

**Assessment of Sites' Suitability Using MCE Method and GIS
for Poultry Microenterprises and Value Chain Development:
A Study in Gazipur District, Bangladesh**

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for Poultry Microenterprises and Value Chain Development:
A Study in Gazipur District, Bangladesh**

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Abstract

Bangladesh's economy is agricultural, with a poor industrial base. Consequently, the incidence of unemployment and poverty is high. There is growing potential for the development of microenterprises (MEs), especially agro-based MEs, created through the extensive collateral-free lending of microcredit/microfinance to small businesses of the poor. This lending is carried out mainly by several microfinance institutes (MFIs)/non-government organizations (NGOs) throughout the country, thus creating employment opportunities for the unskilled poor, who lack the necessary collateral to access loans from formal banking institutions.

In recent years, many commercial poultry MEs have flourished in Bangladesh. These have created employment for a significant number of the poor population, thus playing a significant role in poverty reduction. Gazipur district, where many households—especially of the poor—depend fully on poultry MEs for their earnings, has the highest concentration of poultry MEs/farms in the country, which can exist on small amounts of land. Poor microentrepreneurs have developed poultry MEs extensively, utilizing their inherited homestead land with the help of microfinance. Thus, not all of these MEs are located in suitable places, resulting in poor input supply and marketing facilities for their products in most cases and thus causing higher transport costs and lower profits. On the other hand, the Government, apex funding agencies, NGOs, and donor agencies apply the same policy in providing support services to all these poultry MEs/farmers, irrespective of their location. Thus, the primary objective of this study is to identify the poultry value chain and constraints, mainly those related to the physical and infrastructural environment in Gazipur district, to facilitate institutions to design interventions to help all the microentrepreneurs in those areas with potential or unfavorable areas to increase their profit and be sustainable. Consequently, to help the government, apex funding agencies, donor agencies, and NGOs to select the areas in which to provide more support—financial/technical/infrastructural—instead of following homogeneity in their assistance efforts, this study delineates suitable sites (or sites that lack suitability) for poultry MEs' development, with respect to factors such as flood-free land and infrastructures related to the poultry business-enabling

environment of the value chain in Gazipur district, an area of 1741.53 square kilometers, using a multi-criteria evaluation (MCE) technique within a geographic information system (GIS) context. Microentrepreneurs in highly suitable areas require minimum effort and investment in order to develop poultry microenterprises. If the suitability level is worse, the effort or cost, or both, is too great to be worthwhile for poultry farming. The identification of feasible locations will induce NGOs to provide adequate funding for these MEs for their further expansion, as well as arranging the required infrastructures and support services, such as a flexible lending policy, providing vaccines/medicines, facilitating quality input supply, and marketing, especially for MEs located in vulnerable areas.

The study also verifies the potential of MEs through an analysis of the geographic concentration of poultry MEs/farms and their production competence with respect to sites enjoying different levels of suitability. Hence, the analysis—a combination of field survey data with a site suitability map of ME/farm concentration—potentially enables the Government, apex funding agencies, and donor agencies to reach a greater understanding of the degree of concentration of poor microentrepreneurs/farmers in several areas. This could help these actors to decide where to allocate more funds or where to direct support services. Thus, the study will not only help policy makers to grasp the potential of poultry sub-sector development but also support the verification of suitability levels. Consequently, by providing greater certainty around demand-driven interventions, the study will aid the Government and apex funding agencies/NGOs in arranging preferential and required support services and infrastructure for unsuitable sites, on which relatively numerous farms are developed. Public policy makers might be aware of pockets of needs for infrastructural improvements. However, the study does not only deal with infrastructural facilities; rather, it reveals the favorable and unfavorable environments, derived through a GIS-based analysis of several weighted physical and infrastructural factors. The study reveals that there is a high concentration of poultry MEs/farms at sites that are deemed to be suitable and to contain potential, while there is a considerable concentration in unsuitable areas too. However, these farms/MEs might have limited productivity due to their unsuitable location, as the analysis shows that there is a limited portion of large poultry MEs/farms at

these sites. The study makes recommendations to help vulnerable microentrepreneurs to enjoy better access to facilities and support services, to reduce their production and marketing costs and add more value, and thus to increase their profit. Therefore, the microentrepreneurs would be able to expand their business and create more employment opportunities for the poor, as long as proper initiatives are taken by the Government and apex funding agencies/NGOs. This would create a kind of homogeneous opportunity for all microentrepreneurs in the district to achieve a competitive advantage and thus maintain the sustainable development of the poultry sub-sector.

Keywords: Microenterprise, Microfinance, Poultry value chain development, Enabling environment, Geographic concentration, Homestead land use, Multi-criteria evaluation, Geographic information system, Suitability of sites.

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Abbreviations

ADB	Asian Development Bank
AHP	Analytical Hierarchy Process
ASA	Association for Social Advancement
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
BBS	Bangladesh Bureau of Statistics
BDT	Bangladesh Taka
BRAC	Bangladesh Rural Advancement Committee
CDF	Credit and Development Forum
CEGIS	Center for Environmental and Geographic Information Services
CR	Consistency Ratio
DFID	Department for International Development
DIBD	Danish Industry International Business Development
DLS	Directorate of Livestock Services
DoE	Department of Environment
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GIS	Geographic Information System
ICG	International Consulting Group (ICG)
IFAD	International Fund for Agricultural Development
InM	Institute of Microfinance
LAPO	Lift above Poverty Organization
LGED	Local Government Engineering Department
MCE	Multi-Criteria Evaluation
ME	Microenterprise

MFI	Microfinance Institution
MFTSP	Microfinance and Technical Support Project
NGO	Non-Governmental Organization
PIDM	Participatory Initiatives for Development of the Masses
PKSF	Palli Karma-Sahayak Foundation
PLDP	Participatory Livestock Development Project
PMUK	Padakkhep Manobik Unnayan Kendra
PWD	Public Works Department
SSS	Society for Social Services
TMSS	Thengamara Mohila Sobuj Shongho
USAID	United States Agency for International Development
WLC	Weighted Linear Combination

Chapter One

Introduction

1.1 Background and problem statement

Bangladesh is the most densely populated country in the world. Almost half of the people in Bangladesh live on the wrong side of the poverty line. Historically, periodic anti-poverty programs have not been successful in offering a permanent solution to even a tiny fraction of the huge poor population in the country. It has been proven that merely setting up a charitable fund does not guarantee a way out of poverty. The wage employment approach through food-for-work and vulnerable group development programs was introduced in the 1970s. These programs involved only those who were poor and who depended on manual labor for their daily wages (Osmani and Choudhury, 1983). Although the programs appeared to be effective and provided basic infrastructure, the development of sustainable income generation and employment for the poor has been limited, mainly because of their temporal and seasonal nature (Ahmed *et al.*, 1995). These targeted wage employment schemes can improve consumption levels, particularly the consumption of food by the poor, only if poverty is the direct result of seasonal unemployment. If unemployment is chronic rather than seasonal, however, there is a need for sustainable employment generation (Ravallion, 1991).

Bangladesh's economy is predominantly agricultural, with a very poor industrial base. This is typical of an underdeveloped country, where the agricultural contribution is high but the contribution of the manufacturing and service industries to the national economy is low. The incidence of poverty in Bangladesh is high. Poverty in Bangladesh is a manifestation of increasing landlessness, a low literacy rate, meager technological knowledge, low productivity, and a high population growth rate. All these affect the growth of savings and investment and, as a result, lead to high unemployment levels. The few available jobs

do not pay living wages. The lack of savings and capital makes it difficult for the landless poor to start small businesses or microenterprises (MEs), and hence become self-employed. The creation of employment is a prerequisite for poverty reduction. According to Sen (1985), "... one's exchange entitlement is determined on his ability to find employment and how long and (at) what rate." There is great potential for ME development in Bangladesh, especially among the unemployed poor with little education, less technological know-how, and less productivity. Their only challenge is to obtain capital to start their own business. They do not have access to loans from formal banking institutions since they lack collateral. Informal lenders play an important role in many low-income countries, but they often charge high interest rates, thus inhibiting poor people from investing in income-generating activities. These groups' demand for financial services can be met through a microfinance program.

There is growing potential for the development of MEs, especially agro-based MEs, created through the extensive collateral-free lending of microcredit and microfinance to small businesses of the poor in Bangladesh. This lending is carried out mainly by several microfinance institutions (MFIs)/non-government organizations (NGOs) throughout the country. These NGOs, in turn, receive funding mainly from the PKSF (Palli Karma-Sahayak Foundation), an apex funding agency established by the Government. The PKSF allocates and disburses funds, as well as providing support to NGOs in different areas of the country. In Bangladesh, collateral-free microfinance has accounted for about 40% of the total reduction of poverty (Khandker, 2005).

In Bangladesh, poultry production is one of the fastest-growing, agro-based MEs in the livestock sector and plays a crucial role in agricultural growth and economic development. A considerable portion of the growing population's huge demand for protein is met by the supply of poultry products at a relatively low cost. Poultry farming, which can be undertaken on small amounts of land by poor households, seems to be among the most profitable agricultural activities, especially in a populous country where agricultural land is very limited and highly valuable. In rural areas, many households—especially of the poor—depend fully on poultry farming for their earnings. However, owing to some problems that the microentrepreneurs

in the sector are facing, in relation to the supply of the inputs needed for production and the marketing of the production, they are not able to achieve the optimum production and profits. However, there is great potential for the development of the sub-sector as there is high population growth along with a high demand for poultry produce in the country. In Bangladesh, only about one-third of the total demand for poultry eggs is met by its production, and about one-fifth of the total demand for meat is met by all kinds of sources of meat production (DLS, 2010).

In recent years, many commercial poultry farm MEs have flourished in rural areas in Bangladesh and thus created employment for a significant number of the poor population, thus playing a significant role in poverty alleviation. Poor entrepreneurs, who own as little as 0.5 acres of land, have developed poultry farms extensively, utilizing the small inherited homestead land in front of their home. Paul *et al.* (1990) mention poultry as a comparatively better source of employment to earn cash on homestead land in rural Bangladesh. These poultry farm MEs can be considered as the most important actors in the poultry sub-sector and are in a key position for the profitable operation of all the other actors in the whole value chain.

Gazipur district has the highest concentration of commercial poultry MEs/farms in the country. These poultry MEs are distributed throughout the district. However, not all of these MEs/farms are located in suitable places, resulting in poor input supply and marketing facilities for their products in most cases and thus causing higher transport costs, less value, and less profit. On the other hand, the Government, apex funding agencies (i.e., the PKSF), and donor agencies (such as the World Bank; DFID, Department for International Development; IFAD, International Fund for Agricultural Development; ADB, Asian Development Bank) have to apply the same policy to the allocation/provision of financial and other support to all poultry farmers, irrespective of their location.

Microentrepreneurs/farmers in highly suitable areas require minimum effort and investment in order to develop poultry farms/microenterprises. In an area delineated as moderately suitable, modest effort and investment are required, while if an area is marginally suitable, significant intervention may be required. If the suitability level is worse, the effort or cost, or both, is too great to be worthwhile for poultry farming.

The identification of feasible locations will encourage the establishment of poultry MEs and induce NGOs to provide adequate funding for these MEs for their further expansion, as well as arranging the required infrastructures and support services, especially for MEs located in vulnerable areas. Thus, the identification of suitable land areas for MEs/farms will help enterprise development service providers to decide on proper demand-driven support for microentrepreneurs in different locations, and thus enable all the farmers in the district to have better access to facilities and support services. This will reduce their production and marketing costs and increase their profit, allowing them to expand their business and create more employment opportunities for the poor.

This research determines the spatial distribution of poultry farms/MEs and their production competence with respect to sites enjoying different levels of suitability in Gazipur district. Hence, the study potentially enables the Government, apex funding agencies, and donor agencies to reach a greater understanding of the degree of concentration of poor farmers in several areas. Public policy makers might be aware of areas in need of infrastructural improvements. However, the study does not only deal with infrastructural facilities; it also reveals favorable and unfavorable environments, derived through a GIS-based analysis of several weighted physical and infrastructural factors. The study could help the supporters to decide where to allocate more funds or where to direct support services through the different NGOs working to help the poor out of poverty, thus making the whole sub-sector more sustainable. Some areas might lack adequate infrastructure and a suitable environment or might have few poultry farms. In that case, public policy makers should give priority to areas that are unsuitable and have a higher concentration. The study will not only help policy makers to grasp the potential of poultry sub-sector development but will also support the verification of suitability levels. Consequently, by providing greater certainty around demand-driven interventions, the research will aid the Government and the PKSf/NGOs in arranging preferential and required support services and infrastructure for unsuitable sites, on which relatively many farms are developed.

1.2 Objectives

The main objective of this research is to determine the poultry value chain along with the constraints mainly related to its physical/infrastructural environment and to analyze sites' suitability for poultry MEs in Gazipur district, with the expectation of enabling the Government and NGOs to plan interventions to help all the poultry microentrepreneurs create more value and increase their profit and sustainability.

In particular, the research intends:

- To determine the poultry value chain and identify the constraints mainly related to the physical/infrastructural enabling environment for the poultry value chain that affect the creation of value and optimum profit earnings for the poultry MEs and sustainable development;
- To identify the geographical distribution of poultry MEs/farms linked to the value chain in the study area;
- To examine how well sites satisfy the criteria for poultry farming and identify sites' suitability (and sites' lack of suitability) based on the physical/infrastructural environment and thus to grasp the possibility of unequal distribution of value for producer-level actors of the value chain;
- To make recommendations regarding how to overcome the constraints to the creation of optimum value by the poultry MEs at sites with different levels of suitability, through the interventions of the Government, NGOs, and other supporters of the value chain to ensure sustainable development and more employment and thus greatly reduce poverty in the country.

1.3 Research methodology

This research mainly depended on primary data collected from the field. Some information from secondary sources was also used. As the author has not come across any similar studies, several documents and pieces of literature related to poultry farming and other agriculture activities were reviewed. A sample

survey was conducted, using the methods of semi-structured questionnaire interviews, a case study of poultry microentrepreneurs, and participatory observations, to understand the existing value chain. Poultry microentrepreneurs are the central actors in the chain and are involved with every member in the value chain. In addition, interviews were conducted with individuals representing each node in the value chain, the Government, the private sector, and NGOs. With the purpose of identifying the existing constraints regarding the availability of support services, marketing of the products, and collection of input materials mainly related to the infrastructure in the value chain, information about the relationships among all the participants in the value chain was collected. A questionnaire interview was conducted with livestock experts to determine the weight for criteria for value chain development. To cross-check sites' suitability, microentrepreneurs/farmers were surveyed further after GIS (geographic information system) analysis had been conducted at sites with different suitability classes.

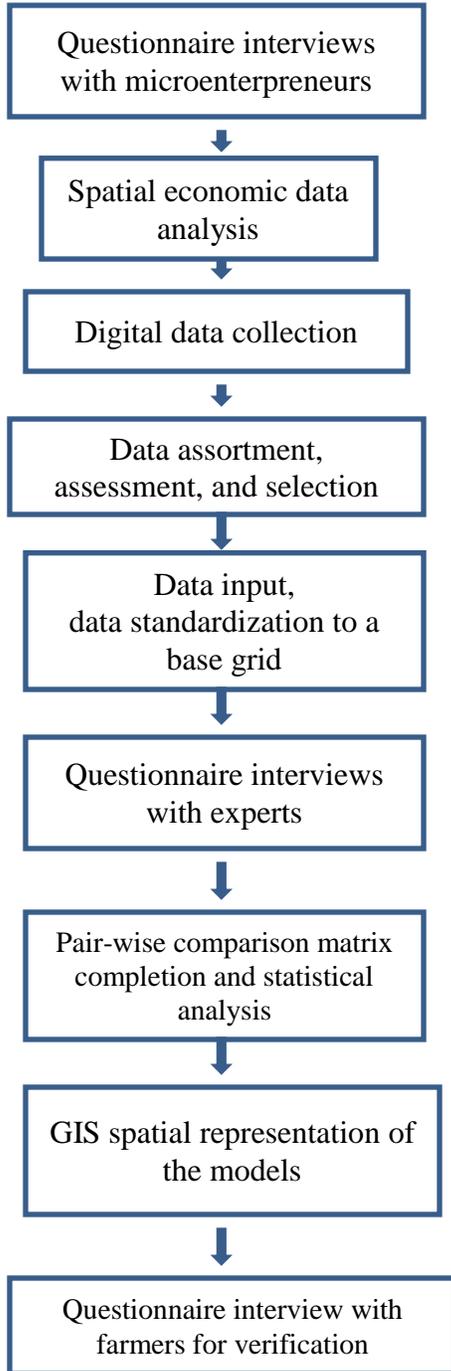
Thematic maps and administrative maps of the study area were used. High/low-lying land with flooding, the location of transportation facilities, the location of government livestock offices and marketplaces for input (chicks, feed, medicine) supply, and the location of forests, rivers, and water bodies were considered as the criteria for poultry sub-sector development. To identify land free from flooding, digital data/maps were collected from the Center for Environmental and Geographic Information Services (CEGIS). Digital data/maps of the distribution of the current roads and highways, the location of big marketplaces/growth centers and government livestock offices, and the location of forests, rivers, and water bodies were obtained from the Local Government Engineering Department (LGED), Bangladesh. Digital data on the location of the current poultry farms/MEs were collected from the Directorate of Livestock Services (DLS), Bangladesh. Some additional socio-economic data were gathered by a field survey.

The selection of the factors to determine sites' suitability for poultry farming was essentially related to the farming system adopted by the microentrepreneurs, which modifies the success of the poultry sub-sector particularly in respect to cost-effective production and marketing. Accordingly, four factors—high/low-lying land with flooding, transportation facilities like roads and highways, the location of

markets/growth centers and government livestock offices, and constraints, such as forests, rivers, and water bodies—were selected and scored and sub-models were developed.

To determine sites' suitability for poultry MEs, the final suitability model, digital data were compiled and analyzed using GIS and MCE. Finally, and as an important part of the whole procedure of using GIS, the geographical distribution of poultry farms and their production at different sites with different levels of suitability for poultry MEs/farms were evaluated through analyzing digital data using GIS to assess the accuracy of the result of the final suitability model. The GIS software used in this study was ArcGIS. A schematic diagram summarizing the procedures that were maintained in manipulating, classifying, and integrating the criteria in the study is provided in Figure 1-1.

Survey and data analysis



Modeling

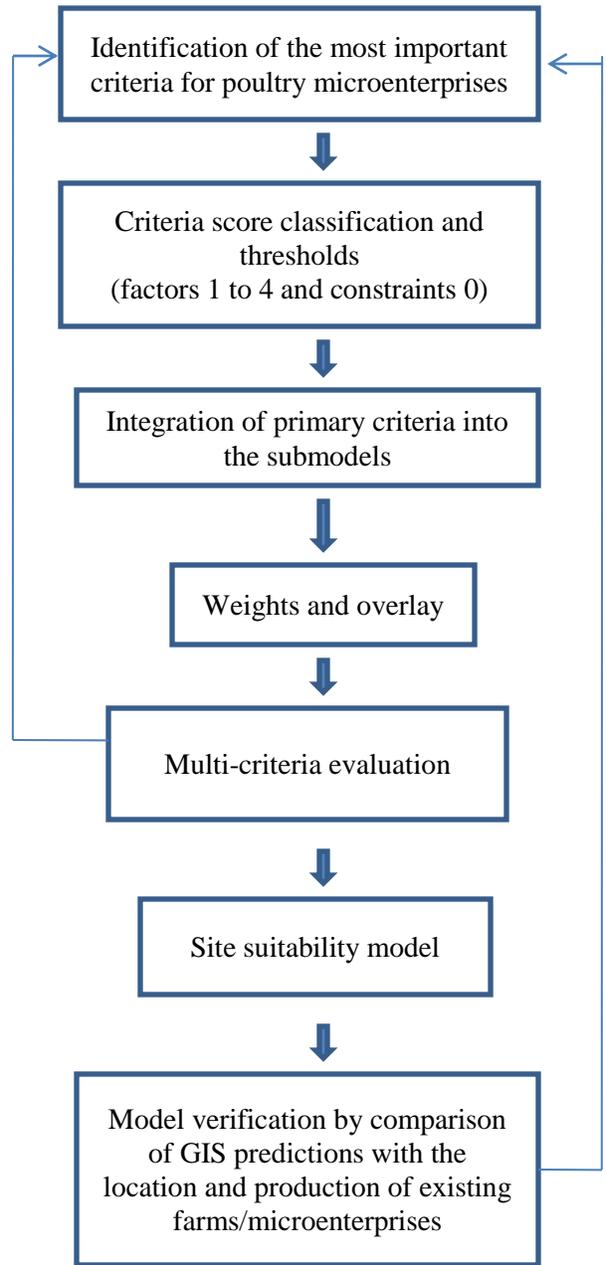


Figure 1-1: Schematic diagram of the analytical procedure involved in the study.

1.4 The study area

The study was carried out in the Gazipur district, an area of 1741.53 square kilometers of land, almost in the middle of the country, as shown in Figure 1-2. The global location of Gazipur district is between 90° 09' and 90° 39' east longitude and 23° 45' and 24° 21' north latitude. Gazipur district is bounded by Mymensingh and Kishoreganj districts to the north; Dhaka, Narayanganj, and Narsingdi districts to the south; Narsingdi to the east; and Dhaka and Tangail districts to the west. Old Brahmaputra, Shitalakshya, Turag, Bangshi, Balu, and Banar are the main rivers that run through the district, which consists of 5 upazilas/sub-districts—Gazipur Sadar, Kaliakair, Kaliganj, Kapasia, and Sreepur; 47 unions; 710 mouzas; 2 municipalities; and 1163 villages. The Dhaka–Tongi road connects Gazipur with Dhaka. There are 5 railway stations in the Gazipur district: Rajendropur, Sreepur, Dhirasrom, Joydevpur, and Tongi. There are around 600 kilometers of paved roads, 348 kilometers of semi-paved roads, and 2,692 kilometers of unpaved roads, 86 kilometers of railways, and 146 nautical miles of waterways. Several NGOs or MFIs (microfinance institutions) operate microfinance programs in the district, among which BRAC, ASA, TMSS, PMUK, SSS, Hunger, Proshika, World Vision, Swanirvar Bangladesh, PDIM, etc. can be mentioned.

The choice of the study area was influenced by the following considerations:

- a. In Gazipur district, the number of commercial poultry farms is the highest in the country. Altogether, 72.9% of the total commercial poultry in the country is located in Dhaka and Chittagong divisions. In Dhaka division, out of 16 districts, 5 have the highest concentration of poultry farms (72% of the commercial production) and Gazipur district ranks first in commercial poultry production among them (BBS, 2006).
- b. The first poultry breeding farm in Bangladesh was established in the district in 1964, when farmers in the area started commercial poultry farming (Islam *et al.*, 2010).
- c. Gazipur district is located near the capital city of Dhaka (37 km away), where the demand for poultry meat and eggs and the concentration of government institutions and NGOs are high, so the district

accesses a large market for its products, along with support services from several government organizations and NGOs, more easily than other districts in the country.

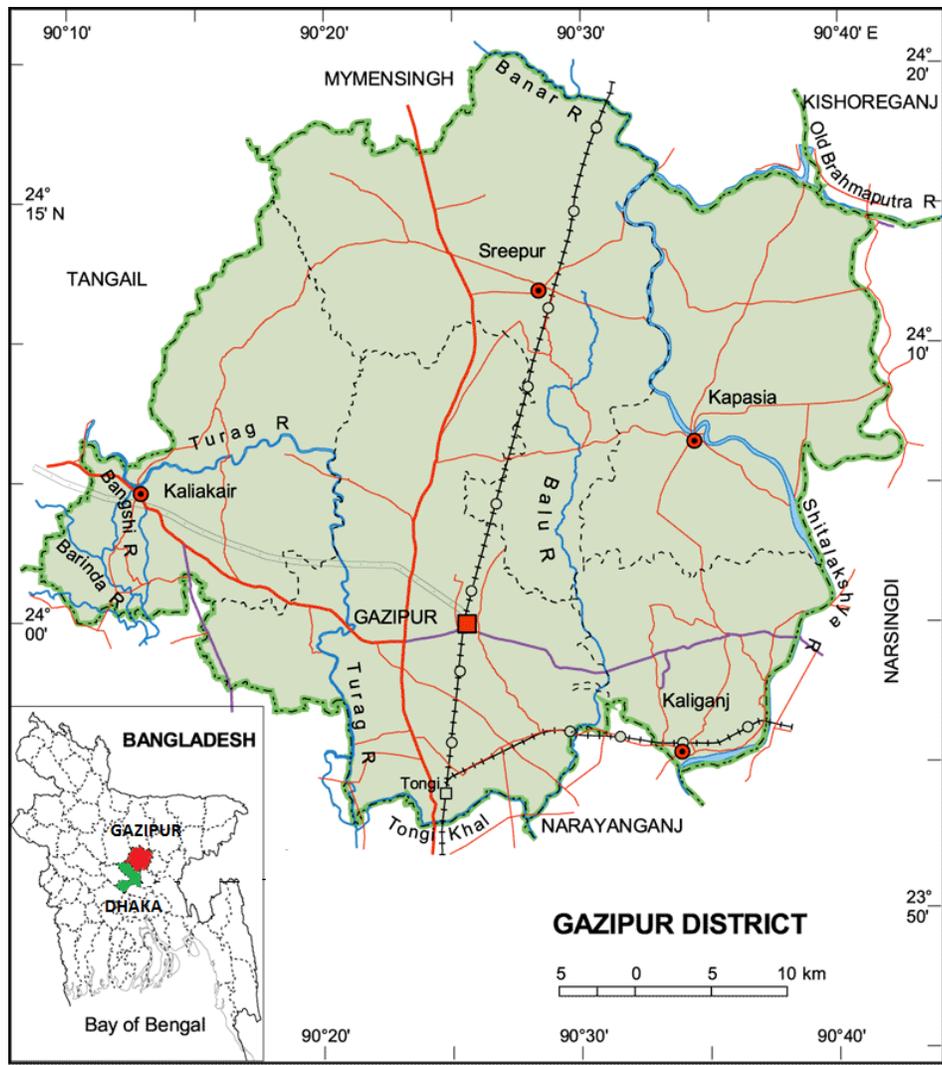


Figure 1-2: The study area: Gazipur district, Bangladesh.

Source: GIS Section, BANGLAPEDIA, Asiatic Society of Bangladesh.

Chapter Two

Review of Previous Studies

2.1 Concepts and definitions of the terms

The study focuses on the delineation of sites' suitability mainly depending on the factors related to the physical/infrastructural environment of poultry MEs and poultry value chain development in Gazipur district. Therefore, this section, through a review of academic and applied literature related to microfinance, microenterprise, value chains, and small agricultural activities, discusses some definitions of the terms expressed by many authors, researchers, and practitioners and the use of MCE and GIS in different small farming activities, as the author has not come across any similar studies or literature related to poultry microenterprises and value chain development based on the identification of the suitability of sites.

2.1.1 Definition and concept of the value chain

There are several definitions of value chains and value chain approaches. The value chain concept was first expressed and explained by Michael E. Porter in 1985 in his book, *Competitive Advantage: Creating and Sustaining Superior Performance*, the key element of which was the value chain model. The relevance of the model is that it takes into account the value changes along the chain, providing a distributional dimension, and it also considers the participation of different actors in the chain. According to the model, value is added by each activity in a chain of interconnected activities, as each product or service passes through different interconnected activities. According to Porter, the value chain is a tool to disaggregate buyers, suppliers, and farms into discrete but interrelated activities from which value stems,

and competitive advantage grows basically out of the value a farm is able to create for its buyers that exceeds the farm's cost of creating it.

According to Kaplinsky and Morris (2000), "The value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production, delivery to final consumers, and final disposal after use." They mention three sets of reasons why value chain analysis is important, one among which is that it is necessary to understand the dynamic factors within the whole value chain to achieve sustained income growth. Following Kaplinsky and Morris (2000), the FAO (2004) defines the value chain as: "the full range of activities which are required to bring a product in service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use." Value chain development is closely connected to cluster development. It considers how to improve the productivity of clusters of producers, while cluster development generally has to consider the market potential of value chains. Definitions of value chains generally encompass a range of related products, while some focus on a single product. A value chain is defined as a supply chain made up of a series of actors—from input suppliers to producers and processors to exporters and buyers—engaged in the full range of activities required to bring a particular product from its conception to its end use (DIBD, 2009). A value chain encompasses the full range of activities and services required to bring a product or service from its conception to sale in its final markets—whether they are local, national, regional, or global. It includes input suppliers, producers, processors, and buyers and is supported by a range of technical, business, and financial service providers (USAID, 2006). A value chain connects the steps a product takes from the producer to the consumer, and value chain development entails improving access to markets and enhancing the efficient product flow, thus ensuring that all the actors in the chain are benefited. Therefore, in order to generate improvements in the supply and quality of the product, it is necessary to consider the location aspect of the production farms, support services, and markets in the chain, which is of the greatest importance, as well as considering other aspects. Shepherd (1996) refers to the concept as a marketing

channel, while describing it as a sequence of stages involved in transferring a product from the farm to the consumer.

Roduner (2007) argues that any agricultural produce not consumed by the farmers' families is a product in the market (local to international) and competes with products coming from nearby or far away. Therefore, all farmers offering their produce for sale are instantly part of a value chain. According to him, value chain development or donor/NGO/government intervention is important as some actors may need support to become an actor in an existing value chain and some actors may be stuck in a value chain that exploits low-income possibilities and seek support for higher-income opportunities. The outcome of the intervention by the development agencies is in the public interest, such as food security, poverty alleviation, environmentally sound practices, etc. Value chain analysis allows the discovery of potential and bottlenecks within three important levels and in the dynamic interactions between them; these are the value chain "actors," who deal directly with the products, that is, they produce, process, trade, and own them; the value chain "supporters," who are the actors who never deal with the product directly but whose services add value to the product; and the value chain "influencers," which are the regulatory framework, policies, infrastructures, etc. at the global, national, and local levels.

Value chain development is often considered to be closely related to cluster development. Accordingly, it generally considers how to enhance the productivity of clusters of producers, while cluster development concerns the market potential of value chains, beyond the immediate geographical focus of the intervention. Porter (1990) defines clusters as groups of industries that trade directly and indirectly with one another, utilize similar technologies, share distribution channels, or face similar labor needs. The value chain approach is used to increase production, income, and employment opportunities for the poor. All the different activities or processes through which a product or service passes until it reaches the final consumer offer the possibility to include microenterprises in regional or global value chains, and thus the chance to lift the poor out of poverty. The value chain approach enables NGOs, as well as government organizations, to identify constraints in the value chain's competitiveness and to design interventions, thus providing the

potential to develop appropriate policies that may enhance competitiveness. Consequently, it may serve as input for government strategies. Most donor agencies use the value chain approach to identify constraints to competitiveness and make policy recommendations. They focus on diverse factors in the value chain. Some follow a micro approach, which focuses on interventions aimed at firm upgrading, and others have a macro approach, which focuses on creating a business-enabling environment. At present, there is no conclusive answer to the question of where interventions have the greatest impact in terms of growth and poverty reduction (DIBD, 2009).

The Asian Productivity Organization (2007) defines a value chain as the sequence of value-adding activities from production to consumption, through processing and commercialization. Each segment of a chain has one or more backward and forward linkages. It also mentions that a chain is only as strong as its weakest link; hence, the stronger the links, the more secure is the flow of products and services within the chain.

A USAID (2006) briefing paper entitled *The Value Chain Framework* describes five elements in a value chain and includes all the farms in the chain: 1. end markets; 2. business and enabling environment; 3. vertical linkages; 4. horizontal linkages; and 5. supporting markets. The end markets are the consumers, not a location, who determine the price, quality, quantity, etc. of a product. The business and enabling environment, at local, national, and international levels, includes laws and regulations and public infrastructure, such as roads, electricity, etc., which either facilitate or hinder the movement of a product. Poor local government operations and weak laws and regulations increase transaction costs and limit relationships and upgrading. The vertical linkages between farms, at different levels of the value chain, ensure the efficient movement of a product to the end market and increase the competitiveness of the entire sub-sector. Facilitating bulk purchasing horizontal linkages (such as associations) among farms performing similar functions reduces the transaction costs for the buyers of many small suppliers. Supporting markets, including financial support services and sector-specific services, is key to upgrading the farms. Support services can be provided by the actors in the chain or by stand-alone service providers. The support services

provided by the actors in the chain tend to be embedded, such that the cost of the service is built into the commercial transactions.

Value chain analysis is the assessment of the actors and factors influencing the performance of an industry and the relationships among the participants to identify the main constraints to increased efficiency, productivity, and competitiveness of an industry and how these constraints can be overcome (Fries, 2007). An integral part of value chain development is the identification of marketable commodities and the value chain constraints and interventions (Gebey *et al.*, 2012).

According to Haggeblade and Gamsler (1991), a sub-sector is defined by its final product and includes all the farms engaged in the supply of raw materials, production, and distribution of the products. Rhyne and Holt (1994) mention that the sub-sector approach aims to identify both the growing portion of sub-sector markets and the barriers that must be overcome if microenterprises are to gain access to those growth markets. Typical areas of intervention include technology development, skill training, collective marketing, or the purchase of inputs. Ledgerwood (2000) mentions that sub-sector analysis involves the provision of financial and non-financial services, and the institutions that identify sub-sector analysis as a means of intervention need to consider some common constraints at the sub-sector level, which includes space for the market's physical infrastructure, such as warehousing; transport availability, reliability, and cost; and the regular availability of input.

Coe *et al.* (2007) mention that geography or territoriality is an important dimension of all commodity chains. According to them, the geography of a commodity chain can range from being concentrated in one particular place to being widely dispersed across a range of localities. This territoriality determines which actors are connected across the global economy and reveals the unequal geographical distribution of value and associated economic development benefits between different nodes along the chain. The creation of value is essential to economic development, and uneven development is a reflection of a relative lack of the physical or organizational resources used to create value by people, households, or

communities/microentrepreneurs. Consequently, the creation of value is influenced by the opportunity to use physical or organizational resources.

A commodity chain is conceptualized as a series of nodes, linked by various types of transactions, such as sales and intra-farm transfers. Each node involves the acquisition or organization of inputs for the purpose of adding value. Commodity chain analysis can consider only a specific segment related to a single product and its locational preferences (Rodrigue *et al.*, 2006).

The above definitions and explanations of the supply chain, sub-sector approach, and commodity chain are conceptually the same, expressed by many authors in their studies after Porter's value chain approach, although the different approaches have, to a certain extent, different focuses and many overlaps. They all describe the interactions of farms (or individuals) to supply goods or services to end users, and they all aim to identify opportunities for and constraints against increasing productivity. All of the concepts discussed, whether chain or cluster, underscore the importance of linkages to gain value and advantages to compete in markets. The value chain, supply chain, and sub-sector approaches focus more on how value is added within an enterprise; finally, the concept of a commodity chain also emphasizes understanding the processes of globalization and why the benefits of economic integration fail to reach developing countries and their poor.

In recent years, value chains have increasingly been recognized as a means to lower transaction costs, add more value, become more competitive, and increase household incomes. Development organizations in many developing countries are promoting value chains to reduce rural poverty by stimulating the productivity and efficiency of MEs/farms. Value chain analysis is used to examine constraints in the enabling environment in which the chains operate. In this study, the author refers to a "value chain" as a progression of a product from farm to market, while the value chain approach tries to create a suitable environment for products to flow very efficiently. The value chain considers poultry production microenterprises and the suitability of their location with regard to the physical and infrastructural enabling environment.

2.1.2 Definition of microfinance

The term “microfinance” is often used interchangeably with “microcredit.” Microfinance comprises financial services of any sort, provided in very small (micro) amounts (World Bank, 2006). Microfinance is a system of credit delivery and a savings mobilizing scheme, especially designed to meet the unique financial requirements of the poor and allow them to improve the status of their living, by providing additional capital without collateral (CDF and InM, 2008).

The term “microfinance” refers to the provision of financial services to low-income clients, and financial services generally include savings and credit. However, some organizations/MFIs that provide microfinance services also provide enterprise development services, such as production training, marketing and technology services, as well as sub-sector analysis and intervention. The Grameen Bank solidarity lending model, developed by the Nobel laureate Dr Muhammod Yunus of Bangladesh, is one of the well-known microfinance approaches. The model was developed to serve landless poor people in any income-generating activity, and is prevalent mostly in Asia. In a microfinance program, several groups of thirty to forty members are formed, who attend weekly meetings at a place near their home. Credit is provided to individuals within the group by the credit officer at the weekly meeting, usually for one year, and payments are made weekly. The loan amounts usually start from US\$100 (Ledgerwood, 2000). Rooyen *et al.* (2012) mention that microfinance services enable microentrepreneurs to build businesses and increase their income and improve the general economic well-being of the poor. A microenterprise loan, which is provided in larger amounts to progressive microcredit borrowers for any microenterprise development, is considered to be an important addition to the range of microfinance services.

A number of studies have shown the significant positive impact of microfinance on household per-capita income/expenditure. An analysis of the result of a survey of 1,798 households in Bangladesh reveals that about 45% of eligible households have participated in microfinance programs (Khandker, 1998). Microfinance is estimated to reduce moderate poverty among recipients by as much as 20%. The consumption of about 5% of program participants increased to the point that their households rose above

the poverty line. This figure suggests that microfinance could reduce poverty in Bangladesh by about 1% a year. Another study by Rahman *et al.* (2005) finds that the total household income of the participants in microfinance programs shows secular growth ranging from 2.8% to as high as 12.2% per annum from 1977 to 2004. The study reveals that although non-participants had the highest average household income at the outset, they were gradually surpassed by the participants.

2.1.3 Definition of microenterprises

There is no universally accepted definition of microenterprises (MEs). Generally, MEs are defined in terms of the workers employed.

A microenterprise refers to a small business or activity that is independently owned and operated with an investment of at least BDT (Bangladesh Taka) 30,000, and which has the potential for further expansion and the creation of employment. A microenterprise can be, as the PKSf considers, a processing- or production-based or service-providing activity, managed and operated by a progressive microcredit borrower, who must be a member of a microcredit-providing organization (Khaleda, 2007). A microenterprise is a kind of small business, often unregistered, with fewer than 10 employees. Traditionally, for a small business that is financed by MFIs/NGOs under a microfinance program, the term microenterprise is used. Poor microentrepreneurs operate microenterprises not by choice, but out of necessity, which is also a result of the relative lack of formal sector jobs available for the unskilled poor.

According to Ledgerwood (2000), these microenterprises, termed growth enterprises, represent the upper end of the poverty scale, and have production and risk-taking experience, keep minimal accounting records, and usually do not pay taxes. In microcredit lending, the amount of credit is small and is generally used for the self-employed. However, with a continuous stream of financing, a self-employed person can graduate to microenterprise level, at which, besides employing family labor, some amount of paid labor may also be used (Ahmed, 2004).

In Indonesia, most enterprises are small and microenterprises that employ 0–19 employees, and these small enterprises make up about 99.8% of the total establishments and contribute 43% of the gross domestic product and 22% of the total investment. These small and microenterprises are farm-based (Brata, 2007). Microenterprises are considered as the “upper-tier informal sector” as they make up the dynamic and productive segment in the informal sector (Blunch *et al.*, 2001).

In a field survey conducted by PKSF on thirty microenterprises, it is noted that agro-based MEs have high potential for future growth. The biggest loans among the members surveyed were witnessed in agro-based MEs, while the average loan amounts and average investments in agro-based MEs are higher than those in other sectors. The demand for loans to invest in agro-based MEs is much higher than that of other sectors. Consequently, the percentage of the demand fulfillment is very low. On the other hand, the demand for loans to invest in service-oriented activities is very low, hence most of these loans can be provided in accordance with the demand. The percentage of demand fulfillment for the loans for service activities is very high. On average, only 52% of the demand for loans to invest in agro-based MEs has been met. On the other hand, the demand fulfillment average reaches as high as 75% for service-oriented activities. The average size of loans and the average size of investments are as high as BDT 31,000 and BDT 221,400, respectively, for agro-based MEs. It is encouraging that, on average, 9.6 persons are employed in agro-based MEs as opposed to 4.6 persons in retailing and wholesaling and 1 person in services. Approximately 90% of agro-based products are supplied to the local market, and the remaining 10% are supplied to the capital city of Dhaka.

A survey was carried out by the International Consulting Group (ICG) on 10,096 enterprises in Bangladesh (Daniels, 2003). The report defines an enterprise as any income-generating activity that markets at least 75% of its product. The survey result shows that the average size of an ME is 5 workers, including the proprietor. Approximately 36% of MEs are operated by the proprietor alone, while 83% have 1 to 5 workers. More than half of all the workers are salaried employees. The report reveals that the industrial structure of the ME sector in Bangladesh consists primarily of wholesale and retail trade and repairs (40%),

the production and sale of agricultural goods (22%), services (15%), and manufacturing (14%). MEs contribute 20 to 25% of the GDP (gross domestic product) in Bangladesh, while manufacturing MEs contribute the highest percentage, followed by agriculture and trade. The largest contribution to the GDP (51%) is from MEs with 2 to 5 workers, followed by those with 1 person (26%).

MEs have been showing rapid development in poultry, livestock, and fisheries. Poultry may be considered as a promising sub-sector in which a large number of small producers and microentrepreneurs are involved in the production and marketing process. However, these small producers are not well organized in terms of their location, resulting in a poor input supply and marketing facility of their products in most cases and thus causing a higher transport cost and lower profit.

2.2 Use of MCE and GIS in small farming activities

Numerous studies on site suitability, related to different small farming activities that cover small and large geographic areas, have been completed using the MCE method and GIS technology. These include: continental-level assessment of aquaculture for Africa (Kapestky, 1994); the strategic reassessment of fish farming potential in Africa (Aguilar and Nath, 1998); regional-level assessment of oat farming in Mexico (Ceballos-Silva and López-Blanco, 2003); peri-urban agriculture development in Vietnam (Thapa and Murayama, 2008); and urban aquaculture development in Bangladesh (Hossain *et al.*, 2009). These papers present the result of the application of GIS and the MCE method to assess land suitability for different agricultural activities.

MCE is a set of procedures designed to facilitate decision making. MCE has received much attention within the context of GIS-based decision making (Pereira and Duckstein, 1993). Multi-criteria decision making can be understood as a world of concepts, approaches, models, and methods that aid an evaluation (expressed by weights, values, or intensities of preference) according to several criteria (Barredo, 1996). The aim of the MCE technique is “to investigate a number of choice possibilities in the light of multiple criteria and conflicting objectives” (Voogd, 1983).

GIS is an integrated assembly of computer hardware, software, geographic data, and personnel designed to acquire, store, manipulate, retrieve, analyze, display, and report efficiently all forms of geographically referenced information geared towards a particular set of purposes (Burrough, 1986; Kapetsky and Travaglia, 1995).

The integration of multi-criteria methods and GIS provides a tool with great potential for obtaining land suitability maps or for selecting sites for a particular activity (Eastman *et al.*, 1995; Mendoza, 1997; Jun, 2000). While GIS provides an appropriate framework for the application of multi-criteria evaluation methods, which are not capable of managing spatial data, the multi-criteria evaluation procedures add to GIS the means of performing trade-offs on conflicting objectives, while taking into account multiple criteria and the knowledge of the decision maker (Carver, 1991).

Hossain *et al.* (2009) delineated suitable water bodies in the Chittagong urban area for carp farming through the MCE technique within a GIS context. The study used ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) satellite images of urban water bodies, water quality, soil characteristics, infrastructure, and socioeconomic factors. Using MCE, 4 experts, including the first author, assigned scores and weights to the factors for evaluation. Analyzing the ASTER imagery and thematic layers, a series of GIS models was developed to identify and prioritize suitable water bodies for carp farming. The evaluation indicates that 77% of the urban water bodies located in agriculture, grassland, fish farming, residential, and commercial areas is most suitable for carp farming.

Thapa and Murayama (2008) evaluated the land for peri-urban agriculture in Vietnam by the integration of a multi-criteria method—AHP (Analytical Hierarchical Process)—and GIS to obtain land suitability maps. The study, based on a field survey with a meeting of local experts and a focus group (local farmers) discussion, selected five spatial parameters, i.e. soil, land use, water resources, road network, and market, as the major factors that influence the peri-urban agriculture. AHP was used to assign weights to the factors for evaluation. A set of questionnaires was developed within the AHP framework. Five raster map results were arithmetically overlaid using the linear combination method to obtain the final suitability

model. The model was classified into four qualitative descriptions as highly suitable, medium suitable, low suitable, and unsuitable. The study used GIS and AHP as an empirical land assessment technique with the aim of helping the policy makers and urban and regional planners to make rapid assessments.

Aguilar and Nath (1998) assessed locations and areal expanses that have potential for warm-water fish farming in continental Africa. GIS was used to assess each grid cell on the basis of four and five land-quality factors important for two types (small-scale and commercial) of fish-farm development. The MCE method was used for scoring and weighting the factors and five experts, including the author, participated. The scoring levels (four to one) were very suitable, suitable, moderately suitable, and unsuitable. Protected areas, large inland water bodies, and major cities were considered as constraint areas and were excluded from the assessment, as they were considered to be implausible. The study estimates the quality of land, scoring about 23% of the area of continental Africa as very suitable for both small-scale and commercial fish farming. From a country viewpoint, the result shows that 11 countries are scored as very suitable in 50% or more of their national area for small-scale fish farming, while 16 countries are rated very suitable in 50% or more of their national area for commercial fish farming.

Chapter Three

Materials and Methods

3.1 Field survey and data collection

A field survey was conducted and the methods that were used include case studies, semi-structured questionnaire interviews with microentrepreneurs, and participatory observations, with the aim of understand the existing value chain. The sample survey of 166 MEs was conducted between December 2010 and February 2011 to collect some basic information, followed by a random sample survey using a semi-structured questionnaire with 48 microentrepreneurs from the 166 MEs to collect information on poultry production and the value chain. The questionnaire involved mainly questions about their level of education; the amount of assets; the main source of their income; the amount of land used for poultry farming; the number of employees; the sources of and distances from input materials and support services; the type and amount of support services; the places to market the products; the means of transport used for input materials and produced materials; the selling price of eggs and chickens; and the problems they face.

Furthermore, case studies were undertaken to gain an understanding of how poor villagers are involved in microcredit programs, how they graduate to being microentrepreneurs, and how they are linked to the value chain.

To cross-check the suitability and verification of sites, a survey of twenty-eight microentrepreneurs/farmers was conducted further through structured questionnaires after the GIS analysis had been completed. This survey took place between July and September 2012 at four sites with different suitability classes. Microentrepreneurs/farmers were asked about the value they receive, their production size and the transportation cost for input materials, the marketing of the products, etc. MEs/farms were

selected from four unions with dominant areas of different suitability classes. The unions are the ultimate tier of administrative jurisdiction. Six MEs/farms were surveyed from highly suitable sites of North Harinal village in Pourashava, eight MEs/farms from moderately suitable sites of Khude Barmi village in Baria union of Gazipur Sadar sub-district, six MEs/farms from marginally suitable sites of Kudabo village in Pubail union, and eight MEs/farms from unsuitable sites of Satiyan village of Jangalia union of Gazipur district. Data were collected on the distance of paved roads, markets, and government offices from the farm, the flooding situation during floods, the places to market the products, the means of transport used for input materials and produced materials, the selling price per hundred eggs and per kilogram of chicken, the amount of land used for poultry farming, and the number of employees.

3.2 Digital data collection

Digital data were collected, compiled, and analyzed using GIS and MCE. The GIS software used in this study was ArcGIS. Information on paved roads and highways, collected from the LGED, was considered in the analysis. The spatial distribution map/digital geo-referenced data on marketplaces/growth centers and local government offices used for analysis were collected from the LGED. Also considered in the analysis was a map of the flooding situation that shows land areas with the deepness of the water during flooding, collected from the CEGIS. Digital data on rivers, water bodies, and forest areas were considered as constraints for poultry MEs' development, and were collected from the LGED. To cross-check the suitability and verification of sites, and to describe the distribution pattern, digital data on current poultry MEs/farms were collected from the Epidemiology Unit of the DLS of Bangladesh to create an accurate description of the MEs/farms' location and to incorporate the information into a digital map.

3.3 Identification of criteria for poultry microenterprises and the value chain

In order to determine the potential sites for poultry farm MEs, the most important criteria were identified based on interviews with microentrepreneurs and livestock experts, as well as the literature review. These are mainly the infrastructures required for the poultry value chain development and physical environment of Gazipur district, such as (a) spatial economic criteria like highways and roads, the location of marketplaces/growth centers, and the location of government livestock offices as sources of support services; (b) physical factors like land and flooding; and (c) constraints like rivers and water bodies and the location of forests (Khaleda and Murayama, 2013a). Neumann *et al.* (2009) mention that the occurrence of poultry can be explained by the historic development of poultry farming and the associated infrastructure and market conditions in the region.

3.3.1 Spatial economic factors

A good transportation and communication system is a prerequisite for poultry business development, including activities such as chick collection, feed collection, the transportation of poultry produce, etc. Therefore, poultry farming sites should be located with consideration of their proximity to accessible roads, mainly to allow access by large delivery trucks of the agents of buyers from Dhaka. Paved roads and highways were considered in the analysis, using data collected from the LGED.

The marketplace is one of the basic infrastructures for poultry farming development. Poultry farmers buy feed, chicks, and medicines from the agents and dealers of large well-known feed industries, hatcheries, and medicine companies, which sell these in shops located mainly in the large marketplaces/growth centers in Gazipur. Therefore, these marketplaces are considered only for inputs (as backward markets), not for outputs or for selling products (as forward markets). The proximity to this basic infrastructure was considered in the analysis because, as Herath *et al.* (2005) note, production increases in regions where the distance to marketplaces is smaller due to lower transaction and transportation costs. Feed is a major input for poultry production and accounts for about 70% of the cost of production (Sapkota,

2001; ACI, 2006; FAO, 2010), and the microentrepreneurs surveyed in Gazipur were found to buy feed almost every other day. Thus, poultry farming site selection should consider the proximity to feed, medicine, and chick supply shops/marketplaces. Digital data on marketplaces/growth centers, collected from the LGED, were considered. Dhaka city can be considered as the only market to sell the poultry and eggs produced by the microenterprises of Gazipur. On the other hand, these MEs/small farms are the main source, which is known to make up about 70% to 80% of the poultry produce that comes from different districts to the wholesale market of Dhaka. Consequently, it is in the interest of the agents of the Dhaka wholesalers to collect poultry produce from the farm gate, without considering their distance. It should be mentioned that there is no city in Gazipur district.

Sources of support services, like credit, vaccines/medicines, and training, are some of the most important factors for the poultry business. Local government livestock offices and several NGOs are the most available sources of these support services. Upazila livestock officers/representatives and veterinary surgeons are posted to the local government livestock offices in every upazila/sub-district. Besides this, upazila livestock officers and veterinary surgeons sit at private chambers at marketplaces, generally near the government offices, and farmers usually prefer to go to the chambers of these veterinary surgeons/personnel for counseling on the prevention of poultry diseases and for vaccination. Thus, veterinary surgeons/personnel play a very important role in poultry disease control. Furthermore, veterinary field assistants and livestock technical assistants provide government support services at a subsidized rate to microentrepreneurs/farmers. The physical distance from these facilities was also considered in determining the potential sites for poultry farming MEs. A spatial distribution map/digital data on local government/livestock offices were used for analysis.

Many NGOs and their branches work extensively to provide microfinance and support services throughout the country, as well as in the study area. NGOs have emerged as efficient partners in development, such as in value chain development, disaster management, self-employment creation, infrastructural development, awareness building, skill development, training, etc. Many NGOs are engaged

in policy advocacy with the government to revise the policies that adversely affect the poor (Datta, 2004). According to the 2007 State of the Microcredit Summit Campaign Report, Bangladesh is having a profound impact on many of the socio-economic dimensions of poverty, and has the world's densest network of NGOs (Daley-Harris, 2007). In Bangladesh, the Dhaka division (of which Gazipur is a district) has the densest network of NGOs. These NGOs deliver most of the support services to the doorsteps of the poor entrepreneurs, organizing group meetings at a place near their (poor people's) home, usually at the group leader's home. The survey findings reveal a similar scenario in which most of the microentrepreneurs' poultry farms are situated within a distance of 1 to 3 kilometers from the NGOs. Therefore, the spatial distribution of the NGOs was not considered in the GIS-assisted suitable site analysis.

3.3.2 Physical factors

Poultry MEs are affected by flooding. About 30 to 35% of the land area of Bangladesh is flooded every year (Milliman *et al.*, 1989) and roads are damaged, disrupting the farms' routine activities. The microentrepreneurs need either to construct their farms on land that is free from regular flooding or to construct their poultry houses on high ground if the farms are built in low-lying areas, but this type of construction involves extra costs. Therefore, land free from flooding is considered to be highly favorable. A map of the landform and flooding situation that shows land areas with the depth of flood water, with an average recurrence interval of 100 years, was collected from the CEGIS and considered in the analysis.

3.3.3 Constraints

The constraints included in this research are geographical areas where poultry farming MEs' development is not possible. Rivers, water bodies, and forest areas were considered as constraints for poultry MEs' development. These areas were represented as a single sub-model by combining all of them.

3.4 Criteria score classification and standardization

Determining the site suitability for poultry farm MEs requires an analysis of the critical factors for their success and sustainability. Poultry MEs' location planning should be based on a comprehensive analysis of the infrastructural conditions within a framework that can incorporate the spatial dimension of the environmental parameters that affect their sustainability. This is necessary to produce a framework to guide decision makers in allocating the scarce resources. Therefore, to identify suitable sites for poultry farm MEs' development, the basic infrastructure of the business-enabling environment of the poultry value chain, along with the physical factors, was considered as an important criterion for the GIS analysis. The factors were classified into four groups and given a physical score from 1 to 4. The scoring levels (4 to 1) were "highly favorable," "moderately favorable," "marginally favorable," and "unfavorable." This classification was used to standardize the different scales upon which the raw data were measured. For each factor, ranges of data that pertain to a desired level of suitability were selected. The selection of ranges involved an interpretation of the data selected and this interpretation was based on the literature research and on the opinions of livestock experts and interviews with microentrepreneurs. The microentrepreneurs' opinions reflect the author's opinion in the selection of ranges. Thus, four factors, namely the proximity to the marketplace, proximity to a government livestock office, proximity to roads/highways, landform, and flooding during the peak rainfall period, and constraints (such as rivers, water bodies, and forests), were selected to determine the suitability of locations for poultry MEs. In all the factor maps, the constraint image was incorporated to exclude areas from consideration. Constraints were assigned a score of zero. Thus, the criteria maps were classified into five groups and given a physical score from 0 to 4; the scoring levels (4 to 0) were "highly favorable," "moderately favorable," "marginally favorable," "unfavorable," and "constraints."

The questionnaire survey on poultry MEs reveals that most of the microentrepreneurs buy their feed after travelling around 0.5 km to 2.5 km from their microenterprises, and to collect quality chicks from the marketplaces, many of them travel up to 4 km. The microentrepreneurs buy feed almost every other day,

while they buy chicks occasionally. Thus, a distance of up to 2.5 km is considered to be favorable for marketplaces and a distance of up to 4 km is considered to be favorable for government offices, as the farmers need to go to government offices or to veterinary surgeons occasionally. The agents of wholesalers come from Dhaka every day with their heavy vehicles/trucks via the highways to buy poultry products from many microentrepreneurs/farmers in Gazipur and they enter different villages through the roads. The quality of these roads usually decreases with the distance from highways, which are usually avoided by the agents, so a distance of up to 2.5 km is considered to be favorable (the same distance as is considered for marketplaces). The selection of this range also considered the in-between distances that Salam *et al.* (2004) and Hossain *et al.* (2009) recommend. They consider a distance of more than 1,000 meters and 4,000 meters from the road to be unsuitable. The field survey reveals that 96.1% of MEs are more than 1,000 meters away from the marketplaces, and no farm was found within a 1,000-meter distance from highways and within a 250-meter distance from roads. Moreover, the livestock experts recommended a 1,000-meter buffer distance from an urban residential area and the national highway and a 250-meter distance from public roads to be unsuitable for the establishment of poultry farms, basically to avoid noise. In Gazipur, government offices/headquarters are located mainly in urban areas (BBS, 2001), and large marketplaces/growth centers contain urban settlement and infrastructures, where the value of land is extremely high (Khan and Akther, 2000). Therefore, in the present classification of these three factors (marketplaces, government offices, and highways), a 1,000-meter distance was considered unfavorable. The microentrepreneurs build their houses and farms in comparatively higher land areas, which are normally about 180 cm higher than the surrounding agricultural land areas. Therefore, flooding up to 180 cm deep is considered favorable in the present classification of the landform and flooding factor. These findings of the field survey are mainly reflected in the selection of ranges in Table 3-1. As no previous study was found to have been conducted on suitable site selection for poultry MEs' development, using MCE and GIS, the classification or selection of ranges of some factors, based on the literature, used papers on other agricultural activities. Salam *et al.* (2004) consider up to a 2,000-meter distance from the road to be suitable,

and more than 4,000 meters to be unsuitable. Dealing with the most perishable products of fish farming, Hossain *et al.* (2009) consider a distance of more than 1,000 meters from the road to be unsuitable, a distance from the market of less than 2,000 meters to be suitable, and a distance of more than 4,000 meters from the source of inputs to be unsuitable. Hence, the above guidelines are reflected with some justified modifications, based on field observation and the poultry business situation of the Gazipur area, in the selection of ranges of suitability of factors for poultry ME development.

3.5 Multi-criteria evaluation (MCE) weighting and scores of different criteria

Potential sites for poultry MEs can be determined by the evaluation of the criteria related to infrastructures and physical environmental elements. The MCE method was applied combining the spatial data describing the causing factors. The MCE method is used to find solutions to decision-making problems characterized by multiple alternatives, which can be evaluated by means of decision criteria (Jankowski *et al.*, 2001).

Table 3-1: Factors and constraints for poultry microenterprises and value chain development

Categories of criteria (factors and constraints)					
Factors		Class 4 Highly favorable	Class 3 Moderately favorable	Class 2 Marginally favorable	Class 1 Unfavorable (currently)
1.	Proximity to marketplace (m)	1,000–1,500	1,500–2,000	2,000–2,500	0–1,000; 2,500 and above
2.	Proximity to govt. office (m)	1,000–2,000	2,000–3,000	3,000–4,000	0–1,000; 4,000 and above
3.a.	Proximity to national highways (m)	1,000–1,500	1,500–2,000	2,000–2,500	0–1,000; 2,500 and above
b.	Proximity to roads (m)	250–500	500–750	750–1,000	0–250; 1000 and above
4.	Landform and flooding during the peak rainfall period (cm deep)	High land to medium-high land (less than 30)	Medium-high land (30–90)	Low land (90–180)	Very low land (180–300)
Constraints		Rivers, water bodies, and forest areas			

Note: Marketplace means a large marketplace/growth center in Gazipur, for input materials (as the backward market), and should not be confused with the consumer market (forward market) for selling eggs/chickens, which is in Dhaka.

The basic starting point of MCE analysis is the construction of an evaluation matrix and the pair-wise comparison matrix developed by Saaty (1977, 1990), known as the Analytical Hierarchy Process (AHP), although a variety of weighting techniques exists to determine the weights for the factors in a multi-criteria evaluation. The comparisons in the AHP concern the relative importance of two criteria involved in determining suitability. The AHP analysis produces a set of weights that sum to 1. The MCE method was applied in combining the spatial data describing the causing factors. The factors and their weights are used as inputs for multi-criteria evaluation by weighted linear combination (WLC). The relative importance of a pair of factors is scored on a 17-point scale (Saaty's rating scale) from the least important ($1/9, 1/8, \dots 1/2$) to the most important (1, 2, ... 9), as in Table 3-2. If a pair of factors is considered to be equally important to the evaluation of the suitability of a site, then a score of 1 is provided. Thus, the weight for each factor is derived and used in MCE to show the potential sites for poultry MEs. In the MCE procedure, the constraint image (forest areas, rivers, water bodies, etc.) was incorporated to exclude areas from consideration.

Table 3-2: Relative importance of two criteria (Saaty's rating scale)

1/9	1/8	1/7	1/6	1/5	1/4	1/3	1/2	1	2	3	4	5	6	7	8	9
Extremely Less important								Equally Important	Moderately Strongly Very strongly Extremely More important							

3.6 Completion of the pair-wise comparison matrix

The development of weights for the factors is based on a pair-wise comparison matrix. A group of 8 livestock experts, with more than 10 years' experience in livestock-related research and work in Bangladesh, participated in the questionnaire. The questionnaire involved asking the experts to score the pairs of factors on Saaty's rating scale according to their importance to evaluate the suitability of sites for poultry microenterprise development and thus help to assign/calculate weights for these factors. A similar method was used by the author after contacting the experts. Based on the field survey, the author's opinion reflected that of the microentrepreneurs. Thus, 9 pair-wise comparison matrices were developed for the author and the 8 other livestock experts. The pair-wise comparison matrices developed are shown in Table 3-3. The weights assigned by the experts to the factors of poultry MEs are summarized in Table 3-4. The table indicates that there is general agreement among the majority of experts about the most important factor, assigning the highest average weight to high/low flooding land, for the evaluation of sites for poultry MEs. The highest weight of 0.442 was assigned to this factor and 0.357, 0.105, and 0.097 to the proximity to the road, proximity to government offices, and proximity to the market, respectively.

In the final step in the AHP, it is necessary to determine whether the pair-wise comparison has been consistent, in order to accept the result of the weighting. The measurement of the consistency ratio (CR) is the way to examine the consistency of entries in a pair-wise comparison matrix. Saaty (1977, 1990) recommends that a CR value equal to or less than 0.10 indicates that the pair-wise judgment is sufficiently consistent. The consistency ratios (CRs) of 0.02 to 0.08 (mean 0.06), in Table 3-4, are well within the ratio of equal to or less than 0.10, and thus indicate that the comparisons of the criteria are perfectly consistent and the relative weights are acceptable for use in the suitability analysis.

Table 3-3: Pair-wise comparison matrix for deriving weights for assessing four factors relevant to poultry microenterprises (the numbers show the rating of the row factor relative to the column).

Expert	Criteria	High/ low land	Proximity to road	Proximity to govt. office	Proximity to market	Weightings
A	High/low (flooding) land	1.00	3.00	5.00	9.00	0.566
	Proximity to road	0.33	1.00	3.00	5.00	0.250
	Proximity to govt. office	0.20	0.33	1.00	5.00	0.138
	Proximity to market	0.11	0.20	0.20	1.00	0.046
B	High/low (flooding) land	1.00	1.00	5.00	7.00	0.421
	Proximity to road	1.00	1.00	5.00	7.00	0.421
	Proximity to govt. office	0.20	0.20	1.00	3.00	0.106
	Proximity to market	0.14	0.14	0.33	1.00	0.051
C	High/low (flooding) land	1.00	0.14	0.33	0.14	0.050
	Proximity to road	7.00	1.00	7.00	3.00	0.557
	Proximity to govt. office	3.00	0.14	1.00	0.20	0.094
	Proximity to market	7.00	0.33	5.00	1.00	0.300
D	High/low (flooding) land	1.00	1.00	3.00	3.00	0.335
	Proximity to road	1.00	1.00	5.00	7.00	0.460
	Proximity to govt. office	0.33	0.20	1.00	3.00	0.133
	Proximity to market	0.33	0.14	0.33	1.00	0.073
E	High/low (flooding) land	1.00	3.00	5.00	7.00	0.559
	Proximity to road	0.33	1.00	5.00	3.00	0.260
	Proximity to govt. office	0.20	0.20	1.00	0.33	0.066
	Proximity to market	0.14	0.33	3.00	1.00	0.115
F	High/low (flooding) land	1.00	3.00	5.00	7.00	0.530
	Proximity to road	0.33	1.00	5.00	7.00	0.315
	Proximity to govt. office	0.20	0.20	1.00	3.00	0.105
	Proximity to market	0.14	0.14	0.33	1.00	0.050
G	High/low (flooding) land	1.00	3.00	5.00	5.00	0.533
	Proximity to road	0.33	1.00	5.00	3.00	0.273
	Proximity to govt. office	0.20	0.20	1.00	0.33	0.067
	Proximity to market	0.20	0.33	3.00	1.00	0.127
H	High/low (flooding) land	1.00	3.00	5.00	7.00	0.530
	Proximity to road	0.33	1.00	5.00	7.00	0.315
	Proximity to govt. office	0.02	0.20	1.00	3.00	0.105
	Proximity to market	0.14	0.14	0.33	1.00	0.050
I	High/low (flooding) land	1.00	1.00	5.00	7.00	0.449
	Proximity to road	1.00	1.00	3.00	5.00	0.364
	Proximity to govt. office	0.20	0.33	1.00	3.00	0.128
	Proximity to market	0.14	0.20	0.33	1.00	0.059

Table 3-4: Relative weighting of four factors for poultry microenterprises according to nine experts based on the pair-wise comparison matrix.

Expert	High/low flooding land	Proximity to road	Proximity to government office	Proximity to market	Sum	Consistency ratio (CR)
A	0.566	0.250	0.138	0.046	1.000	0.06
B	0.421	0.421	0.106	0.051	1.000	0.02
C	0.050	0.557	0.094	0.300	1.000	0.07
D	0.335	0.460	0.133	0.073	1.000	0.06
E	0.559	0.260	0.066	0.115	1.000	0.08
F	0.530	0.315	0.105	0.050	1.000	0.08
G	0.533	0.273	0.067	0.127	1.000	0.07
H	0.530	0.315	0.105	0.050	1.000	0.08
I	0.449	0.364	0.128	0.059	1.000	0.02
Mean	0.442	0.357	0.105	0.097	1.000	0.06

Experts:

A = Author, a geographer with more than 12 years of experience in the field of microfinance operation and research, who reflects the microentrepreneurs' opinion based on the field survey.

B, C, D, E, F, G, H, I = Livestock experts, with more than 10 years' experience in livestock-related research and work as a director/livestock officer at the DLS, Bangladesh, and as a project director/coordinator of different international donor (such as the DFID, IFAD, and ADB) supported projects (such as PROSPER; MFTSP, Microfinance and Technical Support Project; and PLDP, Participatory Livestock Development Project) in Bangladesh.

Weighted linear combination (WLC) was used to overlay the four criteria map results, i.e. market proximity, road proximity (combining roads' and highways' proximity maps), proximity to a government office, and flooding situation suitability maps, with the integration of the AHP result (weight), as inputs for the multi-criteria evaluation by WLC, to derive the final suitability map. WLC is the most prevalent procedure in MCE. With a WLC, factors are combined by applying a weight to each one followed by a summation of the results and multiplication by the products of constraints to yield a suitability map (Eastman *et al.*, 1995). The WLC procedure is:

$$S = \sum(w_i x_i) * \prod c_j$$

where S is suitability, w_i is the weight of factor i , x_i is the criterion score of factor i , c_j is the criterion score of constraint j , and \prod is the product.

Thus, the final suitability map was derived, which was reclassified into five classes (including constraint data) using the equal interval method with the qualitative descriptions of “highly suitable,” “moderately suitable,” “marginally suitable,” “unsuitable,” and “constraints” for poultry MEs.

Chapter Four

Suitability Analysis of Sites for Poultry Microenterprises

The overall objective of this chapter is to examine how well different sites satisfy the criteria for poultry-producing MEs' development. This chapter presents the key results of the GIS analysis, which describes the areal distribution of sites with different levels of suitability. The criteria for poultry MEs' suitability map results are classified into five categories: 1) highly favorable, 2) moderately favorable, 3) marginally favorable, 4) unfavorable, and 5) constraints. The final poultry MEs' suitability model/map, overlaying four criteria map results, is classified into the following five categories: 1) highly suitable, 2) moderately suitable, 3) marginally suitable, 4) unsuitable, and 5) constraints. The results are described in relation to forty-seven unions of Gazipur district.

4.1 Criteria for poultry microenterprises' development and sites' suitability

4.1.1 Proximity to roads/highways and suitability for poultry MEs

The factor of proximity to roads and highways was categorized into 2 parts: roads and highways. For the factor of proximity to roads, 19 unions are scored as highly favorable for more than 20% of their area. Basan has the highest portion of the highly favorable area for this factor, which is about 29% of its total area. Almost all the unions have a great portion (more than 40%) of their area that are scored as unfavorable for this category of the factor. In the category of the factor of proximity to highways, 25 unions have no area that is scored as highly favorable and relatively small areas that are scored as moderately

favorable to marginally favorable with regard to the proximity of this category. Tongi, Pubail, Gaccha, Bashan, Konabari, Srefaltali, and Sreepur are favored with proximity to highways in more than 10% of their area, which is classified as highly favorable. This implies that a huge area in the district is notably lacking in transport facilities. Table 4-1 and Table 4-2 show the suitability of sites regarding the factors of roads and highways as a percentage of the surface area in Gazipur. Figure 4-1 shows the suitability of sites and Figure 4-2 shows the relative area with suitability regarding the factor of roads in different unions. Figure 4-3 shows the suitability of sites and Figure 4-4 shows the relative area with suitability in relation to the factor of highways in different unions in Gazipur.

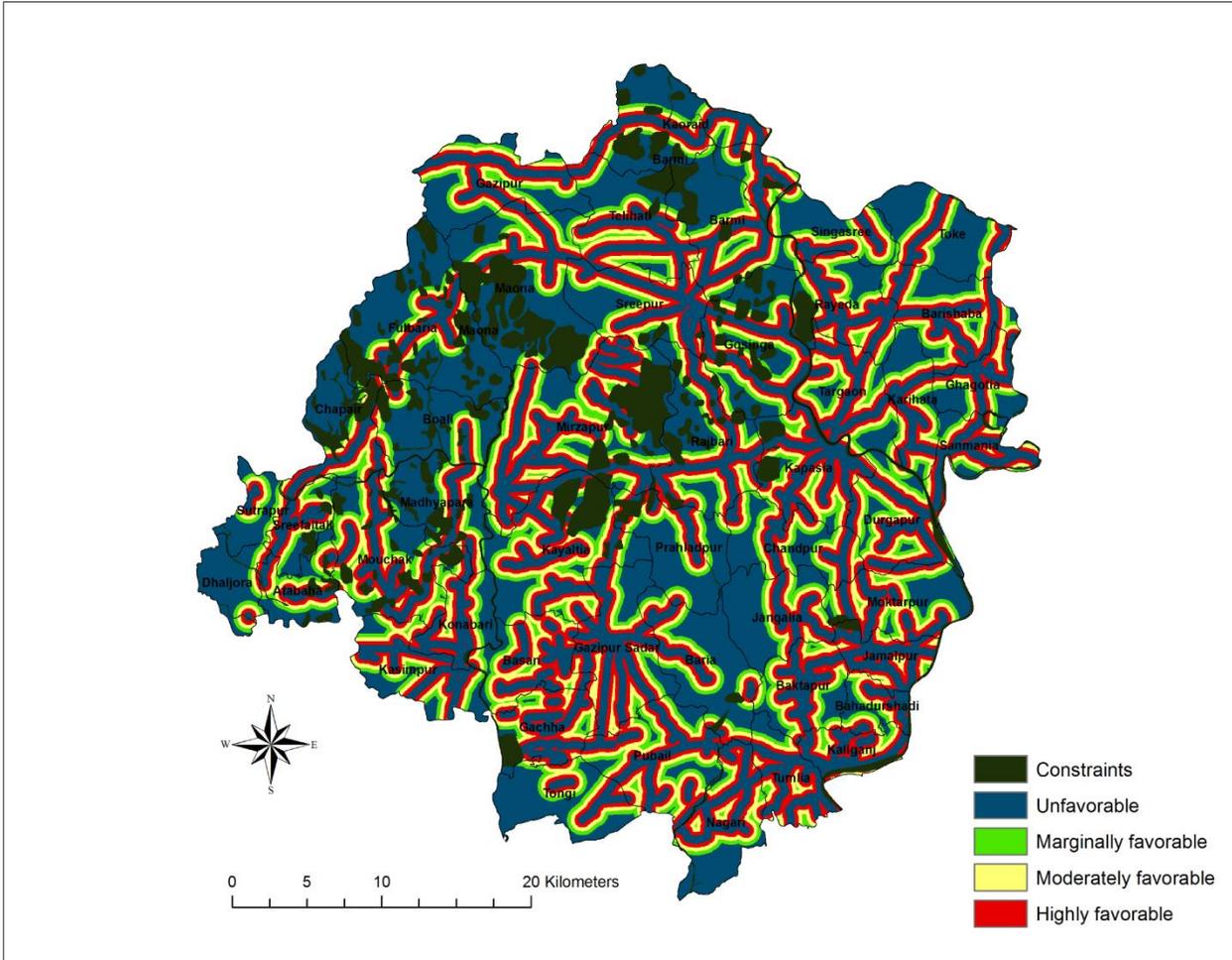


Figure 4-1: Proximity to roads and suitable sites in Gazipur.

Table 4-1: Suitability of sites regarding roads as a percentage (%) of the surface area in Gazipur.

Highly favorable	Moderately favorable	Marginally favorable	Unfavorable	Constraints	Total
16.7	14.3	10.6	47.3	11.0	100.0

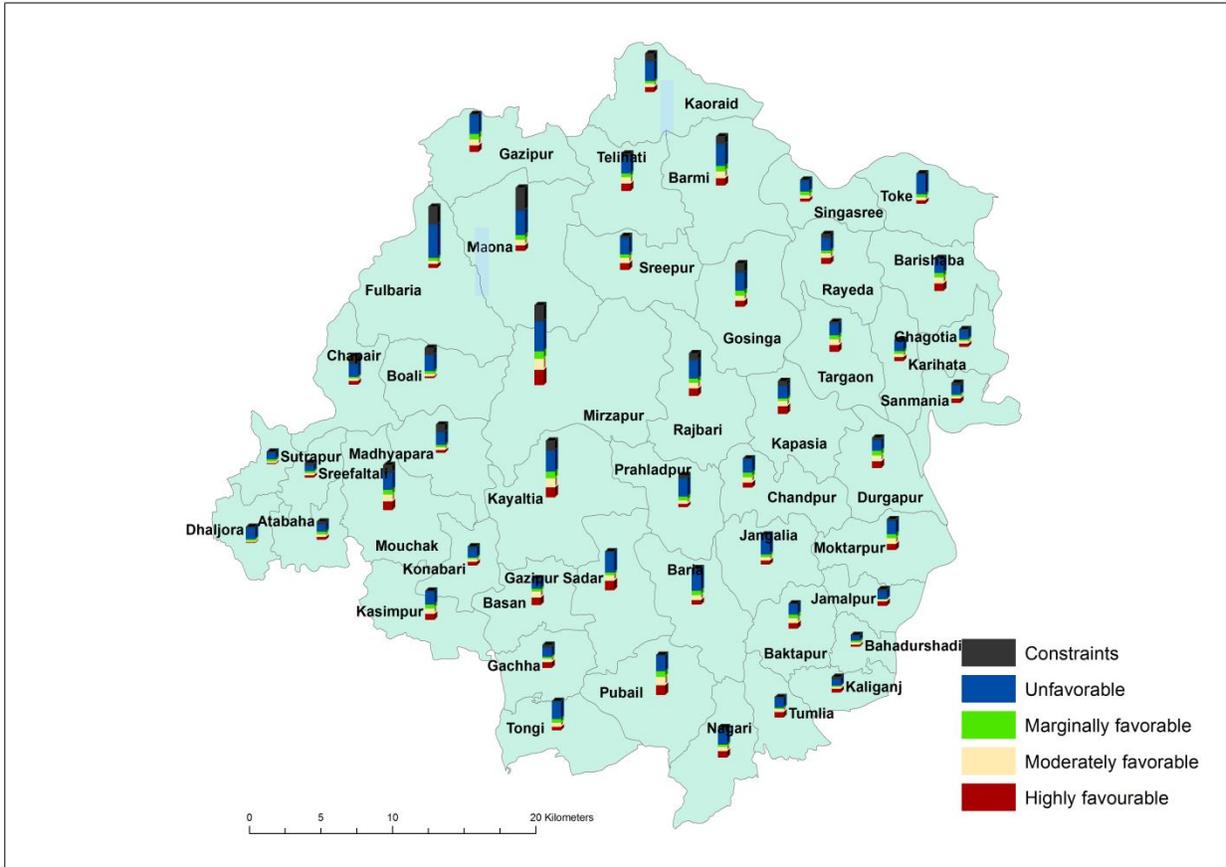


Figure 4-2: Relative area with road suitability by unions in Gazipur.

Note: The charts compare the amount of areas with different levels of suitability by administrative unions with the total of Gazipur.

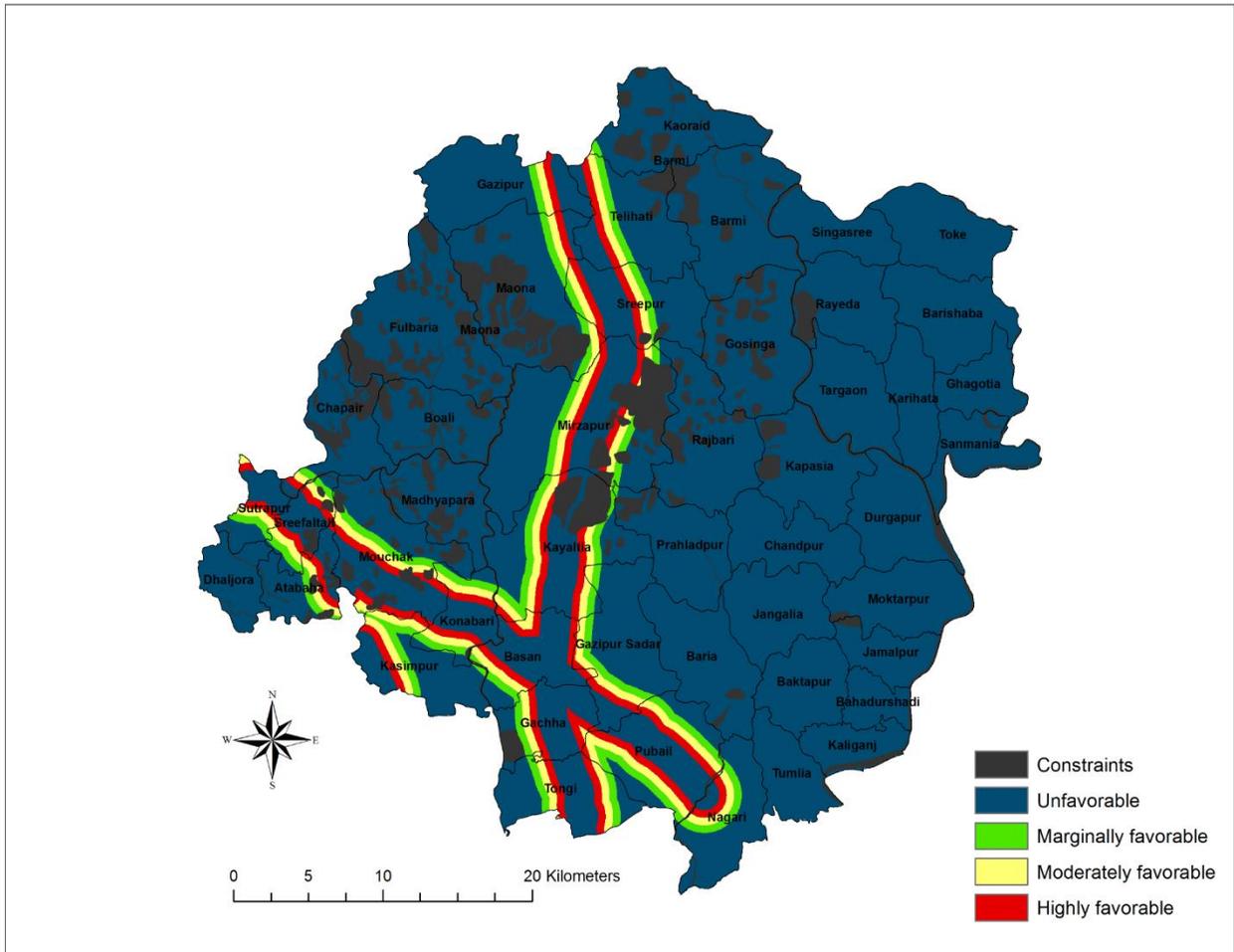


Figure 4-3: Highways' suitability.

Table 4-2: Suitability of sites regarding highways as a percentage (%) of the surface area in Gazipur.

Highly favorable	Moderately favorable	Marginally favorable	Unfavorable	Constraints	Total
4.2	4.1	3.9	76.9	11.0	100.0

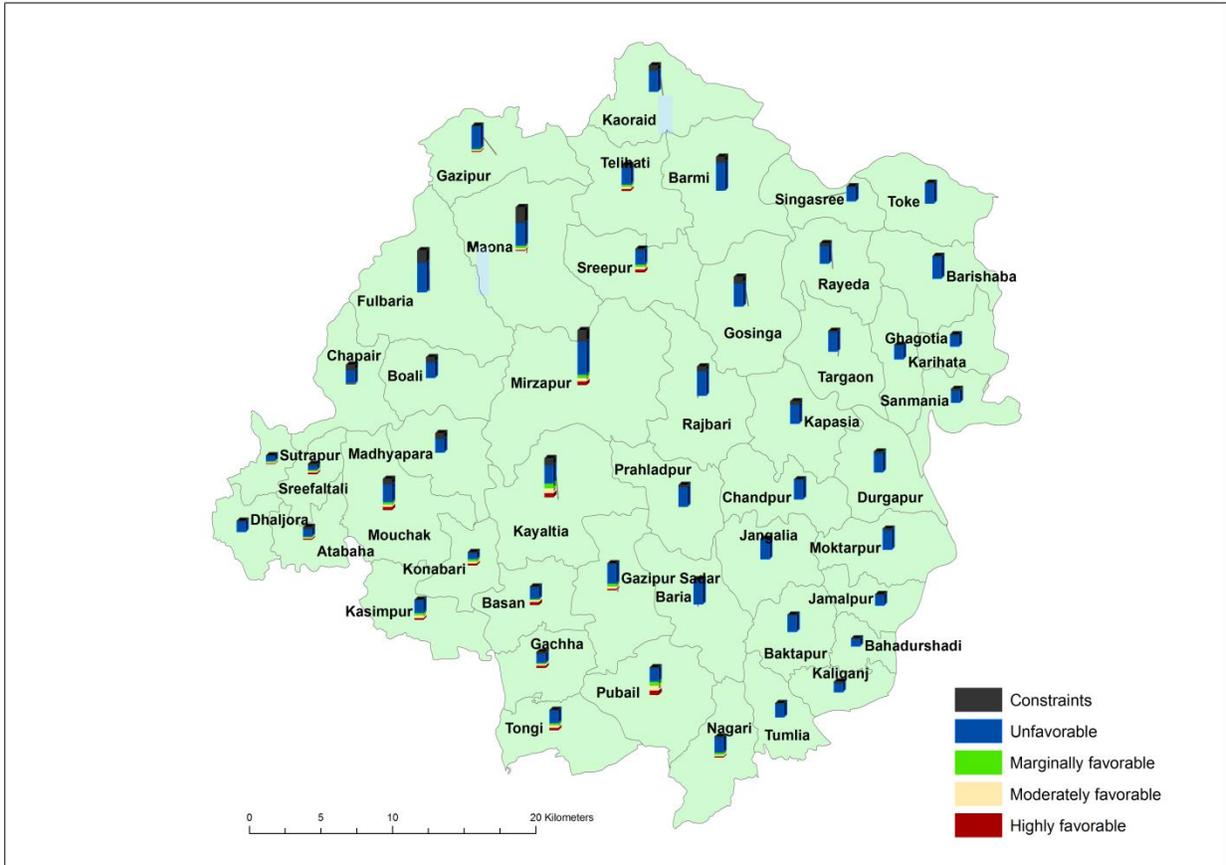


Figure 4-4: Relative area with highway suitability by unions in Gazipur.

Note: The charts compare the amount of areas with different levels of suitability by administrative unions with the total of Gazipur.

4.1.2 Proximity to marketplaces/growth centers and suitability

There are a few unions that have relatively large areas that are considered as highly favorable with regard to their proximity to market/growth centers. Only 6 unions, namely Atabaha, Srefaltali, Jangalia, Kaliganj, Barishba, and Sanmania, have 10% or more of their areas classified as highly favorable. Kaoraid, Ghagotia, Prohladpur, Tongi, Chandpur, and Gaccha unions have no area rated as highly favorable/moderately favorable for their proximity to the market and thus have extensive areas scored as unfavorable with regard to this factor. Table 4-3 shows the suitability of sites regarding the factor of proximity to markets/growth centers for poultry MEs as a percentage of the surface area in Gazipur. Figure 4-5 shows the suitability of sites and Figure 4-6 shows the relative area with suitability for the factor of marketplaces in different unions in Gazipur.

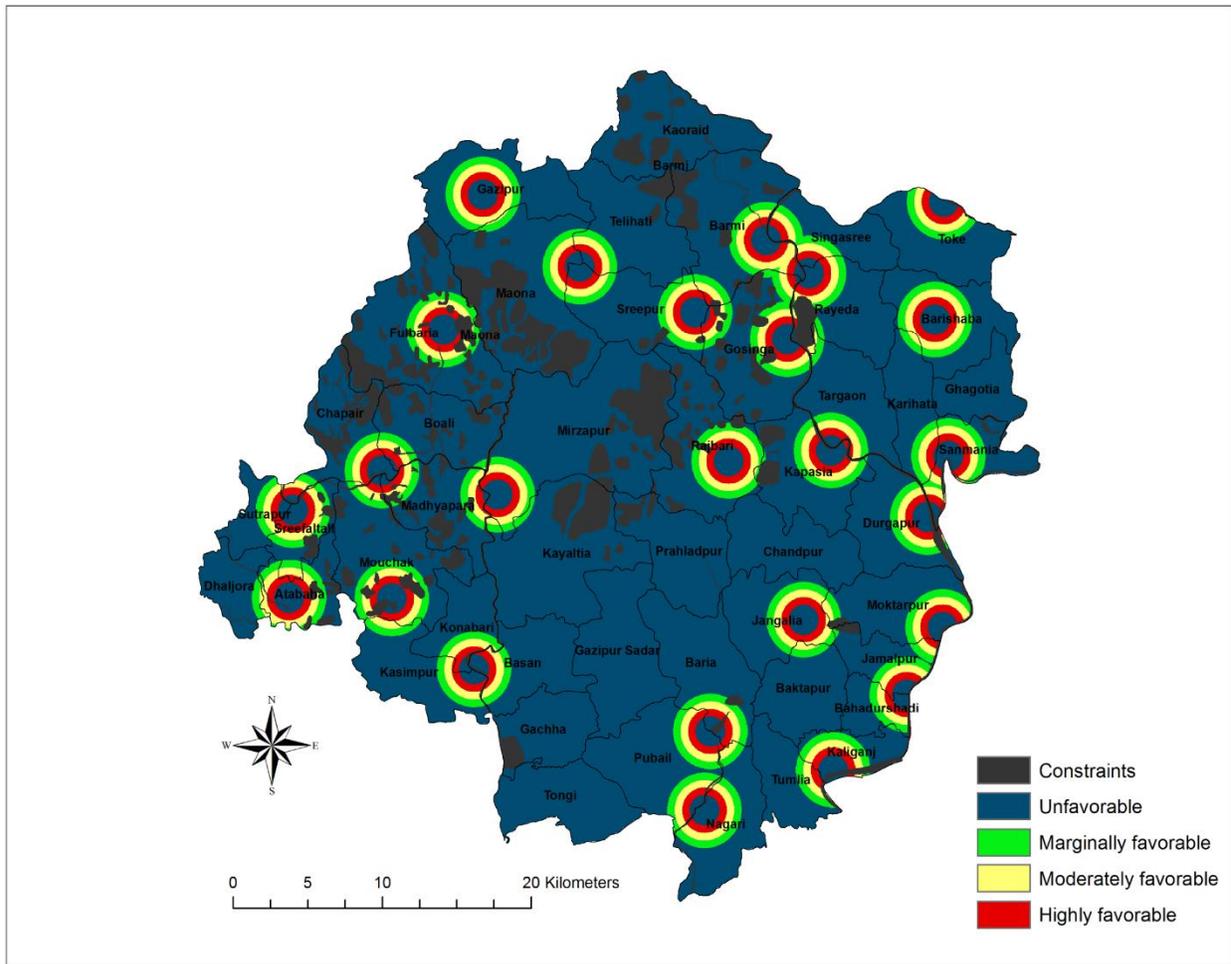


Figure 4-5: Suitability of sites with regard to their proximity to marketplaces/growth centers.

Table 4-3: Suitability of sites regarding the factor of proximity to marketplaces as a percentage (%) of the surface area in Gazipur.

Highly favorable	Moderately favorable	Marginally favorable	Unfavorable	Constraints	Total
4.7	6.4	8.0	69.9	11.0	100.0

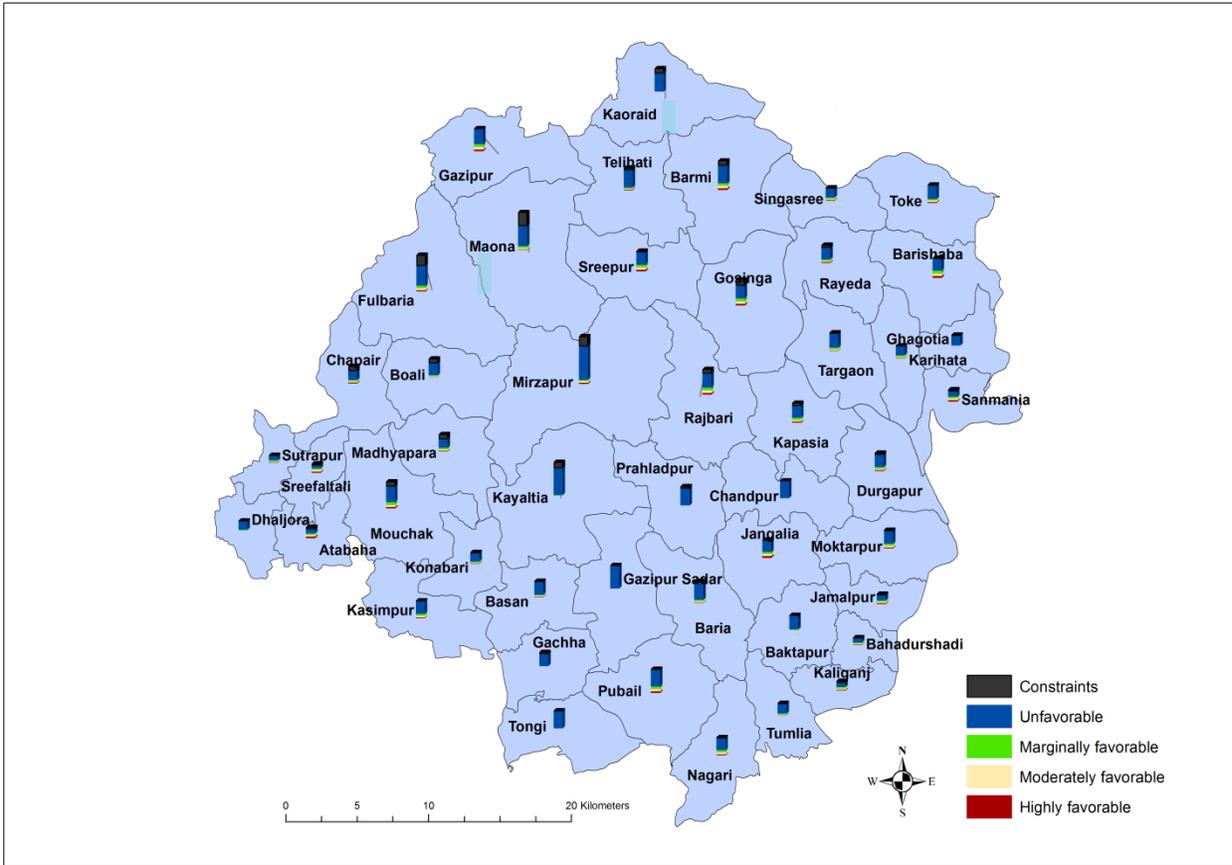


Figure 4-6: Suitability of relative area with proximity to marketplaces by unions in Gazipur.

Note: The charts compare the amount area of different levels of suitability by administrative unions with the total of Gazipur.

4.1.3 Proximity to government livestock offices as a source of support services

Gazipur Sadar, Srefaltali, Kaliganj, Kapasia, and Sreepur are particularly favored in relation to support services and input materials with regard to the factor of proximity of government livestock offices, and have 10% to 30% or more of their areas scored as highly favorable. In this regard, the 21 unions of Kaoraid, Gazipur, Toke, Shingasree, Maona, Fulbaria, Rayeda, Barishba, Ghagotia, Boali, Sanmania, Modhyapara, Chandpur, Moktarpur, Jangalia, Konabari, Kashimpur, Jamalpur, Pubail, Nagari, and Tongi have 100% (except the constraint area) of their area scored as unfavorable, implying that the availability of support services/input materials, particularly vaccination services, is likely to be a serious constraint in these unions. Table 4-4 shows the suitability of sites regarding the factor of proximity to a government livestock office for poultry MEs as a percentage of the surface area in Gazipur. Figure 4-7 shows the suitability of sites and Figure 4-8 shows the relative area with suitability for the factor of government livestock offices in different unions in Gazipur.

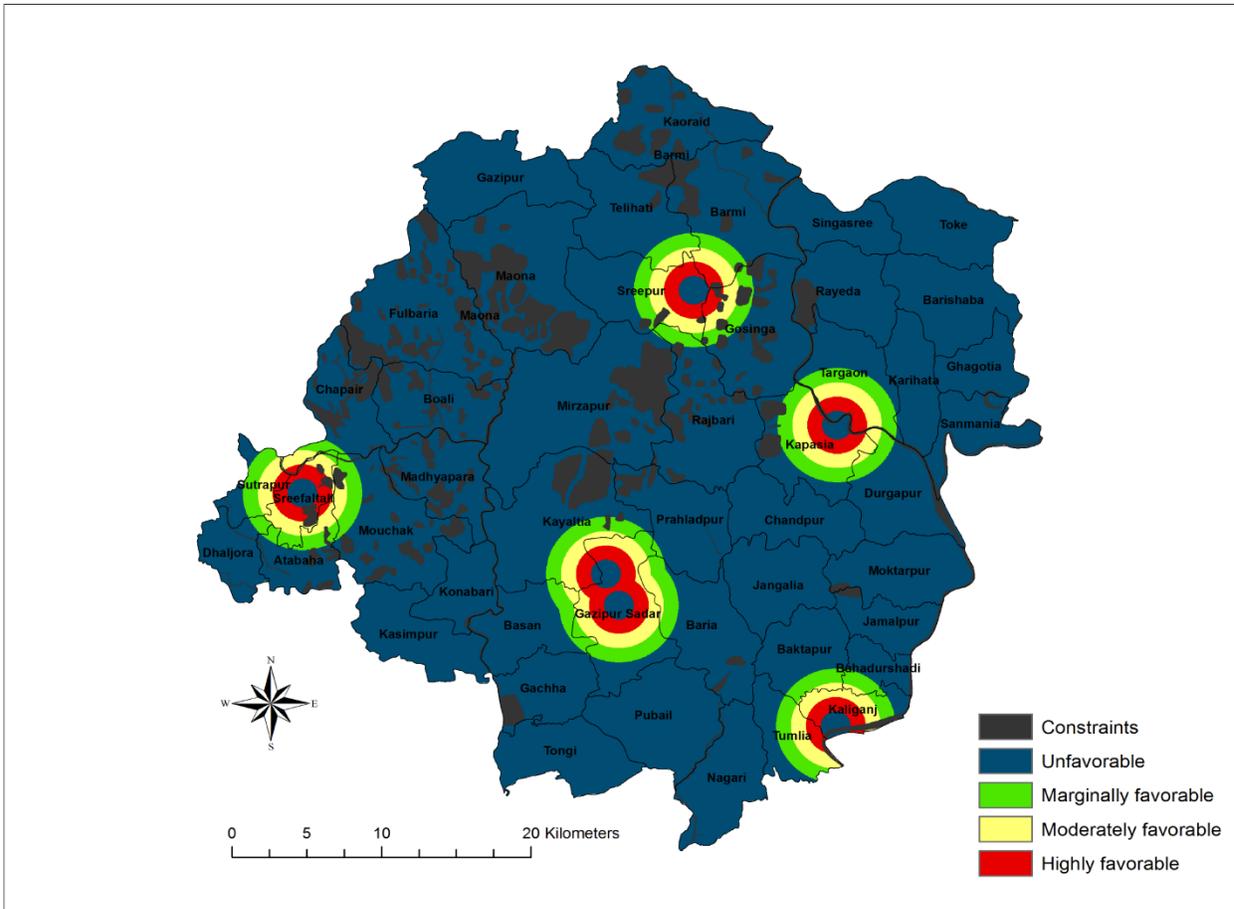


Figure 4-7: Sites' suitability regarding their proximity to government offices.

Table 4-4: Suitability of sites regarding the factor of proximity to government livestock offices as a percentage (%) of the surface area in Gazipur.

Highly favorable	Moderately favorable	Marginally favorable	Unfavorable	Constraints	Total
2.6	4.2	5.5	76.6	11.0	100.0

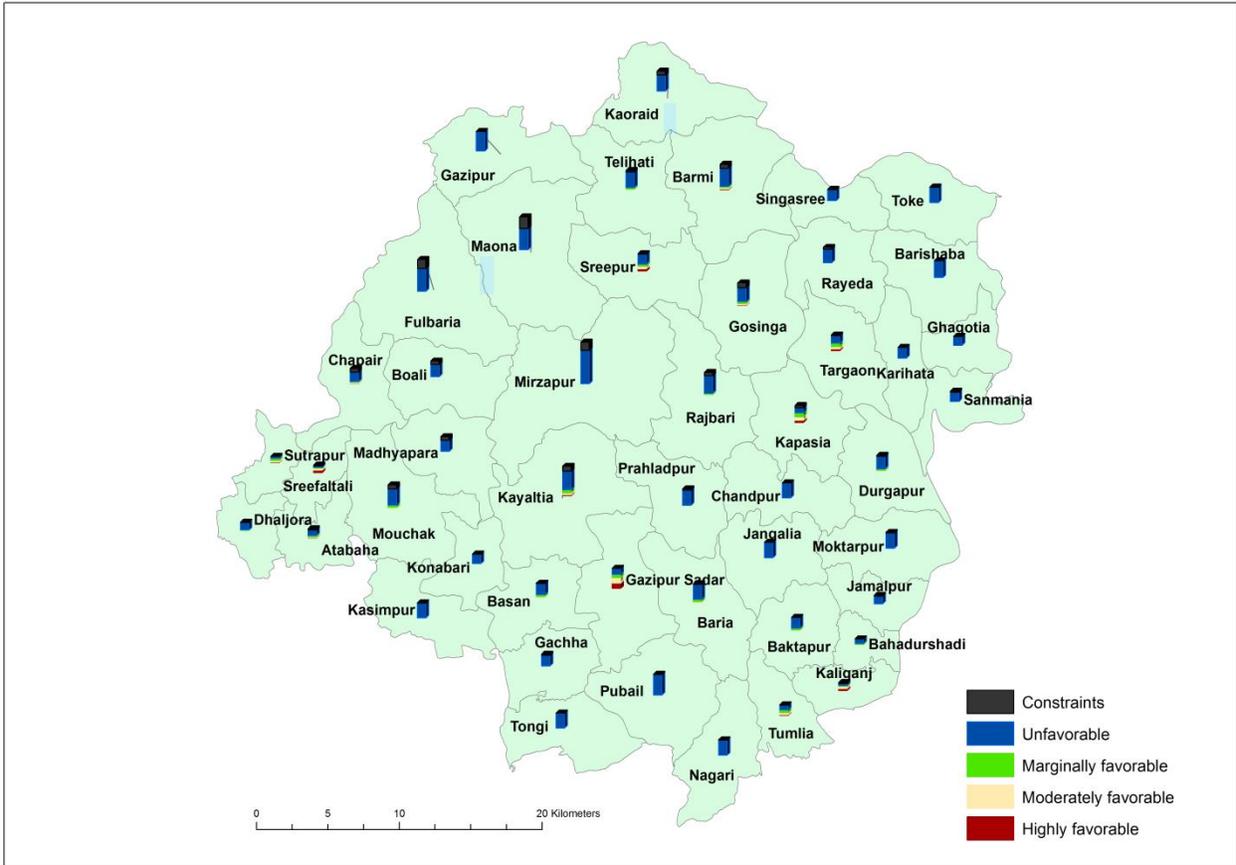


Figure 4-8: Relative area with proximity to government offices suitability by unions in Gazipur.

Note: The charts compare the amount of areas with different levels of suitability by administrative unions with the total of Gazipur.

4.1.4 High/low land with flooding and suitability

Sutrapur, Kaligonj, Baktarpur, and Tumlia unions score as unfavorable for more than 70% of their area for this factor, while Bahadurshadi, Jamalpur, Jangalia, and Moktarpur score as unfavorable for more than 50% of their area. This implies that the poultry farmers in these unions have a greatly unfavorable condition with regard to this factor. Prahladpur, Gazipur, Singasree, and Toke have a very large area considered as highly favorable regarding the flooding factor, which is more than 80% of their area. More than 50% of the area of Gazipur Sadar, Baria, Tongi, Nagari, Chandpur, Mouchak, Kayaltia, Durgapur, Kapasia, Mirzapur, Ghagota, Targaon, Rayeda, Fulbaria, Telihati, Barmi, and Kaoraid is highly favorable. Table 4-5 shows the suitability of sites regarding the factor of flooding for poultry MEs as a percentage of the surface area in Gazipur. Figure 4-9 shows the suitability of sites and Figure 4-10 shows the relative area with suitability for the factor of flooding in different unions in Gazipur.

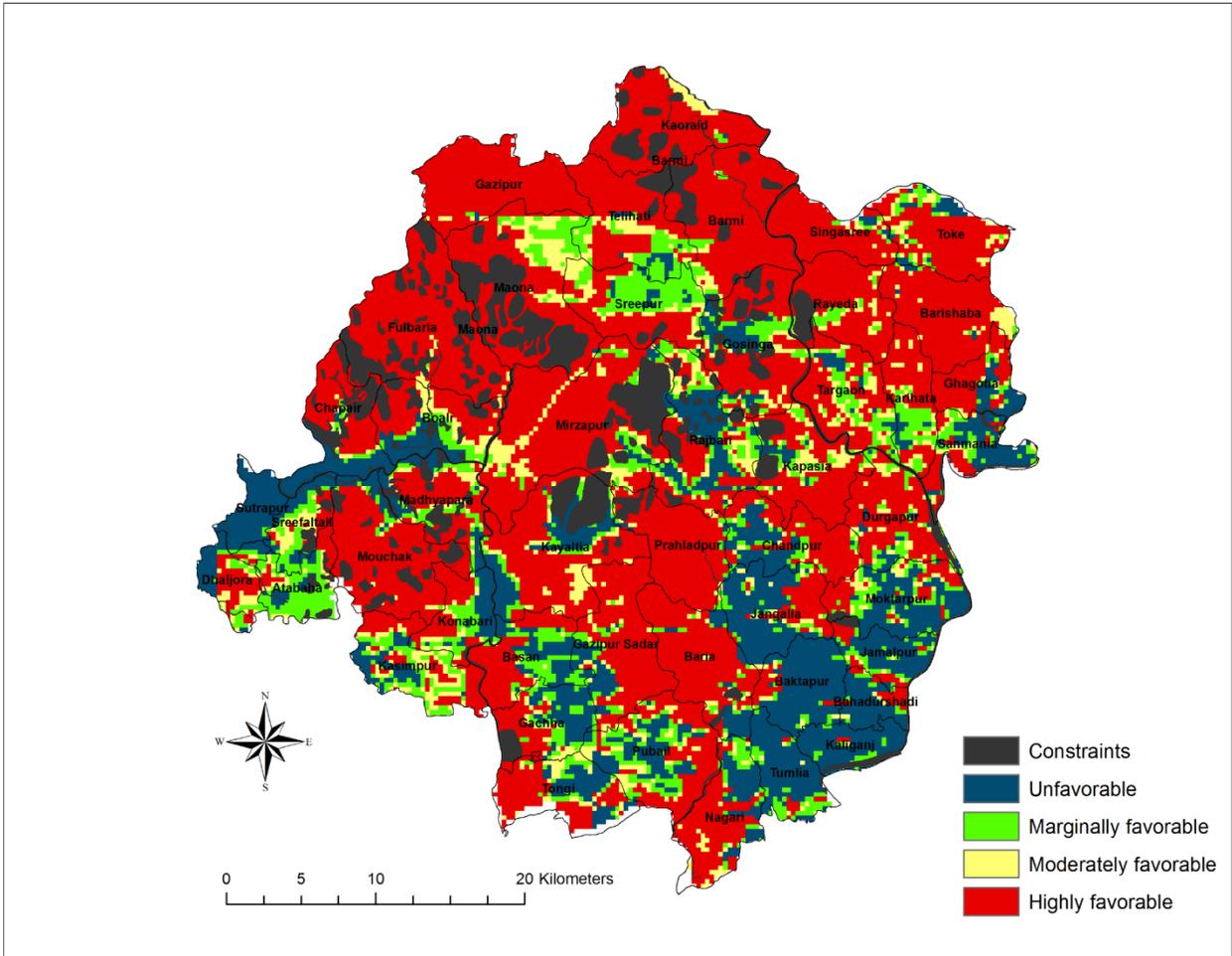


Figure 4-9: High/low land with flooding and suitable sites.

Table 4-5: Suitability of sites regarding the factor of land and flooding as a percentage (%) of the surface area in Gazipur.

Highly favorable	Moderately favorable	Marginally favorable	Unfavorable	Constraints	Total
52.8	8.2	10.7	17.4	11	100.0

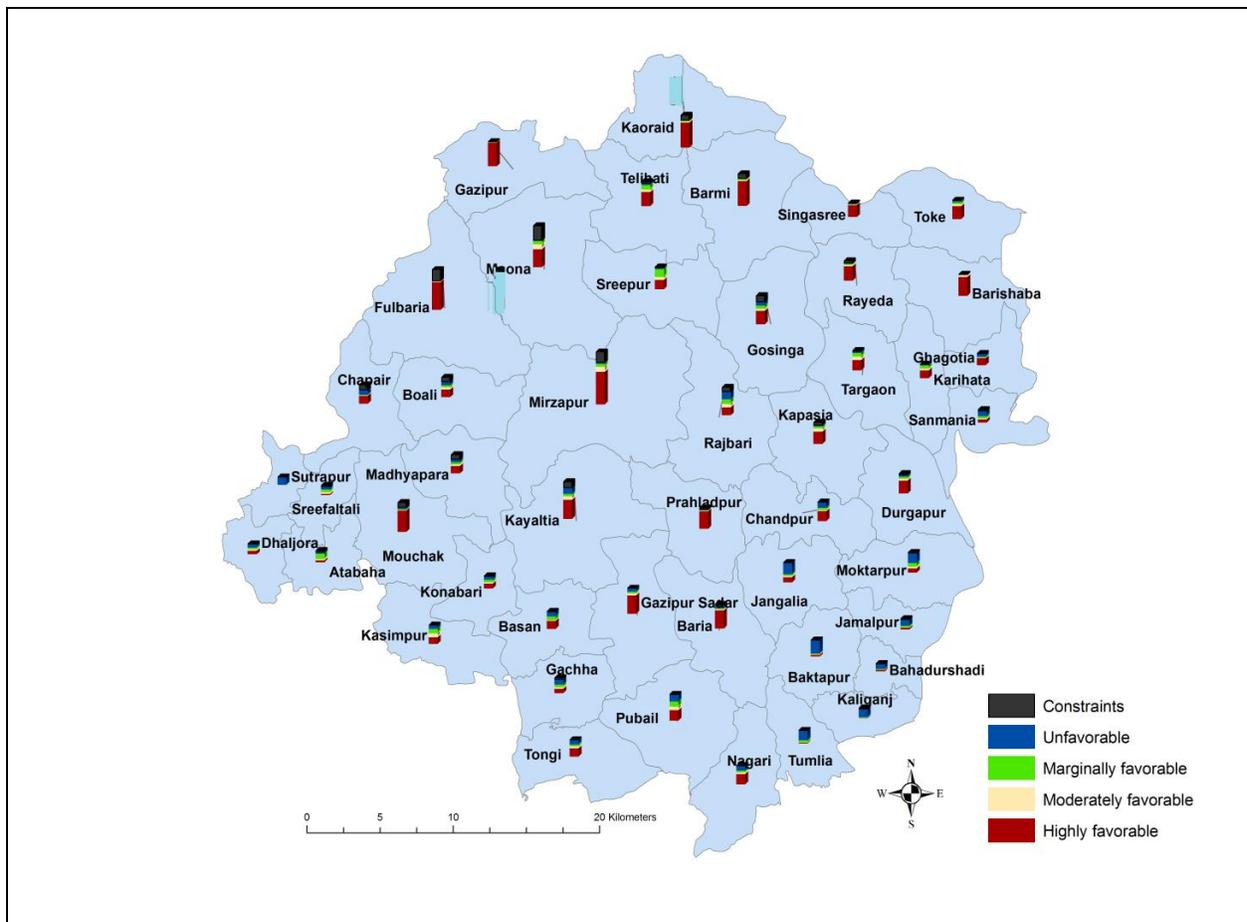


Figure 4-10: Relative area with high/low flooding land and suitability by unions in Gazipur.

Note: The charts compare the amount of areas with different levels of suitability by administrative unions with the total of Gazipur.

4.1.5 Constraint areas for poultry microenterprises' development

Approximately 11% of Gazipur district is considered as a constraint area, which is covered with forest, rivers, and other water bodies (Figure 4-11). These constraint areas, where poultry farm/ME development is not possible, are concentrated mainly in the north-western part of the district. Kaoraid, Maona, Fulbaria, Goshinga, Mirzapur, Chapair, Boali, and Madhyapara stand out as the unions with the largest extent (about 20% to 35%) of constraint area. Among them, Maona has the highest concentration of constraint area, mainly covered by forests in its south-western part, which accounts for about 35% of its surface area.

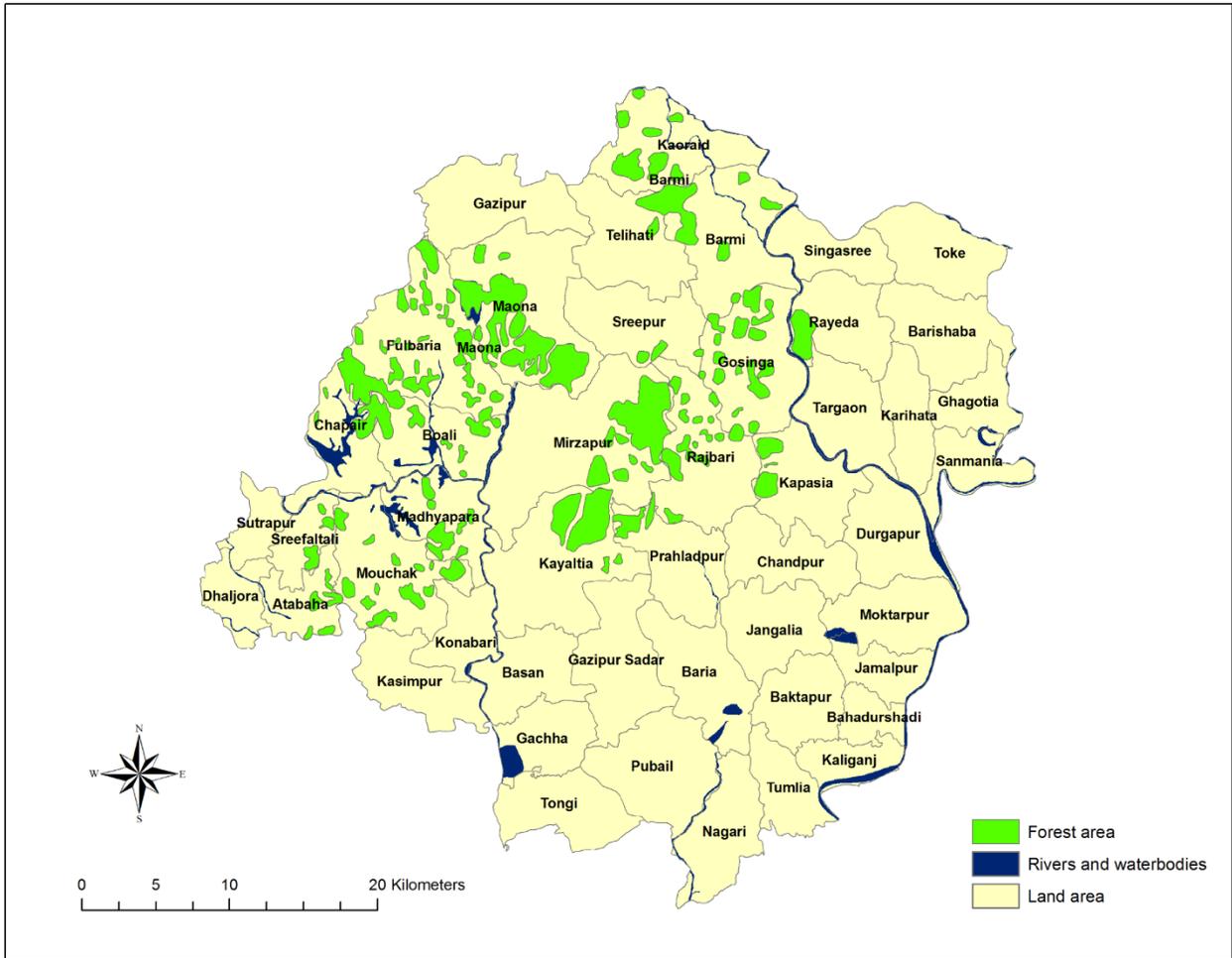


Figure 4-11: Constraint areas in Gazipur.

Source: GIS Unit, LGED.

4.2 Identification of sites' suitability for poultry microenterprises

The final poultry MEs' suitability model/map is classified into the following categories: highly suitable, moderately suitable, marginally suitable, unsuitable, and constraint areas. The model (Figure 4-12) shows that a relatively small percentage of area is highly suitable (212 square kilometers, 11.8%) and a relatively large area is considered to be moderately suitable (899 square kilometers, 49.9%) in Gazipur district, while a considerable area is considered to be marginally suitable (356 square kilometers, 19.8%) and unsuitable (137 square kilometers, 7.6%) for poultry MEs' development. Constraints were identified in 5 sub-districts, which occupy about 198 square kilometers, 11% of the total district area. Table 4-6 shows the suitability of sites for poultry MEs as a percentage of the surface area in Gazipur.

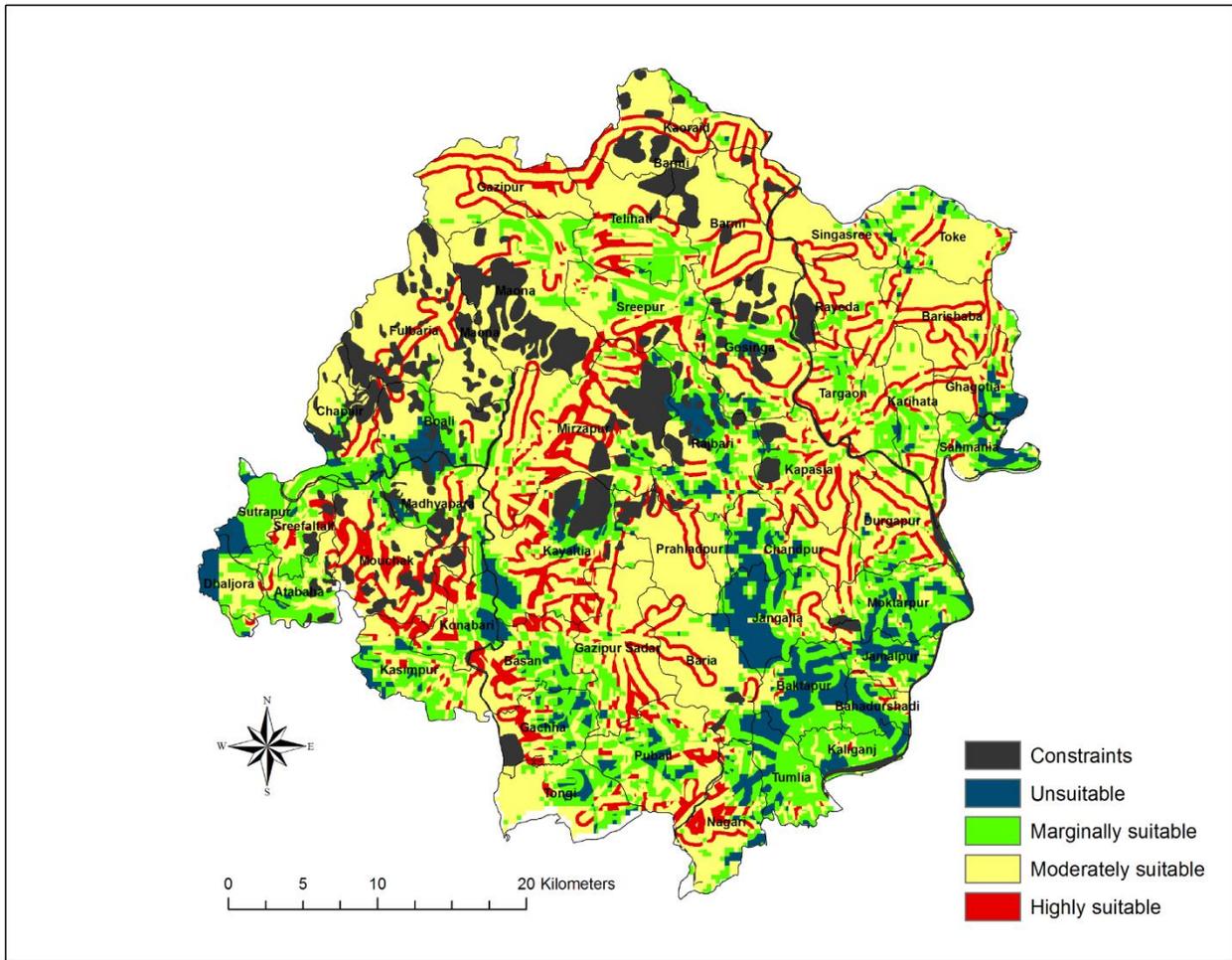


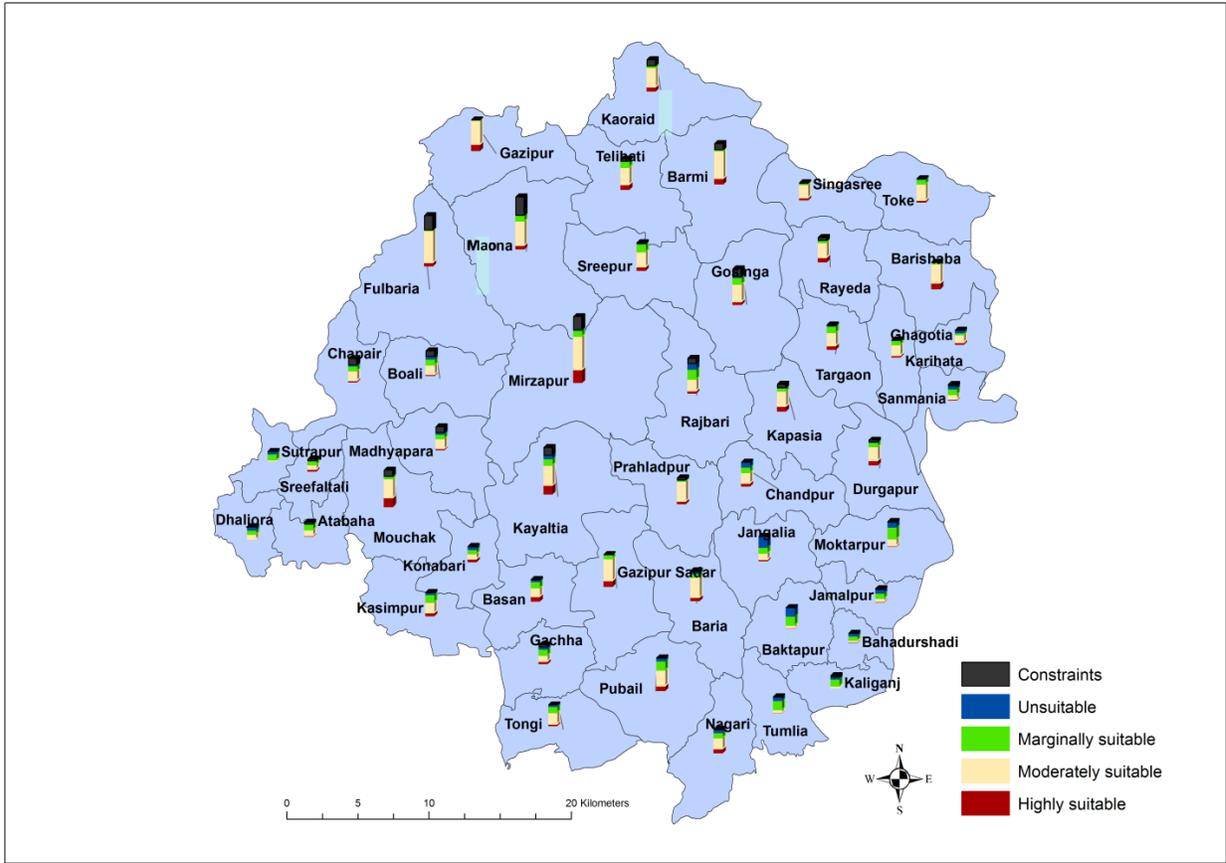
Figure 4-12: Map showing the suitability of sites for poultry microenterprises in Gazipur.

Table 4-6: Suitability of sites for poultry microenterprises as a percentage (%) of the surface area in Gazipur.

Highly suitable	Moderately suitable	Marginally suitable	Unsuitable	Constraints	Total
11.8	49.9	19.8	7.6	11.0	100.0

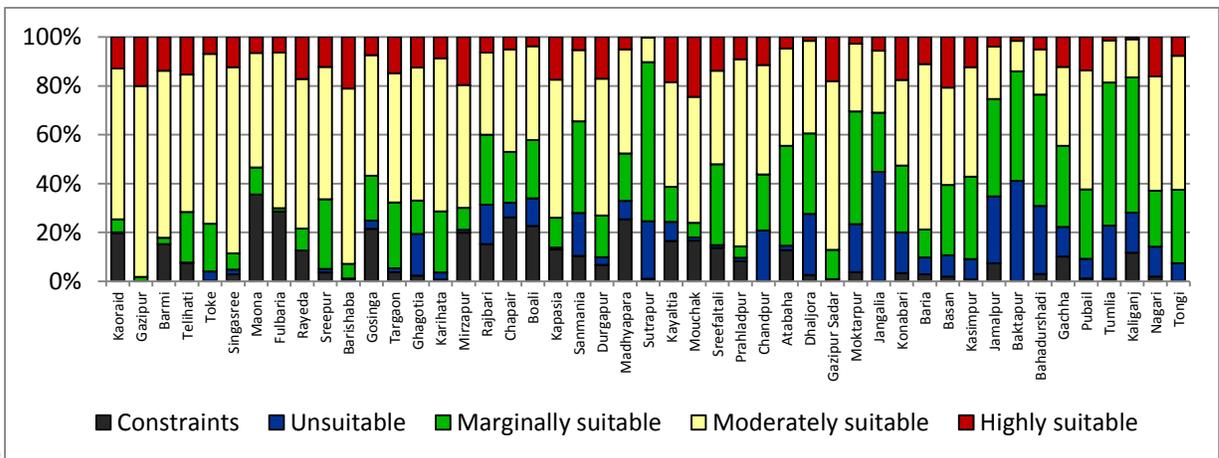
The unions, which are the ultimate tier of administration—namely Kaoraid, Gazipur, Telihati, Toke, Fulbaria, Shingasree, Rayeda, Barishaba, Karihata, Mirzapur, Durgapur, Gazipursadar, Prahladpur, Barmi, Kapasia, Baria, and Mouchak—have extensive areas that are classified as highly suitable/moderately suitable for poultry MEs. More than 70% of the area of these unions falls into the highly suitable/moderately suitable categories. These areas have suitable infrastructural potential with regard to their proximity to roads and highways, proximity to government livestock offices and markets, and land free from regular flooding. The microentrepreneurs in these areas have easy access to marketplaces for buying input materials, and have easier access to support services. Figure 4-13 shows the relative area with suitability for poultry microenterprise development in Gazipur.

Unsuitable/marginally suitable sites are distributed to a great extent in Sutrapur, Baktapur, Tumlia, Bahadurshadi, Kaligonj, Jangalia, Jamalpur, Moktapur, Dhaljora, Sanmania, Konabari, and Kashimpur unions and occur in 89%, 86%, 81%, 74%, 71%, 69%, 67%, 66%, 58%, 56%, 44%, and 42% of the areas of those unions, respectively, and unsuitable sites occur in 24%, 41%, 22%, 28%, 16%, 45%, 27%, 20%, 25%, 18%, 17%, and 8% of the areas of those unions, respectively. These areas are located in the south-eastern part of Kaligonj and Kapasia sub-districts and in the south-western part of Kaliakoir sub-district. Thus, the dominant areas with unsuitability between 25% and 50% are in Baktapur, Bahadurshadi, Jangalia, Jamalpur, and Dhaljora unions. They are considered unsuitable or marginally suitable as they are low-lying and prone to extensive flooding during the rainy season almost every year. Moreover, they are away from good communication systems and especially from the national and regional highways. For this reason, though the areas have the facility of a nearby government office in Kaligonj and Kaliakoir sub-districts, and are considered as moderately suitable with regard to this proximity factor, this factor is not persuasive in delineating the surrounding areas, such as Baktapur, Tumlia, and Bahadurshadi, as moderately suitable for poultry in the final suitability model.



a)

Note: The charts compare the amount of areas with different levels of suitability by administrative unions with the total of Gazipur.



b)

Figure 4-13: Relative area (map and chart) with suitability for poultry microenterprises by administrative unions in Gazipur.

Chapter Five

Poultry Microenterprises and the Value Chain in Gazipur District

5.1 Poultry microenterprises and value chain constraints at different suitability sites

The result of the GIS analysis in the previous chapter shows that Gazipur district has five categories of sites: highly suitable, moderately suitable, marginally suitable, unsuitable, and constraint areas. In this section of the chapter, a description will be given of the poultry microenterprises and the value chain along with the constraints/bottlenecks related to the different physical/infrastructural factors at the sites with different levels of suitability.

5.1.1 Identification of poultry microenterprises and the value chain

The term “poultry” indicates all domesticated species of birds, including chicken, ducks, turkeys, Japanese quail, pigeons etc., while commercial poultry production includes a variety of activities, such as the establishment of broiler chicken farms, layer chicken farms, rearing quail or turkeys for meat, rearing ducks, manufacturing poultry feed, establishing poultry meat shops, as well as poultry or egg-trading activities, etc. (Prabakaran, 2003). In Bangladesh, poultry includes mainly chicken, ducks, and pigeons. Among the poultry population, chickens account for the greatest number. This research deals with the commercial poultry (broiler chicken and layer chicken) farm MEs.

The production of chickens is growing into the largest component of the poultry industry in South Asian countries. However, only two decades ago, most of the chickens marketed in this region came only from backyard chicken production, but in recent years, the proportion of commercial (broiler and layer chicken) production has increased considerably. Broiler chickens were introduced into this region as early as the 1960s, not only among urban consumers, but also in rural households (Prabakaran, 2003). From the mid-1980s to the late 1990s, there was rapid growth in poultry production in Bangladesh, while since the late 1990s, it has been facing stagnancy. During the 1980s and 1990s, the poultry sector grew at a rate of 4.5% and 3.5%, respectively, while the total livestock experienced a growth rate of 1.9% and 1.3%, respectively (Raihan and Mahmud, 2008).

Poultry microenterprises may be considered as the most common microenterprises, particularly among the poor people in rural areas in Bangladesh. Poor people are normally found to be engaged in poultry farming. Many of the NGOs/development agencies have promoted poultry farming among the poor as a route out of poverty (McLeod, 2007). Consequently, poultry farming may be considered as a means for identifying poor microentrepreneurs (Dolberg, 2003).

From the field survey, it was noted that in microfinance services, mainly by several NGOs, microcredit (small loans) is provided to poor farmers. The amount of loans starts at BDT 8000/10,000 and is repaid by the borrowers in installments at a low rate of interest within one year. The borrower must be a member of a group and must have savings with the group. As a member of a group, the microcredit borrower must follow the group's discipline, regularly attend the weekly meetings, and repay the loan installments on a weekly basis. The microcredit member initiates any income-generating activity, such as poultry farming, and can borrow up to BDT 30,000 without any collateral. The microcredit lending policy of the donor organization does not allow one to borrow amounts in excess of BDT 30,000. The initiation of the microenterprise loan is considered to be an important addition to the range of microfinance services of NGOs. Microenterprise loans are provided to progressive microcredit borrowers who have a track record of timely repayment of microcredit and who need more funds to expand their business and enhance their

capacity to run the business. Microenterprise loans range from more than BDT 30,000 to BDT 1 million. Microfinance involves a collateral-free loan program. The group, which consists of 25 to 30 members/beneficiaries with their small amount of savings, acts as collateral to the lenders of the microfinance program. Through microfinance programs, it can be said that poor people have benefited. They can become owners of enterprises without necessarily having their own seed capital. Those who do not want to be self-employed, or those who are averse to borrowing, can be employed by these MEs. Loan defaulting is almost non-existent. The use of social and peer pressure, group motivation, and close monitoring of the NGO staff encourage disciplined and regular repayment of the loans in microcredit lending. The group members live very near to one another and know each other very well, so sometimes when a member becomes a defaulter of a weekly installment, then the other members of the group repay the installment on behalf of the defaulter. The group members can exchange information related to their businesses.

The field survey findings reveal that the poultry MEs are developed mainly in areas of agricultural land. These poultry MEs were developed utilizing small amounts of inherited family-owned homestead land, in front of the farmer's house. The poultry MEs in Gazipur district gain the benefit of the area's better transportation and communication systems, for the supply of the inputs for their MEs/farms and to take their product to the market in Dhaka through the middlemen/agents. It was found that almost 100% of the poultry birds in the district are transported to the big market for broiler chickens and eggs in the capital city of Dhaka, which is situated about 37 kilometers away from Gazipur. All the poultry farms enjoy the benefit of the electricity supply as they all remain under the electricity supply grid.

The value chain for poultry is a complex one that consists of various actors, such as producers, transformers, or suppliers of the product, and traders who commercialize it, i.e. connect the final product with the market. The value chain involves several activities, such as breeding chicks, feed production, input supply (feed, chicks, medicines), poultry production, collection and trade (of eggs or live birds), slaughter, processing, final sale, and consumption. The slaughter and processing of poultry are not very industrialized

in Bangladesh. Several MEs remain involved in these different activities in the chain, but this study describes the poultry production-oriented MEs in the value chain and examines their relationships with the other actors in the chain.

The poultry sub-sector value chain consists mainly of four linked production-oriented MEs, such as small parent farms (breeders), mini hatcheries, day-old chick-rearing units, and poultry-keeping units. Mini hatchery owners buy fertile eggs from breeders and, after hatching, sell day-old chicks to chick-rearing units. After rearing for some weeks, the units sell male birds for meat and female pullets to poultry keepers. Poultry keepers keep poultry to produce eggs, to sell to the market (IFAD, 2009). Many of these MEs start by using a small amount of homestead land and, gradually, the entrepreneurs increase the farm size with the help of microfinance.

In Gazipur district, many households utilize their homestead lands for poultry farming. Many day-old chick-rearing/poultry MEs have developed in the rural areas of the district, as there is a well-developed infrastructure for poultry value chain development compared with other districts of the country, including marketing facilities, transport, medicine and vaccination services, input supply, and information, in Gazipur district.

In Gazipur, as the field survey reveals, the microentrepreneurs collect day-old chicks directly from the agents of big and famous hatcheries, located in the growth centers/large marketplaces, or sometimes the agents themselves take the pullets to the microentrepreneurs. The day-old chicks are transported by road using buses. The microentrepreneurs avoid nearby rural markets and prefer to travel far to select and buy quality chicks from famous hatcheries/agents located in the growth centers in the district, as higher production and higher profit can be expected from using quality chicks. The survey reveals that half of the farmers travel about 5–9 km to collect quality chicks, while 10.42% of the entrepreneurs travel as far as 20–24 km (Table 5-1). However, the most suitable/favorable distance to marketplaces remains within 1.5 km, while more than 2.5 km is unfavorable. This implies that the microentrepreneurs usually face problems in collecting the main input—day-old chicks—due to the distance of marketplaces. The respondents

mentioned that they visit the marketplaces at the growth centers that are located in Mouchak, Maona, Kasimpur, Sreepur, Kapasia, etc. for the input materials.

The field survey of twenty-eight microentrepreneurs/farmers, used as a means of verifying the suitability of sites, reveals that the production characteristics and environment/factors differentiate between microentrepreneurs/farmers at highly suitable and unsuitable sites. These factors include the farm size (production and area), land improvement efforts, value of production, supply and transport cost of input materials, and distance to roads/markets/government offices. The evaluation shows that farms at highly suitable sites are rated as highly favorable with regard to all the factors, that is, with the exception of access to chick markets, which are located an average of 11.7 km from the MEs/farms at highly suitable sites (Table 5-2). This is because farmers usually prefer to travel far to procure good-quality chicks, even choosing to avoid the nearest small markets on occasion. Farms/MEs in moderately suitable and marginally suitable sites are located at sites with different suitability scores with regard to different factors. MEs/farms at unsuitable sites are found at sites rated as unfavorable with regard to all the factors of poultry value chain development.

Table 5-1: Distance of source of inputs (chicks) from the microenterprises.

Distance to the source of inputs (chicks)/marketplace (km)	No. of microenterprises	% of microenterprises
0.5–4	9	18.75
5–9	24	50.00
10–14	9	18.75
15–19	1	02.08
20–24	5	10.42
	48	100.00

Source: Field survey, 2010–11.

Table 5-2: Average distance to marketplaces at sites with different levels of suitability in Gazipur.

Level of suitability	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable
Average distance to a marketplace as a source of chicks (km)	11.7	10	14	36.3

Source: Field verification survey by the author conducted between July and September 2012.

The poultry microentrepreneurs buy vaccines and medicines from the agents of several medicine companies, which are available primarily in the growth center/marketplaces and in the rural markets. The entrepreneurs, who have the facility, collect some vaccines and medicines for free or at a cheap rate from the sub-district livestock department of the Government of Bangladesh. However, the entrepreneurs do not always prefer to collect medicine and vaccines from the government office, as it requires a lengthy process and sometimes the medicines or vaccines do not work well, as the quality deteriorates owing to some shortcomings in the preservation process. The questionnaire survey reveals that, generally, they buy vaccines and medicines from the big markets in growth centers/marketplaces, from which they buy the chicks. The farmers visit the chambers of government veterinary surgeons/personnel at the markets for any information about poultry farming and the prevention of poultry diseases. Figure 5-1 provides a graphic representation of the structural elements of the poultry value chain in Gazipur district. The financing and other support services of the Government, the PKSF, and NGOs are reflected on the left-hand side of the chain.

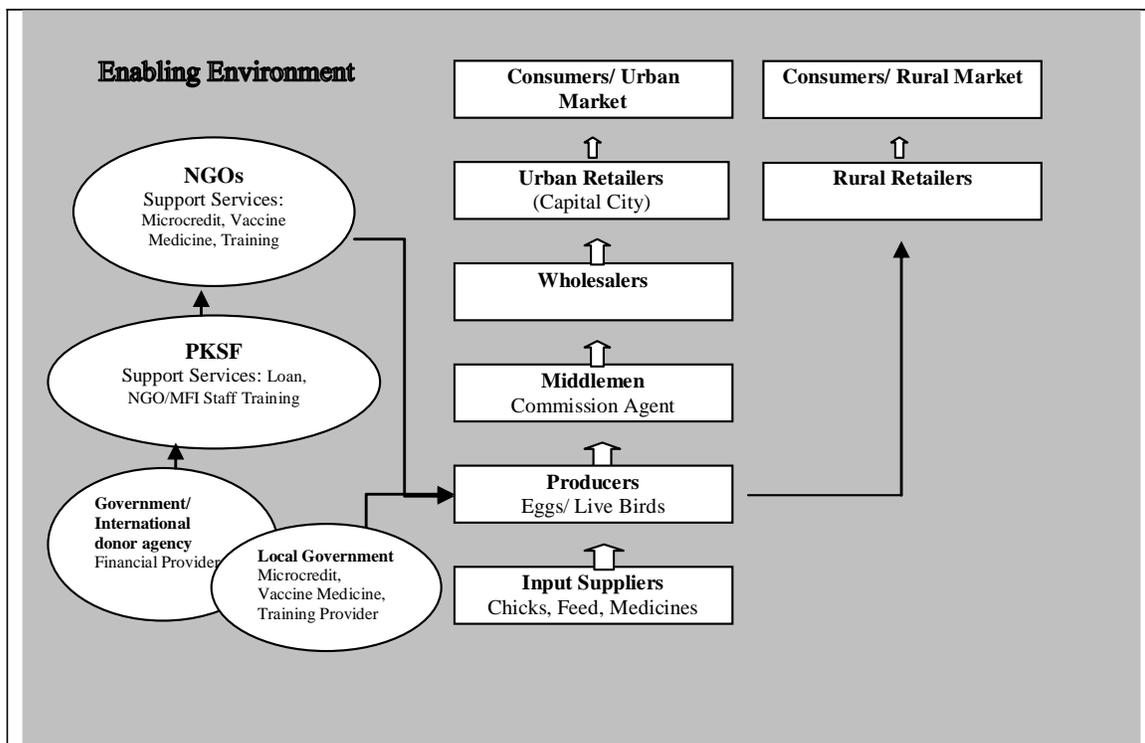


Figure 5-1: The poultry value chain in Gazipur.

Note: The PKSF is an apex funding agency for microfinance and poverty reduction established by the Government of Bangladesh.

Source: Based on the field survey by the author.

The microentrepreneurs generally buy poultry feed from the local rural markets, if the agents of the famous feed mills are available there, but they have to travel a long distance to buy quality feed from the agents/poultry feed companies at the nearest large marketplaces/growth centers if the quality feed company/agents of those companies are not available in their nearby rural markets. The survey reveals that most of the entrepreneurs buy feed from the nearby rural markets about 0.5–2.5 km away from their farms. The entrepreneurs usually buy poultry feed almost every other day, and normally have to carry the 50-kilograms bags of poultry feed by *rickshaw* vans (non-motorized vehicles) from the rural markets to the farms. Consequently, the farmers have to spend a substantial amount on transporting the feed almost every other day. On average, they need around 50 to 60 bags of poultry feed for 1,000 poultry birds every month and have to spend an enormous proportion of their total expenditure on feed to rear poultry birds. The cost of commercial feed accounts for up to 70% of the cost of raising industrial chickens (Sapkota, 2001; ACI, 2006; FAO, 2010). A huge portion of the expenditure on feed is allocated to transportation costs. The field survey of 28 microentrepreneurs/farmers, for the verification of the suitability of sites, reveals that MEs/farms at highly suitable sites are rated as highly favorable with regard to access to feed markets, which are located an average of 1.1 km from the MEs/farms, and MEs/farms at unsuitable sites are rated as unfavorable, with feed markets located an average of 2.6 km from the MEs/farms. The modes of transportation also differ between highly suitable and unsuitable sites. The microentrepreneurs/farmers at unsuitable sites were found to use boats in addition to road transport to carry poultry input materials. Moreover, it was found that the transport costs for feed differ from highly suitable sites to unsuitable sites. This also relates to profitability. These findings imply that farmers at unsuitable sites face great difficulties in transporting a huge amount of feed every day from distant marketplaces by unpaved roads using non-motorized vehicles. Table 5-3 shows the relationship between the distance to feed marketplaces and the costs for transport at sites with different levels of suitability.

Table 5-3: Distance to the feed market and the cost of transport at sites with different levels of suitability in Gazipur.

Level of suitability	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable
Average distance to a marketplace as a source of feed (km)	1.1	1.5	1.5	2.6
Average transport cost for feed (BDT/bag of 10 kilograms of feed)	10	10	15	16.3
Mode of transport used for carrying feed	Rickshaw van	Rickshaw van	Rickshaw van	Rickshaw van/boat

Source: Field survey by the author conducted between July and September 2012.

After rearing the chicks for about six months, the birds start laying eggs. The chickens are rejected and sold when they stop laying eggs after about eighteen months of laying. The microentrepreneurs sell the eggs each day, or every other day, to the agents of the wholesalers from Dhaka. The agents collect the eggs and chickens from the farm gate of several farmers/microentrepreneurs at different distances, when their pick-up vans can reach them, and take the eggs and chickens to Dhaka. However, in the case of some farms, which are located far from the wide paved roads, the entrepreneurs themselves have to take the eggs to the pick-up vans, using small non-motorized rickshaw vans (light vehicles). Sometimes, the wholesalers' agents buy the eggs from middlemen in Gagipur district, who store eggs collected over several days from the entrepreneurs. The wholesalers' agents start to collect the eggs and chickens in the morning and collect for the whole day. They set off for Dhaka at around 9:00 p.m. and take about 2 hours to arrive at approximately 11:00 p.m. (Figure 5-2). The microentrepreneurs are paid at the rate that is fixed at 12:00 a.m. on a certain day, by the society of egg wholesalers in the Tejgaon area, the main egg wholesale market in the city of Dhaka. The price of the eggs is fixed per hundred eggs. The price fixed by the society sometimes differs from the price that the entrepreneurs receive, depending on different factors, such as the proximity of the farm to easily accessible roads, the quantity of eggs (bigger farms receive a better price), the size of the eggs, and whether the entrepreneur took advance payment from the egg wholesaler, as they are bound to sell eggs according to the verbal contract with the agents. It was found in the field survey of 28 microentrepreneurs/farmers for verification that the price of an egg at highly suitable sites was BDT 8.9 on average, while farmers at unsuitable sites received BDT 8.5 for an egg (Table 5-4). In comparison, the retail price/price of an egg at the consumer level in Dhaka was BDT 9 to BDT 9.5, according to the TCB (Trading Corporation of Bangladesh). The range of egg prices at sites of different levels of suitability demonstrates that the profitability of producers at highly suitable sites is high compared with that of farmers at unsuitable sites. The price of chickens is fixed by the society of chicken wholesalers in Dhaka. The main chicken wholesale market is at Kaptan Bazar in Gulistan in Dhaka. All the respondents, during the survey, stated that they sell eggs to the wholesalers in Dhaka, through their (buyers) agents, while only a few of the

respondents sold the birds, according to their own arrangements, to the nearest marketplaces in the growth centers. Some of the respondents reported that a very small portion of their egg production is sold to the rural retailers, following the main delivery of eggs to the agents (Khaleda, 2013).

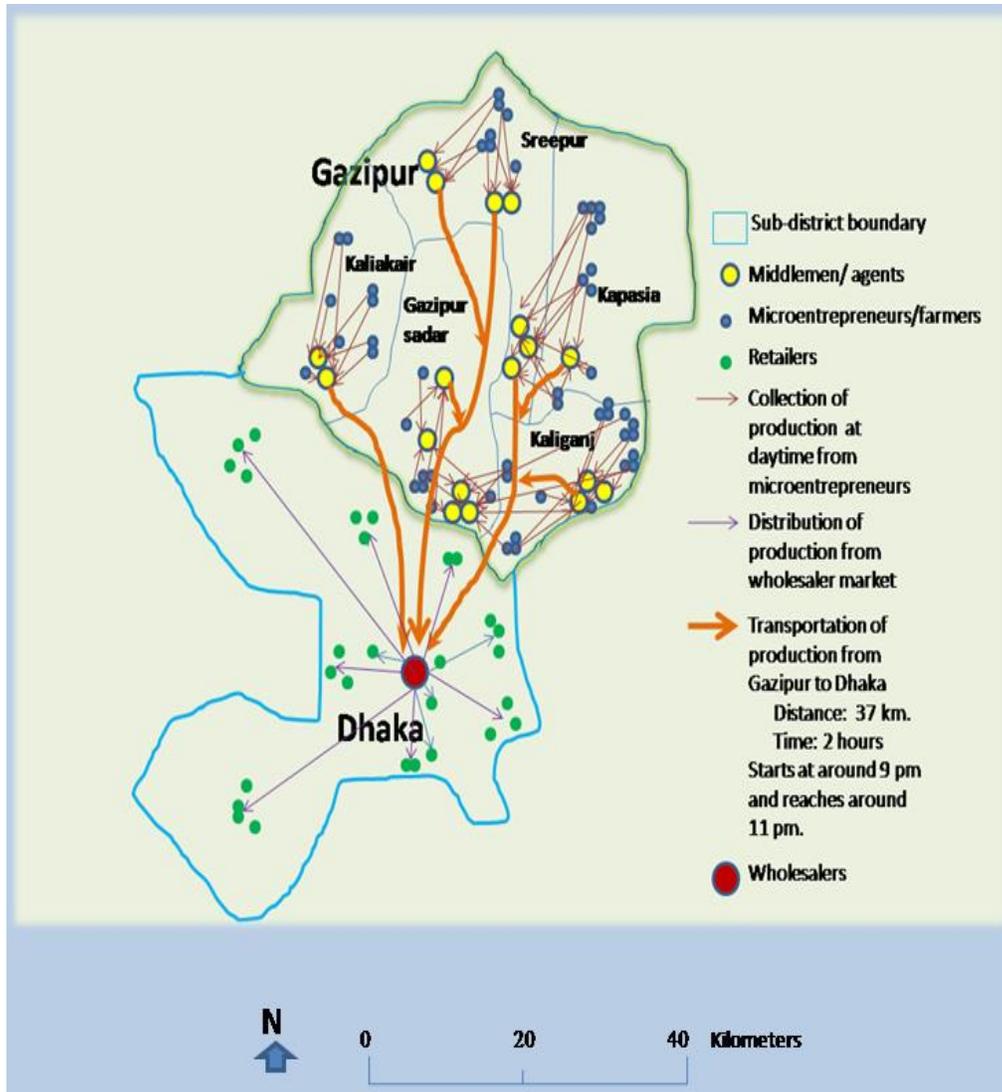


Figure 5-2: Origin and destination of the poultry value chain.

Source: Based on the field survey by the author.

Table 5-4: Price of production at sites with different levels of suitability in Gazipur.

Level of suitability	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable
Average price of production (BDT/eggs)	8.9	8.8	8.7	8.5

Note: BDT 83 = 1 US dollar.

Source: Field verification survey conducted by the author between July and September 2012.

The field survey of 28 microentrepreneurs/farmers, for verification, reveals that farms at highly suitable sites are rated as highly suitable with regard to the factors of proximity to paved roads and government livestock offices. MEs/farms at highly suitable sites are located on average 0.3 km away from the roads and 1 km away from the government livestock office, while at unsuitable sites they are located 3.6 km away from the roads and 11.3 km away from the government livestock office (Table 5-5). There were no well-paved roads or big markets within a favorable distance in the unsuitable area. During the verification survey, a great disparity was observed in the geographic features and associated constraints among four sites of different suitability levels. At an unsuitable site, farms/MEs were found on low-lying land, which floods very frequently. The farmhouses were found to be constructed on high ground or on elevated land, which implies additional expenditure on land construction and improvement. As the expenditure on land is high, farmers cannot build the farm structure using durable materials. At this unsuitable site, farmers' houses are made from bamboo. The site is located very near to an estuary of the Turag River, within about 10 feet, which overflows during excessive rains and causes floods. This site is in a relatively sparsely populated, typical rural area, in a remote corner of the urban developed area. At a marginally suitable site, farms/MEs were found on low-lying land, which floods almost every year. At an unsuitable site, poultry farms were highly inundated in the severe flooding that occurred in the years 1988 and 1998, while, at a marginally suitable site, that severe flooding could not reach as high as the farmhouses and the roads, but inundated the surrounding agricultural fields. The farms at the site were found in locations with surrounding green agricultural fields. Very few concrete structures were found in the area. At the moderately suitable and highly suitable sites, farms/MEs were found in a relatively flood-free highland area, which does not flood. Some of these farmhouses are tin-roofed with brick walls. The sites are dense in comparison with the marginally suitable/unsuitable sites. Some concrete structures—private brick-built houses, mosques, schools, etc.—were found at both of these sites, especially at the highly suitable site.

Table 5-5: Infrastructures and flooding situation at sites of different levels of suitability in Gazipur.

Level of suitability	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable
Average distance to paved roads from the farm (km)	0.3	0.7	1.0	3.6
Quality of roads near the microenterprise/farm	Paved	Paved	Semi-paved	Unpaved
Average distance to the government livestock office (km)	1.0	2.5	7.0	11.3
Level of flooding (cm deep) during severe floods	0	0	135	211

Source: Field verification survey conducted by the author between July and September 2012.

There are different sizes of poultry MEs with different numbers of sheds. Generally, the microentrepreneurs/farmers have 2–3 sheds, each occupying about 1,600 square feet, on average, and each shed contains about 1,000–3,000 birds (Photo 5-1 and Photo 5-2). The verification field survey of 28 microentrepreneurs/farmers reveals that the size of farms and the number of birds at sites with different levels of suitability vary greatly (Table 5-6). The microentrepreneurs surveyed have their own inherited land ranging from 0.5–10 acres. About 44.7% of the entrepreneurs own up to 1 acre of land. Only 21.2% of the farmers were found to own more than 3.5 acres of land, and among them 1 entrepreneur was found to use a portion of 10 acres of leased land. Table 5-7 shows the landholdings of the farmers.

Table 5-6: Production characteristics at sites with different levels of suitability in Gazipur.

Level of suitability	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable
Average size of farm (sq. feet)	4,150	3,072	3,235	1,250
Average number of birds	2,708	2,025	2,003	1,135

Source: Field survey conducted by the author between July and September 2012.

Table 5-7: Landholdings by the microentrepreneurs.

Landholdings	No. of entrepreneurs	Percentage of entrepreneurs
Up to 1 acre	22	44.7
1.5 acre to 3 acres	16	34.1
3.5 acres to 6 acres	5	10.6
6.5 acres and above	5	10.6
	48	100

Note: 1 acre = 0.4046 hectares.

Source: Field survey, 2010–11.



Photo 5-1: Poultry microenterprise: chick-rearing unit.

Photo by the author.

Most of the farmers have long experience in poultry farming and many among them started with a relatively small investment, a considerable amount of which was borrowed from the NGOs as microcredit (a smaller loan amount than a microenterprise loan) and as microenterprise loans. Table 5-8 shows that about three-fourths of the microentrepreneurs have more than six years of experience in poultry farming.

Some of the microentrepreneurs/farmers have received some kind of formal training on poultry farming; the institutions from which they have received training are government training institutions, NGOs, etc. Many farmers have no formal training in poultry farming. They have learnt about the farming procedure and taking care of the birds from friends or neighbors, who have a poultry farm of their own, or by reading books. Only 45% of the farmers stated that they had received formal training from government training institutions, NGOs, etc.

Table 5-8: Experience of the microentrepreneurs in poultry farming.

Experience of the microentrepreneurs (years)	No. of microentrepreneurs	Percentage of microentrepreneurs
1 to 5	13	27.08
6 to 10	15	31.25
11 to 15	11	22.92
16 to 20	9	18.75
	48	100

Source: Field survey, 2010–11.

5.1.2 Employment in the poultry microenterprises

The sample survey conducted by the author reveals that of the 166 farms surveyed, each employs, on average, 3 workers, in addition to the owner, yielding 570 workers in poultry MEs. Of the total workers, 315 include members of the owner's family, and the remaining 255 workers work for monthly average wages of BDT 5,000. Table 5-9 shows that more than half of the MEs employ 1–3 persons on their farm, while 28.92% employ 4–6 persons and only 6.02% employ 7–8 persons. Fewer than 2% of poultry farms employ 10 persons or more. The evaluation of the field survey of 28 microentrepreneurs/farmers, for verification, reveals that farms at highly suitable sites employ 3.8 persons, on average, while farms at unsuitable sites employ only 1.5 persons (Table 5-10). It also expresses the difference in production capability, competence, and profitability between different levels of suitability of sites.

Table 5-9: Number of employees in the microenterprises.

Number of employees	Number of microenterprises	% of farm
1–3	105	63.25
4–6	48	28.92
7–9	10	6.02
10 and above	3	1.81
	166	100

Source: Field survey, 2010–11

Table 5-10: Employment in farms at sites with different levels of suitability in Gazipur.

Level of suitability	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable
Average number of employees	3.8	1.8	3.0	1.5

Source: Field survey conducted by the author between July and September 2012.



Photo 5-2: Poultry microenterprise: poultry-keeping unit.

Photo by the author.

5.1.3 Investment in the poultry microenterprises and sources of funds

Initially, the majority of MEs use their own equity to invest in the establishment of the farm. Along with their own equity, they also use credit from NGOs and from their relatives and friends. Some of the farmers/microentrepreneurs are paid in advance by the middlemen/agents under an informal contract for the sale of their product. The middlemen, on the other hand, obtain funds mainly from their buyers in Dhaka. This advance payment ensures the supply of the production from the farmers to the final buyers/wholesalers. This benefits both the buyer and the seller. In this system of advance selling, as the seller remains bound to sell his product to a particular middleman, the farmers have every chance to receive a discounted price that is fixed by the intermediary/buyer. Sometimes, the farmers try to keep a small portion of their product to sell in the local rural market at a higher price. The farmers are generally prevented from doing this, owing to regular communication with the middleman. As a consequence of the high demand for eggs and poultry meat in the capital city of Dhaka, there is a huge daily supply to Dhaka from Gazipur. Therefore, this advance payment is available to the microentrepreneurs. Microentrepreneurs receive this advance payment from the agents when they cannot obtain a sufficient amount as a loan from an NGO.

The survey reveals that out of 166 poultry MEs, 38 microentrepreneurs, who constitute about one-fourth of the MEs, have invested up to BDT 200,000, and 32 microentrepreneurs have invested up to BDT 1,000,000, constituting about 19% of the MEs. The survey shows that 79 microentrepreneurs, who account for about half of the microentrepreneurs, have taken out an ME loan of up to BDT 50,000 and used the funds in their farms. About 30% of the microentrepreneurs have invested up to BDT 50,000 to BDT 100,000, borrowed as ME loans, while only 5 microentrepreneurs have received a loan amounting to more than BDT 300,000 from the NGOs, constituting 3.01% of the total MEs. Among the 166 MEs/microentrepreneurs, about 143 are female, making up 86.1% of the borrowers. Table 5-11 shows the value of the microenterprise loans that the microentrepreneurs/farmers borrowed from the NGOs and the amount invested by the microentrepreneurs in their MEs.

In most cases, the percentage of ME loans in the total investment is low. More than half of the MEs have utilized an ME loan from an NGO that is less than 20% of their total investment, while only 6.82% have borrowed more than 40% of their total investment. The evaluation of the field survey of both microentrepreneurs and general farmers, which was performed for verification purposes, reveals that more than half (57.1%) of the farmers have received loans from NGOs, while the percentage of microenterprises are highest at unsuitable sites.

Table 5-11: Amount of microenterprise loans and investment by the microentrepreneurs.

Amount of investment (BDT)	Number of MEs	% of MEs
Up to 200,000	38	22.9
200,001–400,000	28	16.9
400,001–600,000	21	12.7
600,001–800,000	29	17.5
800,001–1,000,000	18	10.8
1,000,000 and above	32	19.3
<hr/>		
Amount of microenterprise loan (BDT)		
Up to 50,000	79	47.59
50,001–100,000	50	30.12
100,001–150,000	12	7.23
150,001–200,000	12	7.23
200,001–250,000	1	0.60
250,001–300,000	7	4.22
300,001 and above	5	3.01
<hr/>		
Percentage of microenterprise loans in total investment		
Less than 20	107	64.46
20–39	48	28.92
40–59	9	5.42
60 and above	2	1.20

Note: BDT 70 = 1 US dollar.

Source: Field survey, 2010–11.

5.2 Spatial distribution of poultry microenterprises/farms linked to the value chain at sites with different levels of suitability

For the purpose of verification, it is important to analyze the areas where poultry farming is practiced in terms of suitability levels. In particular, for this study, it is crucial to verify whether the predictions of suitability correspond to the location of existing MEs/farms and to their number, level of production, and profitability. This section mainly involves an analysis of the geographic concentration of MEs/farms along with their production to some extent at sites of different levels of suitability by using ME/farm location data and intersecting the map with the poultry site suitability model. The analysis involves both MEs and farms, as in Gazipur district, poultry farms are generally small, the average farm size is 2,000 birds per farm, and as the small poultry farms that are not taking out a microenterprise loan at present have a chance to obtain a loan in the future. Several studies assign importance to the inclusion of basic information, such as the numbers, location, and characteristics of poor livestock keepers in the spatial distribution of livestock maps. This would be of great value to development agencies in the design of interventions that minimize the adverse impacts and positively affect the poor households in developing countries (Thornton *et al.*, 2002; Kruska *et al.*, 2003). Okwi *et al.* (2005) find high poverty rates in environmentally fragile regions of Uganda. Okwi *et al.* (2006) find a link between poverty and agricultural potential, the availability of resources, and a lack of market access. They mention that access to roads and markets favors the production of high-value products and contributes to incomes.

The previous section has revealed that there is a relative lack of infrastructure and a favorable environment for the poultry value chain in the district. The section also reveals that among the actors of the value chain, the microentrepreneurs/farmers and middlemen are located in Gazipur, while the wholesalers, retailers, and consumers are mainly located in Dhaka. This section deals with the spatial distribution of the main actor of the value chain. This section reveals that the poultry farms/MEs are distributed throughout the district, with a relatively low concentration in some portions. Some MEs are located at highly suitable sites, some are at moderately suitable sites, while a considerable number are at marginally suitable or unsuitable

sites. Thus, it is important to know which sites of the district and how many of the producers of those sites are able to add good value and thus are profitable due to the favorable environment and how many are not able to make a profit due to the unfavorable environment.

In Bangladesh, information related to land used for poultry farming is not available, although some available data reveal the number of poultry birds produced in different areas. According to the Government of Bangladesh's Livestock Department, the total number of chickens is steadily increasing, from about 143 million birds in 2001 to 195 million birds in 2006 and 228 million birds in 2010. The total number of poultry farms is increasing rapidly, from about 787 in 1980 to 148,933 in 2010 (Table 5-12). In the country, poultry egg production meets only about one-third of the total demand—5,743 million against the total demand of 15,184 million eggs. Similarly, all the sources of meat production combined satisfy only about one-fifth of the total demand for meat—1.26 million metric tons against the total demand of 6.39 million metric tons in the fiscal year 2009–10. The Dhaka division accounts for more than 50% of commercial poultry, as the demand and consumption of commercial poultry meat and eggs are high among the city-dwellers in Dhaka. About 73% of all the commercial chicken production farms are located in the divisions of the two largest cities in Bangladesh, namely Dhaka and Chittagong (Table 5-13).

In the Dhaka division, out of 16 districts, 5 districts have the highest concentration of poultry (72%), and Gazipur district ranks first for commercial poultry production among them, producing almost 24% (BBS, 2006). The data demonstrate that the highest amount of agricultural land is used for poultry production in Gazipur district, compared with the land used for the same purpose in other districts of the country.

Table 5-12: Number of poultry microenterprises/farms and employment in Bangladesh.

Year	1980	1998	2001	2010
Number of farms/microenterprises	787	60,670	91,430	1,48,933
Employment	11,805	910,050	1,371,450	22,33,995

Note: Poultry microenterprises/farms with more than 100 poultry birds.

Source: DLS (2010).

Table 5-13: Distribution of commercial poultry by divisions of Bangladesh and districts of Dhaka division.

Distribution of Poultry	Number	Percentage (%)
Administrative Divisions		
Dhaka	11,634,021	53.3
Chittagong	4,281,804	19.6
Barishal	1,001,077	4.6
Khulna	1,668,594	7.7
Rajshahi	2,052,593	9.4
Sylhet	1,171,560	5.4
Total	21,809,649	100.0
Districts of Dhaka Division		
Gazipur	2,783,235	23.9
Narsingdi	2,072,386	17.8
Dhaka	1,242,835	10.7
Kishoreganj	1,076,670	9.3
Tangail	1,200,636	10.3
Other 11 districts	3,258,259	28.0
Total	11,634,021	100.0

Source: BBS (2006) and Dolberg (2008).

Gazipur district consists of 5 sub-districts, each of which consists of a number of unions. These unions—the fourth/ultimate tier of administrative jurisdiction after sub-district, district, and division—are considered as spatial units in the analysis for the purpose of identifying the geographic concentration of poultry farms/MEs. The analysis of geo-referenced data on poultry microenterprises/farms in Gazipur district reveals a further concentration as 12 of the 47 unions account for 48.2% of the total of 5,149 poultry farms/MEs, and 51% of the produce (birds) is linked to value chains sourced predominantly from highly suitable/moderately suitable sites in those unions (Khaleda and Murayama, 2013b). In these unions, there are extensive areas identified as highly suitable/moderately suitable for poultry farming and very little or no area defined as unsuitable. Among these 12 unions, 5, namely Kapasia, Durgapur, and Chandpur in the east and Kaoraid and Barmi in the north, have an extremely high concentration (4.0–5.0%) that accounts for about 25% of poultry farms/MEs and 20% of poultry produce in the district. An extremely high (4.0–5.0%) to high concentration (3.0–3.9%) of poultry farms extends mainly towards the north-west from the east, including 5 more unions, namely Rajbari, Mirzapur, Kayaltia, Maona, and Fulbaria, and the remaining two, namely Mouchak and Pubail in the south (Figure 5-3). Kapasia, Kaoraid, Durgapur, Barmi, Mirzapur, Fulbaria, and Mouchak have more than 70% of their area identified as highly suitable/moderately suitable, while Kayaltia, Maona, Chandpur, Rajbari, and Pubail have 60%, 50%, 56%, 40%, and 62% of their area identified as highly suitable/moderately suitable, respectively. Among these 12 unions, some unions have very little or no area defined as unsuitable. Of these unions, Kapasia has the highest concentration of poultry farms, accounting for 260 farms/MEs, followed by Kaoraid (257), Durgapur (249), Chandpur (223), Barmi (215), and Mirzapur (212). In comparison, there are extremely low concentrations (0–0.9%) to low concentrations (1.0–1.9%) of poultry MEs/farms in the unions where there is a large area demarcated as unsuitable and marginally suitable for poultry farms; notable among them are Baktarpur, Jamalpur, Tumlia, Jangalia, Kaliganj, Dhaljora, Sanmania, Sreefaltali, Karihata, Sutrapur, and Bahadursadi. Figure 5-3 shows the geographic concentration of poultry farms/MEs (percentage of farms) in the different unions in Gazipur.

Figure 5-4 shows the numerical distribution, by union, of poultry farms/MEs linked to value chains in Gazipur.

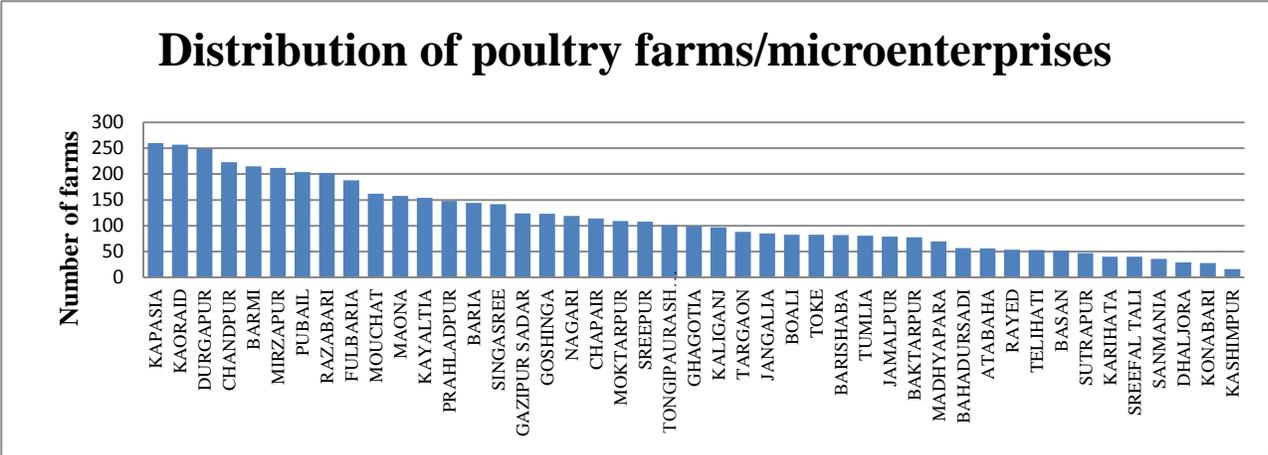


Figure 5-4: Rankings of administrative unions by the numbers of microenterprises/farms in Gazipur.

In Sreepur sub-district, the northern part of the district, an extremely high/high concentration of farms/MEs appears where the union Kaoraid houses 5% of poultry farms/MEs. In Kaoraid, the average size of farms/MEs is large (Figure 5-5) and the union lies in the highest range with regard to the percentage of poultry production and birds per square kilometer (Figure 5-6 and Figure 5-7). Among the other unions of the sub-district, poultry farms are highly concentrated in Barmi and Razabari, which link 4.2% and 3.9% of farms/MEs to value chains.

In the eastern part of Gazipur, Kapasia sub-district, poultry MEs/farms are extremely highly concentrated in Kapasia, Chandpur, and Durgapur, where the land area is mainly highly suitable/moderately suitable. In Sanmania, 25% of the area of which is unsuitable/marginally suitable, there are 36 farms, which account for only 0.7% of the total farms in the district, remaining in the range of extremely low concentration (0–0.9%) of poultry farms/MEs.

Contrary to the strong concentration of MEs/farms in the northern sub-district, which contains a vast highly suitable/moderately suitable area for poultry farms, there is a very limited concentration of poultry farms in the south-eastern sub-district of Kaliganj, which has a large number of marginally suitable/unsuitable areas. No union was found to have an extremely high/high concentration of farms in this region. Among the top 8 unions in Gazipur considered to have the largest area identified as marginally suitable/unsuitable, 7 unions are located in this south-eastern part of the district: Baktarpur (78 farms, 1.5%), Jangalia (85 farms, 1.7%), Tumlia (81 farms, 1.6%), Kaliganj (97 farms, 1.9%), Moktarpur (109 farms, 2.1%), Jamalpur (79 farms, 1.5%), and Bahadurshadi (57 farms, 1.1%). All these unions, except Moktarpur, have a low concentration (1.0–1.9%) of poultry farms/MEs. Moktarpur, by contrast, lies in the range of medium concentration (2.0–2.9%). In these unions, the average size of farms/MEs is very small to medium (Figure 5-5), except in Kaliganj and Tumlia. Most of these unions also lie in the lower ranges with regard to the percentage of poultry production and birds per square kilometer (Figure 5-6 and Figure 5-7).

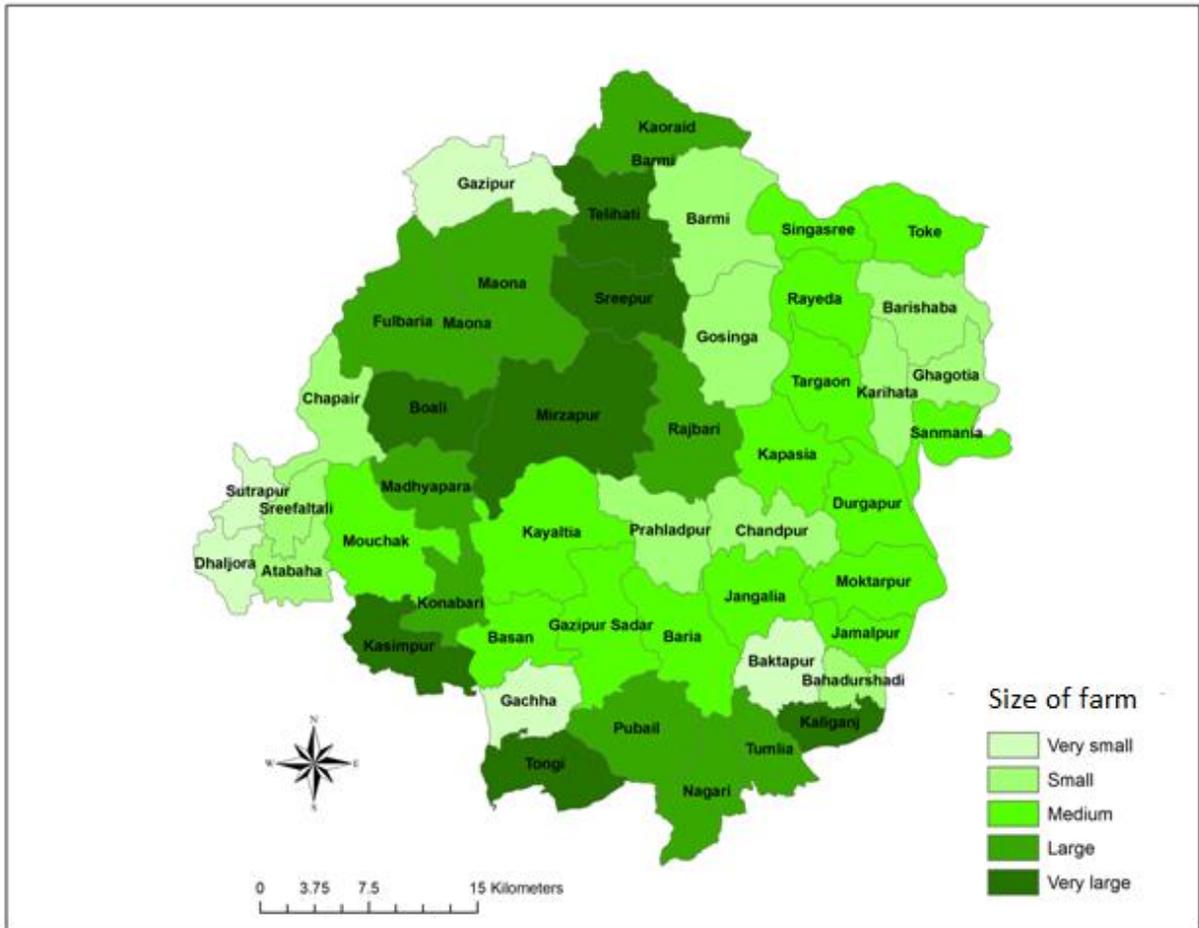


Figure 5-5: Average size of poultry microenterprises/farms by administrative unions.

Note: Very small = fewer than 1,000 birds per farm; small = 1,001–1,500 birds per farm; medium = 1,501–2,000 birds per farm; large = 2,001–2,500 birds per farm; and very large = more than 2,501 birds per farm.

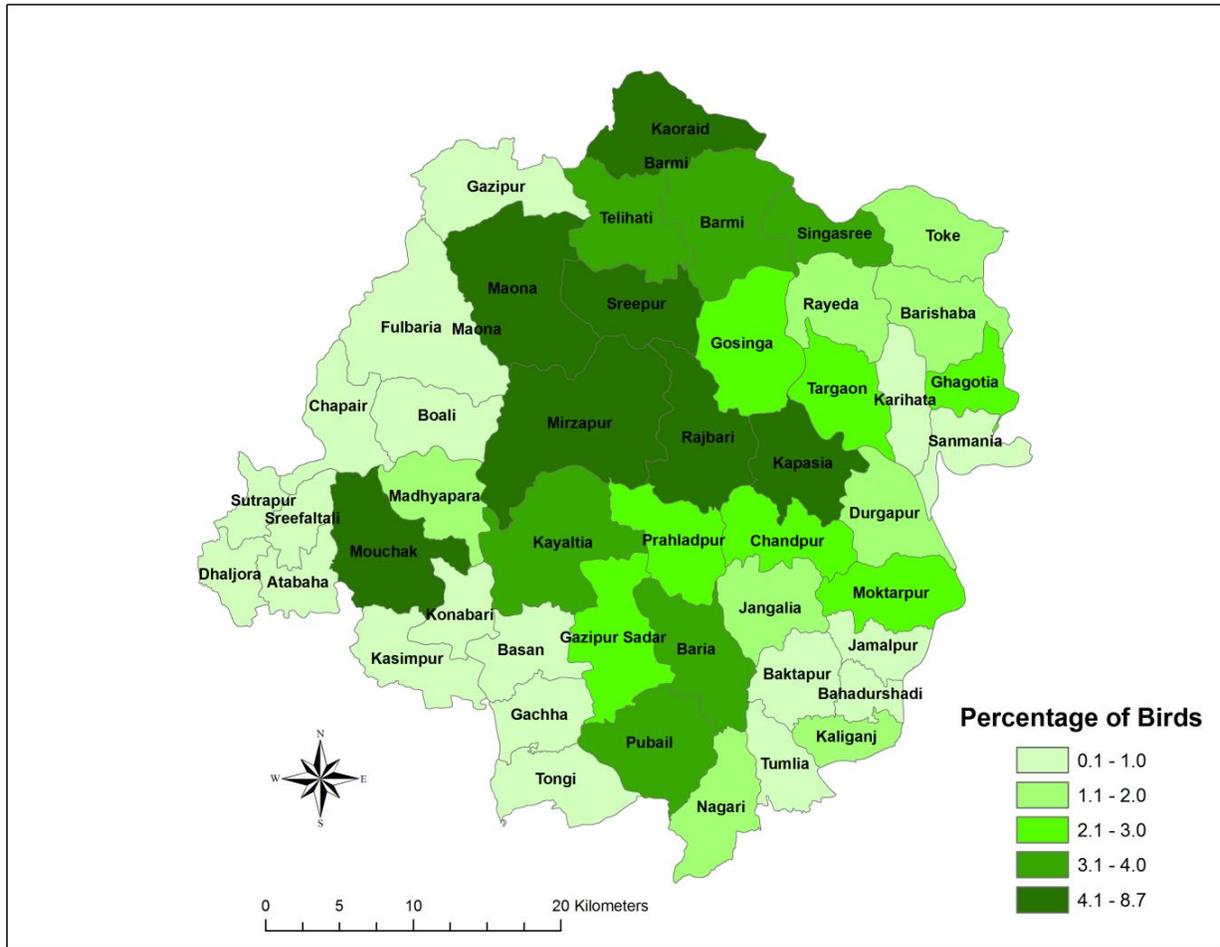


Figure 5-6: Distribution of poultry production (percentage of total birds in Gazipur) by unions.

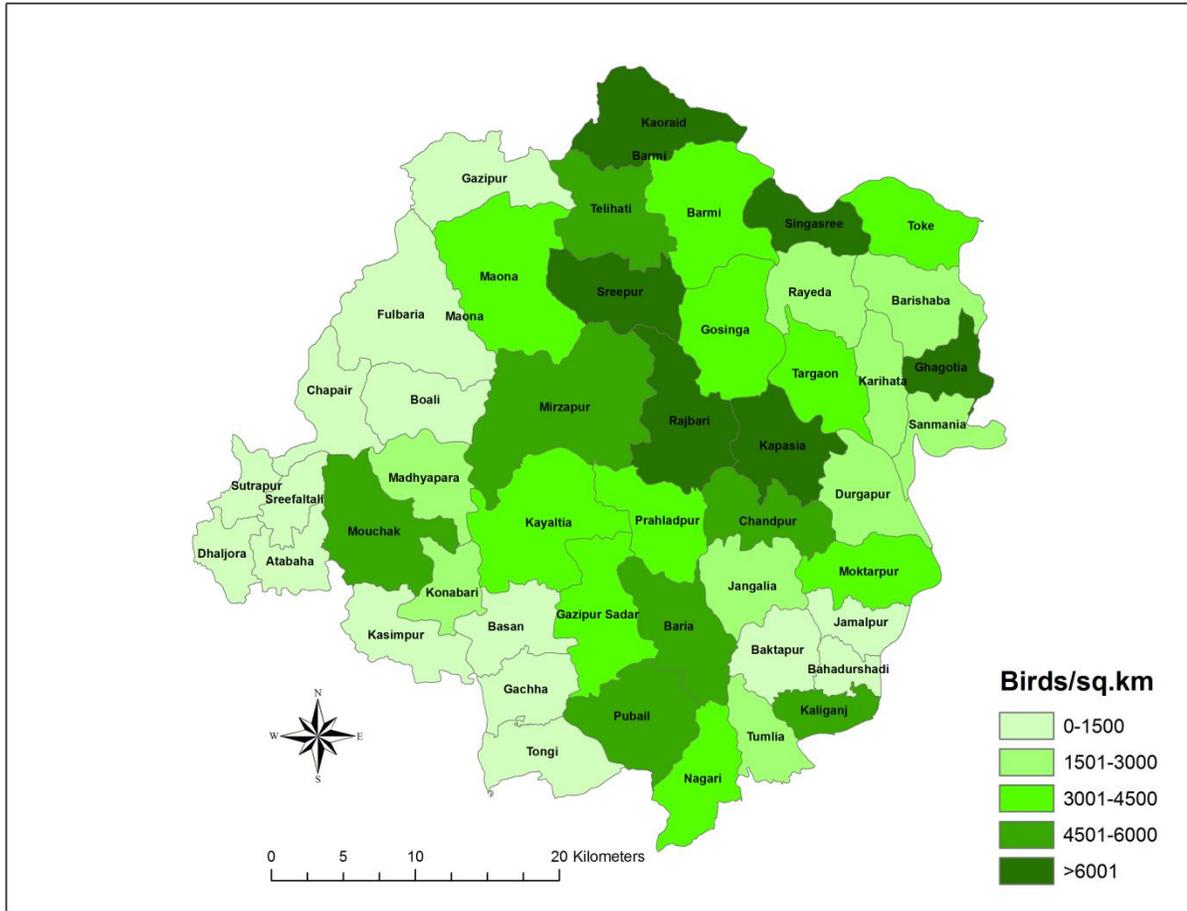


Figure 5-7: Geographic concentration of poultry birds (birds per sq. km) in Gazipur.

In the western part of the district—Kaliakoir sub-district—a high concentration of poultry farms is found in Fulbaria (188 farms, 3.7%) and Mouchak (162 farms, 3.1%), where the land area is mainly highly suitable. An extremely low concentration of farms is found particularly in Sutrapur (47 farms, 0.9%), Dhaljora (29 farms, 0.6%), and Srefaltali (40 farms, 0.8%), a large section of which lies in marginally suitable/unsuitable sites. Sutrapur has the highest percentage (89%) of area considered as marginally suitable/unsuitable among the unions of the district.

In the central sub-district of Gazipur Sadar, there is an extremely high concentration of poultry farms in Mirzapur (212 farms, 4.1%) and in Pubail (204 farms, 4%) and a high concentration in Kayaltia (154 farms, 3%). These unions have access to a range of facilities due to the proximity of government livestock offices, national highways, growth centers/marketplaces, and land free from regular flooding, and thus have extensive areas evaluated as moderately suitable/highly suitable for poultry farming. A medium concentration (2.0–2.9%) of poultry MEs/farms occurs in Gazipur Sadar, Baria, Nagari, and Tongi.

The location of the poultry MEs/farms and their production appears to be influenced by the spatial distribution of suitable/unsuitable sites. Table 5-14 demonstrates that a comparatively low percentage of MEs/farms are linked to value chains from unsuitable/marginally suitable sites. The percentage of production of farms in unsuitable areas is also low, as both the number and the percentage of large farms, producing more than 2,000 birds, are lower in unsuitable areas. This is very evident from Table 5-14, which shows a clear difference in the number of farms and the number of farms with higher production capability between different sites with predominance of different suitability levels; for example, Table 5-15 reveals that the first three unions (Mirzapur, Pubail, and Gazipur Sadar) with a majority of suitable area contain a comparatively higher number of farms per square kilometer and a higher number of large farms, while the last three unions (Sutrapur, Dhaljora, and Jangalia) with a low proportion of suitable area contain a comparatively lower number of farms per square kilometer and a lower number of large farms. In Gazipur district, the farm size varies from 100 birds to 150,000 birds per farm, while the average farm size is 2,000

birds per farm. Figure 5-5 shows the average size of poultry farms in different unions, while Figure 5-6 shows the distribution of poultry produce by administrative unions and Figure 5-7 shows the geographic concentration of birds per square kilometer in some unions of the district.

Table 5-14: Number of poultry microenterprises/farms at sites with different levels of suitability in Gazipur.

	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable	Total
Area (sq. km)	212	899	356	137	1,604
Percentage	13.2	56.1	22.2	8.5	100.0
Number of microenterprises/farms	655	2,809	921	451	4,836
Percentage	13.5	58.1	19.1	9.3	100.0
Number of large farms	95	326	103	31	555
Percentage	17.1	58.7	18.6	5.6	100.0

Note: A comparison between the size of area with poultry production, sites with different levels of suitability, and poultry farms in those sites is considered, constraint areas excluded. Due to an inaccuracy/error in the digital data, 4836 farms are considered in the GIS analysis.

Table 5-15: Number of poultry microenterprises/farms in some unions according to the predominant suitability level of sites.

Name of union	Items	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable	Total
Mirzapur	Area (sq. km)	19.3	49.6	9	1.1	79
	No. of microenterprises/ farms (farms/sq. km)	58 (3)	143 (2.9)	10 (1.1)	0	211 (2.7)
	No. of large farms (%)	21 (36.2)	31 (21.7)	3 (30)	0	55 (26.1)
Pubail	Area (sq. km)	6.7	23.8	13.9	4	48.4
	No. of microenterprises/ farms (farms/sq. km)	17 (2.5)	89 (3.7)	66 (4.7)	32 (8)	204 (4.2)
	No. of large farms (%)	3 (17.6)	17 (19.1)	12 (18.2)	2 (6.3)	34 (16.7)
Gazipur Sadar	Area (sq. km)	8.6	32.8	5.8	0.3	47.5
	No. of microenterprises/ farms (farms/sq. km)	31 (3.6)	89 (2.7)	10 (1.7)	0	130 (2.7)
	No. of large farms (%)	8 (25.8)	19 (21.3)	0	0	27 (20.8)
Sutrapur	Area (sq. km)	0.02	1.4	9.2	3.4	14.02
	No. of microenterprises/ farms (farms/sq. km)	0	1 (0.7)	38 (4.1)	6 (1.8)	45 (3.2)
	No. of large farms (%)	0	0	0	0	0
Jangalia	Area (sq. km)	2	9.3	8.9	16.4	36.6
	No. of microenterprises/ farms (farms/sq. km)	2 (1)	10 (1.1)	26 (2.9)	46 (2.8)	84 (2.3)
	No. of large farms (%)	0	0	7 (26.9)	7 (15.2)	14 (16.7)
Dhaljora	Area (sq. km)	0.3	7.2	6.3	4.8	18.6
	No. of microenterprises/ farms (farms/sq. km)	1 (3.3)	13 (1.8)	3 (0.5)	14 (2.9)	31 (1.7)
	No. of large farms (%)	0	0	0	0	0

5.3 Case study of poultry microenterprises linked to the value chain

5.3.1 A progressive microentrepreneur at a marginally suitable site

“Ashraful Islam” lives in Khilgaon Village in Pubail union in Gazipur district. He lives with his mother and sisters. Islam does not know his age but he is probably in his late 30s. After having only 10 years of schooling, he passed the public school certificate examination. Islam possesses 2 acres of land.

Membership of a microfinance group and loans from an NGO. Islam is a member of a microfinance group of 30, organized by a local NGO. Among these 30 members, 17 borrowed microenterprise (bigger) loans and only 13 were microcredit (smaller loan) borrowers. About 5 years ago, Islam’s mother was a microcredit borrower. In other words, she could borrow only a loan of a small amount ranging from BDT 5,000 to 30,000. His mother’s 5 successive loans (microcredit), each of a higher amount than the previous loans, were used in his poultry farm for purposes such as buying chicks, foods, and medicines and repairing poultry sheds. Investing his own money along with these small loans from the NGO, Islam was able to run his business smoothly and make enough profit to repay his mother’s loan. His mother could repay the loan regularly in 46 equal installments over the course of a year, while also building her saving deposits, though in much smaller amounts than the loan repayment. Sometimes, they were able to repay the loans in a period much shorter than one year, a period set by the loan product of the NGO. Islam’s mother’s good track record of loan repayment and his business development and expansion possibility made her eligible for larger amounts through microenterprise loan products offered by the NGO to progressive microcredit borrowers or to their family members. Consequently, Islam could become a member of the microenterprise loan group of the NGO. He borrowed BDT 0.1 million in the form of a collateral-free loan bearing much lower interest rates than those charged by other informal money lenders. The interest rate charged by the NGO is 12.5%. The borrowing and installment repayment procedures are much easier with the NGO than for loans maintained by formal banks, which are generally bureaucratic and cumbersome. Islam repays the loan installments at a weekly group meeting held at the house of a neighbor,

who is also a member of the microfinance group. Hence, Islam does not need to go far from his home and farm. This helps him amortize the loan installments in accordance with the repayment scheme.

Investment and the supply of outputs. Islam has long experience of poultry farming. He has been farming chickens for about 11 years and has invested a total of around BDT 1.8 million in three sheds for his birds, each with a capacity of about 950 birds. He raises about 2900 layer hens. He used the borrowed money for additional capital for his farm. He employs 3 paid laborers on his farm to look after the birds, each of whom he pays BDT 5,000 per month. None of the employed laborers previously had training in poultry keeping. They received training from another NGO on poultry farming.

Islam sells about 5,400 eggs every other day to poultry agents, who in turn take the eggs by rickshaw van to sell at the Tongi bazaar in Dhaka district, almost 15 kilometers away from his farm. As gross income per month, Islam expects around BDT 0.45 million from egg sales. On a given day, Islam contacts the egg wholesalers' society at the capital city using his cell phone, to enquire about the price. The market information about the price of eggs on a particular day gives him significant inputs into his decision on whether to sell the eggs at that point. If he calculates a loss or lower profit, then he opts to sell on the next day or two days later. On average, he receives BDT 550 per 100 eggs (November 2010).

The supply of inputs/outputs and environmental constraints. Islam buys poultry feed at a cost of BDT 1,200 per bag. He needs 8 bags (400 kilograms) of feed daily from the local market, Mira bazaar, which is about 2 kilometers away (a marginally favorable distance) from his farm. He uses a rickshaw van to bring the feed from the market, paying the van driver BDT 10 per bag. Consequently, he has to expend a lot of time and money every day on transporting feed from a faraway marketplace. He buys vaccines and medicines from the local rural market, and rarely goes to the local government livestock office for medicine or vaccines, as the quality is not always good and the journey is costly and time-consuming, as it is located about 10 kilometers (an unfavorable distance) from the farm. Sometimes, the quantity of the medicine/vaccines does not match the requirements supplied by the government office. He calls on a veterinary surgeon from the rural market for vaccination. He buys chicks every 2 years from big hatcheries,

which are located at Gazipur Sadar, and rears the chicks in a separate chick-rearing unit. In that unit, he rears chicks for about 6 months before they start laying eggs for a period of 18 months.

In Islam's opinion, the most important factors in terms of the location of his farm are its location on relatively high land, which is free from regular flooding, and its location in an area where a very good communication system has been developed. His farm is not very far from a paved road, less than 1 kilometer (a marginally favorable distance), to which his farm is connected by a very short village unpaved road. This enables the agents to transport the eggs by rickshaw van to their pick-up vans. For this, he receives a little less than the market rate. He has never faced any problems related to the marketing of his production, nor has he faced flooding.

5.3.2 A successful microentrepreneur at a highly suitable site

Hamida Begum from Ujilab village, in the Sreepur union of Gazipur district, has a poultry farm of her own. She lives with her husband and son in a brick house, beside which are wire-netted poultry sheds with a tin roof. Besides the poultry ME, they possess 2 acres of land and livestock, such as cows.

Membership of a microfinance group and loans from an NGO. In 2001, Begum became a member of a microfinance group consisting of 30 members of a local NGO. The NGO is located about 2.5 kilometers away from her home and farm. After joining, she used to attend the group meeting every week, and started to maintain a savings account, keeping track of the balance by updating her passbook with the field worker, who collected savings from the members at the weekly meeting.

She took out a loan of BDT 20,000 as soon as she became eligible. After repaying the full amount of her first loan in 46 weekly installments, she took out a 1-year-term loan several times, each time for a higher loan amount, as her monthly profit showed an increase. Her good track record in weekly repayment and regular attendance at the weekly group meeting qualified her for a microenterprise loan: the loan product meant for progressive microcredit borrowers/microentrepreneurs. Most recently, she took out a loan of BDT 0.3 million. She asked for a bigger loan amounting to BDT 1 million, but the amount was not

granted by the NGO, as NGOs normally take a conservative strategy in disbursing big loans, considering the risk and trying to follow a rule of a gradual increase in reaching the loan ceiling amount. Occasionally, when she ran short of funds, she took out an interest-free loan from her neighbors and relatives. The interest rate charged by the MFI is 12.5%. She repays the interest, along with the principal loan amount, at the weekly meeting. She has to repay the full 1-year-term loan amount, along with the interest amount, in 46 weeks.

The NGO kept several documents, such as the photocopy of her land ownership and a bank check signed by the borrower stating the total amount of the loan that she received. This bank check is kept to use in case the borrower defaults on the loan, which helps to file a case against the borrower if the check bounces back from the respective bank account. The NGO requires the documents as an alternative to a mortgage or collateral to cover the risk of a relatively substantial loan.

Investment and employment. Begum raises 9,000 layer hens on the farm, which stands on her own land. She invested a total of around BDT 9 million in 3 wire-netted sheds of about 1700 square feet each, for the birds, each with a capacity of about 3,000 birds. A total of 9 persons (7 male and 2 female) are involved in the farm to look after the birds. Begum's son, named Saeed, is among them, and was trained in poultry rearing by a non-government organization at Savar. Saeed had only 6/7 years of schooling. Begum employs 6 paid laborers on her farm and pays BDT 5,000 per month to each person.

The supply of inputs/outputs and enabling environmental constraints. Begum sells about 5,600 eggs every day to poultry agents, who take the eggs by covered van to sell in Dhaka district. Every day, the poultry agent contacts her to inform her about the price of eggs and the amount of the eggs he wants to buy. If she agrees with the price and amounts proposed, she hands over the eggs. If she does not obtain the desired price, she keeps the eggs for some days and keeps in contact with the agents to remain informed about the price. She earns around BDT 550/100 eggs. Begum expects around BDT 0.1 million income per month from selling eggs.

She buys poultry feed from the marketplace called Joina Bazaar at Nayanpur, which is about 14 kilometers away. She prefers to buy feeds for her poultry from that big market so far away from her farm in expectation of being able to buy the best-quality feed by choosing from the variety of feeds of different companies. She also prefers to buy chicks from the famous big hatcheries located at that Joina Bazar. Every 2 years, she has to buy chicks for her farm. After buying the chicks, she has to rear them for about 5 months and then they start laying eggs.

She buys medicine, vaccines, etc. from a pharmacy in the marketplace called Sreepur Bazar, which is about 2.5 kilometers away from the farm, as it stocks good-quality medicine and vaccines from well-known medicine companies. Begum buys all the main input materials from marketplaces that are beyond a favorable distance. She can collect the input materials from so far away because her farm is big, so the agents agree to take the huge amount of pullets and feed to her farm.

When the chickens stop laying eggs, after about 18 months, Begum sells them at about BDT 250 per chicken to agents who come from Maona Bazaar (about 8 kilometers away from the farm). The agents then sell the chickens to different markets in Dhaka.

According to Saeed, Begum's son, there is no problem related to marketing his farm's products. They have never faced flooding or outbreaks of poultry disease, such as avian influenza. The most important issues, related to the location of the poultry farm, are its flood-free location as well as its good communication and transportation facilities. There is a paved road that reaches very near to the farm and a semi-paved road that arrives at the farm gate. The wide paved roads make it possible for agents to come up to the farm gate with their large pick-up vans, thus helping him to make higher profits, as he does not need to carry the eggs by rickshaw van to the pick-up vans, as some of the other farmers need to do, thus incurring a cost for transport owing to their position away from the paved road.

5.4 Constraints related to the enabling environment in the value chain

Poultry MEs are one of the popular ventures among the poor microentrepreneurs in the country, although this sub-sector faces some very common problems. The availability of quality input materials as well as the inadequate and poor-quality rural infrastructure hinder the marketing of the products. These are the main problems that the poultry sector MEs face, other than requiring funds to continue their business. The fluctuation in the price of raw materials is a very common phenomenon, and a number of poultry farms have closed in Bangladesh as a result of the high price of poultry feed or chicks each year. The USAID ADTP II (2005) study reveals some constraints with regard to commercial broiler farms, such as problems with the consistent availability of quality and disease-free chicks and feed, the lack of finance, the lack of awareness of bio-security, the availability of training, poor-quality vaccines, the lack of technical support and diagnostic facilities, and the availability of a price database.

The main problems identified in the poultry value chain can be categorized into six groups: 1. problems related to the supply of input materials; 2. problems in terms of production and profit; 3. problems related to the marketing of production; 4. inadequate support service; 5. inadequate and poor-quality infrastructure; and 6. the occurrence of natural calamities.

5.4.1 Problems related to the supply of input materials

In Gazipur, microentrepreneurs/farmers depend on industrial feed for their poultry and on large commercial hatcheries for chicks. They purchase medicines and vaccines produced by major, well-known medicine companies. The poultry farmers buy feed, chicks, and medicines from the agents and dealers from the feed, hatchery, and medicine companies, which sell their products either in the rural markets or in the big markets/growth centers. A study by the SEDF (2005) reveals that the hatcheries provide 8% commission to the agents and that the agents make 13% profit from their sales to farmers, thus making 21% profit from selling chicks altogether. The feed millers provide 3% commission to the agents and the agents make 8% profit per kilogram of feed of sales to farmers, and so make 11% profit from selling feed. Thus,

the microentrepreneurs/farmers who depend on a middleman have to bear a higher price for input materials; in other words, the participation of a middleman has a considerable effect on the high price of both feed and chicks. A few microentrepreneurs/farmers benefit from a closer source of input materials for their farms, but many do not, and they need to travel to distant markets to buy good-quality input materials.

There are various qualities of chicks, and sometimes the farmers are deceived during their purchase of chicks when they pay for better-quality chicks, but receive lower-quality chicks. Farmers prefer to travel to distant larger marketplaces in growth centers for quality chicks, if reliable hatchery agents are not available in their nearest rural small market, as well as to buy the best-quality chicks by choosing from various qualities of chicks from many different companies. The frequent fluctuation of the price of the chicks also holds back microentrepreneurs/farmers from maximizing their production capacity and thus making the most of their profitability.

The quality of the feed from different feed millers also varies. The leading feed companies produce feed with balanced nutrients, but the microentrepreneurs/farmers have to depend on the feed from any mill if the reliable feed company agents are not available in their nearest rural small markets, as they need to buy feed almost every other day. For this reason, it is not possible for them visit distant markets frequently for quality feed. The price of feed remains high and rises throughout the year. During the survey, almost all the respondents mentioned the high cost of feed and their extreme frustration with the high feed prices. Owing to the high price of feed and chicks, farmers earn a very low profit margin and sometimes even incur a huge loss.

The price of vaccines and medicines is also very high. Microentrepreneurs/farmers have to expend a great deal of money on vaccinations and medication for their poultry. In some cases, the microentrepreneurs/farmers vaccinate their poultry themselves, and some farmers, who are not trained or educated, or the better-off farmers, call the veterinary surgeons from the nearby rural small markets, if they are available. Some microentrepreneurs/farmers have to depend on unqualified personnel when the veterinary surgeons are not available. The government provides some vaccines and medicines free of charge

or at low prices. During the survey, many of the respondents complained about the quality of government-supplied medicines and vaccines, mentioning the improper storage facilities of government departments. Many of them disliked government-supplied vaccines and medicines owing to their quality, quantity, and lack of timely supply. A few of the respondents complained about bribes taken by lower-class government employees and delays or long procedures maintained by the government department providing the medicines and vaccines. Farmers do not have the facility for late payment for input materials when they buy from the government; however, this is possible if they buy from the agents.

5.4.2 Problems in terms of production and profit

The microentrepreneurs/farmers follow an ordinary production system. They do not possess technical savvy with regard to poultry production, because it would increase their production costs. Government or NGO interventions in scientific production are not extended to microentrepreneurs/small farmers, which could increase their production ability and thus enhance their profitability. The lack of availability of a skilled and trained workforce, inadequate management ability, lack of education, and lack of knowledge of modern technology make them unable to maximize their production and make a profit. Sometimes, microentrepreneurs/farmers are not interested in using proper, modern technology. Moreover, farmers are not aware of their lack of bio-security, which causes outbreaks of disease in the microenterprises/farms. In 2007, poultry farms throughout the country experienced a serious outbreak of avian influenza for the first time, and poultry microentrepreneurs incurred huge losses owing to the death of the birds. As a result, many microentrepreneurs/farmers had to leave the business, creating much unemployment.

5.4.3 Problems related to the marketing of production

The main market for poultry products is in Dhaka; some of the buyers at the largest wholesale market in Dhaka stated, in interviews, that almost 70–80% of the eggs and poultry birds are collected from

the small farms in Gazipur district. On the other hand, there is very low demand for broiler meats and eggs produced in the commercial farms at the village small markets in the locality of Gazipur. A few large poultry-processing industries in the country utilize the production from their own farms. As a result, direct linkages between the microentrepreneurs/farmers and the markets are almost absent, and most of the microentrepreneurs/farmers have to depend completely on the middlemen/agents of the buyers of the wholesale market at Dhaka to market their products from their farm gate. The Society of Wholesalers in Dhaka fixes the price of the microentrepreneurs' products. The price of eggs is fixed per hundred and the price of chickens is fixed on the basis of weight, depending on the consumer demand; the society never takes into account the production costs borne by the microentrepreneurs. In this system of trading, the microentrepreneurs/farmers usually have no options for negotiation, and they have to accept whatever price they are offered. An analysis conducted by Chand *et al.* (2009) shows that the farmers have to sell their broiler chickens in the range of BDT 80–100, while they had to purchase the chicks from the dealers for BDT 38 each, and the total production cost rose to BDT 94 per broiler chicken. Thus, they incurred a loss when they sold the poultry birds at a lower price than the total production cost. Thus, the microentrepreneurs/farmers are prevented from obtaining a fair market value. As the microentrepreneurs are very small and not well-organized and as there is no strong society/association working in their interests and for their profit, they are unable to sell their products at a favorable price.

5.4.4 Inadequate support services

Inadequate financial support from the government and non-government organizations is one of the greatest hindrances that the poultry entrepreneurs face. The credit provided by the government is very small in size and few of the farmers are fortunate enough to obtain government financial support. Farmers in Bangladesh have the opportunity to obtain financial support from the NGOs, which operate their microfinance program all over the country. The NGOs' microfinance program is not found to be demand-driven in respect of the poultry microentrepreneurs. Since microfinance involves collateral-free lending, the

group, consisting of 25–30 members/beneficiaries of the loan, as well as their small saving deposits, act as collateral to the lenders. In the case of microenterprise lending, the loan amount is comparatively higher, and the lenders have to follow a tough lending policy, by imposing different conditions or by keeping different documents as an alternative to a mortgage or collateral to cover the risk of a relatively large loan, such as keeping a photocopy of the document of the land ownership from the beneficiary of the loan or by collecting a good amount of money as savings from the beneficiaries. All these issues make microenterprise lending quite limited. Some might be progressive borrowers of microcredit and the microenterprise might have the potential to expand, but the farmers do not possess land. Thus, they are excluded from the microenterprise lending program owing to this limitation. Alternatively, they sometimes manage to obtain a loan as microcredit or a smaller amount of money. A study undertaken to understand the reason for the increasing incidence of client exit from the LAPO (Lift above Poverty Organization) program, an MFI in Nigeria, shows the importance of a system to track clients' reasons for leaving, especially if the clients leave because of negative factors of the MFIs' policy and practice (Stanley, 2005). The study reveals that 47% of exit clients found the loan sizes to be inadequate. A survey of clients of SHARE, an MFI in India, finds that they were dissatisfied with the small size of the loans (Todd, 2001). Todd's survey of ex-clients finds that their main reason for leaving was not the absence of impact, but their dissatisfaction with the lending methodology. They found weekly repayments difficult to maintain when their business was experiencing a bad time. In addition, many of them found the need to guarantee each other's loans rather onerous.

5.4.5 Inadequate and poor-quality infrastructure

In many cases, the distance of the input supply source from the MEs/farm is not great, which is revealed by the survey. However, it can be considered as a hindrance to the rapid development of the sub-sector in Bangladesh, as most of the roads in rural areas are unpaved or semi-paved and most of the MEs are situated away from paved roads. As such, they have to rely on traditional non-motorized

vehicles/rickshaw vans to carry the input materials from the markets and transport produce from the MEs/farms on unpaved or semi-paved roads, which takes a long time as the roads become muddy, especially during the rainy season, making it difficult to transport the materials from the markets and the produce from the MEs/farms. Not only does this cause the cost of input materials to be higher, but it also makes it difficult for the agents (buyers) to reach the farm with their trucks, to collect eggs and poultry birds. As a result, microentrepreneurs who are located away from paved roads have to sell their products at a much lower price.

Transport distances impose stress on chickens, and that influences the meat quality and can cause weight loss and sometimes even death. Different studies show that the mortality rates among poultry birds increase with longer distances when they are transported. A 50-kilometer journey of poultry causes 0.51% mortality and 5.07% weight loss, while for shorter distances of less than 50 kilometers, there is 0.31% mortality of birds and 4.1% weight loss (Saleque and Rozen, 2009).

There is a poor electricity distribution network in Bangladesh. In particular, some rural areas are not connected to the electricity grid. In Gazipur district, 53.96% of households have electricity on average, which is much less in remote rural areas than urban areas (BBS, 2001). In the extremely hot summer season, the temperature rises to 35–40 degrees Celsius. Higher mortality occurs in the summer season, especially during June to August (Saleque and Rozen, 2009). In the survey, all the MEs/farms in the villages of Gazipur were found to have electricity and used electric ceiling fans, but the respondent farmers complained that the production was hampered by frequent interruptions to the power supply.

5.4.6 Occurrence of natural calamities

Bangladesh is comprised mainly of extensive deltaic floodplains, and is regularly affected by natural disasters, such as floods and cyclones. Its geographical location is largely responsible for its vulnerability. Bangladesh, with a small land area of about 147,570 square kilometers, is criss-crossed by

many hundreds of major and minor rivers that flow through the country, and to the south there is the Bay of Bengal. Most of the rivers overflow their banks, causing floods almost every year during the rainy season. About 30 to 35% of the land area of the country is flooded every year (Milliman *et al.*, 1989). Sometimes, disastrous floods inundate a huge area of the country; for example, the floods of 1988 and 1998 caused about 68% inundation of the total land area (DoE, 2001). During the 1988 flood, 51% of Gazipur's total land area was affected (Islam and Sado, 2000). Poultry farms are affected by extensive flooding. The roads are damaged during floods, disrupting the farms' routine activities, such as marketing their produce, collecting input materials, etc. The farmers need either to construct their farms on land free from regular flooding or to build the poultry houses on high ground, if in low-lying areas. However, this type of construction incurs extra costs.

Chapter Six

Discussion and Recommendations

6.1 Discussion

The empirical analysis of the value chain and sites' suitability, as described in the previous chapters, gives us useful insights into several constraints related to the physical and infrastructural factors that limit the distribution of MEs and their profitability. Any poultry product of a microentrepreneur brought into the market competes with similar poultry products in the market coming from many farmers of different areas. Thus, all microentrepreneurs offering their products for sale become part of the value chain. However, not all these farmers remain in an equally favorable business environment, and as such, they are not equally benefited. For this reason, the farmers require support to be competitive by minimizing their production costs or maximizing their profitability and therefore different levels of government and NGO interventions are needed in different areas. Consequently, regionalization is essential to gain an understanding of the difference in constraints and profitability between sites of different levels of suitability in order to help the supporters of the value chain to decide on the areas for preferable intervention.

6.1.1 Poultry microenterprises and value chain development

Understanding the factors and processes that determine the spatial differences in value and profitability is of crucial importance to the exploration of the dynamics of the poultry value chain. In this study, the business-enabling environment conducive to the establishment of poultry MEs is shown by the distance to large marketplaces, distance to the government livestock offices, paved roads, and state of the landform/flooding situation. The distance from the large marketplaces (as a source of inputs/backward

market, not for outputs or a forward market) is calculated because it is assumed that quality input materials are available only in these large marketplaces. The study also identified the processes that influence the spatial distribution of poultry MEs/farms along with their production competence based on a spatial, empirical analysis. A site near to large marketplaces is more likely to have the facility to buy quality input materials by offering a variety of feed, chicks, and medicines from different companies, ensuring high productivity of the MEs/farms. In addition, the proximity to marketplaces means fewer transaction and transportation difficulties and costs. Moreover, the condition of the roads varies over seasons and regions. There are different types of roads—mainly paved and unpaved. Generally, the road quality decreases from the marketplaces/growth centers, urban centers, and highways towards the remote villages. During the rainy season, which lasts for approximately half of the year, the unpaved roads become muddy, and motorized vehicles cannot move over them. The microentrepreneurs need to carry input materials using non-motorized rickshaw vans over these rural roads, incurring time and monetary loss. Furthermore, the wholesalers' agents with their big trucks/heavy vehicles avoid these unpaved rural roads when they come to buy eggs or chickens from the microentrepreneurs, so the microentrepreneurs have to take their products to the trucks of the agents using non-motorized vehicles, which sometimes cause damage to the products and create a huge loss to the farmers. Considering these disadvantages, unpaved roads and small marketplaces, which are numerous and consequently exist near the MEs/farms, are not considered in the sites' suitability analysis. A flat landform is an important determinant of the general receptivity of poultry farming operation. Gazipur is extensively flat, with many low-lying flooding lands. Flood-free highland areas are more receptive to poultry farming operations. Many disadvantages are simply related to the low-lying flooding land—which not only hampers the possibilities for poultry MEs production but also increases the cost of infrastructure construction and maintenance, roads in particular.

The poultry feed price of a certain company does not vary (a fixed price rate per bag of feed) between different marketplaces in different regions (though the price and quality of feed vary between different companies), as the ingredients are not produced locally and companies depend mainly on imported

ingredients of feed from abroad. Therefore, the price of feed is a function of the distance to marketplaces. The research shows that the average distance to the marketplaces for feed is shorter than that for chicks. This can be explained by the fact that microentrepreneurs usually visit the nearest marketplace, whether it be a small rural market or a large marketplace, and whether it keeps quality feed or not, as they need to buy a huge amount of feed (a number of 10 kilogram bags) almost every day, while they buy chicks occasionally (once in about 2 years for layer poultry and almost every 2 months for broiler poultry) and prefer to travel to distant marketplaces to ensure quality. This pattern underscores the role that large marketplaces play as a major source of the main input materials of poultry farming. For marketplaces, the opposite weighting by the experts during MCE than generally expected is strongly supported. A possible explanation for this result is that the marketplaces are used only for buying inputs, not for selling products, on the one hand, and it is not possible for an individual farmer to take a huge quantity of eggs/chickens to such distant markets in Dhaka due to huge transport costs and security reasons, on the other hand.

Profitability can be related to farm location and production for a number of reasons: 1) the ME/farm size influences the price paid per unit of output/production, so large MEs/farms with huge output obtain good prices from the agents; 2) the size of per unit of production: big egg/chicken production achieves a good price; 3) MEs/farms located close to a paved road, whereby the agents can reach the farm gate, gain a competitive advantage in price; 4) large MEs generally possess sufficient farm storage and the ability to negotiate better prices, so they can sell their products when prices are higher; 5) there is no credit constraint related to large MEs/farms, as many NGOs' microenterprise loan policy allows up to 80% of the lending of the farmer's total investment, which leads them to further big investment and profit; moreover, these NGOs and the government can rely more on large MEs/farms that ensure their repayment ability.

The study included an analysis of spatial distribution in order to attain a holistic understanding of the poultry MEs' status and undertake better decision making for their development. This recognition would not only benefit the microentrepreneurs, but would also guarantee the best utilization of the government and NGOs' limited resources. In unsuitable locations, where several MEs in great need of interventions to

improve their situation exist, any support would be cost-effective, as it would reduce the per capita expenditure for providing the support. Here lies the necessity to discern the spatial distribution of MEs/farms in order to make assumptions about the demands for the necessary funds and facilities to support their sustainability at sites of different levels of suitability.

The exploration of infrastructure- and environment-related factors of the value chain and the suitability of sites makes a valuable contribution to the understanding of the constraints of the poultry value chain in different areas. The present study analyzed the spatial variations of constraints to poultry MEs' expansion in Gazipur. It found that the variation in the suitability of sites or value chain conditions played a very important role in determining the spatial differences in poultry ME production and profitability. Thus, future value chain development efforts should account for regional differences in the value chain environment and microentrepreneurs' profitability.

The poultry value chain analysis of Gazipur discovered bottlenecks within three important levels and in the dynamic interactions between them. Figure 6-1 shows the existing and expected situation of the poultry value chain, in which the three important levels of the value chain are influencers, actors, and supporters. The "influencers" include environment/infrastructure-related problems, which are maximal at unsuitable sites, while there are minimal problems at highly suitable sites. To ensure higher productivity levels, microentrepreneurs at unsuitable sites have to travel longer distances in order to obtain quality chicks, feed, and medicines. As the microentrepreneurs, who are the "actors," travel longer distances, their production cost increases and their profitability decreases. Moreover, the construction of a farm structure on elevated lands requires additional costs. Thus, the microentrepreneurs at unsuitable sites are unable to add high value and make a low profit or sometimes incur a loss. At highly suitable sites, microentrepreneurs have to travel shorter distances both for inputs and for outputs. They can gain/create high value, as some are found to obtain the retail price rate from the agents, while at unsuitable sites no microentrepreneurs/farmers were found to obtain the retail price rate. The prices at sites of different suitability levels demonstrate the lowest possibility to utilize public resources/infrastructure at unsuitable sites and thus the lowest

productivity and profitability, while at the “supporters” level, there is homogeneity in their assistance efforts, such as in microfinance support services, training, infrastructure construction, etc. The Government’s and NGOs’ maximum efforts and investments are required at unsuitable sites and minimum investments are required at highly suitable sites, which can minimize or overcome the constraints. Thus, the microentrepreneurs’ production expenditure can be reduced at different scales at sites of different suitability levels, which will ensure somewhat similar profitability at different sites and can provide equal opportunities to be competitive for all microentrepreneurs.

The verification survey finds a clear difference in the enabling environmental constraints and the number of MEs/farms with different production capabilities between different sites with different suitability levels and suggests that poverty in the geographically challenged regions needs to be reduced on a priority basis through an effective development approach.

Poultry microenterprises and value chain constraints at unsuitable sites. The unsuitable sites are those sites where all the factors coincide with each other, making unfavorable situations for poultry MEs. At these sites, MEs/farms are built on low-lying land, which floods very frequently. The sites most extensively affected by severe flooding are in Kaligonj sub-district, in the southeastern part of the district, followed by some unions in Kaliakoir sub-district, in the western part of the district. Many difficulties and troubles at these unsuitable sites are associated with their low-lying flooding land. The farm structures are constructed on high ground or on elevated land, which implies additional costs. This hampers the routine activities and production of poultry MEs. The microentrepreneurs at these sites need to use boats during the flooding seasons, which last for months, to carry poultry input materials from marketplaces located at an unfavorable distance. The wholesaler agents cannot come up to the farm gate to collect poultry products.

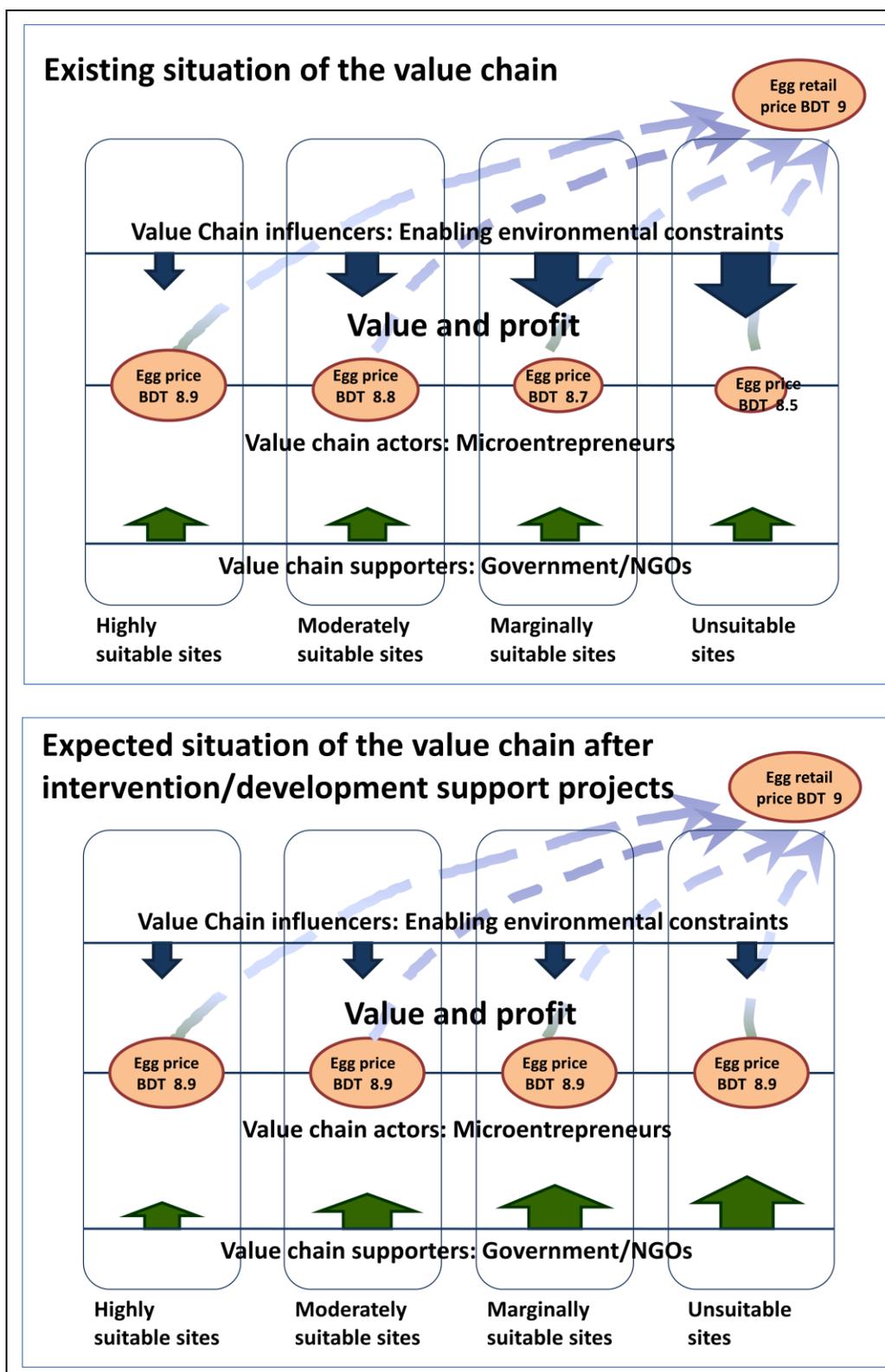


Figure 6-1: Existing and expected situations of the poultry value chain in Gazipur.

These unsuitable sites remain isolated and constrained in their suitability for poultry production due to the frequent flooding and the resulting low quality of roads, which complicate the access to input and output markets. Moreover, microentrepreneurs travel long distances for input materials, which is inconsistent with the infrastructural conditions favorable for poultry farming. The presented analysis clearly indicates that the constraints are highly related to the poor transportation system and distances, which cause low prices of outputs and high cost of inputs. The strong positive relation of ME/farm numbers and their production size with the level of suitability indicates that a number of microentrepreneurs/farmers at the unsuitable sites will remain stuck in the value chain that exploits low-income possibilities as long as these infrastructural and input supply and marketing conditions are improved.

The microentrepreneurs in these remote rural areas usually do not have easy access to government support services for medicine and vaccines or loan support and depend mostly either on microenterprise loans and other support services from NGOs or on their social contacts or wholesaler agents when a loan is required. Some of the farmers buy inputs from agents in the marketplaces and gain the advantage of paying later. Government resources are limited, and do not reach these environmentally vulnerable areas. In these remote villages, the construction and maintenance of any kind of infrastructure costs the Government a great deal. The Government's limited manpower is not employed to serve all these remote rural areas. NGOs have some activities, though they are very limited against the vast necessities; mentionable among them are the vaccination camp and support.

Though the profitability level of MEs at unsuitable sites is very low, there is still potential for the expansion of their business, as long as the proper initiatives are taken by the Government and NGOs, since there is a considerable concentration of poultry MEs/farms: 9.3% in 8.5% unsuitable land areas. The poor microentrepreneurs develop poultry MEs utilizing their own inherited homestead lands. Moreover, the rural poor women find the job to be greatly advantageous, as they can take care of their children at the same time as running their MEs, which are just adjacent to their home and can be undertaken on small amounts of land.

Thus, they are neither encouraged to buy new lands to move to any suitable location nor encouraged to find an activity that is more suited to their location.

Poultry value chain constraints at marginally suitable sites. The marginally suitable sites attained different suitability scores with regard to different factors. The field verification survey on suitability noticed marginally suitable sites on low-lying land, which is flooded almost every year. The relatively low-lying land of the area is submerged, on average, under 135 cm of water during severe floods, and thus corresponds to the marginally favorable range of classification with regard to the factor of the flooding situation. The site is surrounded by green agricultural fields. There are very few concrete structures in the area. The site is an unfavorable distance from the government livestock office, thus farmers face serious problems with regard to the availability of qualified livestock personnel and depend on unqualified personnel for vaccination or for counseling on the prevention of poultry diseases. Concerning this disadvantage, though the site is considered as marginally favorable with regard to the factor of flooding land, this factor is not persuasive in delineating the area as marginally suitable for poultry. The poultry production price at marginally suitable sites demonstrates that the profitability of producers is a little higher compared with that at the unsuitable sites.

Poultry microenterprises and constraints at moderately suitable sites. Moderately suitable sites are those with variable favorability scores with regard to different factors. During the verification survey, a moderately suitable site was found on medium-high land, which is not flooded even during severe floods. Thus, the area corresponds to the moderately favorable range of classification of the flooding situation factor, while the site is within a moderately favorable distance from the government livestock office, marketplace, and paved roads. The medium-high land area implies that the MEs/farms at these sites do not need to undertake any land improvement efforts, thus having a comparatively low cost of ME/farm establishment and little risk and few difficulties in maintaining continuity of production. Some concrete structures were found in the area. The poultry MEs/farms at moderately suitable sites were found to be large. The MEs/farms' size, in terms of their production, is 2,025 birds per farm, on average. The price of

production at moderately suitable sites demonstrates that the profitability of producers is a little higher than at marginally suitable/unsuitable sites.

Potential of poultry microenterprises at highly suitable sites. The verification result indicates that highly suitable sites are characterized by a relatively highland area free from flooding and a short distance from sources of input materials and roads, which are consistent with the physical and infrastructural conditions that are favorable for poultry farming. Production and profitability are likely to increase in these sites with higher suitability where the constraints related mainly to the landform are insignificant and the distance to marketplaces, government livestock offices, and paved roads is smaller, since the transportation and transaction costs will be lower. For example, the intensity of poultry MEs/farms and larger MEs/farms was found to be positively related to their location at sites with a higher suitability level with regard to flood-free land along with facilities of access to large marketplaces, government offices, and paved roads, which is consistent with the large number of poultry MEs/farms in a few administrative unions that tend to be at highly suitable sites of the northern parts of the district.

The MEs/farms at highly suitable sites are rated highly suitable with regard to all the factors, with the exception of access to chick markets, which are located an average of 11.7 km from the farms. This is because microentrepreneurs/farmers usually prefer to travel far to procure quality chicks. Places with a majority of highly suitable sites contain a comparatively higher number of MEs/farms per square kilometer and a higher number of very large MEs/farms. The MEs at these sites employ 1–8 waged laborers on their farm.

6.1.2 Sites' suitability for poultry microenterprises in Gazipur

The present study identified the suitability or lack of suitability of areas for poultry microenterprise development in Gazipur, through the MCE technique within a GIS context, to facilitate institutions to design interventions to help all the farmers in those potential or unfavorable areas to increase their profit and be sustainable. The estimation was influenced by physical factors, such as the landform and flooding

situation, and infrastructural factors related to the poultry business, enabling the value chain environment. Some more factors could be evaluated, physical or socioeconomic, if deemed necessary, such as the slope, availability of labor, etc. As Gazipur is mostly flat with low gradients, the slope was not considered. No problem exists regarding the availability of labor in Gazipur, as small-scale poultry farming does not need highly skilled labor and usually the microentrepreneurs themselves work in their poultry MEs along with family members, if required.

Although strong efforts were made to use objective thresholds for the factors, as the majority of the thresholds were identified based on the field survey result and literature research, there may be some subjectivity in the result. The group of experts generally agreed in choosing the appropriate weights or relative importance of factors. The rank order of the weights, and even the weights themselves, of the study were somewhat similar among the experts. This implies that the weight selections were based on sound decisions. For example, flood-free high/low land was ranked first in importance and given a weight of .566 to .449 by the majority (6 out of 9) of the experts.

The result of the GIS analysis/suitability analysis of poultry ME sites shows that Gazipur district has a vast area that is considered as highly suitable or moderately suitable for poultry farming, identifying 61.7% of the total land, in the context of the existence of a vast area with infrastructures such as wide paved roads, government livestock offices/veterinary personnel, and marketplaces at reasonable distances. A considerable area is considered to be marginally suitable and unsuitable, identifying 27.4% of the total land in Gazipur. In unions to the south-east, Baktapur, Tumlia, Bahadurshadi, Kaligonj, Jangalia, Jamalpur and Moktapur have more than half of their area evaluated as marginally suitable/unsuitable, while about one-fourth of their area is unsuitable and has a considerable concentration (1.0%–2.9% of the total poultry farms) of small farms/microenterprises. Thus, the microentrepreneurs/small farmers at these unsuitable sites require the maximum amount of effort and investment by the supporters in order to help them to achieve sustainability.

High/low flooding land is the least limiting of all the sub-models at the highly suitable level, with about 52.8% of the land area being classified as highly suitable, while about 17.4% is rated unsuitable. This is particularly significant since high/low flooding land was the most important sub-model, which was ranked first in importance for poultry MEs' development. Tumlia, Kaliganj, Bahadurshadi, Baktarpur, the western part of Jangalia, and the eastern part of Moktarpur unions have extensive areas considered as unsuitable with regard to the low-lying land/flooding factor and have a considerable concentration (1.0–1.9% of the total farms) of poultry farms, in which supporters should intervene on a preferential basis to meet the crisis that the microentrepreneurs are facing. The proximity to a government livestock office is the most limiting of all the sub-models at the highly suitable level, with only 2.6% of the land area being classified as highly suitable; however, an additional 4.2% is rated moderately suitable and 76.6% of the land area is classified as unsuitable. Out of 47 unions, 21 have 100% (except the constraint area) of their area scored as unsuitable for this factor, which means that the government livestock office is at least 4 km away from the farms in these unions, implying that the availability of support services/input materials, particularly vaccination services, is likely to be a serious constraint in these unions. Among these 21 unions, Pubail, Chandpur, and Kaoraid have an extremely high percentage of concentration of farms.

6.2 Recommendations

6.2.1 Recommendations for specific development efforts at unsuitable and marginally suitable sites

A special project needs to be implemented in unsuitable/marginally suitable areas of the southeastern region of Gazipur for the sustainability of vulnerable microentrepreneurs/farmers. Several studies reveal that the feed cost accounts for more than 70% of the total cost of poultry production. Therefore, successful poultry production depends largely on the availability of quality feed at a reasonable price, and any endeavor to reduce the cost of feed would greatly reflect on the profitability of the poultry businesses.

In Gazipur, there are varieties of poultry feeds with different qualities and prices produced by different feed companies, which are sold by dealers/agents mainly in growth centers/big marketplaces. Moreover, there are significant differences in transportation costs among sites of different levels of suitability. The survey reveals that the farmers usually use rickshaw vans to transport feed from the market to the farm gate, while farmers at unsuitable sites were found to use boats occasionally, especially during the long rainy season, which incurs a higher cost. Any arrangement to increase the availability of good-quality feed at a reduced cost would greatly contribute to the overall reduction of production costs and thus increase the profitability of the vulnerable poor in this region. As a solution to this problem, a project that could be undertaken is proposed here. NGOs, which organize microfinance group weekly meetings, can implement the project. They have the opportunity to assess the farmers'/microentrepreneurs' need for poultry feed annually/bi-annually/monthly for a certain period of time. Based on the demands, NGOs would make loan agreements with local dealers/agents and disburse loans at a lower interest rate than the commercial rate. Under this agreement, the dealers/agents would supply good-quality feed regularly, at a reduced price, to the farm gate of the microentrepreneurs. The supply of quality feed would ensure high productivity at a reduced cost and thus lead to higher profitability.

More than half of the area of the unions in this region—Baktapur, Tumlia, Bahadurshadi, Kaligonj, Jangalia, Jamalpur, and Moktapur—is evaluated as unsuitable/marginally suitable in the final suitability model, and has a considerable concentration (1.0%–2.9% of the total poultry farms) of small farms/MEs. Moreover, these unions also have extensive area considered as unsuitable with regard to the low-lying land/flooding factor, which was ranked first in importance among the factors for poultry MEs' development. Thus, small farmers/microentrepreneurs in this south-eastern region should receive the maximum amount of effort and investment by the supporters with the highest priority. They require special financial support/grants to construct poultry houses on high ground and to construct quality roads, as these types of construction involve additional costs.

6.2.2 Recommendations for development efforts at sites with different levels of suitability

Improvement of land and roads. The existence of an adequate infrastructure is considered very important when providing microfinance. Even the construction of improved roads or the provision of matching grants for village-determined investments is considered more cost-effective than providing financial services to the poor to increase their earning capacity, particularly in areas where the infrastructure is underdeveloped (Yaron *et al.*, 1997; Ledgerwood, 2000). An improved road and transportation system is the key to minimizing costs and time for input and output supply and using the spare time and money for more production, which ultimately improves the competitiveness of the microentrepreneurs in the market.

The following is an illustration of the cost for preparing a typical 1,250 square foot piece of land and poultry farm structure. The cost also reflects the addition of a 1 kilometer road at sites of different levels of suitability, especially with regard to the flooding factor, in order to compare the costs between sites and help intervention. The construction cost of a wire-netted poultry shed structure with C.I sheet roofing on a metal truss, supported on brick pillars and walls, including the cost of the foundations, is BDT 850 per square foot (Table 6-1). The total cost of constructing a 1,250 square foot poultry farm structure is around BDT 1.06 million at sites with different suitability levels. The cost of preparing land by filling it with sand, for the above-mentioned shed structure, is BDT 24 per cubic foot and becomes around BDT 30,000, BDT 99,000, BDT 207,000, and BDT 375,000 for highly suitable, moderately suitable, marginally suitable, and unsuitable sites. The four different levels of flooding here are: less than 30 centimeters; 30 to 90 centimeters; 90 to 180 centimeters; and 180 to 300 centimeters. The preparation of 1 kilometer of bituminous carpeting road with 10 foot top width based by sand filling would cost BDT 24 per cubic foot. The total cost of producing a 1 kilometer road above the flood level in this example amounts to BDT 0.86 million, BDT 3.07 million, BDT 7.55 million, and BDT 15.74 million for highly suitable, moderately suitable, marginally suitable, and unsuitable sites, respectively. However, the preparation of a more durable higher standard 38 mm thick bituminous carpeting road over 150 meter sand surface with 75 mm thick end

edging would cost more, approximately BDT 180 per square foot. In this instance, the total cost of producing a 1 kilometer road above the flood level amounts to an additional BDT 5.9 million at sites with different levels of suitability (PWD, 2011).

The local government and NGOs should intervene by constructing quality roads in the unsuitable/marginally suitable areas in the south-eastern region of Gazipur. In Bangladesh, in Char Gulla Khali of Noakhali Sadar sub-district, farmers previously faced serious trouble for about three decades, as the nearest market was 10 kilometers away. The establishment of a marketplace was essential for the farmers to buy raw materials at a lower cost and sell their produce at a good price. With the help of the local government, the local people established a market on 2 acres of public land with a paved road connection and electricity supply. This establishment has increased the farm production of corn, as well as the development of new fish ponds and poultry farms, and, as such, job opportunities for about 4,500 people have been created (IFAD, 2009).

Camp for veterinary support. The proximity to the government livestock office is the most limiting of all the sub-models at the highly suitable level, with more than three-fourths of the land area being classified as unsuitable in Gazipur. About half of the total unions have 100% of their area scored as unsuitable for this factor. This implies that the availability of support services, particularly a vaccination services, is likely to be a serious constraint in these unions. Among these 21 unions, 3 unions—Pubail in the south, Chandpur in the center, and Kaoraid in the north, have an extremely high percentage of concentration of MEs/farms. With government collaboration, the NGOs working in these three unions, and also in the south-eastern marginally suitable/unsuitable region, should implement a special program, such as arranging camps regularly to provide veterinary support on the farmers' doorsteps and inviting the Government's livestock personnel. NGOs should also arrange to provide veterinary training on the doorsteps of the microentrepreneurs, for example on poultry-rearing using scientific methods, medication, and vaccinations.

The NGOs can set up a separate cell/department to provide support services and conduct training courses for the poultry microentrepreneurs.

Table 6-1: Construction cost of poultry farm structure/land and roads at sites with different levels of suitability.

Items	Rate (BDT)	Highly suitable	Moderately suitable	Marginally suitable	Unsuitable
Cost of farm structure (1250 sft)	850/sft	1,062,500	1,062,500	1,062,500	1,062,500
Cost of preparation of land (1250 sft)	24/cft	30,000	99,000	207,000	375,000
Cost of preparation of road (1 km)	24/cft	864,000	3,070,080	7,557,120	15,744,000
Construction cost of bituminous carpeting (1 km)	180/sft	5,904,000	5,904,000	5,904,000	5,904,000

Source: PWD (2011).

The Government, its apex funding bodies, and other donor agencies should keep a special/additional allocation of funds to disburse to the farmers/NGOs operating in Pubail in the south, Chandpur in the center, and Kaoraid in the north, and also in the south-eastern marginally suitable/unsuitable region. The Government should make a clear distinction between microentrepreneurs/farmers at sites of different levels of suitability and focus on microentrepreneurs/farmers at unsuitable/marginally suitable sites with lower profitability due to the lack of infrastructure facilities and environment.

Strong associations and sales centers in five sub-districts. The profitability in commercial poultry production depends not only on efficient production, but also on successful marketing of the production. The farmer should consider the marketability of the production to ensure a reasonable profit margin by the farm MEs. Production techniques include proper planning in choosing the location, proper design of poultry houses, arranging for quality inputs such as chicks and feed, adopting appropriate rearing techniques, and taking adequate disease-control measures, to ensure high efficiency and productivity levels (Prabakaran, 2003). Wittlinger and Tuesta (2006) mention that the farmers require specific conditions for a successful outcome, such as the existence of a strong value chain and favorable geographic, climatic, and price conditions. The existence of a well-developed infrastructure for the poultry value chain, including transport, services, and availability of inputs, is needed. The DIBD (2009) mentions that in developing countries, small farms face constraints related to market access, inadequate infrastructure, poor access to finance and high costs of capital, and dilapidated technology. Several studies mention how these factors restrict the competitiveness of the firms, making it very hard to become competitive, and demonstrate that upgrading value chains accelerates economic growth and job creation.

With the utmost importance, it is proposed that the poultry microentrepreneurs in Gazipur district should be organized into strong associations, which would work to ensure their profitability and sustainability. The associations would create a sales center for poultry in a convenient place in every sub-district, which would enable the farmers from the respective sub-district to assemble their products and sell

directly to larger buyers or wholesalers, who would come to the poultry sales center, thus giving them some bargaining power. Five regional sales centers for poultry could be established in each of the five sub-districts where many poultry MEs/farms have been developed. The association could collect products from each microentrepreneur/farmer, using shared transport/vehicle to carry them to the sales center, and thus ensure that the microentrepreneurs/farmers receive a reasonable price. The same vehicle could be used for transporting quality feeds from the big markets to the farm gate, instead of returning empty. At present, the microentrepreneurs use rickshaw vans to transport feed from the small markets, which return empty. This approach would make the maximum utilization of the vehicle and money. Transporting products is a serious concern for the microentrepreneurs/farmers, as it is quite expensive and a risky job to carry the products on personal arrangements, as there is the chance of robbery. The Government can allocate land for establishing a sales center and NGOs can intervene by opening a sales center in each sub-district. The poultry farmers' association would also work to obtain market information, set up a linkage with global markets, share experience, establish different poultry-processing industries and contract farming, etc.

Ledgerwood (2000) provides an example that mentions a US NGO that provides enterprise development services, which helped a group of farmers in rural Zaire to correct the structure of ownership of transport. The NGO assisted local entrepreneurs to assemble the resources to form a shareholder-owned trucking company to serve the producers, who were unable to make any money because they faced excessive transport fees. The NGO undertook the legal work to set up the company and helped to put together the finance plan for the first vehicle.

6.2.3 General recommendations for value chain development in Gazipur

The establishment of feed mills in Gazipur should be encouraged, since poultry farms' productivity depends greatly on nutritious balanced feed and, as stated before, about 70% of the total poultry production cost is spent on poultry feed. NGOs operating microfinance programs should encourage their beneficiaries/borrowers to use agricultural lands in Gazipur for the production of the main ingredients of

poultry feed, such as maize/yellow corn, wheat, soybeans, pulses, oilseeds, etc., and thus gradually minimize the dependence on imported ingredients of poultry feed. The Government can reduce the tax on imported foodstuffs and subsidize poultry feed. All these tasks would influence a reduction in the price of poultry feed.

Microcredit providers should make a policy of lending in such a way that no potential entrepreneur is excluded from receiving a microenterprise loan because of the unfavorable loan ceiling and the lending policy adopted by the NGOs. They can follow a comprehensive evaluation system for microenterprises and beneficiaries, which would act as an alternative to a mortgage or collateral. The potential borrowers and microenterprises might be evaluated using measurements, such as business assets, which could be the number of birds, the cost of products sold, the cost of input materials, household expenses, the loan workers' own "gut feeling" about the microentrepreneurs' drive to succeed, and by weighing intangibles, such as references from customers and neighbors.

Training on scientific methods of poultry rearing, the management of poultry farms, marketing products, medication, and vaccinations should be provided to the farmers. Proper initiatives should be taken by the Livestock Department of the Government to provide intensive training courses, free if possible, to the farmers/microentrepreneurs, especially in regions where many poultry farms/MEs have been developed. The Government and NGOs should provide proper and adequate support, with regard to finance and training, to poultry MEs/farms to enable the microentrepreneurs to increase and maximize their production and profit.

The Government should take initiatives so that public and private insurance companies introduce poultry insurance to protect the farmers from losses in the wake of avian influenza or other natural disasters. The implementation of poultry insurance is needed, and is included in the Government's 2008 national poultry development policy. As most of the farmers run their business using loans from many sources, if insurance coverage were to be extended to them, they would be able to repay their loan and would not need to quit their business in the case of any disaster. The implementation of poultry insurance would encourage

microentrepreneurs/farmers to invest more in their existing farms, and NGOs would dare to meet the demand loan of microentrepreneurs. This would help to minimize the farmers' dependency on buyers selling their produce in advance and thus accentuate their opportunities to negotiate and ensure profit.

Chapter Seven

Conclusions

Poultry has flourished as the most common microenterprise, particularly among poor people in rural areas in Gazipur, as there is flood-free flat land and a well-developed transportation and communication system, with Bangladesh's biggest wholesale market for poultry production in the capital city of Dhaka. All these points make Gazipur very advantageous to the development of poultry farming. Moreover, many NGOs and development agencies promote poultry farming and value chains to reduce rural poverty by stimulating the productivity and efficiency of the poor. For development support services and the allocation of funds, they apply the same policy, irrespective of the microentrepreneurs' location at different sites—favorable or unfavorable. However, for the sustainable development of MEs in the most vulnerable locations, the value chain approach needs to be applied based on zonal farming suitability evaluation with detailed criteria of the enabling environment.

The study found that the value chain constraints vary substantially by regions, causing distortion in the optimal utilization of input materials, scale of production, and profit. It was found that at unsuitable sites, where MEs/farms are on low-lying land and do not have easy access to infrastructures (and therefore face constraints), their input usage, production, and profit are lower. The study results strongly support the assumption that the organization and diversity of value chain environmental constraints have a strong influence on the regional variations in poultry MEs' production and profitability. It was found that value chain constraints have a strong relationship with the concentration of MEs/farms too, which differs at sites with different levels of suitability, but value chain supporters usually ignore this.

The study analyzed the poultry value chain and the associated constraints in Gazipur district and identified potential sites (or sites that lack potential) for poultry MEs, using the MCE technique within a GIS context, employing factors such as flood-free land and infrastructures related to the poultry business, that is, the enabling environment of the value chain. The study classified the poultry farming suitability into four classes and found that the extensive unsuitable and marginally suitable sites with relatively higher concentrations of less profitable vulnerable microenterprises in the south-east should be addressed on a priority basis by the greatest allocation of funds by the government and NGOs (Figure 4-12 and Figure 5-3). Other sites—unsuitable to highly suitable—can be addressed gradually, taking into consideration the relative concentration of MEs/farms and the availability of funds. The result of the study reveals that there exists a considerable portion of the district considered to be marginally suitable and unsuitable with a considerable concentration of MEs/farms; therefore, there is a need for greater efforts and costs to develop the sites and achieve profitability for poultry microenterprises. The result of the study also shows that there are apparently vast areas in Gazipur that have the potential for poultry MEs without serious constraints. It suggests minimal effort and investment in poultry MEs development in the maximum area of the district, which would create enormous opportunities for employment for many poor people through the expansion of many of the existing microenterprises in the area.

The field verification results along with the analysis of the geographic distribution of poultry MEs/farms at different suitability sites based on geo-referenced data demonstrate themselves to be in close agreement with the GIS predictions of suitability. There is a good correspondence between the predictions of poultry business suitability for the locations and the production of existing poultry MEs/farms. Because many MEs/farms with a considerably large production size are located in areas scored as highly suitable or moderately suitable, and a comparatively limited number of MEs/farms with small size and lower profitability are located at sites scored as marginally suitable and unsuitable. These results recommend that reasonable confidence can be placed on the predictions of the suitability of sites. Moreover, the empirical approach, which was based on a field survey, confirms different sites' suitability and profitability, which

would aid in the decision-making process for shaping strategies and gearing investments to overcome the problems.

The understanding of the poultry value chain and the constraints related to infrastructures in the enabling environment that affect the creation of value and optimum profit earnings for the poultry MEs and their geographic concentration at different suitability sites can effectively guide the Government's and NGOs' efforts to reduce the poverty of microentrepreneurs by adopting more location-specific policy options. Thus, the methodology developed in this study would enable policy makers/planners to focus their policies on poverty reduction and sustainable development. The Government, apex funding agencies, and other donor agencies should keep a special/additional allocation of funds to disburse to NGOs working in unsuitable areas with a higher concentration of MEs and farms. These additional funds should be directed towards the provision of collateral-free demand-driven microenterprise loans and other support services to the microentrepreneurs and towards infrastructural development activities. This analysis should allow the Government, the apex funding agencies, and other donor agencies to select areas/unions in which to provide more support—financial/technical/infrastructural—instead of following homogeneity in their support services. The results suggest the effective utilization of the country's limited resources, which is positive for the development of poultry MEs and the ensuing development of the whole sub-sector in Bangladesh.

The empirical observation, the MCE and AHP framework, and the analysis of the geographic concentration of MEs undertaken during the course of this study represent a different approach to investigating the constraints to environment-related criteria for a product's value chain development and sites with different levels of suitability and verification of that suitability. The inclusion of the experts' decision along with the microentrepreneurs' opinion that was reflected in the author's decision in the process of selection and evaluation of the criteria minimized the errors significantly and made the research original. The quantitative measures of the suitability of sites and the constraints of the value chain enabling environment would provide an important message to policy makers, planners, and researchers working in the area. The entire framework applied in the research, from fieldwork to mapping, would be useful for

modelers to follow in developing policies. Though this study was undertaken in Gazipur, the methodology employed here would be useful and applicable for other poultry production areas in Bangladesh. The effective policy for poultry sector development should be conducted based upon scientific discussion and spatial thinking.

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Appendix I : Questionnaire to microentrepreneurs

I. Basic Information

1. Name of Entrepreneur/ Poultry Farmer:.....
2. Address: Vill.....P.O.....Upazila.....District.....
3. No. of family members:.....
4. Level of education:.....
5. Asset (land).....acre
6. Land access: Owned..... Tenant..... Leased..... Others
7. Main source/s of income:.....
8. The year of starting of poultry business:.....

II. Information on Poultry Farm and Value Factors

9. Land used for poultry farming:.....sq. feet
10. Type of poultry production: Commercial.....Local.....Others.....
11. No. of chicken raised per year:.....
12. Market outlets: Sold to middleman at village.....
Sold at nearby village market.....
Sold to city market.....
Sold at capital city market.....
Others.....
13. Distance to markets.....
14. Means of transportation used by farmer to market.....
15. Transportation period.....
16. Cost of transportation per kg of chicken/per 100 eggs.....Taka.
17. Selling price per kg of chicken/100 eggs.....Taka
18. Source of Input.....
19. Distance to input supplier.....
20. Source of feed.....
21. Distance to feed source from farm.....
22. Production Period.....
23. Materials used for poultry house
24. Source of support service such as vaccine, medicine etc.....
25. Distance to support services.....
26. How many employees are involved in the farm: Total.....M.....F.....
27. How much to pay per /month as wage or salary:.....
28. How many members are engaged from farmers family:.....
29. Did the employees get training:.....persons
30. From where the training was received: NGOs.....Govt.....Other.....

III. Financial analysis

31. Source of Finance and amount of money:
Own resources.....
Loaned from MFIs/ NGOs.....

- Borrowed from moneylenders.....
- Borrowed from neighbors or relatives.....
- Others.....
- 32. Distance to the source of finance:.....
- 33. What was the interest rate if loaned:.....
- 34. Total Demand for money:.....
- 35. The year first loaned (if loaned from MFIs).....and amount.....Taka.
- 36. The year first loaned the ME loan..... and amount.....Taka.
- 37. Amount of total investment in Poultry per season/ year.....
- 38. Loan documents.....
- 39. Loan installment repayment mode:.....
- 40. Any problem related to finance.....

IV. Factors related to location of poultry farms

- 41. According to your opinion what are the most important location related factors for the development of the poultry farms:
1..... 2.....3.....4.....5.....
- 42 Which factor do you think is the most important to consider for the development of a farm from the following list. Please score them starting from 4 for the most important one and then score the following according to importance from 3 to 1 for the less important factors:
Distance to market.....
Proximity to road.....
Proximity to government office.....
Flood free land.....
- 43 How much distance should be there among the poultry farms from each other:.....

V. Problems related to production

- 44 Regarding production technology:.....
- 45 Regarding input materials (quality, quantity etc):.....

VI. Problems related to marketing

- 46 Regarding distance to market.....
- 47 Regarding transport.....
- 48 Regarding price.....

VII. Problems related to support service

- 49 Regarding distance to source of support service:.....
- 50 Regarding Quantity and quality:.....

VIII. Information related to disaster

- 51 Have ever faced flooding: Y.....N.....
- 52 Have ever faced outbreak of poultry disease: YN.....
- 53 How much loss you incurred:.....Taka.

IX. Opinion to solve the problems:.....

Appendix II: AHP questionnaire for livestock experts

1. Name:.....
2. Address:.....
3. Profession:.....
4. Designation:.....
5. Education:.....
6. Experience at livestock and Poultry Sector:.....
7. According to your opinion what are the most important location related factors for the development of the poultry farms:
 1.....2..... 3..... 4.....5.....
8. Which factor do you think is the most important to consider for the development of a farm from the following list. Please score them starting from 4 for the most important one and then score the following according to importance from 3 to 1 for the less important factors:
 Distance to market.....
 Proximity to road.....
 Proximity to government office.....
 Landform and flooding.....
9. How much distance should be there among the poultry farms from each other:.....
10. Compare the importance of the factors and circle the value based on their importance for development of a farm on the following ranking scale for criteria and alternatives:

Important

	Extremely	Very strongly	Strongly	Moderately	Equally	Moderately	Strongly	Very strongly	Extremely		
High/ Low (flooding) land											Proximity to road
	9	7	5	3	1	3	5	7	9		
High/ Low (flooding) land											Proximity to Govt. office
	9	7	5	3	1	3	5	7	9		
High/ Low (flooding) land											Proximity to market
	9	7	5	3	1	3	5	7	9		
Proximity to road											Proximity to Govt. office
	9	7	5	3	1	3	5	7	9		
Proximity to road											Proximity to market
	9	7	5	3	1	3	5	7	9		
Proximity to Govt. office											Proximity to market
	9	7	5	3	1	3	5	7	9		

Appendix III: Criteria evaluation and consistency judgment

Expert A

I have developed a matrix as below from the 6 comparisons of 4 factors by putting an actual judgment value, when the judgment value is on the left side of 1 and by putting a reciprocal value, if the judgment value is on the right side of 1.

Reciprocal matrix				
Criteria	Land	Road	Office	Market
Land	1	3	5	9
Road	0.33	1	3	5
Office	0.2	0.33	1	5
Market	0.11	0.2	0.2	1
Sum	1.64	4.53	9.2	20

Note: Land=High/low flooding land, Road= Proximity to roads, Office=Proximity to government offices and Market=Proximity to market places.

By dividing each element of the matrix with the sum of its column, I have normalized relative weight.

Normalized matrix						
Criteria	Land	Road	Office	Market	Sum	Ranking of priorities/ Eigen vector
Land	0.610	0.662	0.543	0.450	2.265	0.566
Road	0.201	0.221	0.326	0.250	0.998	0.250
Office	0.122	0.073	0.109	0.250	0.553	0.138
Market	0.067	0.044	0.022	0.050	0.183	0.046
SUM	1.000	1.000	1.000	1.000	4.000	1.000

The eigenvector of the relative importance or value of 4 criteria is 0.566, 0.250, 0.138, 0.046. Thus, flooding/flood free land is most important according to expert A's comparison between factors, road and office are behind and market is less significant.

The next stage is to calculate λ_{max} so as to lead to measure the Consistency Index and Consistency Ratio. First, we need to multiply the matrix of judgments by the eigenvector for obtaining a new vector. The calculation for the first row in the matrix is:

$1*0.566+3*0.250+ 5*0.138+ 9*0.046= 2.418$ and the remaining rows give 1.080, 0.563 and 0.186. Now we can get four estimates of λ_{max} by dividing this vector of four elements (2.418, 1.080, 0.563, 0.186) by the corresponding eigenvector element. The mean of these values is the estimate for λ_{max} .

Therefore, $\lambda_{max}= \text{average} (2.418/0.566, 1.080/0.250, 0.563/0.138, 0.186/0.046) = 4.181$

Consistency Index (CI) = $(\lambda_{\max} - n) / (n - 1)$, where n is the size of comparison matrix or number of elements.

$$= (4.181 - 4) / (4 - 1)$$

$$= 0.060$$

Consistency Ratio (CR) = $CI / 0.90$, where, 0.90 derived from Random Consistency Index (RI) (Saaty, 1980)

$$= 0.060 / 0.90$$

$$= 0.067 \quad (\text{CR } 0.067 \text{ is } < 0.1, \text{ so the evaluations are consistent and acceptable}).$$

In the same way, relative weighting of 4 factors for poultry microenterprises according to 8 other experts was derived based on pair-wise comparison matrix.

Appendix IV: Questionnaire for microentrepreneurs/farmers at sites of different levels of suitability for verification

I. Basic Information

1. Name of Entrepreneur/ Poultry Farmer:.....
2. Address: Vill.....P.O.....Upazila.....District.....
3. Telephone number:
4. Level of suitability of the site of the farm.....

II. Information on Poultry business and related infrastructure and environment

5. Land used for poultry farming:.....sq. feet
6. No. of chicken raised per year/per batch:.....
7. How many employees are involved in the farm: Total.....
8. How many members are engaged from farmers family:.....
9. Market outlets: Sold to middleman at farm-gate.....
 - Sold at nearby village market.....
 - Sold to urban market.....
 - Sold at capital city market.....
 - Others.....
10. Distance to markets for selling products.....
11. Means of transportation used to market.....
12. Transportation period.....
13. Cost of transportation of chicken/egg.....Taka.
14. Selling price per kg of chicken/100 eggs (date:.....).....Taka
15. How far can trucks come to pick-up the eggs/chicken.....
16. Source of chicks.....
17. Distance to source of chicks from farm
18. Problems related to quality of chicks (if any) company name etc
19. Means of transportation used by farmer to carry chicks.....
20. Transportation period.....
21. Cost of carrying chicks.....Taka.
22. Source and price of feed.....
23. Amount of feed needed per day.....
24. Distance to source of feed from farm.....
25. Means of transportation used by farmer to carry feed.....
26. Transportation period.....
27. Cost for transportation of feed.....Taka.
28. Problems related to quality of feed (if any) company name etc.....
29. Distance to govt office for support services
30. Source and demand for loan/money:.....
31. Problems related to amount of credit.....and reason behind it.....
32. Problems related to supply/quality of vaccine, medicine.....
33. Means to get vaccine and medicine.....
34. Materials used and cost for poultry house.....
35. Cost for construction of main structure.....
36. Distance to paved roads from farm.....km/meter
37. Have ever faced flooding: Y.....N.....

III. Opinion to solve the problems

38. According to your opinion what are the most important infrastructure and environment related problems in your area and what are the ways to solve/ reduce them for the development of the poultry value chain:

1.....

2.....

3.....

4.....

Appendix V: Photographs taken during the fieldwork

		
<p>NGO office room</p>	<p>Microfinance group meeting</p>	<p>Inside view of a layer chicken microenterprise</p>
		
<p>Chick rearing unit of a microenterprise</p>	<p>Outside view of a broiler chicken microenterprise</p>	<p>Outside view of a layer chicken microenterprise</p>
		
<p>Landscape of the unsuitable site</p>	<p>Unpaved road in the unsuitable site</p>	<p>Poultry feed shop in Gazipur</p>



Transportation of feed using non-motorized van by unpaved road



Storage space for eggs inside the microenterprise



Rickshaw is being used to carry eggs to the wholesaler's agent



Truck loaded with eggs



Transportation of eggs from Gazipur to Dhaka



Office of the society of egg wholesalers in Dhaka



Chicken wholesalers market in Dhaka



Egg wholesalers market in Dhaka



Eggs transported from wholesale market to retailer's shop in Dhaka