access to extension
Free-rider risk	Better health control	Better health control

Source: Delgado et al. (2003).

Contract farming is one type of institutional arrangement that promotes linkage of smallholders to the market when transaction costs of direct engagement with the market are high for producers and/or traders. In addition to enhancing incomes of smallholder producers, contract farming may also be beneficial for overall employment and infrastructure

or market development for the larger community. Particularly when multinational agribusiness firms are involved, contract farming may also potentially increase access to lucrative export markets (Eaton and Shephard 2001; Jabbar et al. 2005a). Given current concerns about diseases like avian influenza, quality assurance is becoming an even more challenging task and involvement of smallholders in any supply chain is likely to make management of those chains even more difficult and costly. Under such conditions, contract farming may provide one avenue to keep smallholders engaged.

Contract poultry farming can generate income for resource-poor smallholder producers. Through contractual arrangements, the agro-industry can assist farmers in developing countries to shift from traditional subsistence agriculture to commercial agriculture. This not only has the potential to increase incomes of contracting farmers but also to multiply the effects in the broader economy. Production and price risks are important features of poultry farming. Risk sharing is one of the widely cited reasons for contracting. Numerous studies of contract farming emphasize risk reduction as a principal incentive for producers to enter into contracts (Covey and Stennis 1985).

Conversely, contract farming may disrupt existing farming systems and introduce inflexible production arrangements with producers, potentially jeopardizing food security and incomes of resource-poor producers. Moreover, where contracted product requires substantial investment in equipment or infrastructure, the debt burden of contract farmers may increase along with dependency on large integrators or agribusiness companies which may show characteristics of monopoly firms (Shivramkrishna and Jyotishi 2007). Depending on whether participation in contract farming is restricted to men and/or large-scale farmers, and the rights and treatment of locally-hired labour by such farmers, contract farming arrangements may negatively affect overall equity and gender relationships (Glover 1987). In particular, women and child workers may be disadvantaged due to unfavourable contract terms (Singh 2003).

1.4 Objectives of the study

Contract farming has been emerging as a market institution in Bangladesh, initially under government-led cereal seed production then in horticultural production, and more recently as a private-sector initiative in poultry production. Alongside promoting private-sector roles in the expanding livestock industry, the Government of Bangladesh is also trying to create opportunities for the poor to participate in these markets. A number of studies have analysed the technical and economic performance of commercial poultry farms in Bangladesh, including contract farms in some cases, and found them generally profitable although there was room for better technical performance through improved productivity and reduced mortality. These studies also identified supply-side problems that adversely affected

productivity, such as inadequate supply of day-old chicks and irregular supply of electricity (Kamruzzaman et al. 1999; Sarker et al. 1999; Bairagi 2004; Tohura 2004; Begum 2006).

However, there is inadequate information about the nature and function of the emerging contract farming arrangements, their advantages and disadvantages, and especially the prospects of small-scale producers' participation. The government's Department of Extension recently implemented an agribusiness development project, funded by the Asian Development Bank, to provide investment and technical services on-demand to a variety of agribusiness stakeholders. The project aims to improve value-chain linkages and management between stakeholders; to improve post-harvest technology and processing; to develop a contract-based marketing system; to improve quality control and assurance mechanisms; to improve market management operations and to develop corporate business services for agribusiness stakeholders.

Implementation of this project, especially with respect to contract farming, required information on the form of contracts that the project should promote through its advisory and credit services to enable small and poor entrepreneurs to engage in income-earning activities. Information was also needed on factors that might prevent the realization of the contracts and lessons that could be learned for wider application of contract farming or other institutional forms of business organization that might help the poor.

However, not much was known about how contract farming worked for different commodities under different socio-economic, technological and policy regimes and its impacts on Bangladeshi smallholders. As a result, the project was implemented on the basis of experiences from elsewhere and, in some cases, guesses. This study provided empirical evidence, based on detailed field studies, on some of the issues mentioned above with respect to the poultry sector so that future contract farming efforts may benefit.

The goal of the study was to identify forms of market institutions that would allow smallholder poultry producers to commercially produce broilers and eggs to raise household incomes under rapidly differentiating livestock markets in Bangladesh.

The specific objectives were to:

1. Document the range and extent of contract farming and other organizational arrangements used in smallholder poultry production in Bangladesh.
2. Analyse the structure and conduct of the hatchery, feeds and equipment industries serving the poultry sector and compare the geographical distribution of and access to these inputs along with health, extension and credit services of poultry farming under independent and contract farming arrangements.

3. Identify factors that influence participation or non-participation in contract farming.
4. Compare net incomes and production and marketing costs under independent and contract farming arrangements.
5. Analyse determinants of cost per unit output and net income under independent and contract farming arrangements.
6. Identify policy implications of the findings to promote and facilitate profitable poultry farming.

The following hypotheses were tested:

1. In a given area or environment where there is a choice between independent and contract poultry farming, the decision to participate in commercial poultry production and the choice between independent and contract farming will depend on differences in ownership of production assets (physical, human, financial or social).
2. Contract farmers have better access to information, technology, inputs (day-old chicks, concentrate feeds and equipment) and services (health, extension, credit and market information) compared to independent farmers due to specific contract terms and agreements between parties and market conditions for inputs, services and products.
3. Contract and independent farmers incur significantly different production and marketing costs and earn different marketing margins.
4. Contract poultry farmers earn more income per unit of family resources compared to independent poultry or non-poultry farmers.
5. Cost per unit output and net incomes differ significantly due to differences in physical, human, financial and social assets, and business practices in buying inputs and services and selling products.

The report is organized as follows. Data sources and methods are discussed in Section 2. Section 3 discusses a typology of existing contract farmers while Section 4 analyses the structure and performance of the poultry input and output markets. Section 5 analyses the factors influencing participation of farm households in commercial poultry and contract farming. Section 6 examines the technical and economic performance of different types of poultry farms and the reasons why farmers drop out of poultry business. Conclusions and policy implications are in Section 7.

2 Sources of data and study methodology

2.1 Identification of contract farming arrangements and market actors

Commercial poultry production is a relatively recent business enterprise in Bangladesh and contract poultry farming is even more recent. A stakeholder consultation was held in February 2006 to collect initial information on the types of contract farming arrangements in the country and to identify the market actors involved in the commercial poultry industry. Representatives of various segments of the poultry industry, livestock experts and policymakers were present. Key informants provided information on enterprises that have been involved in contract farming arrangements and on the types of actors involved in the industry. Based on key informant interviews at the stakeholder consultation, three groups of producers involved in the commercial poultry industry were identified:

- Independent farmers rearing layer or broilers. Independent farmers run their businesses without any contractual agreement with a third party and bear all production expenses and risks.
- Contract farmers rearing layers, broilers or breeders. Contract farmers have contractual agreements with integrators, feed mills or traders to supply or purchase inputs and/or supply or sell outputs at pre-determined prices or prices negotiated at the time of final transaction.
- Non-poultry farmers who are not engaged in commercial poultry farming though they may raise a few scavenging poultry for home consumption or sale if there is a surplus.

Independent commercial poultry producers are found throughout the country although more independent poultry farmers occur in districts around Dhaka and some districts linked to large cities like Chittagong and Khulna.¹ ABFL practises formal contract arrangements for broiler and breeder stock production in Kishoreganj district only. Several other enterprises are involved in formal input or output contract arrangements. Their areas of operation overlap to some extent but others operate in exclusive areas.

The following categories of actors are involved in the poultry input supply and output marketing chains:

- Day-old chicks: hatcheries, agents and retailers
- Feed: feed millers, wholesalers, agents, and retailers
- Equipment: wholesalers and retailers
- Drugs: distributors and retailers
- Broilers and eggs: *aratdars*, wholesalers, retailers

1. Bangladesh is administratively divided into 6 divisions, 64 districts and 508 *thanas* or sub-districts. A *thana* typically covers an area of 275 km² and has over 25 thousand people.

Aratdars are large traders and one of the basic institutions in the traditional market system. They buy and store products for varying periods of time. Broilers and eggs are stored for relatively short periods of time because live birds cannot be stored for more than a day without incurring extra feed costs and risking loss of weight, and eggs cannot be stored for long without the risk of spoilage. *Aratdars* may also engage in forward purchase arrangements either directly with producers or through traders without getting involved in the provision of inputs and services.

Wholesalers are large traders but smaller than *aratdars* and deal with one or more inputs (feeds, drugs or equipment) and/or products (broilers or table eggs). They are licensed full-time traders with fixed business premises in the wholesale market and they handle bulk transactions. They purchase products from producers and small traders and sell to the retailers. Unlike *aratdars*, wholesalers operate in both Dhaka market and production areas.

Output retailers are the smallest traders and have permanent stalls in sections of the markets for broilers and table eggs. Input retailers sell one or more inputs and operate in local markets or convenient places close to producers. They mostly buy products from wholesalers for sale to consumers. In each category of contract arrangements, there are various other elements which will be discussed later.

2.2 Selection of study areas and sampling of contract farming enterprises

In order to develop a typology of poultry contract arrangements being practised in the country, the following enterprises involved in contract farming arrangements identified at the stakeholder workshop were sampled:

- ABFL
- Biman Poultry Complex (BPC)
- BRAC
- Kazi Farms Limited
- Paragon Poultry Limited
- Nourish Feed Limited
- Selected egg wholesalers and *aratdars* in Dhaka

Locations were selected where independent and contract arrangements were present simultaneously in order to compare farm practices and performance under the two types of poultry production. In order to understand the function and performance of the input and output marketing arrangements, market agents were selected from the same areas where farm samples were drawn because market agents mainly serve producers.

However, it was clear that all types of farms were not present in all locations. Initially, commercial poultry production occurred mainly in peri-urban areas but over time it has spread away from the main urban centres. For this reason, Gazipur and Kishoreganj districts were purposively selected as study areas where commercial poultry production and contract poultry farming are practised. Gazipur is a peri-urban district close to Dhaka city with a high concentration of various industries and poultry farms. The government has already declared Gazipur a poultry region. Both independent broiler and layer farming are widely practised in Gazipur although some contract arrangements in layer farming are also prevalent. Kishoreganj district is located further away from Dhaka than Gazipur and has an integrator who practices broiler and breeder stock contract farming. Independent broiler farms are also present in the district.

To analyse input and output marketing arrangements, five hatcheries, five feed mills and 84 traders dealing in feeds, drugs and equipment (inputs) and broiler and eggs (outputs) were surveyed. Table 3 summarizes the distribution of trader samples. These were principally selected from Gazipur, Dhaka, Mymensingh and Kishoreganj districts because market actors there mostly served producers in Gazipur and Kishoreganj. Case studies were conducted where many actors in a category were unavailable.

Table 3. *Sample of input and output traders*

Type of input or output	Wholesalers	<i>Aratdars</i>	Retailers	Total
Feed	10	0	10	20
Drugs	5	0	5	10
Equipment	5	0	5	10
Broilers	5	10	8	23
Eggs	5	9	7	21
Total	30	19	35	84

A total of 183 contract farms, 120 independent farms and 60 non-poultry farms were sampled (Table 4). The broiler contract farms operated by ABFL in Kishoreganj were mostly located in Bajitpur *thana* and surrounding areas. Thus, all types of farms were selected from Bajitpur to neutralize the location effect. In order to spread the sample fairly over the entire study location, poultry farms of all types were listed and then 60 contract broiler farms, 40 independent broiler farms, 40 contract breeder farms and 40 non-poultry farms were randomly selected from the master list.

In Gazipur district, a list of poultry farms was prepared based on unpublished information available from the DLS and the poultry farmers' association. Different types of farms were then sampled randomly. Vertically integrated contract farming was not practised in Gazipur but one type of contractual agreement between BRAC and farmers was observed which was

considered a type of formal contract farming. In the case of layer farms, initial stakeholder analysis revealed that *aratdars* practised one type of informal contractual arrangement with producers. Some producers were also contracted by feed millers but such farms could not be identified *a priori* for purposes of sampling although some were represented in the random samples.

Table 4. *Distribution of sampled poultry farmers by farm type and district*

Farm type	Contract farmers		Independent farmers		Non-poultry farmers	
	Kishoreganj	Gazipur	Kishoreganj	Gazipur	Kishoreganj	Gazipur
Broiler	60	42	40	42	40	20
Layer	–	43	–	38	–	–
Breeder	40	–	–	–	–	–
Total	100	85	40	80	40	20

Size of poultry enterprise was not considered as a sampling criterion because current information was not available on size distribution of poultry farms for the study districts or for the country as whole. A study conducted in 2000 in these two districts categorized poultry farms into small (less than 1000 birds), medium (between 1001 and 2000 birds) and large (over 2000 birds) (Jabbar et al. 2005b). However, size distribution of poultry farms might have changed since then as indicated by the trend towards scaling up. The study also found that farms often change from broiler to layer and vice versa. It was therefore decided that farm size would be defined *ex post* according to installed capacity or actual number of birds raised, as appropriate.

While conducting a survey among commercial poultry producers, Jabbar et al. (2005b) observed two fairly common features in the poultry industry: a change from broiler to layer farming or vice versa by some farms and dropping out of poultry business altogether. A similar pattern was observed during the participatory rural appraisal and detailed survey for the present study. A change from one type of poultry farming to another indicates that producers respond to anticipated market opportunities and are able to adapt their fixed infrastructure easily or quickly to effect such changes. On the other hand, many reasons may contribute to business failure and lead to dropping out of this business altogether. In order to understand the causes of business failure and dropping out of poultry farming, a survey was conducted among 140 poultry farms in five districts (Gazipur, Kishoreganj, Jamalpur, Bogra and Rangpur) where commercial poultry farming is concentrated. Since there was no list of farmers which dropped out of business, purposive sampling was done to select farms for interview. The *thanas* within each selected districts were visited and those who dropped out were identified by talking to feed and output traders, DLS staff and other key informants.

To develop a typology of contract arrangements prevailing in the country, identified enterprises involved in contract arrangements were surveyed by a case study approach whereby a checklist or interview guide was used for informal discussions. Data on market actors and farms were collected by structured questionnaires. Graduate students with knowledge on field-level data collection were recruited and trained to conduct the surveys. Each survey questionnaire was developed, improved and pre-tested between February and March 2006. Final surveys were conducted between April and July 2006 and case studies of some trader categories continued until August 2006. On average, 5.2 batches of broiler birds were raised on broiler farms each year. Detailed data were collected for one production cycle on a recall basis. The data were then annualized based on the assumption that a farm's activities, input use and performance per batch remained about the same. Detailed data from layer farms were collected for one production cycle of 17 months on a recall basis, and the costs and returns were calculated per unit output for the entire cycle. The sampled farmers, like most newly emerging commercial farmers in Bangladesh, were not yet accustomed to keeping systematic accounts of their business operations. However, some of them (especially contract farmers) had kept some records of their transactions so the recall data were reported partly from memory and partly from partial records.

The survey among drop-out farms was conducted from July to September 2007 using a structured questionnaire but allowing open-ended questions. The interviewees were asked a direct question about the reasons for dropping out of the business. The survey also included additional information to understand the nature of the business and its management, e.g. flock size, duration of business, sources of supply of inputs and veterinary services, training in poultry farming, quality of the poultry houses, feeding and management practices, types and skills of labour employed etc. The information was important to help identify possible links between the stated reasons for dropping out and the technical and financial management of the business.

Statistical Package for the Social Sciences software was used for data entry and analysis. During data collection and management, the team members supervised the enumerators' work. Descriptive statistics were used to analyse characteristics of various samples. In the absence of adequate sample sizes for econometric analysis, descriptive statistics complemented with case study approaches were used to analyse input and output markets. Probit and logit models explained participation in commercial poultry and contract farming. Farm budgets and cost functions assessed performance of poultry farms. Specific concepts, statistics and functional forms used to analyse specific issues are discussed in more detail later.

3 Types of contract farming and other institutional arrangements in poultry production and marketing

Commercial poultry production is rapidly increasing and rudimentary forms of contract farming are emerging. However, it is unclear whether the necessary support systems such as infrastructure, information and legal frameworks are available to smallholders and poor producers to enable them participate in such contract arrangements in a remunerative way. Contract farming and other institutional arrangements in poultry production were classified according to (i) scope, products or services covered, (ii) formation, enforcement and monitoring of the contract agreement, (iii) sharing of benefits, risks, responsibilities and liabilities and (iv) scope of sustainable participation of smallholders. Based on these elements, three types of contract arrangements were identified:

1. Formal production-marketing contracts: Actors supply inputs and services, sell outputs, and share risks and benefits. The agreement is documented and signed by the parties.
2. Formal input marketing contracts: Actors supply one or more inputs and services to producers, either directly or through market agents. The agreement is documented and signed by the parties.
3. Informal output marketing contracts: Actors buy outputs from existing producers. The agreement is verbal or in a form that may not be considered acceptable in a formal court in case of a dispute.

3.1 Formal production-marketing contracts

Only three enterprises operate this type of contract: ABFL in Kishoreganj, BPC near Dhaka and BRAC. Table 5 summarizes the main features of the contractual arrangements of these enterprises.

3.1.1 Broiler farming by ABFL

ABFL is a subsidiary of the Islam Group of Companies, Dhaka. It is a multi-enterprise company with the largest private-sector commercial operations in the agricultural sector. In 1991, ABFL established a broiler farm in Bhagalpur, Kishoreganj district, about 110 km northeast of Dhaka. The company started contract farming as an experimental program with a group of 20 farmers. Later in 1994, ABFL adopted a vertically integrated poultry contract growing program and provided technical and professional support to rural poultry farmers to encourage them to take up poultry farming as an income-generating activity.

Table 5. Summary of main features of contract arrangements of selected integrators in the poultry sector of Bangladesh

	ABFL	BPC	Kazi Farms Ltd.	BRAC
Type of organization	Private limited company	Corporation	Private limited company	Non-governmental organization
Product/input/services	Commercial broiler: Live and dressed Breeder stock	Day-old chicks, dressed broilers	Day-old chicks	Day-old chicks, broilers, layers, feed
Form of contract arrangement	Formal input–output	Formal input–output	Formal input supply	Formal input–output
Backward linkage activities for contracted products, inputs or services				
Package of technology, inputs or services	Medical treatment and consultation Stable price of product Day-old chicks Feed or cash loan for operational expenses	Chick treatment and technical support	Marketing service	Medical treatment and consultation Stable price of product Day-old chicks, feed and medicine
Clients/suppliers	Experienced poultry farmers	Experienced poultry farmers	Agents or distributors	Poultry farmers
Criteria for selecting clients/suppliers	Education, road communication, sincerity, enthusiasm	Farm location, experience of client, shed condition	Financial solvency, goodwill	n/a
Size of clientele groups	Commercial broilers: 350 farmers, 1500 to 2500; average 1800 Parent stock: 122 farmers	25 contract farmers; batch size 1000 to 5000 birds; average 2500	550 to 600 agents or distributors	215 contract farmers; batch size 500–2000 birds; average 800.
Geographical locations covered	Six upazilas of Kishoreganj district: Kulairchar, Bajitpur, Pakundia, Hosainpur, Kishoreganj and Sadar	Savar, Manikgonj, Tongi and Tangail (about 60 km from the poultry complex)	All upazilas	All over Bangladesh
Volume of input, product or service delivered	Commercial broilers: 100 t of feed per month Parent stock: 1000 t of feed per month	5000 to 8000 day-old chicks per week	1,500,000 day-old chicks per week	100,000 day-old chicks per month 2500 t of feed per month

	ABFL	BPC	Kazi Farms Ltd.	BRAC
Value of input/service delivered	Commercial broiler feed: BDT* 50 million Parent stock: BDT 17.5 million	BDT 100,000 to 160,000 per week	BDT 30 million per week	Day-old chicks: BDT 30 million Feed: BDT 320 million
Forward linkage activities for contracted products, inputs or services				
Clients, intermediaries and users of products/services	Own sales centre for dressed broiler, dealer for feed and chicken	Biman Catering Centre, British, Thai, Qatar, Emirates Airways	Agent/distributor	Agent/distributor
Criteria for selecting clients	Financial solvency, level of literacy	N/A	Financial solvency	n/a
Size of the clientele group(s)	Sales centres: Five in Dhaka; 300 countrywide for feed and day-old chicks	More than 15 airlines	550 to 600	n/a
Location of supply outlet:	Dressed broilers: Dhaka, Chitagong, Sylhet Day-old chicks and feed: Whole of Bangladesh	Zia International Airport	Whole Bangladesh	Whole Bangladesh
Volume of products and services supplied by locations and clientele groups	Seven tonnes of dressed broilers per day	6 to 10 t of dressed broilers per week 10,000 chicks per week	1,500,000 chicks per week	n/a
Value of Product/service supplied by locations and clientele groups	n/a	n/a	BDT 30,000,000	n/a
Approximate market share of the organization	10% of day-old chicks	1% of day-old chicks	10% of day-old chicks	15% chicks
Major market competitors	Kazi Farms Ltd, Paragon for day-old chicks; National Nourish Quality Fresh for feed	Kazi, ABFL and Paragon	ABFL, Paragon and CP	Kazi, ABFL and Paragon
Provision for enforcement of contract	Mostly informal and social	Persuasion	Ensuring sound supply	Contract deeds
Monitoring mechanism	Daily or weekly supervision by 120 personnel	Field visit by staff	n/a	Bottom-up and top-down monitoring by staff

	ABFL	BPC	Kazi Farms Ltd.	BRAC
System of ensuring product quality	Inspection, supervision, lab. test	Visual inspection	n/a	Technical supervision
System of settling disputes	Social or legal	According to agreement	n/a	Team for settling dispute
System of sharing benefits	Benefits: Farmer BDT 5/kg, Company BDT 3/kg Risk: 100% farmer with insurance	Benefits: Farmer BDT 14/kg Risk: 100% farmer	n/a	
Are policies, institutions and support services conducive to operation of the contractual/ collaborative activities?	No	No comment	No comment	Yes

* BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

Source: Interviews with the respective firms

ABFL included small, medium and large farms in its poultry programs. In this regard, ABFL differs from vertically integrated farms in developed countries where big trading companies usually prefer to enter into contracts solely with large-scale farms and farmers in order to minimize transaction costs. One of ABFL's objectives was to increase incomes and improve the welfare of farmers in the surrounding area. This motivation may partly lie in the fact that the owner of the Islam Group of Companies comes from the locality, so contributing to the improved welfare of his local people through his business ventures may serve as a dual business-welfare objective.

Over time, ABFL has developed into a vertically integrated firm and established its own feed mill and hatchery. It consists of a modern hatchery that produces 60 thousand broilers and layer parent birds, and supplies 100 thousand day-old chicks per week for the fast growing poultry industry. The firm has also established retail sales centres in Dhaka to supply eggs and poultry meat to consumers. ABFL's poultry complex is one of the largest in the country. Its initial poultry feed mill was established primarily to provide balanced feed for its contract poultry farms. The feed mill was later expanded to meet the demand for poultry feed throughout the country. ABFL currently has three feed mills with a capacity of 10 thousand tonnes of feed per month. The company distributes balanced feed to farms throughout the country using its own distribution channels.

Figure 1 shows the vertical stages of the ABFL broiler contract farming system. Other components of ABFL's poultry operations are not shown, e.g. day-old chicks from hatchery and feeds from feed mills which are also sold in the open market in addition to being supplied to the contract farms.

The agreement between ABFL and a contract farmer is very simple. Any farmer located in the company's operating area is eligible to enter into a contractual agreement. From 1994 to 2003, ABFL provided day-old chicks, feeds and veterinary supplies on credit and ensured purchase of the output. The entire credit liability of the contract farmer was adjusted against the value of the delivered products. After the avian influenza scare in 2003 following incidences in Southeast Asia, ABFL changed the arrangement from input supply on credit to cash. Although there was no avian influenza in the country in 2003, there was suspicion among producers and consumers which affected the industry. Prices of broilers and day-old chicks decreased drastically within a few days. Many farmers went out of business as they incurred unsustainable losses. ABFL reportedly incurred losses worth nearly Bangladesh Taka (BDT)¹ 150 million due to the incident. Consequently, the number of the ABFL contract farms fell from 650 to 200 in 2004 but increased to 315 the following year.

1. Bangladesh Taka (BDT). USD 1 = BDT 65.31 at 1 June 2006.

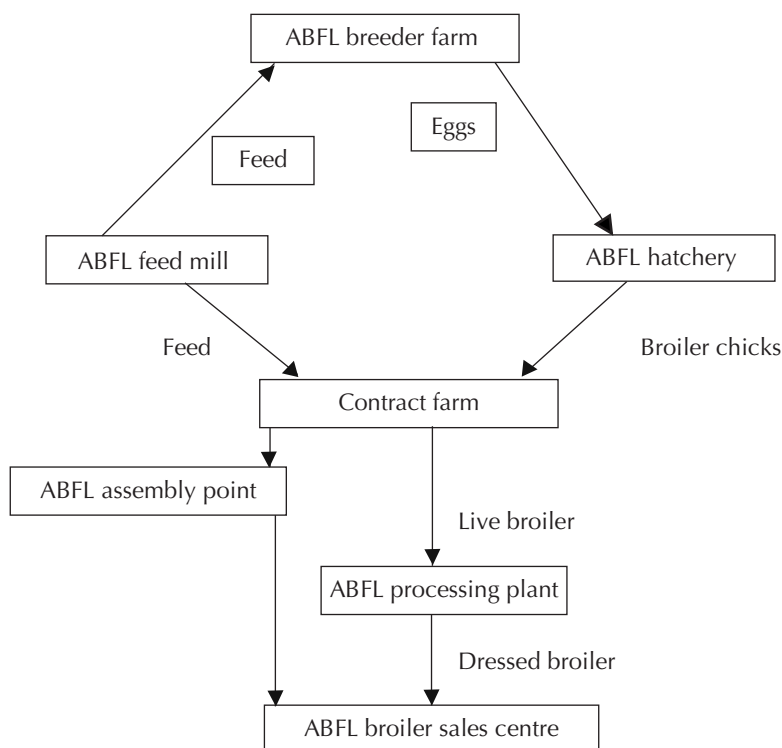


Figure 1. Structure of the broiler component of ABFL.

The sharing of responsibilities between contract farmers and ABFL in the vertically integrated farming system is shown in Table 6. The contract farmers typically provide land, housing, equipment and labour. Farmers are responsible for building a covered shed at their own cost to ensure a healthy environment for proper growth of the birds. The farmers are supervised by ABFL extension staff. The average duration of the grow-out cycle is five to seven weeks for an average sized (1.5 kg) broiler. Until 2003, ABFL would buy mature live broilers from contract farmers at a fixed price per kilogram and then sell the broilers through its sales centres in Dhaka. After 2003, when price of poultry fell drastically, ABFL changed its contract arrangement and stipulated that farmers would be paid a lower price compared to the prevailing market price. For example, in 2003, farmers were paid BDT 53/kg when the market price was BDT 60/kg live weight.

Risk reduction was cited as an important reason for entering into a contractual agreement. There are two types of risks: price risk and production risk. Price risk greatly influences the variability of revenue. The biological nature of broilers and their short storage life are important causes of price instability. Production risk mainly happens due to the death or loss of birds. Outbreak of diseases may also cause considerable economic losses and erode confidence in poultry farming. The major poultry diseases in the study areas were fowl

cholera, Gumboro disease, fowl pox and Newcastle disease. Gumboro and Newcastle diseases cause huge losses.

Table 6. *Sharing of responsibility in broiler production between the contract farmer and ABFL*

Particulars	1994 to 2002		2003	
	Contractor	Farmer	Contractor	Farmer
Land, buildings and equipment		X		X
Manure handling, storage and disposal capacity		X		X
Day-old chicks	Credit		Cash	
Feed ingredients, processing and delivery	Credit	X	Cash	X
Fuel, electricity and telephone		X		X
Facility repairs		X		X
Veterinary services and medicine	Credit		Cash	
Transportation cost of all inputs and outputs		X		X
Labour: production and maintenance		X		X
Labour: supervisory and specialists	X		X	

Source: Field survey.

Most farmers are generally risk averse and tend to choose businesses that are less revenue-risky. Because poultry keeping is a risky enterprise and farmers are not able to deal with distant urban markets individually, ABFL initially tried to reduce price risk through a forward contract and purchase arrangement. This was later changed in favour of a risk sharing arrangement between ABFL and the contract farmers by assuring a certain share of the prevailing market price. An insurance scheme linking compensation based on mortality rate was introduced to reduce production risk.

There is no poultry insurance system for independent farmers in Bangladesh. ABFL is the only organization that has introduced an internal insurance scheme to cover the risk of loss and safeguard the interest of its contract farmers in case of death of immature chicks due to diseases and other reasons. According to this scheme, ABFL operates a contributory security fund. Farmers contribute BDT 1.50 per chick to the fund at the time of purchase of day-old chicks. If chick mortality is 3%, 4–6%, 7–10% and 11–15% then 80, 40, 20 and 10%, respectively, of the premium contribution is refunded to the farmer. If the mortality rate is above 15%, the farmer can claim the full insured value as compensation. In this case, for birds up to 20 days old, the farmer receives BDT 20 per bird after deducting 15% from the number of lost birds. For birds older than 20 days, BDT 30 is paid per bird after calculating the benefits from birds up to 20 days old. The U-shaped compensation is to induce contract farmers to undertake better management and care of the birds to reduce mortality. In general, a mortality rate of up to 15% is considered normal or acceptable. In exceptional cases when the mortality rate exceeds 15% within 20 days or so, farmers incur heavy losses. In this

situation, a fuller compensation principle is applied to encourage the farmers to continue poultry farming. As a result, contract farmers feel secure in the face of disease-related risks except in the case of avian influenza which had broken out when the scheme was introduced and so was not explicitly covered by the scheme.

The desire to overcome marketing constraints is a major motivation for joining contract farming. In Bangladesh, poultry farms located far away from major urban markets face several problems in marketing including inability to sell birds at desired times due to lack of buyers, inadequate transport facilities to carry birds to markets, uncertain prices and low bargaining power. By entering into contractual agreements, farmers can be assured of market outlets.

Access to technical knowledge and management skills is another advantage of contract farming. Most poultry farmers in Bangladesh start businesses without acquiring proper technical knowledge and management skills. Facilities to train farmers on various aspects of poultry farming and management are inadequate in the country. A major deficiency is in knowledge about feeding regimes and management that heavily affect production efficiency. Most independent broiler farm owners reported that they did not have sufficient knowledge about poultry diets and optimal rations. In broiler production, the feed ratio varies for starter, grower and finisher stages and managing these properly is needed for profit efficiency. ABFL provides initial training in the management of the contract farming package and also provides continuous supervision throughout the growing period.

The ABFL contract broiler farming system is a partnership; the contract farmer provides land, housing, equipment and labour and ABFL provides inputs (initially on credit but later on cash), technical knowledge, supervision and an assured market for products at pre-agreed prices or a pricing mechanism that reduces price uncertainty.

3.1.2 Breeder stock farming contracts by ABFL

ABFL started contract breeder stock farming more recently. Its hatchery production systems totally depend on import of grandparent stock from abroad, usually from France, USA and the Netherlands. ABFL rears the imported birds under its own supervision. The eggs obtained from the grandparent stock are hatched and the day-old chicks are distributed to selected contract grower farmers as breeder stock birds. After 25 weeks, the parent stock birds lay hatchable eggs which ABFL buys back. After hatching they distribute the day-old chicks to contract and independent broiler farmers to rear as broilers.

A written agreement is made between ABFL and the contract breeder stock farmers. The contract is usually for a 10-year period and can be renewed upon mutual agreement. Unlike broiler contract farming, only solvent or relatively wealthy farmers in ABFL's areas

of operation areas are eligible to participate in the scheme because of the larger investment requirement. According to the agreement, ABFL provides day-old chicks, feeds and veterinary supplies on credit. It also offers intensive supervision and ensures purchase of the output. The credit liability of the contract farmer is adjusted against the value of the products. Unlike broiler contract farming, input credit was not discontinued in breeder stock contracts (Table 7).

Table 7. *Sharing of responsibility of the contract farms and contractor (ABFL) in breeder stock farming*

Particulars	Breeder stock contract farmer	
	Contractor	Farmer
Land, buildings and equipment		X
Manure handling, storage and disposal capacity		X
Day-old chicks	Credit	
Feed ingredients, processing and delivery	Credit	X
Fuel, electricity and telephone		X
Facility repairs		X
Veterinary services and medicine	Credit	
Transportation cost of all input and output		X
Labour: production and maintenance		X
Labour: supervisory and specialists	X	

Source: Field survey.

The contract farmer typically provides labour, land, housing and equipment and builds a covered poultry shed under the direct supervision of ABFL experts to ensure a healthy environment for proper growth of the birds. Building the shed is a relatively costly investment, which few rural households can afford. Thus if need be, ABFL helps farmers to access bank loans of up to BDT 800 thousand from Uttara Bank. If any additional funds are required, ABFL provides 50% on credit and the farmers bear the remaining cost.

ABFL's internal insurance scheme also covers breeder stock farms but the rates of premium and compensation are different. Farmers contribute 4% of the price of day-old chicks to the fund as premium and get refunds based on rate of mortality. If the mortality is less than 10%, 11–25% and 26–50%, then 70, 60 and 75%, respectively, of the premium is refunded. If the mortality rate is above 50%, then the farmer can claim the full insured sum. In this case, BDT 60 per bird is paid if the bird dies at the laying stage. In the event of bird dying at the growing stage, the farmer receives BDT 100 per bird. The reasons for applying the U-shaped compensation principle are the same as for broiler contract farming discussed earlier. Because of this, farmers feel secure enough to subscribe to the scheme.

3.1.3 Broiler farming contracts by BPC

BPC is a sister concern of Biman Bangladesh Airlines Corporation and deals in dressed broilers. The complex started operating in 1997. With 25 contract growers in Dhaka, Tangail, Manikgonj and Gazipur districts, about 60 km from the poultry complex at Savar, the system ensures supply of dressed chicken for Biman Catering Centre and two sales centres in Dhaka. Biman Catering Centre supplies chicken-based foods to different airlines operating out of the Dhaka International Airport.

BPC has entered into contract agreements with 25 farmers who have built good poultry sheds and have experience in broiler farming. Batch sizes vary from 1000 to 5000 birds with an average of 2500 birds. BPC also provides day-old chicks on credit, offers veterinary treatment and buys back live chicken from the contract farmers at a pre-determined price. In 2006 the price was BDT 100/kg from February to July and BDT 95/kg from August to January. The price is reviewed periodically based on market conditions and any price risk is shared between BPC and the contract farmers. However, production risk is fully borne by the farmers. Disputes between the contractor and the contract farmer are rare but when they occur, they are settled through mutual negotiation and understanding.

3.1.4 Broiler farming contracts by BRAC

BRAC is the largest national NGO in the country and its involvement in contract poultry farming has evolved over time. BRAC is committed to reducing poverty and empowering the poor through providing credit, training and technical assistance.

According to Saleque (2000), BRAC considered poultry as a potential candidate for income generation among landless and small farmers, particularly destitute women, many of whom owned a few chicken. In Bangladesh, 70 to 90% of households keep poultry while fewer keep goats and cattle. Landless households or those owning less than half an acre keep more than half of the total poultry population. Poultry is sometimes used as the first investment for a livestock ladder to increase income and get out of poverty, in the sense that one can move from poultry to goats/sheep to cattle, and so on.

There were almost no job opportunities for the landless, disadvantaged Bangladeshi women in the 1970s and early 1980s. These women were BRAC's targets for relief and development work after Bangladesh attained independence in 1972. But relief was not a mechanism for sustainable livelihoods for poor people as relief beneficiaries needed income-earning opportunities. Since women who received relief had small poultry flocks, it was conceived that expanded poultry rearing could be an income earning activity for a large number of poor women. This belief that relief-dependent poor women could be helped to undertake poultry

rearing as an income earning activity and thus gradually move on to self-sustained livelihood activities was the foundation of the poultry model that BRAC developed jointly with the DLS that eventually became a major development innovation (Islam and Jabbar 2005).

Between 1978 and 1985, BRAC and DLS developed a smallholder poultry model that targeted landless and poor households, especially women members. Initially there was no model or specific design but over time several activities were put together linked through a network of nine interrelated actors, each performing a specific task, e.g. hatching eggs, rearing day-old chicks to a certain age, rearing day-old chicks to mature birds, supplying feeds and vaccinations, and selling eggs and broilers.

DLS supplied day-old chicks from its hatcheries as foundation material for the network groups. After success of the pilot model, it was replicated in several areas between 1985 and 1992 when the concept was adopted by major donors like the International Fund for Agricultural Development, the World Bank, the Asian Development Bank and the Government of Bangladesh. The adoption was carried out through a three-phase development project from 1992 to 2003. BRAC and DLS remained involved in the implementation of this development project by providing some services along with several other NGOs.

DLS continued to provide day-old chicks for the project participants. However, its limited capacity to supply day-old chicks became a problem for expansion of the model at some stage. In response, BRAC started to produce day-old chicks to serve the requirements of the poultry model (Dolberg 2001). However, in addition to filling the supply shortage of day-old chicks, BRAC also saw a business opportunity and used the experience of the poultry model to develop a contract growing system. It supplied day-old chicks and other inputs on credit to smallholder producers and initially bought back eggs and broilers at pre-determined prices. The difference between this model and commercial contract growing is that BRAC focused on poverty alleviation by specifically targeting smallholders (Islam and Jabbar 2005).

After the smallholder poultry development project ended in 2004, many of its poultry network groups became non-functional and the many supply chains collapsed. However, BRAC continued to support more efficient and functional groups by supplying day-old chicks through its regular livelihood enhancement program while developing alternative mechanisms to promote contract poultry farming as an income-generating activity among smallholders.

Between 2002 and 2004, BRAC tried contract farming in Sherpur district by providing key inputs such as day-old chicks, feed and medicine on credit and buying back broilers at pre-determined prices. BRAC sold day-old chicks and feed to poultry farmers through dealers. It

also provided support for training, vaccines and medicine and helps to sell products through agents at existing market prices. At the field level, dealers made informal contract arrangements with farmers by selling inputs and buying outputs on credit. The arrangement did not work, however, because farmers violated the terms of the contracts, particularly when market prices were higher and they opted to sell their outputs in the local market instead of to BRAC.

BRAC recently entered into an arrangement with Mexicana Chicken, a fast food retailing enterprise of the Nasir Group of Industries. Under the arrangement, BRAC supplies hygienic broilers raised by 215 contract farmers in seven districts: Gazipur, Manikganj, Norshingdi, Kishoreganj, Tangail, Mymensingh and Brahmanbaria. Batch sizes range from 500 to 2000 birds with an average of 800 birds. BRAC supplies farmers with day-old chicks and other inputs through agents, and offers technical supervision and quality assurance in line with specifications of Mexicana Chicken. BRAC usually enters into written contracts with producers to buy products at the prevailing market price. The contracts include a provision that if a specified quantity of products cannot be supplied or bought due to unavoidable circumstances, the other party must be informed at least three days in advance.

The price risk is shared by both parties to the contract because the contract price depends on market price fluctuation. The production risk is fully borne by the farmer. The contract arrangement assures farmers of access to quality inputs and assures the integrator of a stable input market.

3.2 Formal input marketing contracts

There are 130 hatcheries in the country, 68 of which are fully functional and the rest partially functional or closed. There are 52 registered feed mills of which 40 are fully functional. In some cases, a single company may include both types of enterprises; of these, Kazi Farms, Paragon Poultry and Nourish Feed operate formal input marketing contracts.

3.2.1 Day-old chick supply contracts by Kazi Farms

Established in 1996, Kazi Farms is the largest Bangladeshi producer of parent stock and day-old chicks for broilers and layers. In 2006, the company established the largest poultry feed mill in Bangladesh. It later began exporting poultry products to the Middle East and Nepal, and is managing operations of a broiler-breeding farm in the Sultanate of Oman.

Kazi Farms also provides countrywide sales services through its network of over 100 salespersons stationed in different poultry-producing areas. Day-old chicks and feeds are distributed by 600 feed and chick distributors countrywide. Financially solvent persons of high integrity, as judged by the company, are selected as distributors in charge of one or

two *thanas*. The company enters into a written contract with the distributors under which they must meet the target purchase volume of day-old chicks and feed. Distributors are also required to deposit a security bond with the company, normally equivalent to the price of 1000 chicks. Distributors purchase day-old chicks and feed through advance payment in cash or banker's draft. There is no provision of credit sale.

Under the informal contractual arrangement with the farmers, the company has set up a service network of veterinarians and animal husbandry graduates to help farmers deal with poultry diseases. These technical personnel regularly visit the client farmers and offer veterinary services free of charge. This is an investment by the company to ensure chick survival so that its own feed and day-old chicks business can be sustained and expanded. In this contract arrangement, both production and price risks are borne by the farmers. However, farmers benefit from a supply of healthy day-old chicks and feed during peak and lean periods.

3.2.2 Contracts by Paragon Poultry and Nourish Feed

Paragon Poultry is one of the largest producers of day-old chicks in Bangladesh. It has developed a special type of contractual arrangement through which it supplies day-old chicks and feeds to poultry keepers through its countrywide network of 205 dealers. It supplies 400 thousand day-old chicks per week and 140 t of feed per day. The company claims over 10% of the market share of day-old chicks in the country. It does not participate directly in the purchase of the farmers' products, but some of the dealers help farmers to sell the products. The farmers bear all production and price risks.

Nourish Feed is one of the largest poultry feed producers in the country. It also produces day-old chicks as a supplementary venture. It supplies day-old chicks and feed to the farmers through its 160 dealers operating across the country. The company supplies 300 thousand day-old chicks per week and 330 t of feed per day. The company has a substantial market share for poultry feed and a 2% market share of day-old chicks in the country. The company's major competitors in the feed market are Kazi Farms, ABFL and Paragon Poultry. It does not purchase of farmers' products directly but occasionally helps farmers to sell products through the dealers. For this reason, the farmers bear both production and price risks.

3.3 Informal output marketing contracts

Dhaka-based *aratdars* and egg wholesalers sometimes make forward purchase contracts with layer farmers in Gazipur district. They also sometimes engage in contracts with agents who then buy eggs from producers with or without prior contracts to supply the *aratdars*. Forward purchase contracts differ from formal contracts in that the former are made with

existing farms to purchase products rather than to establish new farms. In this arrangement, *araddars* make lump-sum advance payment which is adjusted from the value of products at the time of delivery. The main benefit for producers is that the cash advance is considered a source of credit to buy inputs when going to a formal credit agency may be time-consuming or problematic. The price of eggs is unilaterally fixed by the *araddars*. Although these prices approximate the prevailing market prices, they are sometimes lower than the immediate past prices and hence are unexpected from the producers' point of view. The basis of fixing price is not made clear by the *araddars* so producers supply eggs without foreknowledge of the price to be paid. The *araddars* in Dhaka, through their syndicates, fix the price daily and the producers have no choice but to accept it. The *araddars* allegedly extract unduly high margins or commissions through this practice.

4 Structure and conduct of poultry input and output markets

The main inputs for poultry production are day-old chicks, feeds, equipment and veterinary medicines, while the main outputs are eggs and broilers. The performance of the industry can be assessed by examining the structure and conduct of the industry at the aggregate level as well as by assessing the trading practices and performance of input and output traders.

Market structure can be identified by considering the number and size distribution of buyers and sellers, the extent to which products are differentiated, how easy it is for other firms to enter the market and the extent to which firms are integrated or diversified (Bain 1968; Ferguson 1988). More specifically, market structure for a commodity can be evaluated in terms of four dimensions: (a) the degree of seller concentration, (b) the degree of buyer concentration, (c) the degree of product differentiation and (d) the condition of entry to the market.

Concentration has two alternative meanings: (a) control of a large proportion of some aggregate of economic resources or activity by a small number of the units which control the aggregate or (b) control of a large proportion of such an aggregate by a small absolute number of these units (Scarborough and Kydd 1992; Abbot 1993).

In a competitive business, firms are expected to earn normal profit because the existence of abnormal or super-normal profit should invite new entrants into the market and thus push down the profit rate to normal level. It is generally well known that in a competitive market, a trading firm's temporal or spatial arbitrage performance depends on its financial, physical and human capital assets as well as its ability to minimize costs. There are physical marketing costs (e.g. transport and storage) and transaction costs that arise from coordinating the exchange among relevant market agents and include the costs of obtaining and processing market information, negotiating contracts, monitoring agents and enforcing contracts.

Transaction costs are unique and specific to individual market agents, so the agents in the market conduct transactions on the basis of their own costs. When transaction costs are very high, markets become thin or even fail (Williamson 1985; North 1989; Hoff and Stiglitz 1990; Gabre-Madhin 2001).

Gabre-Madhin and Negassa (2004) have argued that trading practices also influence trading performance. They define trading practices or the way exchanges are conducted as observable market behavioural outcomes of underlying market institutions. Market institutions encompass 'rules of the game', rules and laws, informal norms, formal and informal organizations and associations. These institutions may determine trading

practices with respect to, among others, mode of purchase and payment, inspection of goods, negotiation and enforcement of contracts, contract violations and means of settlement.

Some examples of trading practices include use of regular suppliers and customers, use of brokers/agents for purchase and sale, cash or credit purchase and sales etc. Trading practices may also be determined by type and composition of assets as firms operating under the same set of underlying market institutions often do not follow similar trading practices. In this case, in empirical estimation of performance, possible multi-collinearity between asset ownership and trading practices should be examined. On the other hand, trading practices may impact on traders' performance through their influence on transaction costs. However, most trading practices, unlike most transaction costs, are observable and measurable. Thus, trading practices are sometimes used as proxies for transaction costs in empirical investigation.

In this study, industry-level analysis was carried out on hatcheries and feed mills only. Poultry drugs are either manufactured locally or imported so a full picture of the drug market could not be gathered for industry-level analysis. Various poultry equipment other than those required as main capital investment is produced by a large number of local manufacturers. Production of poultry equipment has developed into a cottage or small-scale industry, so industry-level analysis for equipment could not be done due to lack of information. However, trader practices and performance as proxies for transaction costs were analysed for all the four inputs as well as for broilers and eggs.

4.1 Structure and conduct of hatcheries and feed mills

4.1.1 Geographical distribution of hatcheries and feed mills

Some companies or investor enterprises own both hatcheries and feed mills which, though registered separately, use the same distribution network. Thus, the two are discussed together. Available information indicates that there are 130 hatcheries in the country, 68 of which are fully functional and the rest either partially operational or temporarily closed. Ninety percent of the functional hatcheries have their own breeding or parent stock farms. There are also 52 registered feed mills in the country but 40 are currently in operation.

About half of the hatcheries and functional feed mills are located in Gazipur, Chittagong and Dhaka districts (Table 8) which have the highest concentration of poultry farms. The hatcheries tend to be set up closer to poultry farms or production areas because long-distance transportation of day-old chicks is more problematic and costly than transportation of feeds. Thus, hatcheries are more widely distributed compared to feed mills.

Table 8. *Distribution of hatcheries and feed mills by district*

District	Number of hatcheries	Number of feed mills
Gazipur	21 (16.2)	12 (30.0)
Chittagong	22 (16.9)	8 (20.0)
Dhaka	17 (13.1)	2 (5.0)
Jessore	6 (4.6)	1 (2.5)
Faridpur	7 (5.4)	–
Rajbari	13 (10.0)	1 (2.5)
Bogra	5 (3.9)	–
Khulna, Mymensingh	8 (6.2)	5 (12.5)
Manikganj, Narayanganj	6 (4.6)	5 (12.5)
Kishoreganj	2 (1.5)	2 (5.0)
Others*	23 (17.6)	4 (10.0)
Total	130 (100)	40 (100)

*19 for hatcheries, four for feed mills.

Percentages in parentheses.

Source: Field survey (2006).

4.1.2 Structure of day-old chick and feed markets

In this study, the potential capacity of production of day-old chicks and the potential hourly production capacity of feed were considered in order to assess the level of industry concentration. In the hatchery industry, the three-firm seller concentration was estimated at 30% and the 10-firm seller concentration at 72%. The respective corresponding figures for the feeds industry are 27 and 50%. According to Bain's classification of industry on the basis of seller concentration, the poultry hatchery industry in Bangladesh can be classified as moderate to highly concentrated. The concentration of the feed industry is slightly lower and has been decreasing since the 1990s due to entry of new firms (Khan 1998). However, the industry remains generally underinvested as indicated by supply shortage of day-old chicks and need for advance booking and payment. Broiler and layer farm owners are the buyers of day-old chicks and feeds. There are many small poultry farms which are scattered all over the country. The small size, dispersed location and passive role of the poultry farms indicate low buyer concentration.

4.1.3 Marketing chains for day-old chicks and feeds

A few hatcheries distribute day-old chicks in different districts while others operate in their local areas. Some hatcheries specialize in either broilers or layers while others produce both types. Each hatchery may use more than one strain of breeding stock for broilers and layers. Five companies have also started grandparent farms.

The hatchery owners sell the day-old chicks at the hatchery, directly to the broiler and layer farm owners at sales centres or to poultry farmers through sales agents. In the case of contract farming, the contractor sells day-old chicks from the hatchery to the selected contract growers. Taking the hatchery industry as a whole, a large proportion of total production is disposed through sales agents. The commercial broiler and layer farmers usually need to make advance bookings with the hatcheries with a portion of the order value as down payment at least one month before the date of delivery. However, the duration of advance booking varies depending on the hatchery or buyer. Advance booking is used mainly because total demand for day-old chicks from broiler farms at a particular time is sometimes higher than the installed capacity in the hatchery industry as the industry is underinvested. Thus, there is need to assure supply from the demand side. Also, because of the perishability of the day-old chicks, hatchery owners want to have an assured order.

Day-old chicks are packed either in paper boxes or bamboo baskets. A standard box carries 51 day-old chicks. Hatcheries use their own or hired means of transport to ferry day-old chicks from the hatchery to the sales centres or agent's store. Commercial farm owners arrange their own transport from the agent's store. Farmers generally do not use specialized transport but transport day-old chicks in passenger buses, rickshaw vans or locally made three-wheeler vehicles called *nasimon* or *korimon*. These non-specialized means of transportation are hazardous and increase the likelihood of mortality during movement, though definite information on mortality during transportation was not obtained.

Different feed mills distribute their products in different ways. Some feed manufacturers distribute feeds through agents while others use independent traders (wholesalers and retailers). Some like BRAC have their own sales centres and selected agents for feed distribution. Enterprises with both hatchery and feed mills use the same distribution channels or sales agents for both products. Figure 2 shows typical feed marketing chains.

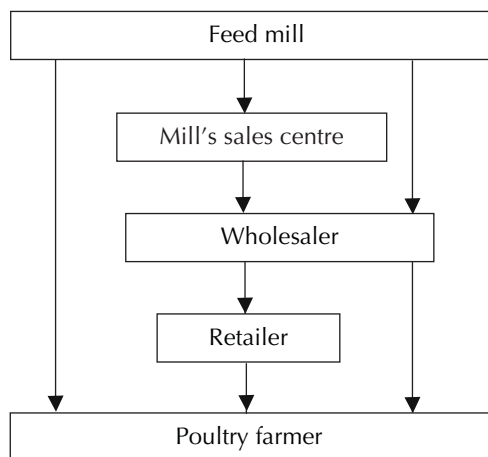


Figure 2. Marketing chains used for distribution of poultry feeds.

4.1.4 Product differentiation

Product differentiation refers to the extent to which buyers distinguish competing outputs of the various sellers established in the industry (Bain 1968). Buyers and sellers in the hatchery industry use strain of breeding stock as the main criterion to differentiate products. Currently, several broiler and layer strains are available in the country though three broiler strains and one layer strain dominate the market (Tables 9 and 10).

Table 9. Number and percentage of poultry farmers using different strains of broiler birds by farm type and district

Strain	Kishoreganj		Gazipur		Both areas	
	Contract	Independent	Contract	Independent	Contract	Independent
Hubbard Classic	27 (45)	8 (20)	7 (17)	17 (40)	34 (33)	25 (31)
Kasila	22 (37)	14 (35)	30 (71)	9 (21)	52 (51)	23 (28)
Cobb-500	11 (18)	15 (38)	4 (10)	11 (26)	15 (15)	26 (31)
CM Classic Starbro	–	3 (8)	1 (2)	1 (2)	1 (1)	4 (5)
Hibro	–	–	–	4 (10)	–	4 (5)
Total	60	40	42	42	102	82

Percentages in parentheses.
Source: Field survey (2006).

Table 10. Number and percentage of farmers using different strains of layer birds by farm type in Gazipur district

Strain	Independent	Informal contract	Overall
Hi-sex brown	11 (29)	15 (35)	26 (32)
Hi-land	2 (5)	4 (9)	6 (7)
Hyline	4 (11)	9 (21)	13 (16)
Babcock-300	4 (11)	2 (5)	6 (7)
Ross-308	–	1 (2)	1 (1)
Shaver -579	2 (6)	6 (14)	8 (10)
ISA brown	4 (11)	2 (5)	6 (7)
Shaver star cross	–	2 (5)	2 (3)
BV-300	3 (8)	1 (2)	4 (5)
Victoria	–	1 (2)	1 (1)
Brown nick	5 (13)	–	5 (6)
Flex	1 (3)	–	1 (1)
Golden	1 (3)	–	1 (1)
Lohman brown	1 (3)	–	1 (1)

Percentages in parentheses.
Source: Field survey (2006).

Poultry farmers do not really know what they are buying as they have no way to ascertain the biological characteristics of the various strains or their quality. Hatcheries use different brand names for broiler and layer day-old chicks and some hatcheries have established goodwill among buyers by providing quality day-old chicks and differentiated products. Hatchery owners, especially large ones, care about their reputation in the market as farmers may not be able to tell the strain of chick at the time of purchase but know how it performs afterwards (this is called an 'experience good'). So, suppliers of day-old chicks know that they can sell low quality chicks in the short-run but this will eventually affect their reputation and they will lose customers. Kazi Farms and other input marketing contract operators are examples of suppliers who are concerned about reputation.

Two types of feeds are used in the poultry sector: ready-to-use and feed ingredients. Broiler farmers use ready-to-use manufactured feeds while layer farmers purchase feed ingredients separately for mixing. The ready-to-use feeds of different feed mills available in the market are not homogeneous in nature. Manufacturers differentiate poultry feeds on the basis of quality, brand name, sales promotion and packaging.

4.1.5 Condition of market entry

Condition of entry refers to the disadvantage of potential entrant firms as compared to established ones. The apparent supply shortage of day-old chicks indicates under-investment in the hatchery industry. Reasons for under-investment include legal barriers (lengthy licensing process), shortage of investment capital or shortage of raw materials. However, hatchery owners reported that the Bangladeshi hatchery industry currently has no legal barriers to entry for potential entrants. Inputs for the hatchery industry, (e.g. parent stock, equipment) can be easily imported from abroad. The main problems for potential firms are lack of capital and qualified personnel. These conditions and excess demand for day-old chicks enable the established firms to control the market for day-old chicks. In the feed industry, there is no legal barrier for potential entrants. Conversely, there are incentive programs such as tax holidays and import duty exemption on equipment and feed ingredients. However, feed manufacturers cited scarcity of raw materials and inadequate and irregular power supply as major barriers to entry for potential investors in the feed industry.

4.1.6 Market conduct of hatcheries and feed manufacturers

In terms of price policy, the hatchery owners set the price of day-old chicks independently but consider the reaction of competitors in the market. They usually sell day-old chicks at fixed price to farm owners and agents but provide a commission to the agents. It is important to note that there is no bargaining between buyers and sellers of day-old chicks at any point in the supply chain; it is basically a supply-driven market. Similarly, feed millers usually

set the prices for wholesalers, there being little scope for bargaining except that rates of commission may vary depending on volume of purchase.

In terms of product development policy, the hatcheries in Bangladesh have not developed their own research and development systems to produce day-old chicks. The parent stock is imported and hatcheries try their best to maintain the inherent quality of the birds through proper management. They are always conscious about the quality of the day-old chicks they produce but none disclosed any criteria or processes through which the quality of birds could be evaluated. Feed millers also use state-of-the-art technology to manufacture feeds based on imported and local raw materials. The industry does not conduct any organized research to develop feeds based on local raw materials nor does it have any links with academic research institutions to carry out such research through bilateral arrangements.

In terms of sales promotion, some hatcheries advertise in newspapers and magazines or use posters, leaflets and workshops to promote their products in spite of excess demand for day-old chicks. Some firms also provide incentives (such as foreign trips) to the agents for better sales performance.

Feed millers usually promote their products through advertising, seminars and workshops and by providing quality assurance and incentives such as differential commissions to traders. Some millers also provide incentives to farmers.

4.2 Trading practices and performance of feed traders

4.2.1 Trading practices

Ten feed wholesalers were selected from four market places to assess how the feed wholesale and retail markets operate and perform: five from Sreepur, two each from Gazipur Sadar and Mymensingh Sadar and one from Dhaka. Thirteen feed retailers were also selected: six from Sreepur, three each from Gazipur Sadar and Bajitpur *thana* in Kishoreganj district, and one from Mymensingh Sadar.

The wholesalers purchased feeds from different mills. About 10% of the traders purchased feeds from mills located 105 to 110 km away. Twenty percent of traders who travelled 75 to 80 km to buy feeds while the rest covered travelled between 5 and 45 km.

Forty-six percent of retailers collected feed from sellers located 10 km away, 31% bought feed from sellers 20 to 50 km away while 23% had the feed delivered directly to them. Thirty-eight percent of retailers sold feed within a five-kilometre radius, 15% sold feed within 10 km and 23% supplied feed to buyers situated up to 20 km away. Only 8% of retailers travelled up to 35 km away to sell feed.

Sampled wholesalers handled six brands of processed feeds used by the broiler farmers: National Feed, Sunny Feed, Biswas Feed, Nourish, Quality Feed and Saudi-Bangla Feed. Thirty percent of wholesalers handled only one brand, 30% handled two, 10% handled three while the rest dealt with feed ingredients. Wholesalers sold feeds to both poultry farmers and retailers. Seventy-eight percent of retailers and 75% of farmers bought feeds regularly from wholesalers.

Sampled retailers sold ten brands of feeds. Twenty-three percent of traders sold National Feed, 23% handled Chomak Feed and 8% each handled one of the four remaining brands. Each of the remaining retailers handled two brands. We could not establish whether this apparent brand specialization was because of conditions imposed by feed millers.

The feed manufacturers set the wholesalers' buying price. Some manufacturers charged BDT 0.15 less per kilogram of feed to cover the cost of transport when wholesalers transported feed themselves. The wholesalers sold feed to retailers and farmers either for cash or on credit. In 2005, 90% of wholesalers reportedly sold feeds on credit to an average of 45 buyers. In setting the selling price, 90% of wholesalers charged a fixed margin on the total cost of feed marketing and 10% of the wholesalers marked up a certain percentage of the total cost as profit. The price of feed varied from brand to brand. Moreover, individual sellers did not charge the same price to all buyers. Feed prices were discriminated on the basis of mode of payment (cash vs. credit) and volume of purchase (small vs. large), as reported by all traders, while 90% also considered regularity in purchase or store loyalty as a basis for price discrimination. There was no arrangement of cost and risk sharing in feed trading between manufacturers and wholesalers.

Retailers bought feeds at a price fixed by the wholesalers. Retailers were very loyal to their suppliers and frequently sold feed on credit. In 2005, one retailer served an average of 33 farmers and retailers set the selling price of feed by adding a fixed margin to the cost of marketing and the purchase price of the feed. The selling price of feed was discriminated on the basis of quantity of purchase, mode of payment and customer loyalty.

Generally, wholesalers and retailers did not use any form of sales promotion but usually sold feeds on credit. Retailers also helped farmers to sell their products on time. In this way, an informal relationship or contract was established between feed traders and poultry farm owners at the local level.

4.2.2 Traders' business performance

Wholesalers handled 87 t of feed per trader per month and spent an average of BDT 15,454 per tonne on feeds whose average sale price was BDT 16,439. Wholesalers incurred BDT

486 as marketing costs, 80% of which was related to purchase activities and the rest to sales activities (Table 11). This resulted in an operating margin of BDT 985 per tonne on the purchase price. The sampled feed retailers sold an average of 52 t of feeds per month. The average purchase price was BDT 15,404 per tonne and the sale price BDT 16,379/t. Retailers incurred BDT 321 as marketing costs, 74% of which was for purchase-related activities, resulting in an operating margin of BDT 975 (6.3% of the purchase price).

Table 11. Wholesalers' and retailers' marketing costs and margins of feed trade

Cost item	Wholesaler (n=10)	Retailer (n=13)
	Amount (BDT)	Amount (BDT)
Purchase price	15,454	15,404
Marketing costs		
Communication	20.88 (4.3)	20.27 (6.3)
Transportation	203.95 (42.0)	137.56 (42.8)
Loading & unloading	12.57 (2.6)	24.67 (7.7)
Wastage	30.84 (6.3)	–
Shop rent	48.28 (9.9)	40.76 (12.7)
Labour	82.30 (16.9)	70.56 (22.0)
Electricity charge	13.97 (2.9)	15.79 (4.9)
Telephone	9.77 (2.0)	–
License fee	7.39 (1.5)	6.48 (2.0)
Subscription	10.17 (2.1)	5.32 (1.7)
Others*	45.98 (9.5)	–
Total	486.10 (100.0)	321.41 (100.0)
Sale price	16,439	16,379
Margin	985	975

Percentages in parentheses.

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

*Cost of collecting market information and negotiating contract, which can be considered as part of overall marketing and transaction costs.

Source: Field survey (2006).

Transport and labour were the two main cost items for both categories of traders. Because data on actual turnover for the whole year were not available, the annual rate of return per unit of operating capital could not be accurately calculated to assess if the generated returns were comparable to other businesses or at least equivalent to the going bank rate.

Normally, the retail average purchase and sale prices should be equal to or greater than the wholesale selling price. However, the retail prices were lower than the average wholesale selling price. One explanation for this is that the sampled wholesalers did not sell their stock to the sampled retailers so a one-on-one comparison was not possible. In addition, the

sampled retailers did not handle the same brands or combination of brands of feeds as the sampled wholesalers. Prices also varied from brand to brand (Table 12); this could also partly explain the price differences between wholesalers and retailers.

Table 12. Average buying and selling prices (BDT/t) of wholesalers and retailers of selected brands of feeds

Brand of feed	Wholesaler (n = 10)		Retailer (n = 13)	
	Buying price	Selling price	Buying price	Selling price
National	13,225	14,135	13,333	14,267
Biswas	15,000	16,000	–	–
Quality	21,000	22,000	21,200	22,000
Nourish	16,000	17,000	13,975	14,925
Saudi-Bangla	14,500	15,500	–	–
Suny	13,000	14,000	–	–
Surma	–	–	13,500	14,500
Chomok	–	–	13,133	14,000
Kazi	–	–	15,100	16,100
Pancha	–	–	15,500	16,500
Fresh	–	–	17,500	18,500
Aftab	–	–	15,500	16,500
Jayso	–	–	15,300	16,500
Average	15,454	164,39	15,404.10	16,379.20

Source: Field survey (2006).

4.3 Trading practices and performance of veterinary drug traders

More than 100 pharmaceutical companies in the country have been reportedly involved in the veterinary drugs business. An estimated BDT 3500 million worth of health and nutrition products are marketed annually in the country though the volume of poultry drugs business is not accurately known (Ahammad 2006). In order to analyse the trading practices and performance of wholesale and retail traders of veterinary drugs, five wholesalers of poultry drugs were selected: four from Sreepur and one from Joydevpur Sadar *thanas* of Gazipur district. Six retailers were also selected: three from Sreepur and one each from Fulbaria, Bajitpur and Mymensingh Sadar *thanas*.

The marketing chain for drugs is simple and comprises only three actors: pharmaceutical companies, wholesalers and retailers. The pharmaceutical companies distribute drugs to both wholesalers and retailers. Retailers also purchase drugs from wholesalers for sale to poultry farmers. Wholesalers collect drugs from Dhaka and Tongi where most of the drug importers

and manufacturers are located. The sampled drug traders started this business between 1995 and 2005. One of the retailers started this business in 1990, the other four between 1998 and 2003, and one in 2005. The sampled wholesalers usually sold drugs of seven pharmaceutical companies: ACI Limited, Arif (Bangladesh) Ltd., Renata Ltd., Rampart Power Bangladesh Ltd., Square Pharmaceuticals Ltd., ACME Laboratories Ltd. and SKF. In addition to these seven companies, Jayson, Veds, Techno Drug and Aventis also supplied drugs directly to the sampled retailers.

The pharmaceutical companies set the prices of drugs for both wholesalers and retailers. All the wholesalers and retailers reported that they often sold drugs on credit. In 2005, each wholesaler sold veterinary drugs on credit to an average of 200 buyers while retailers sold drugs on credit to an average of 101 poultry farmers. Thus, the average seller of veterinary drugs served many more farmers than the average feed trader.

Each wholesaler reportedly handled 5 to 15% of the market in their areas of operation, indicating that the market is quite competitive. Different wholesalers sold drugs at different prices depending on the brand and reputation of the manufacturing company. The company usually bore the cost of transporting veterinary medicines from the factory to wholesaler's store and other costs associated with transportation (e.g. damage). Each of the sampled retailers reportedly handled between 1 and 40% of the market in their areas of operation, indicating that competition might not be very high in some places.

Both wholesalers and retailers promoted sales by offering credit and other incentives to buyers. All five wholesalers offered credit, four provided incentives to traders and two provided incentives to farmers. Of the six sampled retailers, five practised credit sale, two provided incentives to farmers and three tried to maintain personal contact with buyers.

The wholesale and retail sale price was set in various ways such as by adding a fixed margin to unit cost plus purchase price of drugs. All sampled wholesalers adopted the prevailing market price as their selling price while 80% of retailers set the sale price by adding a fixed margin to their cost of marketing. All wholesalers and about two-thirds of retailers of veterinary drugs practised price discrimination. Most wholesalers used volume of purchase and loyalty as the basis for price discrimination while 67% of retailers used cash or payment of arrears.

4.4 Trading practices and performance of poultry equipment traders

Traders in poultry equipment handled a range of equipment including brooders, waterers, chick guards, feeders, egg trays, feed trays, mugs and *bungas* (pots used to lift feed ingredients at the time of sale and to distribute feeds on the feeding tray).

In order to analyse their business practices and performance, five wholesalers and five retailers were selected from Dhaka, Sreepur, Gazipur and Mymensingh Sadar *thanas*. One wholesaler started this business in 1996 and two others in 2000 and 2001, respectively. On the other hand, three of the retailers respectively entered the business in 1995, 1999 and 2000 and two in 2001. Both wholesalers and retailers invested their own capital.

Three of the wholesalers procured their equipment from Nayabazar while two bought theirs from Islambagh where manufacturers mainly marketed their products. Wholesalers regularly got their supply of equipment from selected suppliers and then sold it to retailers. Three wholesalers sold directly to farmers, two travelled 20 to 25 km and three travelled 65 to 70 km to buy equipment. Three wholesalers sold to buyers within 20, 30 and 60 km of their business premises while two sold to buyers all over the country. The market share of individual wholesalers varied from 5 to 30% of the market in their areas of operation.

Manufacturers usually set prices for wholesalers who set the resale price by adding a fixed margin to the purchase price and cost of marketing the equipment. The margin varied depending on the size and value of equipment (Table 13).

Table 13. *Marketing margins of equipment wholesalers by type of equipment (BDT per unit of equipment)*

Equipment	Purchase price plus marketing costs	Sale price	Marketing margin
Brooder	385	520	135
Waterer	29	33	4
Chick guard	139	148	9
Feeder	29	32	3
Egg tray	12	14	2
Feed tray	30	33	3
Bunga	26	29	3
Mug	28	31	3
Net for fencing (per square foot)	13	15	2

n=5.

Source: Field survey (2006).

Out of the five sampled wholesalers, four based price discrimination on the purchase and buyers' loyalty while two based it on mode of payment. There was no contractual arrangement between manufacturers and wholesalers and no sharing of cost or risks in trading of poultry equipment. Wholesalers adopted various means of promoting their products: two used credit sale, two provided incentives to buyers and three maintained personal contact with buyers.

Generally, retailers regularly purchased equipment from selected wholesalers. Three of the five retailers travelled 75 to 80 km to buy equipment while the other two travelled 85 to 90 km and 115 to 120 km, respectively. However, their sales were confined within 4 to 60 km of their respective business premises.

In buying equipment, three retailers mentioned that the price was set by wholesalers. One retailer mentioned that the price was negotiated with the suppliers while another used the prevailing market price. All retailers set their selling price by adding a fixed margin to the buying price and cost of marketing the equipment. They did not sell products on credit. The market share of individual retailers in their areas of operation was 25% for one trader, 20% for each of three traders and 10% for another. The retailers of equipment charged different prices to buyers depending on sales volume and customer loyalty. Due to risks in the business, retailers had no arrangement for cost sharing either with suppliers or the ultimate buyers of the equipment. Eighty percent of retailers kept good contact with the poultry farmers to increase their sales while the rest provided discounts as incentives to encourage buyer loyalty.

4.5 Trading practices and performance of broiler and egg traders

4.5.1 Marketing chains for broiler producers

The contract broiler farmers of Kishoreganj sold their products to the contractor or integrator (ABFL). Contract farmers delivered birds to the company's purchase points or headquarters. The company disposed of the birds through its retail sales centres in Dhaka for sale to consumers or to wholesalers and retailers in Dhaka. Some birds were processed at the company's processing plant in Kishoreganj into dressed broilers and chicken nuggets which were then supplied to the company's retail sales centres in Dhaka and various supermarkets (Figure 3).

BRAC's contract growers in Gazipur, Manikganj, Norshingdi, Kishoreganj, Tangail, Mymensingh and Brahmanbaria delivered their birds to BRAC's purchase points from where they were transported to BRAC's processing plant in Gazipur. Dressed broilers were

then supplied to Mexicana Chicken, the fast food outlet with which BRAC has a supply contract to deliver hygienic chicken. The processing plant also produced dressed broilers for supermarkets from live birds supplied by contract farmers and BRAC's broiler farm.

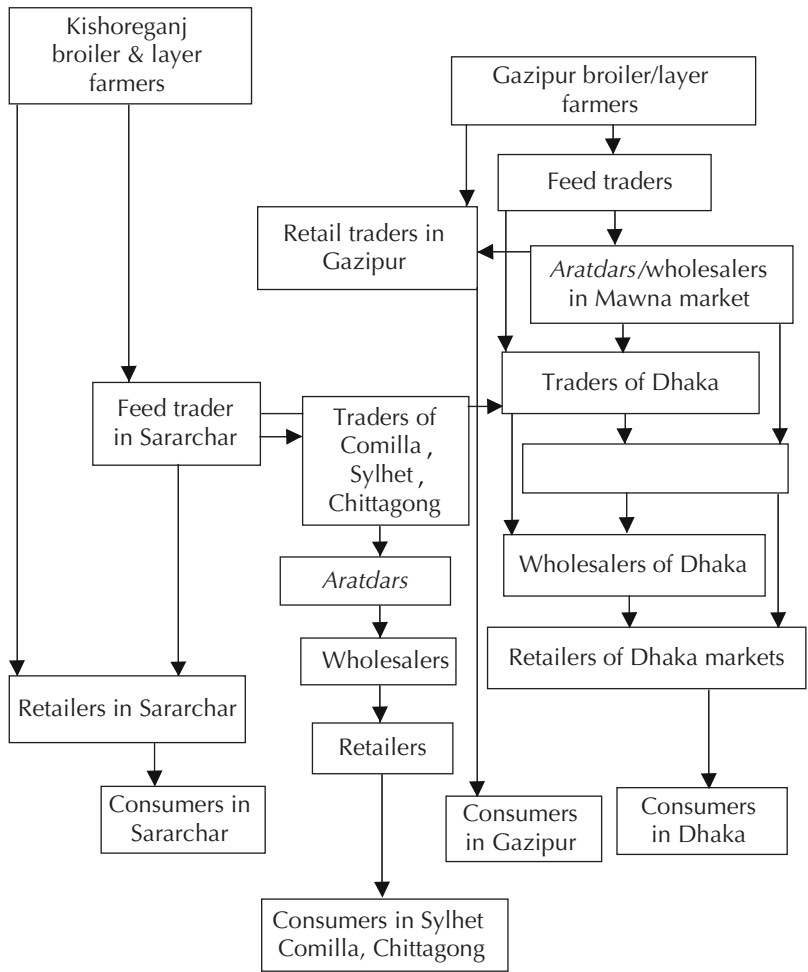


Figure 3. Main marketing channels for broiler producers in Gazipur and Kishoreganj districts.

The chains for the independent broiler producers were different and complex. Dhaka, Chittagong and Khulna are major urban markets served by commercial broiler and egg producers as well as producers of scavenging local chicken and eggs throughout the country. Each of the 62 district towns and other smaller urban centres are also served by local producers in those districts. The marketing chains at the district level may vary to some extent between the districts. This study focused only on the Dhaka market and its supply channels especially from the two districts where farm surveys were conducted, Gazipur and Kishoreganj.

Figure 3 gives a generic flow of supply chains for broiler and eggs to Dhaka from Gazipur and Kishoreganj districts. There were some differences between broiler and egg supply chains in two respects; some traders handled both products while others specialized in only one. Additionally, the nodes in the supply chains and their actors and functions are not exactly the same for the two products. However, Figure 3 summarizes the principal nodes in the supply chains for the two products.

Broiler farmers in Kishoreganj sold broilers with the help of feed and medicine traders at the Sarachar wholesale market. The feed traders telephoned different market places to collect information about the price of broilers. The terms and conditions of transactions were mostly settled over the phone. The traders then collected the broilers from the farm gate in the presence of the negotiator (feed trader). The transaction was mainly done in cash. The feed traders received a commission from the farmers of BDT 0.50/kg of broilers sold. A few live birds were also sold to the local retailers at the farm. However, the role of feed traders in broiler and egg marketing in Kishoreganj was not as prominent as in Gazipur.

The supply chains from Gazipur and the actors involved were much more complex (Figure 3). Key nodes or points in the Gazipur supply chain are Mawna wholesale market, Dhaka central market in Tejgaon and various municipal markets in the city where consumers usually shop. The first intermediary in the chain was sometimes the feed trader who either bought products from farmers or facilitated the linkage between farmers and traders with or without a fee. The main motivation of feed traders was to promote sales of feeds by helping the farmers to link with regular buyers.

Mawna wholesale market plays an important role in the supply chains for broilers in Gazipur district. It is a small business centre located in Valuka Upazila in Gazipur. There are about 40 traders (media partners/*aratdars*) at the market, who act as commission agents of the *aratdars* of Dhaka central market in Tejgaon. Mawna market also has 15 to 20 traders and brokers. Out of the 40 traders, five ran their businesses individually while 35 did so in partnership with others. They kept contact with feed traders and poultry growers at the village level and broiler traders in Tejgaon central market. Traders in the central market made specific orders to be delivered to the media partners. Sometimes the media partners kept a small stock of broilers to meet emergency orders from Dhaka. They charged the farmers a fixed commission of BDT 2.00/kg which was unrelated to the price of the product.

At the Mawna market, price was negotiated between the *aratdars* in Mawna and the buyers in Dhaka central market. Although the forces of supply and demand were important, buyers in Dhaka dominated as they were fewer and more organized than the broiler growers and the *aratdars* in Mawna.

The Tejgaon broiler market in Dhaka city is considered the central market for commercial broilers and local poultry. Live chicken from different districts of Bangladesh are assembled in this market. There are about 32 broiler *aratdars* at the market but some of them also act as wholesalers. The market has a long covered shed with supply of water and electricity. The broiler *aratdars* usually buy from 10 to 12 suppliers from different districts and sell to 24 to 32 wholesalers in various Dhaka markets. The suppliers deliver the consignments to the *aratdars'* premises. The market is open seven days a week and transactions are completed by 0800 hours. Commercial broilers are sold by weight while local chicken are sold by number. The price is set daily through bargaining. In fixing the daily price, the *aratdars* consider the level of demand and the volume of supply in the market. Transactions are made both in cash and on credit. In case of credit sale to wholesalers, the buyers return the dues in the evening or the next morning. The *aratdars* set prices on behalf of the broiler suppliers and charge a commission for their services.

Sixty percent of sampled broiler wholesalers Dhaka purchased broilers from traders and while the rest bought broilers from traders as well as *aratdars* at Tejgaon. Buying prices were determined by bargaining with *aratdars* or traders but, in most cases, wholesalers accepted the *aratdars'* price. Wholesalers usually set the sale price by marking up the total cost as profit. All wholesalers discriminated selling price on the basis of volume of purchase and buyer's loyalty while 40% of wholesalers also considered mode of payment as a basis for price discrimination. In 2005, only 40% of wholesalers bought broilers on credit from about 16 suppliers; payment was made after the broilers were sold.

In order to understand the retailing of broilers, eight retailers were interviewed: four from Mawna Chowrasta in Gazipur, three from Karwan Bazar in Dhaka city and one from Tejgaon, Dhaka. The retailers in Mawna market were regular broiler traders by occupation. All of them ran their businesses using an average of BDT 75 thousand from their own funds. Their average volume of business was estimated at 313 kg of broilers per day. Only one of the four retailers purchased broilers from suppliers on credit.

Karwan Bazar in Dhaka city is an important wholesale and retail market of livestock products including broilers and eggs. Sampled broiler traders invested an average of BDT 83,333 in their businesses. The average volume of business per retailer was estimated at 100 kg per day. Of the three sampled retailers, two purchased broilers on credit. Retailers received an estimated daily margin of BDT 500.

Table 14 shows the estimated daily costs and margins of *aratdars* in Mawna and Tejgaon markets and wholesalers in Tejgaon market. *Aratdars* sold broilers on behalf of the broiler suppliers, collected money from buyers in case of credit sale and deducted a commission from the proceeds and paid the balance to the suppliers.

Table 14. Daily costs and margins of broiler aratdars and wholesalers in Mawna and Dhaka markets

	Mawna aratdars (n = 5)	Tejgaon aratdars (n = 5)	Tejgaon wholesalers (n = 5)
Volume handled per day (kg)	4200	2012	830
Purchase price	na	na	66,981.00
Marketing costs			
Communication/telephone	26.67	64.27	16.67
Transportation	–	–	61.00
Loading and unloading	–	72.00	–
Wastage (mortality)	–	20.00	334.90
Shop rent	44.00	29.80	92.50
Labour	120.00	120.00	153.33
Electricity	17.92	17.92	11.67
Licence fee	1.37	1.37	1.37
Subscription	–	575.00	–
Others	96.00	204.00	150.00
Total	305.96	1152.36	821.44
Cost of purchase	na	na	67,802.44
Sale price	na	na	69,520.80
Margin	8400*	4024*	1718.36

Commission received at the rate of BDT 2.00/kg.

na= not applicable (*Aratdars* do not buy broilers but act as agents of broiler suppliers).

Source: Field survey (2006).

For wholesalers, 41% of the daily cost was due to wastage or mortality of birds and 19% was due to labour. Wholesalers' return on investment was 2.53%. *Aratdars* received a commission so the rate of return on investment did not apply to them.

4.5.2 Marketing chains for egg producers

This section will discuss the supply chains linking Gazipur district with the Dhaka market. The egg *aratdars* of Tejgaon central market and Mawna undertake informal forward purchase contracts with layer farmers in Gazipur district. The sampled egg *aratdars* of Tejgaon were professional traders with between nine and 20 years of experience. They had each invested between BDT 300 thousand and BDT 1 million of their own capital. Sixty percent of the *aratdars* advanced money (credit) to layer farmers to supply them with farm eggs regularly according to agreed terms and conditions. In 2005, the *aratdars* advanced an average of BDT 31,667 per farmer to six farmers. The daily volume of business was 66 thousand eggs per *aratdar*. Sixty percent of the *aratdars* monitored the production performance of the contracted layer farmers weekly while the rest did not. There was no risk-sharing arrangement between farmers, *aratdars* and buyers.

Egg *aratdars* in Mawna had five to six years of experience and had invested between BDT 300 thousand and BDT 700 thousand in their businesses. Most *aratdars* advanced cash to the layer farmers to ensure a regular supply of eggs; each *aratdar* advanced an average of BDT 80 thousand to about 25 layer farmers. Thirty percent of the *aratdars* monitored the layer production performance weekly while 25% did so every other day. They received eggs from the layer farmers located 10 to 15 km away and their daily volumes varied from 5000 to 80 thousand eggs with an average of 26 thousand eggs per *aratdar*. They generally followed the price announced by the *aratdars* at central market in Dhaka to fix the local purchase price. Farmers bore the cost of transport regardless of whether they delivered the eggs to the *aratdar* or the *aratdars* collected eggs directly from the farmers. As in Tejgaon, there was no risk-sharing arrangement between farmers, *aratdars* and buyers.

The *aratdars'* association in Tejgaon met every night at 2200 hours to set the price for the following day. The price was set by considering the demand and supply situation and size of eggs in the market. The *aratdars* were responsible for collecting proceeds from the sale of eggs and remitting them to farmers after deducting costs and payable commissions. About 40% of the *aratdars* charged a 5% commission while the rest charged BDT 0.15 per egg. In practice, the rate of commission varied from farm to farm and supplier to supplier based on the amount of loan advanced by the *aratdar*. The egg *aratdars* at Mawna and Tejgaon markets charged a daily storage fee of BDT 150 and 158, respectively, per 1000 eggs stored. They incurred costs amounting to BDT 24.40 per 1000 eggs in Mawna and BDT 12.44 in Tejgaon resulting in a margin of BDT 126 and BDT 146, respectively (Table 15). Transport was the principal cost for both locations.

Table 15. *Aratdar's daily marketing costs and margins per 1000 eggs in Mawna and Tejgaon markets*

Cost item	Mawna market (n = 4)		Tejgaon market (n = 5)	
	Amount (BDT)	Percent	Amount (BDT)	Percent
Commission	150.00		158.00	
Communication	1.83	7.5	0.74	5.9
Transportation	17.31	70.9	8.83	71.0
Shop rent	1.28	5.3	0.66	5.3
Labour	3.69	15.1	1.94	15.6
Electricity	0.24	1.0	0.13	1.1
Licence fee	0.05	0.2	0.14	1.2
Total cost	24.40	100.0	12.44	100.0
Margin	125.60		145.56	

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

Source: Field survey (2006).

Egg wholesalers in Tejgaon handled an average of 17,500 eggs per day. The *aratdars* at the central market set the wholesale buying price; 40% used the prevailing market price, 60%

added a fixed margin to the purchase price and marketing cost and 20% marked up the purchase price and marketing cost. All wholesalers discriminated selling price on the basis of mode of payment, volume of purchase and buyer loyalty. In 2005, only 20% of wholesalers bought on credit from two suppliers and made a margin of BDT 5.00 by selling 100 eggs.

Retailers in Dhaka sold an average of 1060 eggs per day. Twenty percent of the retailers bought eggs on credit at the price set by the wholesalers and *aratdars*. The sale price was determined by adding a percentage of the total cost of marketing to the cost and buying price of eggs. The retailers also charged different prices to buyers depending on the size of purchase and buyer loyalty. They earned a gross margin of BDT 58.49 per 100 eggs and BDT 620 per day.

Figures 4 and 5 respectively illustrate the average prices of broilers and eggs at different points in the supply chain. Producers received different prices in the survey year due to seasonal differences in supply and demand. Therefore, the extent of price spread along the supply chain may differ under different demand-supply or market conditions which could not be fully captured by the data collected. However, the figures indicate the actors involved in the supply chains and their possible margins under an average condition.

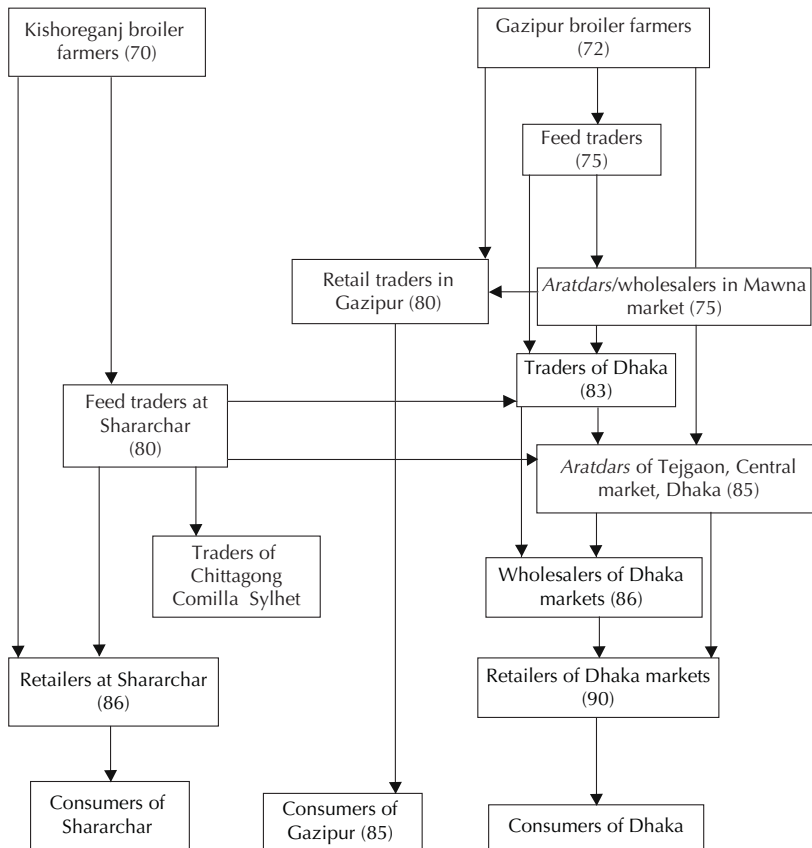


Figure 4. Sale prices of broilers (BDT/kg) at different points in the market chains in Gazipur and Kishoreganj.

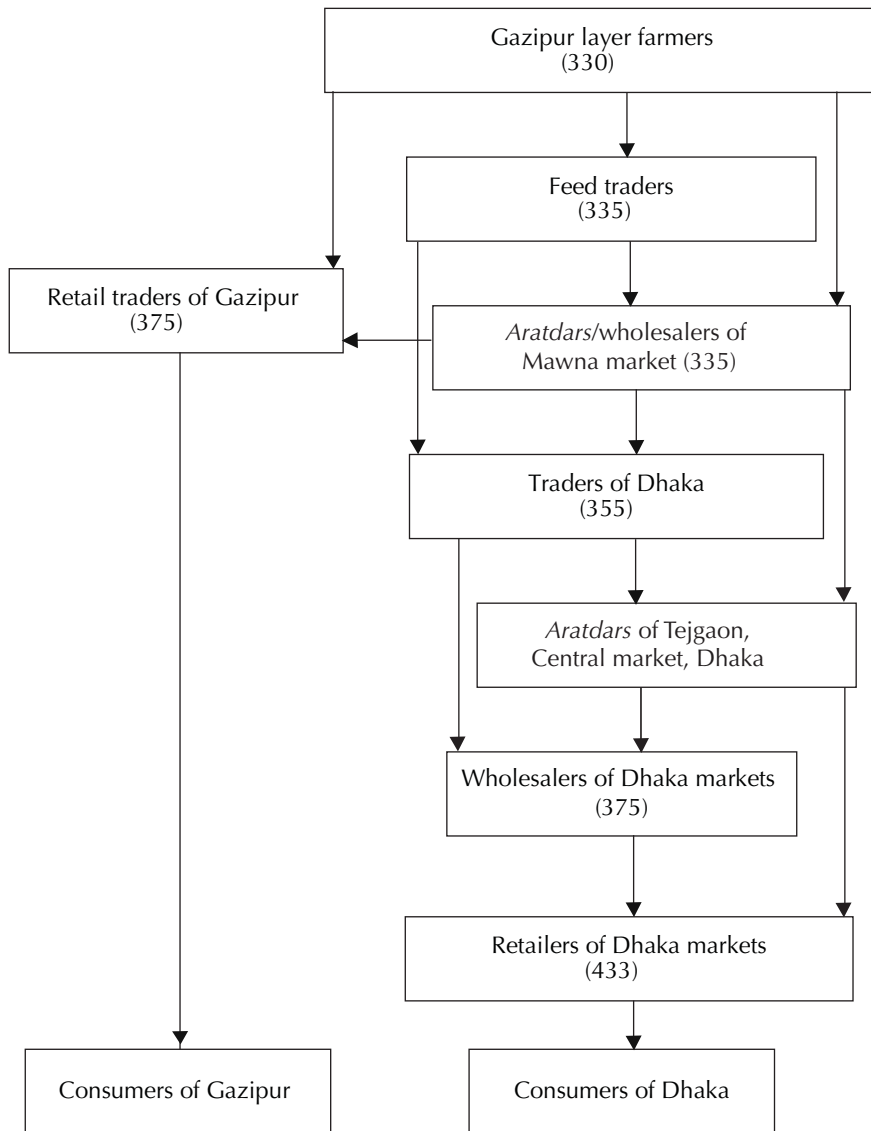


Figure 5. Sale prices of eggs (BDT/100 eggs) at different points in the market chains in Gazipur.

5 Determinants of participation in commercial and contract poultry farming

5.1 Choice of models to explain market participation

Earlier studies on market participation focused on explaining the non-engagement or partial engagement of subsistence and semi-subsistence agricultural households in markets, especially the food market. Theoretical and empirical contributions to this debate include Becker (1965), Barnum and Squire (1979), Singh et al. (1986), Goetz et al. (1988), von Braun et al. (1989), de Janvry et al. (1991), Sadoulet and de Janvry (1995) and Taylor and Adelman (2002). In these studies, it is argued that in a competitive market environment where factors and products are tradable so production and consumption decisions are separable, households maximize profits subject to their production constraints then maximize utility subject to their income and time constraints. However, in semi-subsistence agricultural situations, all factors and products are not readily tradable because of high transaction costs leading to missing markets or market failure. In such situations, production and consumption decisions may not be separable, so households usually maximize utility subject to their production constraints, consumption needs and time constraints, and may engage in market sales only when the household's shadow price of a commodity is lower than the market price minus transaction costs of that commodity.

Another set of theoretical and empirical studies focused on methodological issues related to explaining the decision process in market participation and technology adoption. The main tenets of these studies are that the decision about market participation is mostly a two-stage process whereby the first step is the decision to engage in market and the second a decision on the extent of engagement. Technology adoption also involves a similar process whereby the first decision is to adopt a technology followed by a decision on the extent of adoption. In empirical verification of these decisions, the statistical estimation problem is posed by samples with a dependent variable taking a value of zero representing non-participation in market and positive values indicating varying degrees of participation in market. Such variables are called censored or limited dependent variables. Ordinary least squares (OLS) procedures are unsuitable for estimating the parameters of independent variables to explain the censored dependent variable because several essential assumptions of such models are not satisfied and the predicted values cannot be interpreted as probabilities.

In order to analyse such two-stage decision processes, the probability of a household's participation in market first is estimated by using logit or probit regression and then the entire sample, with both zero and non-zero values, is used to assess the determinants of the level of participation by applying Tobit regression (Tobin 1958; McDonald and Moffit 1980; Maddala

1983; Kinsey 1984; Goetz 1992; Greene 1993). Some applications of these procedures in market participation analysis include King (1980), Lee (1982), Walton and Ragin (1990), Goetz (1992), Roncek (1992) and Key et al. (2000).

Goetz (1995) suggested that the tobit procedure may be applied in two different ways. First, a full tobit model can be used in which the entire sample, with zero and positive values, is included. In this case, an estimated coefficient shows the joint effect of a regressor on both the probability of the dependent variable being non-zero (probability of participation in market) and the extent of participation. Second, a truncated model can be used in which only farms with non-zero values for participation are included. In this case, an estimated coefficient shows the effect of a regressor on the probability of higher extent of participation. The sample with non-zero participation is a truncated part of a larger sample so truncated tobit is more appropriate than OLS estimator to estimate coefficients.

The parameters of logit, probit and tobit models are estimated by maximum likelihood estimation methods. However, there may be difficulties in obtaining consistent estimates by this method if there is a possibility of selectivity bias in samples. In this case, selectivity bias may be corrected by using an alternative procedure suggested by Heckman (1976). In the first step, the probability of participation is estimated by using probit regression. In the second step, an additional variable—the inverse Mills ratio (calculated from the probit model)—is added to the model of the extent of participation to adjust for selection bias.

In this study, we were interested in assessing the probability of rural household participation in commercial poultry farming in general and contract poultry farming in particular. By definition, commercial poultry farming is a cash crop or fully market-oriented enterprise. If a rural household practised poultry farming, it had to decide on the scale of operation. Therefore, household models dealing with non-engagement or partial engagement in markets were not relevant to analyse these samples and selectivity models were used instead. Probit and multinomial logit models were used since the first step was to determine the probability of a household's participation in commercial poultry and contract farming. Distribution of the size or scale of operation of participant households showed that there was a large distance between the censored point (non-participant) and the first positive value (the smallest scale of operation). Moreover, there were small differences in the scale of operation among the participants in a particular type of poultry enterprise in a given district as indicated by low standard error of means of the size of broiler and layer flocks. For example, in Kishoreganj district, the average installed capacity of contract broiler farms was 2131 birds while that of independent broiler farms was 2000 birds. In Gazipur, contract broiler farms had an average installed capacity of 1115 birds while that of independent broiler farms was 1087 birds.

Average installed capacities of contract and independent layer farms in Gazipur were 1076 and 1362 birds, respectively.

The actual sizes of the enterprises during the survey period were slightly lower than the installed capacities for all the enterprises and districts. These figures indicated that the size of a particular enterprise was relatively fixed in a given district. Therefore, it was apparent that the decision of a household to participate in commercial poultry and contract farming and the decision on the scale of the enterprise were joint and simultaneous. Once a decision was made to establish a commercial poultry enterprise, the size of the enterprise was also chosen almost instantaneously. Thus, only factors influencing the probability of participation in commercial poultry and in contract farming were analysed in detail.

Gazipur and Kishoreganj districts had a longer history of commercial poultry development compared to other districts. Smaller scale poultry farms could be found in the two districts and it appears that over time, the sizes of enterprises have increased and relatively stabilized at some level (see Jabbar et al. [2005b] for an indication of this pattern). In other districts where commercial poultry farming has a shorter history or is emerging, it may be possible to find poultry farms of more varying sizes.

5.2 Factors hypothesized to have influence on participation

Contract farming is sometimes considered as a possible institutional mechanism to give smallholders access to higher priced markets and a strategy to get out of poverty by benefiting from the expanding markets for high-value products. In Bangladesh, most farmers are smallholders or landless. Since poultry is a rapidly growing sector, if smallholders can capture a fair share of this market, it will lead to an equitable distribution of benefits to different scales of farms from the expanding poultry market. This study examined the nature of participation of rural households in commercial poultry and the factors that determined their participation.

Three types of farms were sampled: non-poultry, independent commercial poultry and contract poultry farms. Contract farms were involved in production of broilers, layers or breeder stock. In terms of participation, the following options could be considered and compared:

- Among all farms, non-poultry vs. commercial poultry farming
- Among participants, independent poultry vs. contract poultry farming
- Among contract poultry farms, broilers/layers vs. breeder stock production
- Among all farms, non-poultry vs. independent poultry vs. contract poultry farming
- Among commercial farms, independent broiler/layer vs. contract broiler/layer vs. contract breeder stock production

Thus, if participation is considered as a dependent variable, there are options where either two or three discrete choices are involved without any order of preference or value. For binary choices, probit regression model was used to identify factors that explained the choices. In case of three discrete choices, multinomial logit regression model was used to identify factors that explained the choices. Types of contract farms were different in the two survey districts so the districts and the aggregate sample combining the two districts were analysed separately. Several sets of independent variables were tried in different combinations to identify the best-fit equation, based on a set of hypotheses about the effect of these variables on the relevant choices. The factors hypothesized to influence participation in commercial poultry and contract farming are discussed below.

5.2.1 Age of the household head

It was hypothesized that the probability of participating in commercial poultry and contract farming would be lower for older farmers as they may be unfamiliar with improved poultry production technologies and management or may have difficulties adopting new technologies quickly.

5.2.2 Education of the household head

It was hypothesized that the probability of participating in commercial poultry and contract farming would be higher for better educated farmers as this would allow them to acquire knowledge and skills about improved commercial poultry production technologies quickly. They may also be more willing to learn.

5.2.3 Supply of family labour

Because poultry is a labour-intensive enterprise that requires close supervision throughout a production cycle, it was hypothesized that households with a higher supply of family labour would be more likely to participate in commercial poultry and contract farming.

5.2.4 Land holding

It was hypothesized that the probability of participating in commercial poultry and contract farming would be higher among households with larger land holdings as it might allow allocation of some land to poultry away from crop production. Larger land holdings might also allow diversification of production enterprises into poultry, fishery, horticulture etc. to increase income.

5.2.5 Farm income

Higher farm income (from crops, horticulture, fisheries and large animals but not poultry) might influence participation in commercial poultry and contract farming either positively by providing capital for investment in poultry or negatively by discouraging investment in poultry if other farm activities provided good income and employment opportunities. A potential endogeneity problem here is that income from poultry might have been invested by some farmers to increase farm income. However, verification of this would have required information on farm income levels before the poultry farm was established. Because this data was not available, existence of this relationship could not be tested and no definite direction of influence was hypothesized.

5.2.6 Remittance income

Some household members work away from home, either within the country or abroad. Income that they remit may constitute a varying proportion of household income and may influence participation either positively by providing investment and operating capital or negatively as working away from home may mean less household labour to run a commercial poultry enterprise. Therefore, no definite direction of influence was hypothesized.

5.2.7 Non-agricultural business income

Having non-agricultural business income might influence participation either positively by providing investment, operating capital and scope for further diversification of income or negatively as labour supply for commercial poultry operations might be limited. Therefore, no definite direction of influence was hypothesized.

5.2.8 Borrowing

In theory, credit can play a role in establishing a farm where capital constraints limit ability to invest. Credit can also help regular operations by facilitating access to inputs and services. However, it was difficult to use credit as a variable to explain if it played any role in a farmer's decision to participate in commercial poultry or in the choice of the form of commercial poultry farming to be pursued. This was because of a number of reasons, which are explained below.

At the time of the survey, some respondents had outstanding credit from formal or informal sources but it was unclear if that was for initial investment, operational expenses or both. Also, we were unable to ascertain whether the farmers actually needed credit.

It was not clear if the respondents obtained investment credit before they started the business. Initially, contract farmers in Kishoreganj received inputs and some investment capital on credit but after the avian influenza scare in 2003, credit supply of inputs was replaced by cash sale except in the case of breeder stock farms.

Some informal contract farmers in Gazipur borrowed from *araddars* or wholesalers in Dhaka under forward sale contracts, exclusively or mostly to cover operation costs of already established farms rather than for new investments. Thus, these farmers could not be considered in the analysis to explain participation in commercial or contract poultry farming.

A few non-poultry farms also borrowed money for agricultural purposes. However, borrowing status was included in the models where appropriate to explain if a particular type of farm had higher or lower probability of borrowing.

5.2.9. Risk perception

In theory, differences in perception about risk in the poultry enterprise might influence the decision to participate in commercial and contract poultry farming. In addition to normal production and market risks, avian influenza has added a new dimension to the industry environment as it may require mass culling or complete stamping out of flocks in affected areas even if a particular farm is not directly affected. When ABFL introduced contract broiler farming in Kishoreganj in 1994, avian influenza was not an issue of concern for the poultry industry in Bangladesh. Prospective participants in contract farming were only concerned about the normal production and market risks (mortality, market access and price), which the contract farming arrangement addressed. However, after the avian influenza scare of 2000 and drastic (though temporary) fall in broiler prices, many farms underwent losses and gave up contract farming. Partly in response to this, ABFL introduced a compulsory contributory insurance scheme for its affiliated contract growers to cover mortality risk (see Section 3), which encouraged some of the farmers who dropped out due to losses to restart contract farming and some to enter the business.¹ In Gazipur, there was no insurance scheme for sharing of risk by formal or informal contractors so producers bore all production risks. Although this study recognized the importance of risk perception in choice of farming types, differences in the evolution of the circumstances in the two districts made it impossible to discern the risk perception of the sample farmers in a way that would allow it to be used as a variable to explain participation in commercial and contract poultry farming.

1. The country's first outbreak of avian influenza was reported in April 2007 in one of the farms operated by BPC. Subsequent outbreaks were reported in a number of other private farms in several districts and the disease was contained after quick intervention by the government and other stakeholders.

Table 16 summarizes the average values of some of the variables. In both districts, commercial poultry farmers were significantly younger than non-poultry farmers. Independent layer farmers in Gazipur were and significantly younger than all other farmer types in both districts. Non-poultry farmers in both districts were significantly less educated than other groups. Breeder stock farmers had the highest level of education. These observations suggest that young educated persons are adopting commercial poultry production, especially breeder stock farming, using modern technology that requires formal education.

Table 16. *General characteristics of sample households by farm type and district*

Characteristic and district	Broiler		Layer		Breeder stock	Non-poultry
	Contract	Independent	Contract	Independent		
Age of household head (years)						
Gazipur	38 (2.26)	39 (1.85)	38 (1.78)	32 (1.49)	–	43 (2.05)
Kishoreganj	40 (1.33)	36 (1.62)	–	–	38 (1.39)	45 (2.06)
Education of household head (years)						
Gazipur	9 (0.61)	9 (0.67)	10 (0.54)	10 (0.44)	–	4 (1.05)
Kishoreganj	9 (0.52)	8 (0.46)	–	–	11 (0.44)	4 (0.56)
Land holding (acres)						
Gazipur	1.86 (0.29)	2.06 (0.26)	2.57 (0.33)	2.21 (0.38)	–	2.03 (0.21)
Kishoreganj	3.70 (0.64)	2.09 (0.53)	–	–	6.49 (0.57)	1.52 (0.12)
Percent farms with remittance income						
Gazipur	9.5	9.5	2.3	2.6	–	5.0
Kishoreganj	3.3	1.7	–	–	5.3	12.5
Percent farms with non-agricultural business income						
Gazipur	35.7	42.9	16.3	21.5	–	15.0
Kishoreganj	38.3	33.3	–	–	36.8	27.5

Standard error of the mean in parentheses.

Source: Field survey (2006).

Land is the most important productive asset of rural households in Bangladesh. It can be used as a proxy for wealth or poverty as it indicates the potential for generating output and income. On this basis, it appears that breeder stock farmers in Kishoreganj were generally the wealthiest of all types of farmers. In Kishoreganj, contract farmers were wealthier than independent farmers who were wealthier than non-poultry farmers. In Gazipur, the differences in land ownership between the types of farmers were less pronounced. Contract farmers in Kishoreganj were wealthier than those in Gazipur. Broiler and layer farmers in the two districts allocated 2.7 to 6.7% of their land to poultry. Breeder stock farms devoted 8.6% of a larger average holding to poultry.

The average income earned by different types of farmers varied considerably (Table 17). In both districts, non-poultry farmers earned the lowest gross income. Commercial poultry accounted for over half of gross income among contract and independent broiler farmers in Kishoreganj but about 30% among their counterparts in Gazipur. Contract and independent layer farmers in Gazipur earned, respectively, 68 and 52% of their income from poultry. Breeder stock farmers earned 68% of their income from poultry, indicating a high degree of specialization. About one third of the income of non-poultry farmers came from remittances from family members working away from home, either in-country or abroad. Remittance was not very important among the other types of farmers though it constituted about 10% of income among broiler farmers in Gazipur. In both districts and across all types of farms, farms without any remittance had lower average incomes compared to those with remittance.

Table 17. Average annual gross income of farmers and percentage share of income sources by farm type and district

	Breeder farms	Layer farms in Gazipur		Broiler farms in Kishoreganj		Broiler farms in Gazipur		Non-poultry farms	
	Kishoreganj (n = 40)	Contract (n = 43)	Independent (n = 38)	Contract (n = 60)	Independent (n = 40)	Contract (n = 42)	Independent (n = 42)	Kishoreganj (n = 40)	Gazipur (n = 20)
Average gross income per farm (BDT)	452,601	224,446	191,534	185,074	153,711	157,082	144,713	103,605	108,000
Average gross income of farms without remittances (BDT)	447,351	223,283	189,955	180,241	150,711	140,511	130,570	70,305	99,000
Percent share by source									
Crop	15.9	13.9	13.3	21.6	15.2	15.5	18.1	40.0	51.3
Other agricultural services	13.3	11.2	9.8	15.7	23.0	20.4	19.4	20.5	32.3
Scavenging poultry	0.2	0.1	0.1	0.3	0.1	0.3	0.4	0.3	0.4
Commercial poultry	60.0	68.2	52.6	52.5	54.6	30.8	30.2	–	–
Business	9.5	6.1	23.4	7.4	15.2	22.6	22.9	7.1	7.7
Remittance	1.2	0.5	0.8	2.5	1.9	10.4	9.1	32.1	8.3
Total	100	100	100	100	100	100	100	100	100

Includes income from fishing, service, livestock etc.

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

Source: Field survey (2006).

Several sources of loans for broiler and layer farmers were identified though in practice farmers used only a few. Independent farmers took more loans than contract farmers except breeder stock farmers who mostly borrowed from integrators. ABFL contract farmers in Kishoreganj received loans from traders, commercial banks and agricultural banks after the company stopped giving inputs on credit (Table 18). The formal sector, especially commercial banks, still remains a minor source of credit for poultry and other commercial agricultural activities. Contract farmers in Gazipur borrowed from broiler and egg *aratdars* in Mawna and Dhaka.

Table 18. Proportion of farmers who took loans from different sources and average amount borrowed (BDT) by farm type and district

Source of loan	Kishoreganj		Gazipur	
	Contract	Independent	Contract	Independent
Broiler farms				
Friends and relatives	–	30,000 (2.5)	–	57,500 (4.8)
Traders	40,000 (1.7)	34,000 (2.5)	–	–
Money lenders	–	–	29,000 (2.4)	–
Commercial banks	104,250 (10)	–	–	35,000 (7.1)
Agricultural banks	166,000 (3.3)	60,000 (7.5)	170667 (7.1)	15000 (2.4)
Others	70,000 (1.7)	30,000 (5.0)	5000 (2.4)	–
NGOs	–	54,000 (12.5)	–	33,714 (16.7)
All sources	106,750 (17)	47,833 (30)	109,200 (12)	36,231 (31)
Layer farms				
Friends and relatives	–	–	200,000 (2.3)	27,188 (10.5)
Traders	–	–	70,000 (2.3)	–
Commercial banks	–	–	33750 (4.7)	14,000 (2.6)
Agricultural banks	–	–	8750 (4.7)	30,000 (2.6)
Others	–	–	70,000 (2.3)	28,750 (10.5)
All sources	–	–	60,714 (16)	26,775 (26)
Breeder farms				
ABFL	78,289 (94.7)	–	–	–
Friends and relatives	1,500,000 (2.6)	–	–	–
Commercial banks	729,412 (42.1)	–	–	–
Agricultural banks	800,000 (2.6)	–	–	–
NGOs	60,000 (2.6)	–	–	–
All sources	305,776 (100)	–	–	–

Percentage of farms borrowed loans in parentheses.

Source: Field survey (2006).

5.3 Factors influencing participation in commercial poultry farming

Having considered the general characteristics of the sampled farms, credit and risk perception were not included as variables. The results of best-fit equations with the remaining variables are discussed below. Table 19 shows the coefficients of the probit regression equation and related statistics that explain the probability of participation in commercial poultry.

The log likelihood function and the proportions of samples correctly predicted for their likely status in terms of participation indicate a good fit of the equation. There were some

minor differences between the two districts in terms of the significance of certain factors in explaining the nature of participation. As expected, the probability of participation in commercial poultry was significantly lower among older farmers, significantly higher among better educated farmers and significantly higher among farmers having more labour supply and land.

Table 19. *Estimated coefficients and related statistics of probit regression on participation of farms in commercial poultry production by district*

Independent variables	Gazipur β (St error)	Kishoreganj β (St error)	Both districts β (St error)
Age of household head (year)	-0.0111 (0.0105)	-0.0344*** (0.0093)	-0.0231*** (0.0064)
Education of household head (year)	0.1439*** (0.0330)	0.1737*** (0.0352)	0.1433*** (0.0219)
Family labour supply (person units)	0.2056** (0.1002)	0.1483** (0.0758)	0.1802*** (0.0565)
Land holding (acres)	0.0005 (0.0014)	0.0013 (0.0010)	0.0014* (0.0008)
Farm income (BDT)	-0.000008* (0.000005)	-0.000002 (0.000003)	-0.000006*** (0.000002)
Remittance income dummy (yes = 1)	-0.1860 (0.6260)	-0.5752 (0.5678)	-0.2137 (0.3582)
Non-agricultural business income dummy (yes = 1)	-0.1228 (0.3162)	0.0172 (0.2763)	-0.0174 (0.1948)
Borrowing dummy (yes = 1)	7.6472 (186086.73)	0.8513** (0.3492)	1.0883*** (0.2924)
Maximum likelihood estimates			
Log likelihood function	-43.25890	-57.64815	-111.4442
Restricted log likelihood function	-63.37018	-95.34712	-163.1068
Chi square	40.22256	75.39793	103.3251
Significance level	0.000	0.000	0.000
Percent correct prediction	95	83	89
N	185	180	365

***, ** and * indicate significant at less than 1, 5 and 10%, respectively.

Non-poultry = 0, participants = 1.

In Gazipur, the probability of participation in commercial poultry decreased significantly as agricultural income increased, while in Kishoreganj the nature of influence was similar but not statistically significant. Remittance and non-agricultural business income had negative effects on the probability of participation in commercial poultry though this was not statistically significant. As explained earlier, higher farm and non-farm income may have discouraged participation in commercial poultry due to better income and employment from agriculture. However, a reverse causality is also possible as involvement in commercial poultry might have led farmers to invest labour and capital in poultry rather than in non-farm

business. Commercial poultry farmers had a significantly higher probability of borrowing compared to their non-poultry counterparts.

5.4 Factors influencing participation in contract poultry farming

Table 20 shows the coefficients of the probit regression equation and related statistics that explain the probability of participation in contract poultry farming.

Table 20. *Estimated coefficients and related statistics of probit regression on participation of farms in contract poultry farming by district*

Independent variables	Gazipur β (St error)	Kishoreganj β (St error)	Both districts β (St error)
Age of household head (years)	0.0027 (0.0064)	0.0098 (0.0085)	0.0021 (0.0049)
Education of household head (years)	0.0003 (0.0216)	-0.0319 (0.0301)	-0.0063 (0.0166)
Family labour supply (person units)	0.0678 (0.0439)	-0.0063 (0.0556)	0.0191 (0.0321)
Land holding (acres)	-0.0012* (0.0007)	0.0001 (0.0004)	0.0002 (0.0003)
Farm income (BDT)	0.000005 (0.000003)	0.000008** (0.000004)	0.000005** (0.000002)
Remittance income dummy (yes = 1)	-0.2743 (0.4459)	0.1234 (0.7727)	-0.0789 (0.3538)
Non-agricultural business income dummy (yes = 1)	-0.2764 (0.2058)	-0.0212 (0.2522)	-0.1328 (0.1513)
Borrowing dummy (yes = 1)	-0.7034*** (0.2573)	0.0783** (0.2786)	-0.1610 (0.1730)
Maximum likelihood estimates			
Log likelihood function	-106.7001	-72.78010	-192.4608
Restricted log likelihood function	-114.2935	-83.75774	-204.4303
Chi square	15.18683	21.95529	23.93890
Significance level	0.034	0.003	0.001
Percent correct prediction	69	90	86
n	165	140	305

***, ** and * indicate significant at less than 1, 5 and 10%, respectively.

Independent = 0, contract = 1.

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

The log likelihood function and the proportions of samples correctly predicted for their likely status in terms of participation in contract poultry farming indicate a good fit of the equation, especially for Kishoreganj district. However, compared to the function explaining participation or non-participation in commercial poultry, the function had a slightly weaker fit indicating that some important variables explaining participation in contract farming might not have been identified or may have been omitted. In both districts, only land holding and farm income appeared to play some role in the probability of participation in

contract farming. In Gazipur, the probability of participation in contract farming decreased significantly as land holding increased but in Kishoreganj, land holding had no significant effect. In Kishoreganj, the probability of participation in contract farming increased with an increase in farm income but income had no effect in Gazipur. In Gazipur, contract farmers were less likely to take loans while opposite was true in Kishoreganj especially because all the contract breeder stock farmers there took loans because the contractor did not supply inputs on credit as before.

In Kishoreganj, ABFL introduced both broiler and breeder stock contract farming farmers theoretically had a choice between the two. The coefficients of the probit regression equation and related statistics explaining the probability of participating in contract broiler or breeder stock farming are shown in Table 21.

Table 21. *Estimated coefficients and related statistics of probit regression on participation of farms in contract broiler and breeder stock production in Kishoreganj*

Independent variable	β (Standard error)
Age of household head (years)	-0.009865 (0.009244)
Education of household head (years)	0.016896 (0.032851)
Family labour supply (person units)	-0.20996*** (0.0674)
Land holding (acres)	0.000258 (0.00030)
Farm income (BDT)	0.000005*** (0.000001)
Remittance income dummy (yes = 1)	0.18402 (0.66018)
Other business income dummy (yes = 1)	0.28574 (0.26375)
Maximum likelihood estimates	
Log likelihood function	-67.25925
Restricted log likelihood function	-78.74247
Chi square	22.96645
Significance	0.0008
Percent correct prediction	75
n	140

***, ** and * indicate significant at less than 1, 5 and 10% respectively

Broiler = 0, breeder stock = 1.

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

The log likelihood function and the proportion of the sample correctly predicted for their participation in broiler or breeder stock contract farming indicate a good fit of the equation. The probability of producing breeder stock rather than broilers was significantly lower among households with more family labour. Female family members were allowed to work in broiler farms but not in breeder stock farms. The reason for this was unclear though it is possible to speculate that since women also handled various household activities including cooking, they were more likely to pose a risk to the breeder birds. Thus, a larger overall labour supply

allowed for participation in broiler farming but not necessarily in breeder stock farming where male labour had to be hired as needed. The probability of participation in breeder stock farming increased significantly with higher farm income perhaps because this allowed higher capital investment required for breeder stock farming compared to broiler farming. Other factors did not have a significant influence on the choice between contract broiler and breeder stock farming. All the breeder stock farmers borrowed money so this was not included as a variable.

In order to compare the profiles of non-poultry, independent and contract poultry farmers simultaneously, a multinomial logit model was fitted to the entire sample. Table 22 summarizes the results.

Table 22. *Estimated coefficients of multinomial logit model fitted to the sampled non-poultry, independent and contract poultry farms*

	Independent farms ^a β (Standard error)	Contract farms ^a β (Standard error)
Intercept	0.314* (0.926)	-1.406 (0.888)
Age (years)	-0.054*** (0.019)	-0.030* (0.018)
Education (years)	0.207*** (0.050)	0.273*** (0.048)
Family labour supply (person units)	0.271** (0.120)	0.358*** (0.116)
Landholdings (acres)	0.003** (0.001)	0.003** (0.001)
Gross household income (BDT)	0.0001 (0.0001)	0.0001 (0.000)
Farm income (BDT)	0.0001*** (0.0001)	0.0001 (0.000)
Dummy remittance income (yes = 1)	-0.595 (0.906)	-0.131 (0.808)
Dummy other business income (yes = 1)	-0.138 (0.442)	0.005 (0.423)

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

***, ** and * indicate significant at less than 1, 5 and 10%, respectively.

a. Reference category is non-poultry farms.

-2 log likelihood = 567.921, chi square = 11.488, Sig = 000, N = 339.

Pseudo r square: Cox and Snell 0.28, Nagelkerke = 0.324, McFadden = 0.16.

Compared to non-poultry production, the probability of being an independent or contract poultry farmer was significantly lower among older household heads and significantly higher among better educated household heads, households with more labour and households with larger land holdings. The probability of being an independent poultry farmer was significantly higher among households with larger farm income but the effect was not significant among contract farmers. The influence of remittance income and other business income was not significant. Among commercial poultry farmers, another multinomial logit model was fitted to simultaneously compare the profiles of independent, informal and formal contract farmers. The results are summarized in Table 23.

Table 23. *Estimated coefficients of multinomial logit model fitted to sampled independent, informal and formal contract poultry farmers*

	Informal contract ^a β (Standard error)	Formal contract ^a β (Standard error)
Intercept	-3.154*** (0.076)	-3.128*** (0.750)
Age (years)	0.011 (0.013)	0.016 (0.013)
Education (years)	0.171*** (0.0430)	0.130*** (0.040)
Family labour supply (person units)	0.229*** (0.071)	0.013 (0.076)
Landholdings (acres)	-0.001 (0.001)	0.002** (0.001)
Gross household income (BDT)	0.0001 (0.0001)	0.0001* (0.000)
Farm income (BDT)	0.0001 (0.0001)	0.0001* (0.000)
Dummy remittance income (yes = 1)	0.035 (0.709)	0.467 (0.741)
Dummy other business income (yes = 1)	-0.380 (0.349)	0.607* (0.355)

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

***, ** and * indicate significant at less than 1, 5 and 10%, respectively.

a. Reference category is independent farms.

-2 log likelihood = 628.704, Chi square = 86.714, Sig = 0.000, N= 339.

Pseudo R square: Cox and Snell 0.23, Nagelkerke = 0.26, McFadden = 0.12.

The probability of engaging in informal contract poultry farming was significantly higher among better educated household heads and among households with more labour. The probability of being involved in contract farming was also significantly higher among better educated household heads and households with larger land holdings and larger gross, farm and non-agricultural incomes. The effects of other factors were not statistically significant. In Kishoreganj, the probability of engaging in contract broiler farming or production of breeder stock was significantly higher among households with larger farm incomes compared to independent poultry farmers. Other factors were not statistically significant.

6 Technical and economic performance of sampled poultry farms

The technical and economic performance of broiler, layer and breeder stock farms was analysed in each district. Technical performance was measured in terms of biological production parameters. The following were measured for broilers: feed conversion ratio, mortality rate, sale weight and fattening days to sale weight. For layers, the measured parameters were the length of laying period, mortality, egg production per laying period and age at first laying for layer birds. Economic performance was measured in terms of costs and returns per unit of output, benefit–cost ratio and income per unit of family labour. Family labour was the main resource employed by smallholder commercial poultry farms.

6.1 Characteristics of meat and egg production in sampled farms

The average meat production (live weight) characteristics of the contract and independent broiler farms are summarized in Table 24. There were significant differences between Gazipur and Kishoreganj but not so much between farm types within a district. Both independent and contract farms in Gazipur were about half the size of the corresponding farms in Kishoreganj. Contract farms in Kishoreganj had a capacity utilization of 72% while that of independent farms was 87%. In Gazipur, contract farms had a capacity utilization of 80% and compared to 87% in independent farms. Farms in Gazipur also used a shorter fattening period and achieved a lower sale weight than those in Kishoreganj. Feed conversion ratio was more favourable in Gazipur but mortality rates were not significantly different between the two districts and farm types. Price received per kilogram of broilers in Gazipur was also lower than in Kishoreganj.

Egg production characteristics of the layer farms in Gazipur are summarized in Table 25. Contract farms were smaller in size and their capacity utilization was lower than that of independent farms. However, contract farms reared birds for a longer duration so produced more eggs per laying period than independent farms. Mortality rates were about the same for both types of farms but about 12% mortality rate could be considered high for commercial farms as it had implications for costs and profits.

Breeder stock farms are a special type of enterprise observed only in Kishoreganj. Large integrators normally undertake such operations but in Kishoreganj, ABFL introduced contract breeder stock farms as an innovation. These contract farms were closely supervised by ABFL to minimize disease risk and ensure high quality output. The birds produced an average of 178 eggs over a 337-day laying period (Table 26).

Table 24. Average meat production (live weight) characteristics of broiler farms by farm type and district

Characteristic	Contract			Independent		
	Kishoreganj	Gazipur	All	Kishoreganj	Gazipur	All
Capacity (no. of birds per batch)	2131 (154)	1115 (79)	1713 (108)	2000 (210)	1087 (110)	1624 (127)
Actual no. of birds reared	1537 (117)	892 (56)	1271 (79)	1738 (308)	946 (95)	1332 (163)
Duration of fattening (days)	37 (0.4)	34 (0.9)	36 (0.5)	37 (0.4)	32 (0.5)	35 (0.4)
Sale weight per bird (kg)	1.42 (0.03)	1.38 (0.06)	1.41 (0.03)	1.44 (0.03)	1.28 (0.02)	1.36 (0.02)
No. of batches completed in last 12 months	4.92 (0.2)	5.07 (0.2)	4.98 (0.1)	5.12 (0.2)	5.31 (0.3)	5.22 (0.2)
Feed conversion ratio	2.19 (0.07)	2.13 (0.09)	2.22 (0.06)	2.26 (0.16)	1.98 (0.07)	2.12 (0.09)
Mortality rate (%)	6.7 (0.92)	7.6 (0.99)	7.2 (0.67)	9.8 (2.13)	6.5 (1.28)	9.0 (1.23)

Standard error of mean in parentheses.

Source: Field survey (2006).

Table 25. Average egg production characteristics of layer farms in Gazipur by farm type

Characteristics	Contract	Independent	t-value
Average capacity (no. of birds per batch)	1076 (135)	1361 (212)	-1.30
No. of birds reared per batch	899 (71)	1285 (21)	-2.00**
Age at first laying (days)	158 (2)	163 (8)	0.58
Duration of rearing birds (days)	574 (11)	535 (14)	2.13**
Length of laying period (days)	408 (10)	385 (15)	2.13**
Mortality rate (%)	11.8 (0.9)	12.8 (0.9)	-1.17
No. of eggs per bird during laying period	335 (9)	308 (10)	2.09**

***, ** and * indicate significant at less than 1, 5 and 10%, respectively.

Standard error of mean in parentheses.

Source: Field survey (2006).

Bird productivity differed significantly between strains of birds and decreased significantly with increased feed use, indicating possible overfeeding (Table 27). Productivity increased significantly with higher costs of drugs and vaccinations which may have reduced mortality rate. Since there were no similar independent breeder stock farms to compare, it was unclear if this performance was good or bad. The selling price of 100 hatching eggs was BDT 788 against the highest corresponding price of BDT 357 for table eggs for consumption; this might compensate the lower egg productivity of breeder stock farms.

Table 26. Average characteristics of contract breeder stock farms in Kishoreganj

Characteristic	Value
Capacity (No. of birds per batch)	3200 (111)
No. of male day-old chicks/pullets	413 (14)
No. of female day-old chicks/pullets	2883 (100)
Ratio of female to male birds	7:1
Price of day-old chicks (BDT/unit)	192.89 (6.77)
Laying period (days)	337 (6.27)
No. of eggs per bird during laying period	177.68 (3.5)
Selling price of 100 hatching eggs (BDT)	787.63 (9.42)

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

Standard error of the mean in parentheses.

Source: Field survey (2006).

Table 27. Factors influencing number of fertile eggs produced per bird in breeder stock farms in Kishoreganj

	β (Standard error)
Constant	212.221*** (49.483)
Feed in laying period (kg/bird)	-1.664*** (0.554)
Laying period (days)	0.089 (0.085)
Mortality (%)	0.215 (0.324)
Strain 1 dummy (Arber acres plus = 1, other = 0)	-14.061* (7.413)
Strain 2 dummy (Hubbard classic = 1, other = 0)	-29.914** (10.874)
Strain 3 dummy (Kasila = 1, other = 0)	-7.424 (7.736)
Strain 4 dummy (ISA JA57 = 1, other = 0)	24.768** (10.686)
Rearing capacity used (%)	-22.280 (21.100)
Drug and vaccination cost (BDT)	7.43E-005* (0.000)
Education of owner (years)	1.450 (1.183)
Age of owner (years)	0.436 (0.344)
Ratio of hired and family labour	-2.031 (1.569)

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

***, ** and * indicate significant at less than 1, 5 and 10%, respectively.

R² = 0.67, Adj R² = 0.51, F = 4.145, significance = 0.001, n=40.

Source: Field survey (2006).

6.2 Input and output marketing and prices

6.2.1 Feed use and prices

The quantity of poultry feeds used and the prices paid are shown in Table 28. All broiler farmers used industrial feed. Both contract and independent broiler farmers in Gazipur used significantly less feed per production cycle compared to farmers in Kishoreganj because of

a lower fattening period in Gazipur. Farmers in Gazipur paid significantly more for broiler feeds; the reason for this was unclear because Kishoreganj was farther away from major feed mills except the one owned by ABFL which may dominate the Kishoreganj market. However, independent broiler farmers in Kishoreganj paid significantly higher prices than contract farmers, probably because contract farmers usually paid ex-factory prices to ABFL while independent farmers bought in the open market.

Table 28. *Quantity of industrial feed used per production cycle and prices paid by broiler farms in 2005*

Items	Kishoreganj		Gazipur	
	Contract	Independent	Contract	Independent
Broiler farms				
Quantity used (kg/100 birds)	294a (6.2)	275b (8.3)	261 a (10.4)	232b (5.3)
Price (BDT/50 kg)	812a (2.8)	828b (5.8)	842a (2.8)	841a (4.5)
Layer farms				
Quantity used (kg/100 birds)	–	–	5762a (171)	5091b (214)
Price (BDT/50 kg)	–	–	717a (7.6)	704a (9.2)
Breeder farms				
Quantity used (kg/100 birds)	5303 (93)	–	–	–
Price (BDT/50 kg)	701 (0.92)	–	–	–

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

Standard error of the mean in parentheses.

In each row, means with the same superscript are not significantly different at the 0.1 level.

Source: Field survey (2006).

In Gazipur, the two types of broiler farmers paid almost the same price perhaps because feed market here was more competitive. Most independent broiler and layer farmers in both districts bought feed on credit from feed traders. Payment was made after selling broilers and eggs. Analysis of feed trader practices discussed in Section 4 indicated that prices paid per unit of feed by poultry farmers could potentially differ between farms within a district due to differences in the brand and volume of feed purchased, purchase terms (cash vs. credit), purchase source (wholesaler or retailer) and terms for coverage of transport cost (buyer or seller).

Independent layer farmers in Gazipur used significantly less feed than contract farmers per production cycle because of the laying period was shorter. Most layer farmers used manufactured feeds while a few bought feed ingredients which they used to prepare the feed. Independent farmers paid a lower price per unit than contract farmers but the price difference was not significant. In Kishoreganj, breeder stock farmers paid a significantly lower price per unit of feed than broiler farmers because breeder and broiler farms use different types of feed.

6.2.2 Sales outlets and prices of broiler and eggs

In Kishoreganj, all contract farmers sold their broilers to ABFL and all independent farmers sold to wholesalers (Table 29). In Gazipur, 71% of contract farmers and 88% of independent farmers sold to wholesalers while the rest sold to *aratdars*. Over 75% of contract and independent layer farmers in Gazipur sold their eggs to *aratdars* while the remaining 25% sold to wholesalers.

Table 29. Sales outlet for broiler and eggs by farm type and district

	Kishoreganj		Gazipur	
	Contract	Independent	Contract	Independent
Broiler farms				
Wholesalers	–	40 (100)	30 (71)	37 (88)
<i>Aratdars</i>	–	–	12 (29)	5 (12)
ABFL	60 (100)	–	–	–
All	60 (100)	40 (100)	42 (100)	42 (100)
Layer farms				
Wholesalers	–	–	6 (14)	8 (21)
<i>Aratdars</i>	–	–	37 (86)	28 (74)
Cooperatives	–	–	–	2 (5)
Total	–	–	43 (100)	38 (100)

Percentages in parentheses.

Source: Field survey (2006).

Eighty-five percent of contract broiler farmers in Kishoreganj delivered birds to the ABFL purchase centre or the processing plant while 15% delivered birds to buyers at the farm gate. All contract broiler farmers and nearly all independent broiler farmers in Gazipur delivered their birds to buyers at the farm gate. Among layer farmers in Gazipur, 84% of contract farmers delivered eggs to buyers at the farm gate and 16% sold eggs at the local market. Sixty-three percent of independent farmers delivered eggs to the farm gate and 29% sold their eggs at the local market. An additional 8% delivered eggs to the buyers' purchase centre.

All contract and independent broiler farmers in Gazipur sold their birds on cash basis. In Kishoreganj, 95% of independent farmers sold their birds on cash basis with the remaining 5% selling on credit. Fifteen per cent of contract broiler farmers sold their outputs to integrators on cash basis, 12% on credit and 63% on a combination of cash and credit. Since the farmers paid cash for day-old chicks, feeds and drugs, the reason for selling birds on credit or cash-credit combination was unclear. Among layer farmers in Gazipur, 95% of contract farmers and 84% of independent farmers sold eggs on cash basis while the rest sold eggs on credit.

In terms of method of price fixation, all contract broiler farmers in Gazipur and Kishoreganj had a *priori* price agreement with the integrator or other contract buyers. Among independent broiler farmers, 92% in Kishoreganj and 95% in Gazipur used bargaining to determine the spot price while the remainder either agreed to take the post-sale price (price at which the product was sold by the buyer trader) or sold at a previously agreed price. Among layer farmers in Gazipur, 82% of both contract and independent farmers agreed to take the post-sale price and 18% used bargaining to determine the spot price; only one contract farmer had a pre-agreed price.

Lowest and highest prices received per unit output by layer and broiler farmers in the two districts in 2005 are summarized in Table 30. In both the districts, there was a near 50% difference between the highest and lowest prices received by contract and independent farmers due to seasonal variation in supply and demand for broilers and eggs. Since prices paid to contract farmers were linked to the prevailing market prices, both contract and independent farmers faced similar price movements and highest and lowest prices received by different farm types were similar except in case of broiler prices in Gazipur where the average lowest price received by independent farmers was significantly better than that received by contract farmers. It may be recalled that contract farmers in Gazipur usually forward sell to *aratdars* in Dhaka against advances or loans so the farmers may have been subjected to a lower price than the prevailing market price which independent farmers received.

Table 30. Highest and lowest prices received per unit output by farmers in 2005

	Kishoreganj		Gazipur	
	Contract	Independent	Contract	Independent
Broiler farms				
Highest price (BDT/kg)	76.13a (0.59)	76.01a (0.63)	74.29a (0.93)	76.00a (0.83)
Lowest price (BDT/kg)	54.00a (0.87)	52.00a (1.47)	52.00a (1.23)	57.00b (1.12)
Layer farms				
Highest price (BDT/100 eggs) –	–	–	361a (3)	357a (4)
Lowest price (BDT/100 eggs) –	–	–	250a (4)	252a (5)

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

Standard error of the mean in parentheses.

In each row, means with the same superscript are not significantly different at the 0.1 level.

Source: Field survey (2006).

6.3 Disposal and use of poultry excreta

Poultry excreta create health and environmental hazards unless properly used, stored or disposed of. About 80% of broiler farmers in Kishoreganj, 71% of independent farmers in Gazipur and 48% of contract broiler farmers in Gazipur dumped excreta in open spaces. The rest of the farmers stored poultry excreta in protected covered reservoirs (Table 31).

Table 31. *Percentage of farmers reporting method and location of storage of poultry excreta*

Farm type	Storage system and location	Contract farmers		Independent farmers	
		Kishoreganj	Gazipur	Kishoreganj	Gazipur
Broiler	Dump in open space/no specific place	80	48	81	71
	Protected covered reservoir	18	52	20	29
	Open and protected covered reservoir	2	–	–	–
Layer	Dump in open space/no specific place	–	38	–	60
	Protected covered reservoir	–	63	–	39
Breeder stock	Dump in open space	53	–	–	–
	Protected covered reservoir	48	–	–	–
All	Dump in open space/no specific place	69	43	81	66
	Protected covered reservoir	31	58	20	34
	Open and protected covered reservoir	1	–	–	–

Source: Field survey (2006).

The use of protected covered reservoirs was slightly higher among layer farmers in Gazipur and breeder stock farmers in Kishoreganj. Farmers usually avoided the extra cost of proper storage methods because there was no environmental regulation in the country. Local public health authorities, producers and contractors were aware of the long-term consequences of dumping of poultry excreta in open spaces.

Improper storage and disposal of excreta poses a risk of water pollution and other health hazards in areas where intensive poultry production is carried out and especially where population density is high. Use of stored excreta may reduce environmental risks to some extent if it is stored for a short time. Up to 47% of farmers in both districts did not have a specific use for stored excreta (Table 32). Use of excreta as manure in crop fields or fish ponds was common among some farmers, who also sold excreta for use in vegetable fields or fish ponds.

6.4 Costs and returns of broiler farms

In estimating costs and returns, all purchased inputs and services were valued at their actual acquisition costs, including transport cost where applicable. Transport costs may not be incurred for farms located near the input store compared to those located far from the input store. Thus, the nominal purchase price might be the same for the two farms but the total acquisition cost per unit of the same input would be different.

Family labour was valued according to the opportunity cost principle, taking the local wage rate of BDT 80 for male labour and BDT 40 for female labour. Depreciation on buildings and equipment was estimated by the straight-line depreciation method. Interest on operating

cost was estimated assuming a 10% interest rate which was the rate that the country's public commercial banks charged on short-term loans.

Table 32. *Percentage of farmers reporting pattern of use of poultry excreta*

Farm type and pattern of use of poultry excreta	Contract		Independent	
	Kishoreganj	Gazipur	Kishoreganj	Gazipur
Broiler farms				
Used as manure in crop field	2	45	0	35
Used as manure in fish pond or sold	7	7	3	5
Sold	20	13	50	19
Used as manure in crop field/fish pond or sold	5	2	5	5
Manure in crop field and sold	23	7	12	19
Unspecified	43	26	30	17
Layer farms				
Used as manure in crop field	–	39	–	10
Used as manure in fish pond	–	12	–	14
Sold	–	12	–	32
Used as manure in crop field/fish pond or sold	–	7	–	8
Unspecified	–	30	–	36
Breeder stock farms				
Used as manure in crop field	5	–	–	–
Used as manure in crop field and sold	20	–	–	–
Used as manure in fish and sold	5	–	–	–
Used as manure in crop field/fish pond or sold	23	–	–	–
Unspecified	47	–	–	–
All farms				
Used as manure in crop field	3	42	0	24
Used as manure in fish pond or sold	6	11	3	10
Sold	12	12	50	25
Used as manure in crop field/fish pond or sold	12	2	5	4
Used as manure in crop field and sold	22	5	12	11
Unspecified	45	28	30	26
Total	100	100	100	100

Table 33 summarizes the cost structure of broiler farms in both districts. Contract farms generally had higher average costs than independent farms while Gazipur's independent farms had the lowest unit cost. Labour was mainly from family sources. Casual and fixed hired labour was less than 2% of the total cost. Contract and independent broiler farmers in Kishoreganj hired, respectively, 337 and 342 person-days of casual labour per year per farm. Over 90% of the hired workers were women. Contract breeder stock farms in Kishoreganj

hired 594 person-days per farm per year, 39% of whom were women. In Gazipur, contract and independent broiler farms hired, respectively, only 46 and 53 person-days per farm per year; women comprised up to 30% of hired workers.

Table 33. *Cost structure of contract and independent broiler farms by district*

Cost and return	Contract			Independent		
	Kishoreganj	Gazipur	All	Kishoreganj	Gazipur	All
Total cost per 100 birds (BDT)	9744	9316	9532	9101	8691	8913
Percent share by source						
Casual labour	0.80	0.64	0.72	1.03	0.99	1.01
Family labour	8.98	5.45	7.26	3.74	6.94	5.30
Day-old chicks	27.77	33.07	30.00	34.56	35.97	35.17
Feed and additives	50.75	48.70	50.12	50.53	46.82	48.55
Drugs and vaccines	3.54	4.23	3.83	4.26	3.15	3.70
Others*	1.03	0.78	0.93	0.71	0.35	0.53
Interest on operating capital	4.64	4.65	4.65	4.69	0.99	4.67
Total variable cost (A)	97.51	97.53	97.52	98.48	94.21	97.90
Fixed hired labour	0.94	0.97	0.95	0.57	0.44	0.50
Depreciation on buildings and equipment	1.55	1.50	1.54	0.94	1.68	1.59
Total fixed cost (B)	2.49	2.47	2.50	1.53	2.12	2.10
Total cost (A+B)	100	100	100	100	100	100

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

*Polythene, water, litter, electricity etc.

Source: Field survey (2006).

Contract and independent layer farms in Gazipur hired, respectively, 196 and 275 person-days of casual labour per farm per year; up to 3.5% of these were female. Farms in Gazipur were generally smaller than in Kishoreganj so they mostly used family labour. Many young women in Gazipur and Dhaka were employed in garment industries so getting them to work in less attractive poultry farms may have been difficult.

Estimated coefficients of the cost function show that cost per unit output was significantly higher for contract farms in Kishoreganj. Cost per unit output decreased significantly as farm size and utilization of physical capacity increased, indicating economies of scale. Cost per unit output increased significantly as number of fattening days and sale weight increased. Cobb-500 was slightly more costly than other strains (Table 34).

Differences in labour use did not significantly affect cost per unit output.¹ Given that the technology package was almost fixed, inter-farm differences in labour use were expected to be low. To capture any effect of labour input intensity, labour and labour squared were

1. Prices are usually used as variables in cost functions rather than quantities of inputs. However, unpaid family labour accounted for most of the labour input of the sampled farms. These were rated at the prevailing constant wage rate in the area so the source of any variation was the quantity of labour and not the wage rate.

specified as variables. The labour variable was automatically excluded by the best-fit model, indicating that labour input did not vary widely across the sample. The ratio of hired labour to family labour was included as a variable to see if increased use of hired labour had any effect on the cost per unit output but the coefficient was not significant. Table 35 shows the costs and returns per 100 birds in broiler farms.

Table 34. *Estimated coefficients of cost function for broiler farms*

Independent variable	β (Standard error)
Constant	5.766** (2.304)
Farm type dummy (contract = 1, Independent = 0)	0.066*** (0.023)
District dummy (Kishoreganj = 1, Gazipur = 0)	0.117** (0.057)
Market outlet dummy (farm gate = 1, other = 0)	0.028 (0.049)
Ln number of day-old chicks reared	-0.136*** (0.028)
Ln rearing capacity used	-0.070 (0.043)
Ln mortality rate	-0.011(0.009)
Ln fattening days	0.551*** (0.116)
Ln sale weight per bird (kg)	0.254*** (0.067)
Ln education of household head (years)	0.006 (0.006)
Ln of total labour (person days)	na
Ln square of total labour (person days)	0.010 (0.015)
Ln ratio of no. of hired and family labour	-0.001 (0.007)
Dummy (strain, Kasila = 1, other = 0)	0.036 (0.033)
Dummy (strain, Hubbard Classic = 1, other = 0)	-0.001 (0.035)
Dummy (strain, Cobb-500 = 1, other = 0)	0.058 (0.040)
Feed price (BDT/bag)	0.228 (0.335)

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

R² = 0.45, Adjusted R² = 0.41, F= 9.33, n=183, Significance = 0.000.

na: Variable was automatically excluded by the model.

Dependent variable, Ln total cost per 100 birds.

Source: Field survey (2006).

Net return per unit output was the lowest for contract farms in Kishoreganj and highest for independent farms in the same district. When family labour cost was included, the benefit cost ratio (BCR) ranged from 1.01 to 1.05 between farm types and districts. Since this is a residual over all costs, it is a return to management. When family labour was excluded so that the benefit accrued to family labour, the BCR rose to between 1.09 and 1.11; this was considered reasonable. This translated into a return per person-day of family labour ranging from BDT 108 for contract farms in Kishoreganj to BDT 215 for independent farms in the same district. Independent farmers in Kishoreganj earned the highest labour income per unit of labour while contract farms in the same district earned the lowest labour income.

Table 35. *Costs and returns per 100 birds in broiler farms*

Cost and return (BDT)	Contract farms			Independent farms		
	Kishoreganj	Gazipur	All	Kishoreganj	Gazipur	All
Total cost (A)	9744	9316	9532	9101	8691	8913
Total gross return (B)	9845	9729	9797	9554	8998	9269
Net return (B–A)	101	414	265	453	306	356
BCR with family labour cost	1.01	1.04	1.03	1.05	1.04	1.04
BCR without family labour cost	1.11	1.10	1.11	1.09	1.11	1.10
Return to family labour per person-day	108	176	134	215	134	160

BCR: benefit cost ratio.

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

Source: Field survey (2006).

Although independent farms in Gazipur incurred the lowest cost per unit output, they earned the second lowest labour income rate. The reasons for the significantly different labour income rates were unclear. Possible reasons include the sum of small differences in cost per unit, prices received per unit output and differences in technical performance. The labour returns were similar to or slightly higher than the prevailing wage rates for skilled labour in the respective districts, indicating that poultry was a reasonable option for income generation for mixed smallholder farmers.

In Kishoreganj, 93% of hired labourers in broiler farms were women. Because these women had few opportunities for alternative employment, poultry farming provided a reasonable employment opportunity, though at a significantly lower wage rates than male labour. Gazipur is a peri-urban area with higher opportunities for alternative employment because of the presence of various industries. Thus, returns to family poultry workers in this district were comparable to hired industrial wage labourers.

6.5 Costs and returns of layer farms

Table 36 summarizes the average cost per unit output and its component shares for contract and independent farms in Gazipur. The cost per 100 eggs was higher for independent farms though feeds and additives accounted for about 75% of costs in both farm types. Shares of different cost items did not differ much between the two farm types. The unit cost of some items may have been higher in independent farms. In the cost function, egg productivity per bird was the only statistically significant variable that affected the cost per 100 eggs (Table 37).

Table 36. Cost structure of contract and independent layer farms in Gazipur

Items	Contract farms	Independent farms
Average cost per 100 eggs	318	358
Percentage share by source		
Casual hired labour	0.00	0.28
Family labour	8.18	5.87
Day-old chicks	3.14	4.19
Feed and additives	74.84	75.98
Drugs and vaccine	4.09	4.47
Other costs ^a	1.57	1.68
Interest on operating capital	4.72	4.75
Total variable cost (A)	96.54	97.21
Annual fixed labour ^b	1.26	1.40
Depreciation on building and equipment	2.20	1.40
Total fixed cost (B)	3.46	2.80
Total cost (A + B)	100	100

a. Polythene, water, litter, electricity etc.

b. Labourers who are hired on annual basis.

Source: Field survey (2006).

Table 37. Estimated coefficients of cost function for layer farms in Gazipur

Independent variable	β (Standard error)
Constant	233.630*** (87.932)
Dummy (farm type, contract = 1, other = 0)	-4.910 (15.073)
No of starting day-old chicks/pullet	-0.008 (0.020)
Mortality rate (%)	1.913 (1.294)
Days at first laying	0.588 (0.394)
No. of eggs per laying period per bird	-0.131*** (0.044)
Capacity used (%)	25.132 (43.682)
Education (years)	-0.911 (2.400)
Dummy (Sale location, farm gate = 1, other = 0)	-1.738 (16.944)
Ratio of no. of hired and family labour	-6.422 (10.438)
No. of total labour (person days)	-4.458 (13.956)
Square of no. of total labour (person days)	1.972 (1.512)
Dummy (strain 1, BV-300 = 1, other = 0)	-55.952 (35.086)
Dummy (strain 2, Brown Nick = 1, other = 0)	-4.754 (23.639)
Dummy (strain 3, Hyline = 1, other = 0)	-11.143 (27.733)
Dummy (strain 4, ISA Brown = 1, other = 0)	-52.253 (32.827)
Dummy (strain 5, Shaver = 1, other = 0)	-16.666 (27.292)
Dummy (strain 6, Hysex brown = 1, others = 0)	-13.458 (20.855)

*** significant at less than 1%.

R² = 0.38, Adjusted R² = 0.21, F = 2.208, n = 79, significance = 0.012.

Dependent variable: cost per 100 eggs per cycle.

Source: Field survey (2006).

Costs and returns of contract and independent layer farms in Gazipur are summarized in Table 38. Net return and BCR per 100 eggs were significantly higher for contract farmers; Independent farmers only broke even. Returns per person-day were BDT 167 for contract farmers and BDT 73 for independent farmers. For contract farmers, these returns were comparable to the skilled labour wage rate in the district which has many industries. Conversely, the returns for independent farmers were far below the going wage rate. Since poultry is only one of the enterprises that farmers can engage in and since female labour has a slightly lower opportunity cost, the lower earnings for independent farms were still acceptable.

Table 38. *Costs and returns per 100 eggs in contract and independent layer farms in Gazipur*

Item	Contract farms	Independent farms
Total cost (A)	318	358
Gross return (B)	354	359
Net return (B – A)	36	1
BCR with family labour cost	1.11	1.00
BCR without family labour cost	1.21	1.07
Return to family labour per person-day	167	73

BCR: benefit cost ratio.

Source: Field survey (2006).

6.6 Costs and returns of breeder stock farms

Table 39 shows the costs and returns of breeder stock farms per production cycle of about 17 months. Feeds accounted for 60% of the total cost and day-old chicks for 16%. Operating cost items such as day-old chicks, industrial feeds, additives and drugs were supplied on credit by the integrator so these items were excluded in calculating the interest on operating costs. Returns included revenue from sales of hatching eggs, rejected eggs, culled birds, used litter and bags, and insurance refunds. The BCR of 1.10 was comparable to that in Gazipur. Cost per unit increased significantly with longer laying periods but decreased with higher egg productivity (Table 40).

6.7 Overall income difference between farm types

Per capita income from all sources was regressed on a number of factors to compare overall farm income of different farm types in both districts and the contribution of poultry income to overall income (Table 41). Income per capita from all sources did not differ significantly between contract and independent poultry farms. Income per capita was significantly lower in Kishoreganj than in Gazipur, in broiler and layer farms and in larger families. Conversely, it was significantly higher among better-educated farmers and in households with remittance and business incomes.

Table 39. *Costs and returns per cycle of contract breeder farms in Kishoreganj*

Costs	Quantity	BDT	Percent
Hired male labour (person-days)	2655	185,821	4.62
Hired female labour (person-days)	1063	37,193	0.92
Total hired labour (person-days)	3718	223,013	5.55
Day-old chicks (number)	3296	645,168	16.04
Industrial feed until laying period (kg)	42,162	590,272	14.68
Industrial feed & additives during laying (kg)	131,950	1,847,296	45.94
Drugs	–	206,000	5.12
Electricity	–	94,263	2.34
Other costs ^a	–	124,017	3.08
Interest on operating capital		31,258	0.78
Total variable cost		3,762,288	93.55
Total male family labour (person-days)	534	37,384	0.93
Depreciation on housing	–	133,635	3.32
Depreciation on tools and equipment ^b	–	89,181	2.22
Total fixed cost		260,200	6.47
Total cost		4,022,487	100.00
Returns			
Hatching eggs (number)	468,829	3,694,370	83.83
Rejected eggs (number)	17,460	45,921	1.04
Culled birds (number)	2821	611,404	13.87
Used litter and bags	–	38,277	0.87
Refund from insurance	–	16,928	0.38
Total gross return		4,406,900	100.00
Gross margin (Gross revenue—variable costs)		644,613	
Net return (Gross margin—fixed costs)		384,413	
BCR with family labour (male)		1.10	
BCR without family labour (male)		1.11	
Return to family labour per person day (BDT)		790	

a. Litter, tax, sterilization, polythene, sacks etc.

b. Waterer, feeder, fan, generator, laying box, egg tray, van, hand tube well, pump/motor, tank, drum, bucket, nipple drinker etc.

BCR: benefit cost ratio.

BDT: Bangladesh Taka. USD 1.00 = BDT 65.31 at 1 June 2006.

Source: Field survey (2006).

Table 40. *Estimated coefficients of cost function for breeder stock farms*

Independent variables	β (Standard error)
Constant	4.665 (4.804)
Ln no. of day-old chicks reared	0.020 (0.192)
Ln mortality (%)	-0.022 (0.056)
Ln days of first laying	0.493 (0.564)
Ln laying period (days)	1.020 (0.362)
Ln capacity used (%)	-0.334 (0.235)
Ln no. of fertile eggs per bird	-1.216*** (0.381)
Ln education of owner (years)	0.097 (0.102)
Ln ratio of no. of hired and family labour (person-days)	0.154 (0.212)
Ln total no. of labour in poultry	-0.194 (0.322)
Dummy (strain 1, Arber acres plus = 1, other = 0)	0.038 (0.091)
Dummy (strain 2, Hubbard Classic = 1, other = 0)	-0.066 (0.132)
Dummy (strain 3, Kasila = 1, other = 0)	-0.121 (0.098)
Dummy (strain 4, ISA JA57 = 1, other = 0)	-0.097 (0.121)

*** Significant at less than 1%.

R² = 0.66, Adj R² = 0.48, F = 3.603, n = 37, significance = 0.003.

Dependent variable: Ln total variable cost per 100 eggs.

Table 41. *Factors influencing per capita income of the sample farms*

Independent variables	β (Standard error)
Constant	25719.332*** (7253.358)
Dummy (Farm type, Contract = 1, Independent = 0)	-232.745 (3126.589)
Dummy (Location, Kishoreganj = 1, Gazipur = 0)	-5615.329* (3243.522)
Dummy (Enterprise 1, Broiler = 1, otherwise = 0)	-7774.724* (4407.682)
Dummy (Enterprise 2, Layer = 1, Otherwise = 0)	-10799.550* (5551.167)
Dummy (Enterprise 3, Breeder stock = 1, Otherwise = 0)	15287.068** (6328.806)
Dummy (Business income, Yes = 1, Otherwise = 0)	14590.923*** (2834.937)
Dummy (Remittance, Yes = 1, Otherwise = 0)	37665.660*** (5586.187)
Education of owner (years)	1268.216*** (370.492)
Family size (number of persons)	-2410.935*** (534.023)
Age of owner (years)	-12.960 (120.776)

***, ** and * indicate significant at less than 1, 5 and 10%, respectively.

R² = 0.28, Adj R² = 0.26, F = 13.548, n = 37, Significance = 0.000.

Source: Field survey (2006).

6.8 Reasons for discontinuing the poultry business

Out of the 140 sampled poultry farmers in five districts that discontinued the poultry business, 84% raised broilers and 16% layers. These farmers were in business for an average

of 3.1 years for broiler farms and 6.3 years for layer farms. Forty-six percent of the layer farmers operated for more than seven years before discontinuing the business while 61% of broiler farmers dropped out within three years of setting up the business (Table 42).

Table 42. *Percentage of broiler and layer farms operating before dropping out*

Years of operation	Broiler farms (%) n = 118	Layer farms (%) n = 22	All farms (%) n = 140
1	23.7	9.1	21.4
2	19.5	13.6	18.6
3	18.6	9.1	17.1
4	16.1	4.5	14.3
5	11.9	13.6	12.1
6	6.8	4.5	6.4
7 or more	3.4	45.6	10.1

Chi square = 44.391, significant at less than 1% level.
Source: Field survey (2006).

Table 43 lists the cited reasons for dropping out of poultry farming. Most farmers gave several reasons so the percentages do not add up to 100.

Table 43. *Proportion of farmers citing reasons for dropping out of poultry farming*

Perceived main reason(s) for dropping out	Percent sample
Input price higher than output price; lower price of output; output price not remunerative	81
Problems related to day-old chicks:	
Price was high	63
Desired quality was not available	51
Timely supply was not available	34
Adequate quantity was not available	31
Shortage of capital	60
High mortality of birds	47
Low productivity of birds	43
Low demand for products in local market	33
Moved into other business	29
Disagreement among family members/partners	26
Difficult to sell in distant markets	17

Source: Field survey (2007).

The main reasons leading to business failure and eventual dropping out of business were inconsistency between input and output prices, problems related to supply and price of day-old chicks, shortage of capital, high mortality and low productivity, low local demand for products and difficulty in accessing distant markets. All these reasons were enterprise-

neutral (i.e. similar pattern among broiler and layer farms) and scale-neutral. For each reason or combination of reasons given for dropping out of poultry keeping, there was no significant difference in the scale of operation between those who cited the reason and those who did not. No systematic technical and management problems were associated with the stated reasons for dropping out except for high mortality and low productivity, which had implications for contract farms.

Forty-seven percent of the 140 drop-out farms cited high mortality leading to unsustainable losses as the main reasons for dropping out of business. Mortality in the year the business was discontinued averaged 9.4% for the entire sample but 12.6% for those who discontinued poultry farming because of high bird mortality; this difference was not statistically significant. Contract farmers under ABFL are covered by an insurance scheme which allows them to claim full compensation if bird mortality rates are above 15%. However, independent poultry farmers do not have a similar insurance scheme so high bird mortality often forces independent farmers to discontinue poultry production.

High mortality may have been due to the farmers' lack of technical skills in poultry management. Of the 66 farmers who dropped out of poultry business due to high mortality, 61% had no formal training. However, 42% had obtained technical knowledge on poultry farming from neighbours, 21% from traders of day-old chicks and feeds, 17% from drug suppliers or agents of pharmaceutical companies and 20% through trial and error or other means. Of the farmers who did not cite bird mortality as a reason for stopping commercial poultry farming, 31% had obtained technical knowledge on poultry farming from neighbours, 42% from traders of day-old chicks and feeds, 16% from drug suppliers or agents of pharmaceutical companies and 11% through trial and error or other means. Thus, it appears that lack of formal technical knowledge on commercial poultry farming was a major reason for high mortality leading to business failure.

Forty-three percent of the 140 drop-out farms cited losses due to low productivity of birds as the main cause of business failure. Of these, 75% did not get supply of day-old chicks in time, 70% did not get the desired number of day-old chicks, 97% said the quality of day-old chicks was low and 89% were dissatisfied with the quality of veterinary drugs. Of the farmers who did not drop out of poultry business because of low bird productivity, 60% did not get supply of day-old chicks in time, 50% did not get the desired number of day-old chicks, 75% said the quality of day-old chicks was low and 63% were not satisfied with the quality of veterinary drugs. Thus, problems with quality veterinary drugs and supply of day-old chicks appeared to be the main factors that led to losses and business failure although other factors may have played a role.

7 Conclusion and policy implications

7.1 Forms of contract poultry farming

A rapid appraisal involving various stakeholders and detailed follow-up surveys among enterprises involved in various forms of contract arrangements indicated that there were three major types of contractual arrangements in the country's poultry sector:

Production marketing contract: The contractor supplies inputs and services to the contract farmers and then buys the farmers' poultry products. Three different enterprises operate this system: ABFL, BRAC and BPC. However, the terms and conditions vary among the contractors; terms and conditions cover input provision, risk sharing, price fixation procedures, extent of geographical coverage and number of poultry farms involved. The three enterprises together handle less than 700 contract broiler farms in different districts. The enterprises do not all operate in the same areas so they are not direct competitors at the farm level.

Formal input marketing contract: Actors are involved in contracts to supply day-old chicks, poultry feed and/or services directly to farmers or through contracted agents. The agreement is documented in writing and signed by the parties. Kazi Farms, Paragon Poultry and Nourish Feed Mill belong in this category. These companies do not usually buy outputs from farmers but agents and traders who handle the contractor's inputs often facilitate sale of farm outputs as a promotional service to create and expand their input markets. The companies differ in terms of the degree of contractual relations and extent of inputs and services provided. Because the main purpose of these enterprises is to promote input marketing, their business strategies are very dynamic and adaptable to market conditions.

Informal output marketing contract: Actors are involved in contracts to buy farm outputs. The agreement is either verbal or in a form that may not be acceptable in a formal court in case of dispute settlement. Primarily stockists (*aratdars*) and wholesalers of Dhaka central broiler and egg markets and those from other major markets in the supply chains enter into contracts with producers either directly or through agents. The contracts are usually made with already existing poultry farms. Many small-scale commercial poultry farmers enter into such informal contracts because of limited access to formal credit to set up new farms or meet operating costs of established farms or because of the difficulties and real costs of accessing such credit.

7.2 Structure and performance of input and output markets

Other than physical investment in buildings and major machineries, the main inputs in the poultry industry are day-old chicks, feeds, veterinary drugs and small equipment. The

main outputs are broilers and eggs. The structure and performance of the hatchery and feed industries were assessed at the aggregate level by looking at seller and buyer concentrations, degree of product differentiation and entry conditions for new firms. Performance of markets for drugs and small equipment were also assessed by analyzing the trading practices and performance of wholesale and retail traders of these inputs. Similarly, the structure and performance of the broiler and egg markets were analysed by looking at the supply chains, market actors and their market shares, roles, trading practices, costs and marketing margins.

The level of concentration in the hatchery industry in Bangladesh was low to moderate and the hatcheries were located in as many as 31 districts. Only 52% of the hatcheries were in operation while there was significant waiting time and advance payment required for farmers to get timely supply of day-old chicks from operational hatcheries indicating unexploited production capacity and room for additional investment. Product differentiation was reflected in the use of several imported strains for broilers and layers.

The concentration in the feed industry was lower than in the hatchery industry. Seventy-five percent of the feed processing plants were in operation. They had not developed their own distribution channels. Six brands of processed feeds for broiler farms were available in the study areas while layer farmers purchased feed ingredients to prepare feed. Feed markets were competitive at all levels. At the factory level, feeds were sold on cash basis while at retail level most feeds were sold on credit. There were no legal barriers to entry into the hatchery and/or feed manufacturing industries but inadequate supplies of raw materials and irregular electricity supply were major disincentives for new investments in these industries.

Supply chains for broilers and eggs differed between independent and contract farmers and between the two districts. In Gazipur, the chains were fairly complex involving a number of nodes. Some actors at the upper end of the chain, such as *arats* and wholesalers, had greater control of the market especially in influencing the price at all levels of the chain. However, there were significant seasonal differences in prices of broilers and eggs due to seasonal differences in demand. The estimated price spread between producers and consumers of broilers and eggs indicated that market actors at different levels made different rates of margins but the overall price spread appeared reasonable relative to the services provided and level of investment made.

7.3 Factors influencing participation in commercial poultry farming

The results of probit and logit models indicated that the probability of participation in commercial poultry farming was significantly higher among households with higher

education, larger land holdings and more family labour, and significantly lower among older farmers and farmers with more agricultural income. This indicated that family labour was already engaged in good income generation so there was little immediate incentive and scope for diversification. Commercial poultry farmers were also more likely to have borrowed from formal or informal sources of credit compared to non-poultry farmers.

Among commercial poultry farmers, the profiles of independent and contract farmers did not differ significantly except that in some cases, the probability of engaging in some kind of contract arrangement was significantly lower among households with larger land holdings but significantly higher with higher farm income which might have provided required capital for investment. Contract farmers in Gazipur were less likely to have borrowed from formal or informal sources of credit but the opposite was true in Kishoreganj where all the contract breeder stock farmers had borrowed from at least one source of credit.

In Kishoreganj where there was an opportunity to choose between participation in contract broiler or breeder stock farming, the probability of being a contract breeder stock farmer was significantly lower in households with more family labour but higher in households with larger farm income that might have provided the required capital. This may have been because female labour was generally excluded from breeder stock farms, which was not the case for broiler farms. Thus, even with more family labour, effective family labour available for breeder stock farming was lower. Overall, relatively wealthier and more educated households engaged in commercial poultry production. The profiles of independent and contract farmers involved in commercial poultry production were not significantly different. The form of contract chosen was often a function of what was available in a given area as enterprises offering contract arrangements did not operate countrywide.

7.4 Performance of contract and independent poultry farms

Formal contract farms and broiler production were prevalent in Kishoreganj while informal or semi-formal contract farms and layer production was dominant in Gazipur. The average flock size in contract and independent farms in Kishoreganj was 2000 birds in Kishoreganj and 1000 birds in Gazipur.

The average profitability of broiler farms did not differ significantly between contract and independent farms but it differed between the two districts. Contract layer farms performed much better than independent layer farms. These differences were due to differences in feed conversion ratio, fattening days and sale weight (for broilers), and egg production per bird per laying period and length of laying period (for layers).

Overall, the poultry enterprise generated returns to family labour that were comparable to prevailing wages for semi-skilled and skilled labour in the study areas. This indicated that commercial poultry production was a reasonable option for income and employment generation. Commercial poultry farming also helped to diversify the income of both independent and contract poultry farmers. However, the extent of wage employment generation at the producer level was relatively low as most of these farms relied on family labour. Moreover, female workers were paid less than their male counterparts; this might be a reflection of the labour market which currently offers women fewer alternative employment opportunities.

Based on a sample of independent poultry farms in five districts, the key reasons for business failure after one or more years of operation were identified as high input prices, irregular supply of day-old chicks and poor quality of veterinary drugs. These factors caused high mortality and low productivity.

7.5 Policy implications

Formal production-marketing contract farming or classical contract farming represents a small share of the commercial poultry industry in the country. Therefore, one may conclude that formal contract farming offers few opportunities for potential commercial poultry farmers in Bangladesh to participate in such farming arrangements. Among the three operators, BRAC has a greater potential to help small-scale farmers to participate in contract poultry production; the average land holdings and flock sizes of BRAC's contract farmers are the smallest among the three operators.

The main advantage of production-marketing contracts to the producers is an assured outlet for their products. However, sharing of production and price risks, and mode of payment for inputs vary among the three operators. The lack of regulations on minimum wages in the poultry industry has led to wage discrimination between male and female workers in independent and contract farms. This problem probably may not be solved immediately but creation of awareness about this inequality may be a first step towards redressing the problem.

Formal input marketing contracts cover supply of inputs and services. The three large enterprises that operated this type of contract will continue to play a dominant role in the expanding poultry industry. A dual structure is emerging in the hatchery and feed industries whereby a few large operators derive economies of scale and control large market shares. If policy distortions (e.g. cheaper credit, import subsidy on raw materials and tax relief) continue to favour the large operators, their smaller counterparts may be pushed out of business.

Continued competition in the industry will be beneficial for producers, inputs suppliers and input traders as it will keep prices low and improve services and product quality. So long as the input industries remain competitive and new entrants have adequate incentives to join, arrangements will emerge that are beneficial to both poultry producers and input suppliers. However, if concentration in the input industries increases due to true economies of scale or policy distortions, poultry producers are less likely to benefit.

The true extent of informal output marketing or forward purchase contracts could not be ascertained. However, evidence from Gazipur indicates that this arrangement may be fairly widespread. Forward purchase contractors are informal moneylenders who provide credit to small-scale producers whose access to formal credit is either limited or costly. Lack of information on supply, demand, prices and market power of buyers were the main problems for producers under this type of contract. Easier access to formal credit at interest rates and terms comparable to larger operators will increase the bargaining power of small-scale producers under forward sale contracts. The entry of additional formal contract farming operators will increase opportunities for producers to choose between input purchase and output marketing options. It will also increase the bargaining power of producers who enter into informal forward purchase contracts.

Some formal and informal contractual arrangements may not always provide adequate incentives to smallholder farmers. Current formal contract arrangements provide an assured market outlet. However, prices are generally linked to prevailing market prices so contract farmers do not get a price advantage over their independent counterparts. In fact, producers with informal forward purchase contracts are sometimes disadvantaged due to lack of access to market information on supply, demand and prices. Therefore, access to market information needs to be improved in order to provide farmers with an opportunity to continue to engage in contract arrangements. In addition, policy should encourage more business enterprises to enter into contract arrangements with small-scale poultry farmers.

The input- and output-related factors that led to business failure can be addressed by market institutions modelled on contract farming. In the Bangladesh context, contract farming currently covers a small share of the industry so there is wide scope to expand this type of market organization for the benefit of producers, hatchery owners, feed manufacturers and integrators.

The hatchery and feed industries have unused capacity and unexploited investment opportunities. They also face constraints such as lack of raw material, irregular electric supply and lack of investment capital. Removing these constraints at input supply and output marketing domains will require joint efforts of private investors and public-sector organizations involved in research, extension, credit, trade and power supply. Local research

in hatchery management is seriously lacking among hatchery owners and in publicly-funded livestock research organizations. As a result, all poultry strains are imported. Adaptive research is essential for sustained and efficient functioning of the industry.

The input industries and the output marketing channels have created many production- and marketing-related jobs. Small traders and market actors are also involved in creating an equity effect in the industry. Policy should encourage increased investment and competition in the industry for the benefit of investors, traders, producers and the labour market.

The dynamic growth of the industry shows that new norms and practices are evolving as a result of innovative actions by larger enterprises in response to market demand and investment opportunities. However, timely access to quality inputs, services, credit and markets remained major challenges for smallholder producers.

The risk of major diseases, especially avian influenza, remains a problem for the industry. In April 2007, an outbreak of avian influenza was reported in a farm operated by BPC. The disease soon spread to other private farms in several districts but was quickly contained after the government and other stakeholders intervened. The consequences of the outbreak and the containment strategy need to be assessed to learn lessons for future management of such outbreaks.

The potential risk of avian influenza may limit expansion of formal contract poultry farming and may also lead to emergence of terms that are more favourable to integrators. For example, ABFL's decision to change its terms of input supply from credit to cash was aimed at reducing its share of the price risk. However, this move created capital constraints for small-scale producers who now have to access credit from private moneylenders at high interest rates.

In this regard, ABFL's self-financing insurance scheme that covers normal disease risk should be reviewed to assess its suitability to include epidemic diseases like avian influenza. Other integrators or insurance industry players may adapt and scale up this scheme throughout the country. By accommodating such high risk events, the insurance scheme will allow small producers to remain engaged in the poultry sector alongside large operators. However, the public sector needs to provide a general policy and regulatory framework to facilitate the use of such insurance schemes by individual enterprises and to ensure that the interests of all parties are adequately safeguarded.

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