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DEMAND FOR POULTRY FEEDS:

IMPLICATIONS FOR WHEAT AND MAIZE PRODUCTION IN BANGLADESH

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Any comments for its further improvement are welcome.

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INTRODUCTION

Wheat and maize are important components of poultry feeds. The demand for these two grains, therefore, is expected to increase with the growth of poultry farms in the country. The major objective of this study is to carry out projections of demand for poultry feeds and their implications for wheat and maize production in Bangladesh over the next 20 years.

ESTIMATION PROCEDURES

Two approaches have been employed to estimate demand for the use of grain (wheat and maize) as poultry feeds: (1) the Demand Analysis Approach and (2) the Trend Analysis Approach. The study employs both the approaches in order to obtain a range of demand estimates for the use of grain as poultry feeds for the years 2005, 2010, 2015 and 2020. The year 2000 is considered as the base year.

The Demand Analysis Approach involves projecting demand derived from the consumption of poultry products (meat and eggs) through the incorporation of factors such as population, urbanisation and income growth and income elasticities of demand.

With the use of base year data for per capita consumption, poultry products (separately for meat and eggs) are projected for various years. Such projected quantities of poultry products are translated into feed requirements and finally into projected use of grain for poultry feeds. These projections are carried out, disaggregated by village (scavenging) and commercial poultry birds (layers and broilers), using appropriate feed coefficients since the feeding practices vary significantly among these three types of birds.

Future feed requirements can also be considered based on the growth in the poultry population. The Trend Analysis Approach, thus, involves assessing future feed requirements through estimating historical trends of growth in the poultry population.

The projected poultry populations have been used to project future feed requirements and subsequent use of grain such as wheat and maize.

DATA SOURCES

A basic problem in any analysis of the poultry sector relates to the lack of reliable and adequate data on use by type of feed and by category of poultry output, and on poultry population, disaggregated by scavenging and commercial birds.

The study is largely based on information from secondary sources such as Agricultural Censuses and the FAO Yearbook. Such information is supplemented by primary data generated from field surveys. In particular, the data on the current poultry production system, generated by the field surveys, have been used. Also, some data were collected from a rapid market survey including a few key-informant interviews.

Estimate for Consumption on Poultry Products

Some data on consumption aspects were compiled from the Flood Impact Study conducted by Food Management Research Support Project (FMRSP) recently. The survey data, however, relate to consumption in rural areas. Consumption data for urban households are compiled from the Household Expenditure Survey (HES).

Estimate for Poultry Population

Historical data for poultry populations are sparse. The major sources of data on poultry population are the Agricultural Censuses. The information for the years between the censuses is collected from various sources such as Alam (1997), the FAO Yearbook (1997) and the Department of Livestock Services. Trend estimates are carried out separately for chicken and duck populations. Later, chicken populations have been combined with duck populations to represent the total poultry population.

Estimate for Scavenging Birds

There is no recent published data on poultry heads or poultry farms. Moreover, whatever data available are not disaggregated by scavenging and commercial birds, let alone by layer or broiler type. In particular, there is a serious lack of data on poultry of scavenging nature. Official sources (e.g., Agricultural Censuses, Livestock Department and FAO Yearbook) only provide the total poultry population and the number of commercial farms. Hence, the only way of estimating the scavenging birds is through segregating the commercial birds from the total poultry population available from secondary sources. Later, these are cross-checked with the data collected from the field surveys and key-informant interviews.

The average (weighted) bird size of private commercial farms is in the range of 640 and 485 for layer and broiler respectively. Using these figures for average farm size, the total birds under private farms are estimated. The deduction of this from the total poultry population, estimated earlier, gives the estimate of scavenging birds for various years.

RESULTS

National Consumption of Poultry Products for the Base Year 2000

The per capita consumption multiplied by population (urban and rural) gives estimates of rural and urban consumption for poultry products. The total rural consumption of poultry meat for the base year 2000, based on FMRSP data, is estimated to be 104 thousand metric tons. The estimate based on HES data, is quite close, 106 thousand metric tons. The rural consumption of poultry eggs for the year 2000 is estimated to be 1831 millions, based on FMRSP data. The HES, however, estimates the total number of eggs to be as high as 2711 million. Since the FMRSP consumption data for rural households are the most recent and the data for urban households are not

available from this source, the analysis uses a combination of the two sources in estimating total national consumption. In other words, the analysis uses FMRSP data for rural households and HES data for urban households in estimating the total national consumption. Thus, the national consumption of meat for the year 2000 is estimated to be 172 thousand metric tons while the consumption of eggs for the year 2000 is estimated to be 3007 million. These estimates have been used as the base year figures in the projection exercise.

Projections of Consumption of Poultry Products (Demand Analysis Approach)

Besides population and income growth, the Demand Analysis Approach requires that the responsiveness of demand for poultry products to income growth be incorporated in the exercise. The estimated income elasticities are adopted from Alam (1997).

Following this approach, the national consumptions of eggs are projected to be 4347 millions, 4878 millions, 5397 millions and 5866 millions for the years 2005, 2010, 2015 and 2020 respectively. Thus, the national consumption for eggs is estimated to increase by 62 percent by the year 2010 and by 95 percent by the year 2020. The corresponding national consumption figures for meat are projected to be 227, 255, 283 and 307 thousand metric tons for the four selected years respectively. Thus, national consumption for meat is expected to increase by 48 percent by the year 2010 and by 78 percent by the year 2020.

Projections of Poultry Population (Trend Analysis Approach)

Using the past trend growth rates, two estimates of poultry population were carried out based on two methods: the poultry population trend method and the per capita (of poultry) trend method. One can use either of the two, or the mean of the two estimates. In this analysis, the mean of the two estimates was calculated, which has subsequently been used in the projection of grain use as poultry feeds. Starting from the

base year figure of 172 million poultry population and using the past trend growth rates, the projected poultry populations are estimated to be 218, 279, 356 and 451 million for the four selected years respectively. Thus, the Trend Analysis Approach, based on past trends, suggests that the poultry population is expected to increase by 64 percent by the year 2010 and by 165 percent by the year 2020.

The use of high rates of past trend growth in the projection exercise has led to severe overestimation of poultry, poultry farms and hence feed requirements. The major reason relates to lack of a longer and continuous data series from which trends have been estimated. On the other hand, it is more likely that the high trend growth rates, which demand appropriate and adequate policy supports to sustain, may not be applicable over the next twenty years. Under these circumstances, the analysis also uses the current population growth rate, as a proxy to past trend growth rates, for the projection of poultry population and poultry farms. The data derived from these projections have subsequently been used in the projection of grain use as poultry feeds.

Projection of Grain (Wheat and Maize) Use as Poultry Feeds

The analysis presents projected use of grain (wheat and maize) for poultry feeds, by poultry type, for the four selected years. The projected use of grain for poultry feeds is estimated through adopting both the approaches and also, by use of feed ingredients as well as feed coefficients obtained from the field surveys.

Based on information collected from our field survey, an average rate of 10 percent mortality has been assumed. For both layers and broilers, feed consumptions are adjusted to the annual level. For layers, feed consumption (per week) applies for the life cycle of 78 weeks, from which that for 52 weeks is estimated and used in the projection exercise. For broilers, the average feed consumption (per week) applies for the life cycle of 6 weeks. Six batches of broilers in a year are considered. Thus, for broilers, feed demand for 36 weeks is considered in a year. The wheat consumption by scavenging

birds is estimated to be 20 percent of average quantity consumed by layers and broilers. No maize consumption is considered for scavenging birds. Half of the scavenging birds are assumed to lay eggs in the whole year.

Adopting the Demand Analysis Approach, the figures for use of total grain as poultry feed is projected to be 665, 746, 826 and 898 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively. Thus, starting from the base-year requirement of 631 thousand tons, the projected use of grain for poultry feeds is expected to increase by 18 percent by the year 2010 and by 42 per cent by the year 2020 (Table 7).

According to the Trend Analysis Approach using past trend rates of growth, the figures for projected total grain as poultry feeds are 794, 1022, 1346 and 1817 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively.

However, taking current population growth rate as the trend rate of growth, the Trend Analysis Approach suggests the projected total grains as 683, 740, 801 and 867 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively (Table 7).

Two alternative projections adopting the Demand Analysis Approach and the Trend Analysis Approach (taking current population growth rate as the trend rate) appear to be within a reasonable range. Further refinements in the projections could be made if more data were available. Ideally, separate income elasticities for village and commercial poultry products, and separate growths for rural and urban areas should be used. Impacts of changes in prices could also be modeled. Nonetheless, both the projections indicate substantial growth over the next two decades.

The use of grain for poultry feeds for the base year 2000 is estimated to be 631 thousand metric tons. Of this, wheat accounts for 141 thousand metric tons and maize accounts for 491 thousand metric tons, accounting for 22 and 78 percent of total grain requirements in the base year respectively. Current production levels for wheat and maize in Bangladesh are in the range of 1800 thousand and 65 thousand metric tons

respectively. Thus, the total poultry feed requirement is approximately one-third of the total wheat and maize production in Bangladesh. The requirement of wheat as poultry feed is nearly 8 percent of the total domestic production and the requirement of maize as poultry feed is about 7.6 times its domestic production.

1. INTRODUCTION

The poultry sub-sector is crucially important in the context of agricultural growth and the improvement of diets of people in Bangladesh. The sector is particularly important in that it is a significant source for the supply of protein and nutrition in a household's nutritional intake. It is an attractive economic activity as well, especially to women and poor population.

One of the major problems of the development of the poultry sub-sector in Bangladesh relates to the lack of sufficient and appropriate feeds (Mitchell 1997; Alam 1997). Relevant research suggests that a high priority is given to the improvement of the feed supply in the sector, which is expected to help in developing resistance to diseases, on one hand, and production of quality products, on the other.

Poultry farms in Bangladesh are growing fast in recent times. Following a high population growth, urbanisation and demand elasticity, the demand for poultry products is expected to increase in the future. Hence, poultry farms are also expected to further increase over time. Wheat and maize together constitute over half of total poultry feeds, of which over four-fifths is maize and less than one-fifth is wheat. Although the use of wheat and maize for livestock and poultry feed is growing rapidly in developing countries in general (Sarma 1997), this has not yet reached a significant proportion in Bangladesh. Maize in Bangladesh is still a minor crop in terms of acreage, accounting for only 3 percent of wheat and 0.2 percent of rice. Although it is possible to produce maize throughout the year, maize is currently produced in the country largely in winter season. The demand for both livestock and poultry feeds, comprised largely of wheat and maize ingredients, appears to be currently met from only imports, and at seemingly relatively higher costs. In view of this, the domestic production of maize and wheat has an

important role to play in the development of poultry vis-à-vis the agricultural sector in Bangladesh.

Against this background there exists a large potential (even for export) for the poultry sector in Bangladesh. The major objective of this study is to address the potential of the grain (maize, in particular) economy, through carrying out projections of demand for poultry feeds in Bangladesh. More specifically, the study intends to estimate the total use of grain as feed by the poultry sector, through assessing the current levels of demand and supply of poultry and poultry products. Finally, the study aims at spelling out policy implications for wheat and maize production in Bangladesh in the future.

2. METHODOLOGY

EXISTING LITERATURE AND MAJOR DATA SOURCE

Research on livestock resources in Bangladesh, in general, and the poultry sub-sector, in particular, is rather limited. The major contributing authors include Alam (1995; 1997), Mitchell (1997) and the studies conducted from time to time by the Department of Livestock.

The research by Alam (1995), which was later updated (Alam 1997), is a useful document on livestock resources in Bangladesh, presenting the then status and the future potential of the sector. The research, concentrating more on cattle and buffaloes, estimated the livestock (including poultry) population and their products and growth rates as of 1994-95. The research also delineated the socio-economic aspects of livestock including spelling out the constraints to livestock production. Mitchell (1997), in a policy paper based on a mission to Bangladesh, outlined the problems and prospects of the livestock sector. He also covered the consumption and marketing aspects of poultry products in Bangladesh, largely using data generated by the FAO Yearbook (1997). The paper by Haque and Raha (1997) is a research note concentrating on maize marketing in Bangladesh at the micro level. The study by Saha and Asaduzzaman (1998) outlined the present status of production organisation and technology, concentrating on the poultry sector with a special emphasis on disaggregated input-output structure for the sector. The study is a background study, aiming at estimating relevant input-output coefficients for use in the construction of the national input-output table.

This study has also consulted other documents published elsewhere, such as Sarma (1986) and Mink (1987). Sarma (1986), in a research report published by IFPRI (Washington), is concerned with the analysis and projections (to 2000) of the use of cereals for livestock feed in developing countries. Mink (1987) has addressed the use of

corn in livestock feed and the future of the corn economy in Indonesia. The study focused on current levels of corn use and likely future growth of corn-based livestock feeds in Indonesia.

Despite the availability of the studies mentioned above, knowledge about aspects relating to the supply and demand of poultry feed in Bangladesh is rather limited. In particular, data on the present poultry population and poultry products, disaggregated by commercial and scavenging nature, are not available in any of the studies mentioned above.

Data Source

The study is largely based on information from secondary sources; Agricultural Censuses (1960; 1977; 1983/84; 1996) are the main sources of historical data on poultry population. The FAO Yearbook (1997) was also a source in this respect. However, such information is supplemented by primary data generated from field surveys. A basic problem with the analysis of poultry population and feed trends relates to the lack of reliable and adequate data on their use by type of feed and by category of poultry output. In particular, the data on poultry population, disaggregated by scavenging type and commercial farms in rural and urban Bangladesh, are sparse.

As can be observed in the first Part of the Report, the commercial farms are the prime focus of the current analysis, as few scavenging birds are likely to have direct grain-feed requirements. The data on the current poultry production system, generated by field surveys, have been used. The data on aspects such as feeding practices, feed requirements and farm size by type, collected also from the surveys, have been used.

A rapid market survey including a few key-informant interviews was also conducted. Data and information collected are, among others: (1) feeding requirements and practices of scavenging birds, (2) proportion of scavenging and commercial birds, (3)

proportion of scavenging layers and broilers, (4) proportion of commercial layers and broilers, (5) average life span of various types of birds, (6) average eggs produced by scavenging layers and commercial layers, (7) average weight of live birds and meat produced by various types of birds, (8) wheat consumed by scavenging birds, (9) age and productive age of various birds and (10) mortality rate of various types of birds. The key-informant techniques of data collection were also adopted to supplement the information collected from secondary sources and to make projections of the growth of poultry farms and poultry products.

ESTIMATION PROCEDURES

Demand Analysis Approach

The major theme of this study component involves carrying out projections of demand for poultry feeds and its implications for wheat and maize production. For this purpose, first, the projection of poultry and poultry products has to be carried out. Two approaches can be employed to estimate the medium and long-term demand for use of grain as poultry feeds[1]. One approach involves projecting demand derived from the consumption of poultry products (meat and eggs). The approach may be called the "Demand Analysis Approach". Demand for poultry products is expected to increase with the increase in consumer income. Thus, the projection of growth in demand for products requires the incorporation of income growth and income elasticities of demand. Preferably, demand for poultry products should be disaggregated by income or socio-economic groups, to allow for differential impacts across different groups, also in both rural and urban areas. Additionally, in this approach, factors such as population and urbanisation growth have to be taken into account in the estimate of future feed demand.

The responsiveness of demand for poultry products to per capita income growth

[1] The approach is largely drawn from the Indonesian study by Mink (1987).

has to be estimated from some past studies. It could be ideal to have separate elasticity estimates for village and commercial poultry products, presumably because of potential variations of qualities and tastes in these two markets. With the help of these income elasticities and the base year data for consumption per capita, consumption of poultry products (separately for meat and eggs) can be projected through incorporating, among others, growth in population, urbanisation and incomes. Such quantities of poultry products can be translated into feed requirements and finally into projected use of grain and demand for poultry feeds. These estimates are carried out, preferably disaggregated by village (scavenging) and commercial poultry birds, using appropriate feed coefficients.

Trend Analysis Approach

Future feed requirements can also be considered as dependent on the growth in the poultry population. An alternative approach, thus, involves assessing future feed requirements through estimating historical trends of growth in the poultry population. The approach may be termed as the "Trend Analysis Approach".

If supply constraints are more likely to dominate the demand characteristics in determining the growth of poultry, this approach may be more appropriate to project the future poultry population. In this approach, the rate of increase in the poultry population can be estimated by analysing the past trends. Both simple linear trends and log-linear trends from the time series data on poultry populations have been examined. However, the latter type of trend estimates has proved to be more appropriate.

Both the approaches require the knowledge of the current poultry production system so that the number of poultry or the quantity of poultry products can be translated into feed requirements and thus determine the implications for domestic production of wheat and maize.

In the Trend Analysis Approach, the figures of projected poultry populations have been used to project future feed requirements and subsequent use of grain (wheat and maize), through using appropriate feed coefficients. The poultry populations have been disaggregated by village (scavenging) and commercial birds (layers and broilers), as the feeding practices vary significantly among these three types of birds, which was observed from our the field surveys.

The study employs both the approaches in order to obtain a range of demand estimates for the use of grain as poultry feeds, for the years 2005, 2010, 2015 and 2020. The year 2000 is considered as the base year. Presumably because of variations in feeding practices and hence feed consumption level (in terms of, type and quality, for example) field data were collected from poultry farms on three categories: (1) village birds (household-level), (2) small commercial farms and (3) large commercial farms. The first category is, by and large, of scavenging nature while the second and third types live on improved feeds such as 'concentrates'. It is envisaged that, broadly, the first type exists in rural areas and the other two types exist in urban and semi-urban areas. So, broadly, two markets for poultry feeds exist: rural and urban. The small commercial farms, largely located in semi-urban areas, by and large, have less refrigeration; and modern processing facilities while large commercial enterprises, located largely in urban areas, use relatively modern production technology. Therefore, it is envisaged that the categorisation of poultry birds into three types will cover both rural and urban markets and enterprises. The analysis, thus, needs to be disaggregated into village (scavenging) birds and commercial birds as much as possible.

Estimate for Consumption of Poultry Products

As already mentioned, there is serious data constraint for the consumption of poultry products from secondary sources. Some data on consumption aspects, however, were compiled from the Flood Impact Study conducted by FMRSP-IFPRI during 1998-

99. The broad objective of the Flood Impact Study was to assess socio-economic impacts on households due to the 1998 flood. The study was carried out in three rounds, at three different points of time: immediately after the 1998 flood (November-December, 1998), four months after the flood (February-March, 1999) and 12 months after the flood (November-December 1999). The survey covered 155 villages across 7 districts and generated longitudinal data sets at the three points in time, through conducting the investigation to the same set of 757 householders.

This analysis used household data (by land categories) on consumption of poultry products generated by the above-mentioned survey. The poultry products considered in this analysis include meat and eggs. For obvious reasons of potential adverse impacts on householders' consumption baskets in the aftermath of the flood, the consumption data collected for the third round (12 months after the flood) survey are used.

The above mentioned survey data, however, relate to consumption in rural areas. Following this, consumption data for urban households are compiled from the Household Expenditure Survey, which are available for 1995/96. The consumption data for the base year 2000 are estimated from trend analyses.

Estimate for Poultry Population

Historical data for poultry populations are even sparse. The major sources of data on poultry population are the censuses, Agricultural Census 1996, Agricultural Census 1983/84, Agricultural Census 1977 and Agricultural Census 1960. The information for the years between the censuses is collected from various sources such as Alam (1997), the FAO Yearbook (1997), USAID (1991), the Livestock and Poultry Survey (1988-89) and the Department of Livestock Services. Trend estimates are carried out separately for the chicken and duck populations. Later, chicken populations are combined with duck populations to represent the total poultry population.

The trend estimates were carried out by fitting semi-logarithmic models.

Estimate for Scavenging Birds

The poultry production is dominated by commercial farms that are located in mostly urban areas, and by chicken of scavenging nature that are located in rural areas. The Department of Livestock Services (DLS) keeps records for the poultry farms at the Thana level. These records form the basis for an enumeration of the total number of commercial farms rearing different species of poultry in the country. However, there is no updated published data on poultry heads or the number of poultry farms.

Any projection of poultry feed requirements requires first an estimate of the total poultry population, disaggregated by village poultry (of scavenging nature) and grain-consuming commercial birds (layers and broilers). A basic problem of this analysis relates to a lack of reliable and adequate data on poultry populations. Moreover, whatever data are available are not disaggregated by scavenging and commercial birds, let alone by layer or broiler type. In particular, there is a serious lack of data on birds of scavenging nature. Official sources (e.g., Agricultural Censuses, Livestock Department and FAO Yearbook) do not have such disaggregated data. These sources only suggest the total poultry population and number of commercial farms. Hence, the only way of estimating the scavenging birds is through segregating the number of commercial birds from the total poultry population, through the use of data collected from field surveys and key-informant interviews.

The Livestock Department suggests that of all the private commercial farms, about 22 percent are broiler and 78 percent layer farms. Our key-informant interviews and expert opinions suggest that 81 percent of the commercial farms are layers and 19 percent are broiler farms. Our sample survey of 71 commercial poultry farms shows that the average size of broiler farms is 622 and 1544 for a small and large-scale unit respectively. The corresponding bird size of layer type estimates as 607 and 4870 at

small and large scale respectively. These figures for the per enterprise bird size appear to be on a very high side, presumably because of the presence of an extreme sample covered in and around Dhaka city[2].

Unofficial data compiled from the Livestock Department, however, show that the average (weighted) bird size of private commercial farms is in the range of 640 and 485 for layer and broiler types respectively (Appendix Table A.3). These figures of average farm size have been used in the current analysis. The trend estimates having been carried out separately on the total commercial farms (by layers and broilers) and total poultry population (Table 4), these figures for average farm size are used to estimate the total birds under commercial farms. The segregation of the birds under commercial farms from the total poultry population gives the estimate of scavenging birds for various years. Later, these are crosschecked with the data collected from the field surveys and key-informant interviews.

[2] For example, the broiler and layer farms, located in Gazipur, have an average size of as high as 1833 and 7572 respectively.

3. ANALYSIS AND RESULTS

As already mentioned, the study employs two approaches in order to obtain a range of projection for the use of grain (wheat and maize) as poultry feeds, for the years 2005, 2010, 2015 and 2020. The year 2000 is considered as the base year. The first approach, the Demand Analysis Approach, involves projecting demand for grain derived from the projected consumption of poultry products (meat and eggs). The consumption per capita, multiplied by population (urban and rural), gives estimates of rural and urban demand for poultry products. Finally, the total demand for poultry products is projected through incorporating, among others, growth in population, urbanisation, income and income elasticities.

PER HOUSEHOLD AND PER CAPITA CONSUMPTION OF POULTRY PRODUCTS FOR 2000

Two data sources, the Food Management Research Support Project (FMRSP) and the Household Expenditure Survey (HES), have been used to estimate per household and per capita consumption of poultry products.

As the demand for poultry products is likely to be income-elastic it would be important to have consumption data disaggregated by various socio-economic groups, to allow for potential variations among such groups. Such data disaggregations are expected to give better estimates of aggregate data at the national level.

Per capita consumptions of poultry products for farm households in rural areas (disaggregated by land categories) are compiled from the first source[3]. Table 1 gives such data on per household and per capita consumption (by land holding categories) in

[3] Flood Impact Study (1999), FMRSP, IFPRI. Farmers are grouped into four land holding categories: marginal, small, medium and large, according to operated land. Consumption refers to that in the previous month of the time of the survey (See Table 1).

Table 1 — Per Household and Per Capita Consumption of Poultry Products in Bangladesh Diet (2000)

Farm category[1]	Chicken meat		Chicken eggs	
	Estimate 1	Estimate 2	Estimate 1	Estimate 2
	Per capita consumption (Kg/Year)	Per capita consumption (Kg/Year)	Per capita consumption (No/Year)	Per capita consumption (No/Year)
Rural farm households				
Landless	1.13	NA	16.0	NA
Marginal	0.61	NA	14.8	NA
Small	1.24	NA	20.3	NA
Medium	1.30	NA	21.2	NA
Large	2.92	NA	25.0	NA
Rural households	**1.03**	**1.05**	**18.1**	**26.8**
Urban households	**NA**	**2.49**	**NA**	**43.3**

Notes: [1] Farmers are categorized according to operated land.
Marginal - 0.01 - <0.50 acres
Small - 0.50 - < 2.5 acres
Medium - 2.5 - < 5.0 acres
Large - > 5.0 acres

Sources: Estimate 1 is based on monthly per household consumption data (for rural households), generated from Flood Impact Study (1999), FMRSP.
Estimate 2 is based on (1995/96) data on per capita daily consumption, from Household Expenditure Survey (1997). The data for Estimate 2 are based on trend estimates.

selected areas of rural Bangladesh for the year 2000. It can be seen that per capita and per household consumption of poultry products, as expected, vary significantly with various land-holding households. Following that these data relate to only rural areas, per capita consumption data for urban households are compiled from the second source (HES data), which are available for 1995/96. The data for the year 2000 are estimated from trend analyses.

As is evident from the Estimate 1 (FMRSP data) presented in Table 1, within the rural households, per capita consumption of both poultry meat and eggs almost systematically increases with the increase in land holdings. Per capita consumption of meat for the landless households, for example, estimates as 1.13 Kg (per annum), which increases to 2.92 Kg (per annum) for the large land-holding category. Similarly, per capita consumption of eggs for the landless households estimates as 16 (per annum), which increases to 25 (per annum) for the large farmers. For the rural areas, as a whole, per capita consumption of chicken meat and eggs per annum estimates as 1.03 Kg and 18.1 respectively.

In the case of computation from HES data (Estimate 2) obtained from trend estimates, it is evident that per capita consumption of meat in rural areas (1.05 Kg) is almost equal to that estimated from FMRSP data (1.03). However, the estimate for per capita eggs based on HES data (26.8) differs significantly compared to that obtained from FMRSP data (18.1).

NATIONAL CONSUMPTION OF POULTRY PRODUCTS OF THE BASE YEAR 2000

Based on the per capita consumption figures, the consumptions of poultry meat and eggs for rural and urban households have been estimated, which are shown in Table 2. As already mentioned, two data sources have been used to estimate consumptions of poultry products. As can be seen from the table, the total rural demand for poultry meat

Table 2 — National Consumption of Poultry Products (2000)

Farm category	National consumption of meat (000 Tons/Year)		National consumption of eggs (Million No/Year)	
	Estimate 1[(1)]	Estimate 2[(2)]	Estimate 1[(1)]	Estimate 2[(2)]
Rural farm households				
Landless	7.34	-	103.91	-
Marginal	30.07	-	729.46	-
Small	38.37	-	628.21	-
Medium	11.82	-	181.57	-
Large	16.66	-	142.66	-
Rural households	**104.26**	**106.20**	**1831**	**2711**
Urban households	**NA**	**67.65**	**NA**	**1176**
TOTAL	**171.91**	**173.85**	**3007**	**3887**

Notes: [(1)] Estimate 1 uses FMRSP (Flood Impact Study) data for rural consumption, and HES data for urban consumption.
[(2)] Estimate 2 uses HES data for both rural and urban areas.

Sources: Poultry includes duck populations.
Land category proportions, collected from Bangladesh Economic Review, are taken as a proxy for population proportions (in corresponding categories).
Population in 2000 is estimated as 128.31 million, of which 101.14 million are rural and 27.17 million are urban.

in the year 2000, based on FMRSP data, is estimated as 104 thousand metric tons[4]. The estimate based on HES data is close to this, 106 thousand metric tons. The rural demand for poultry eggs in the year 2000 is estimated as 1831 million, based on FMRSP data. The HES source, however, estimates the rural demand for eggs at as high as 2711 million. Since the FMRSP consumption data on rural household are the most recent and the data for urban households are not available from this source, it is suggested that the analysis uses a combination of the two sources in estimating the total national consumption. That is, the analysis uses FMRSP data for rural households and HES data for urban households in estimating the total national consumption. Thus, the national consumption of meat for the year 2000 is worked out as 172 thousand metric tons while the consumption for eggs for the year 2000 is estimated as 3007 million. These estimates have been used as the base year figures in the projection exercise carried out later[5].

PROJECTIONS OF CONSUMPTION OF POULTRY PRODUCTS (DEMAND ANALYSIS APPROACH)

The Demand Analysis approach of the projection exercise (for selected years) requires that the responsiveness of demand for poultry products to income growth be incorporated. Alam (1995) estimated income elasticities as 1.23 for meat (all types) and 2.00 for eggs for the late 1990s. This study uses these figures of income elasticities in the projection exercise[6]. The elasticity for meat (all types) has been used approximately for

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[4] The population for 2000 is estimated as 128.31 million, of which 101.14 million are rural and 27.17 million are urban.

[5] As will be seen later in sensitive analysis, the projection is also carried out using exclusively HES consumption data.

[6] Alam (1995) suggested the elasticities to be tentatively 1.14 for meat and 1.67 for eggs for the year 2000, which was suggested to be approximately further declining, by the year 2010, to 0.83 and 1.30 for meat and eggs respectively. As will be seen later, the two sets of elasticities have been used in carrying out a sensitivity analysis.

chicken meat. The average annual income growth per capita, estimated on the basis of past trends, is 2.83 percent. A projection for the human population, disaggregated by rural and urban population was carried out (See Appendix Table A.1 for estimated equations and Table 4 for relevant estimates).

Starting from the base year (2000) data for consumption per capita, consumption of poultry products over years is projected through incorporating growth in population (rural and urban), income and income elasticities (for poultry products). Table 3 presents projected total national consumption of poultry products in Bangladesh (Demand Analysis Approach) by poultry and poultry product type. The act of disaggregations by poultry type and products is made using information collected from the market survey and key-informant interviews.

As can be seen from the table, the projected figures on national consumption of eggs are 4347 millions, 4878 millions, 5397 millions and 5866 millions for the years 2005, 2010, 2015 and 2020 respectively. That is, the national consumption for eggs is estimated to increase by 62 percent by the year 2010 and 95 percent by the year 2020.

The corresponding figures for national consumption of meat are projected to be 227, 255, 283 and 307 thousand metric tons for the four selected years respectively. That is, the national consumption of meat is expected to increase by 48 percent by the year 2010 and 78 percent by the year 2020.

The projected quantity of poultry products can be translated into feed requirements and finally, into use of grain (maize and wheat), which is discussed later in this section.

This projection exercise involves substantial estimation procedures, entailing many supporting assumptions. In fact, more precise estimates require detailed and practical knowledge about poultry production systems and feed coefficients, according to types of poultry such as village (scavenging-layers and broilers) and commercial

Table 3 — Projected National Consumption of Poultry Products in Bangladesh (Demand Analysis Approach)

Poultry products by type	Base year 2000	Projection for poultry products over the next 20 years			
		2005	2010	2015	2020
Poultry eggs (millions)					
Scavenging	1323.08	1912.57	2146.10	2374.59	2581.15
Layer (Commercial)	1683.92	2434.18	2731.40	3022.20	3285.10
Total	**3007.00**	**4346.75**	**4877.50**	**5396.79**	**5866.25**
Poultry meat (000 Tons)					
Scavenging	90.42	119.60	134.27	148.62	161.62
Layer (Commercial)	67.22	88.91	99.81	110.48	120.14
Broiler (Commercial)	14.27	18. 87	21.19	23.45	25.50
Total	**171.91**	**227.38**	**255.27**	**282.55**	**307.25**

Note: Poultry includes duck population.

Sources: Estimates of total consumption for poultry products are based on Table 2, and through incorporation of income growth and income elasticity of demand for products. Base year figures for total national consumption (for both eggs and meat) are obtained from rural estimate based on FMRSP data, and urban estimate based on HES data.
The disaggregations by poultry type and products are made on the basis of data collected from market survey.

chickens, layers and broilers (which consume more grain), ducks and swine. It is also imperative to obtain details on demand characteristics, dependent on quality and tastes for village and commercial poultry meat and eggs. While such detailed information is lacking or demanding[7], there are other shortcomings, as well. It is difficult to assess how much these domestic demands of poultry products are met from domestic supply and how much from imports.

Following this, it may often be more appropriate to estimate the use of grain as poultry feed through adopting the second approach e.g., through analyzing historical trends in the poultry population.

PROJECTIONS FOR THE POULTRY POPULATION (TREND ANALYSIS APPROACH)

The second approach, the Trend Analysis Approach, involves estimating the rate of increase in the population of poultry on the basis of past trends. Semi-log models are used to estimate trends from time series data. Table A.1 (Appendix Table) presents trend equations for the poultry population and private commercial farms. Trend equations are estimated separately for the chicken and duck populations. As can be seen from the table, almost all the equations fit well, at a highly acceptable level of statistical significance.

As is evident, based on past trend growth rates, chicken populations are growing at an average rate of 5.3 percent per annum (which is more than three times the current population growth rate) while duck populations are growing at an average rate of 0.5 percent per annum. Historical data on exclusively chicken meat were not available. Production of meat (all types) is growing at a 2.8 percent rate annually.

Current government policies in Bangladesh are centred on the market economy where the private sector is playing a vital role. This is also true for private poultry farms,

[7] The relevant assumptions in this analysis are based on a quick market survey and a few key-informant interviews.

in general, the farms experiencing a significant growth in recent time. It can be seen from Table A.1 that chicken farms are growing at an annual rate of 1.5 and 6.1 percent for fowls and rearing categories respectively. Duck farms are growing even more rapidly, at an average annual rate of 3.4 percent and 10.4 percent for fowls and rearing categories respectively.

Projections of poultry and duck populations and commercial farms for the selected four years (2005, 2010, 2015 and 2020) are presented in Table 4. The number of private chicken farms (fowls) is projected to be in the range of 29,202, 31,414, 33,743 and 36,352 in the years 2005, 2010, 2015 and 2020 respectively. The corresponding projections for chicken farms (rearing) are 21,775, 29,555, 40,115 and 54,448 in the four selected years respectively.

The number of private duck farms (fowls) is estimated to be in the range of 19,149, 22,720, 26,957 and 31,984 in the four selected years respectively. The number of corresponding duck farms (rearing) is estimated to be 16,831, 28,311, 47,620 and 80,098 respectively.

Table 5 presents projections of the total poultry population, based on the past trend rates of growth for the four selected years, 2005, 2010, 2015 and 2020. Poultry includes the duck population. Two estimates were carried out based on two methods: the poultry population trend method and the per capita (of poultry) trend method. One can use either of the two, or the mean of the two estimates. In this analysis, the mean of the two estimates was worked out and subsequently used in the projection of grain use as poultry feeds. The projected poultry populations are 218, 279, 356 and 451 million for the four selected years respectively. Thus, the Trend Analysis Approach, based on past trends, suggests that the poultry population is expected to increase by 64 percent by the year 2010 and 165 percent by the year 2020.

Table 4 — Projections for Supply Indicators for Poultry (Based on Past Trend Growth Rates)

Indicators	Base year 2000	Projections for years			
		2005	2010	2015	2020
Duck population (million heads)	13.777	14.101	14.432	14.771	15.118
Chicken population (million heads)	156.96	204.91	267.49	349.20	455.87
Private chicken farms (Fowls) (number)	27,146	29,202	31,414	33,743	36,352
Private chicken farms (Rearing) (number)	16,043	21,775	29,555	40,115	54,448
Private duck farms (Fowls) (number)	16,139	19,149	22,720	26,957	31,984
Private duck farms (Rearing) (number)	10,007	16,831	28,311	47,620	80,098
Human population (000)	128,310	139,911	151,890	162,682	171,420
Rural population (000)	101,138	105,960	110,127	112,609	113,103
Urban population (000)	27,172	33,951	41,763	50,073	58,317

Notes: Projections for poultry population and farms are based on past trend growth rates. The projection for human population is adopted from UN (1998a) and Islam (1997).

Sources: Estimates are based on data collected from (1) Agricultural Census 1960 (2) Agricultural Census 1970 (3) Agricultural Census 1983/84 (4) Agricultural Census 1996 (5) Livestock and Poultry Survey (6) Department of Livestock Services, GOB (7) Alam (1997) (8) FAO Yearbook (1997) (9) UN (1998a) (10) UN (1998b)

Table 5 — Projections for Poultry Population (Trend Analysis Approach)

Method	Base year 2000	Projections for poultry population for years (millions)			
		2005	2010	2015	2020
Trend estimate (on poultry population) method	170.737	219.011	281.922	363.971	470.990
Trend estimate (on per capita poultry) method	169.369	216.862	276.440	348.139	430.264
Average [(1)]	170.053	217.937	279.181	356.055	450.627

Notes: Poultry includes duck population
[(1)] Average represents the mean from two estimates based on two methods: the poultry population and the per capita poultry trend method.

Sources: Estimates are based on data collected from (1) Agricultural Census 1960 (2) Agricultural Census 1970 (3) Agricultural Census 1983/84 (6) Agricultural Census 1996 (5) Livestock and Poultry Survey (6) Department of Livestock Services, GOB (7) Alam (1997) (8) FAO Yearbook (1997) (9) UN (1998a).

The figures for average farm size (shown in Appendix Table A.3) give the estimate for total birds under private farms (disaggregated by layer and broiler type)[8]. The segregation of commercial birds from total birds gives the estimate of scavenging birds.

At this stage, it is important to say a few words on the use of trend growth rates in the current projection exercise. As will be seen later in sensitivity analyses (Tables 8 and 9), the use of high rates of past trend growth in the projection exercise has led to severe

[8] Estimates from the Livestock Department show that, of all the commercial farms 78 percent are layer and 22 percent broiler farms. Our market survey and key-informant interviews indicate the corresponding proportions to be in a close range, 81 percent for layers and 19 percent for broilers. The current analysis uses the estimates provided by the Livestock Department. Taking into account of the average farm size (Table A.3), layer poultry population accounts for 82.4 percent and broiler accounts for 17.6 percent in the total commercial birds.

overestimation of poultry, poultry farms and hence feed requirements. The major reason relates to a lack of a longer and continuous data series from which trends have been estimated. On the other hand, it is more likely that the high trend growth rates, which demand appropriate and adequate policy supports to sustain, may not be applicable over the next twenty years. In these circumstances, the analysis uses the current population growth rate, instead of past trend growth rates, for the projection of poultry population and poultry farms.

Taking the current population growth rate as a proxy to the past trend growth rate, the projected poultry populations, disaggregated by type (scavenging, layers and broilers) are shown in Table 6. Finally, these disaggregated figures of poultry populations are used in the projections of grain use as poultry feeds, which is discussed in the next section.

Table 6 — Projections for the Poultry Population by Scavenging (Village) and Commercial Type in Bangladesh (Trend Analysis Approach)

Poultry type	Base year 2000	Projections for poultry population for years (million birds)			
		2005	2010	2015	2020
Village (= Scavenging)	128.04	138.62	150.07	162.47	175.88
Layer	34.61	37.48	40.57	43.92	47.54
Broiler	7.40	8.02	8.67	9.39	10.16
Total	**170.05**	**184.12**	**199.31**	**215.78**	**233.58**

Notes: The current population growth rate has been taken as a proxy to the past trend growth rate.
Poultry includes duck population. Mortality is not considered in these estimates.
For the approach of deriving the distribution of poultry population among poultry type, see text.

PROJECTED USE OF GRAIN (WHEAT AND MAIZE) FOR POULTRY FEEDS

Table 7 presents projected use of grain (wheat and maize) for poultry feeds, by poultry type, for the selected four years. Two separate estimates are carried out through adopting two approaches, the Demand Analysis Approach and the Trend Analysis Approach. The Demand Analysis Approach uses rural consumption from FMRSP data, urban consumption from the HES source (Table 2) and fixed income elasticities for eggs and meat for the projection of demand for poultry products. The Trend Analysis Approach uses the current population growth rate as a proxy to past trend growth rates for the projection of poultry population and poultry farms. The data derived from these projections have subsequently been used in the projection of grain use as poultry feeds.

The projected uses of grain for poultry feeds are estimated by the use of feed ingredients and feed coefficients shown in Tables A.4 through A.5 (Appendix Tables). As the field survey suggests, an average mortality rate of 10 percent has been assumed. For both layers and broilers, consumptions are adjusted for the annual level. For layers, the feed consumption (per week) level applies for the life cycle of 78 weeks, from which that for 52 weeks is estimated. For broilers, the average feed consumption (per week) applies for the life cycle of 6 weeks. In all, 6 batches of broilers in a year are considered. In other words, the feed demand for 36 weeks is considered in a year. As estimated from the field survey, the wheat consumption by scavenging birds is equivalent to 20 percent of the average quantity consumed by layers and broilers. No maize consumption is considered for scavenging birds. Half of the scavenging birds are estimated to lay eggs in four seasons of the year.

As can be seen from Table 7, adopting the Demand Analysis Approach, the figures for projected use of total grains as poultry feeds are 665, 746, 826 and 898 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively. In other words, starting from the

base-year requirements in this approach, the projected use of grain for poultry feeds is expected to increase by 18 percent by the year 2010 and 42 percent by the year 2020.

Table 7 — Projected Use of Grain (Wheat And Maize) for Poultry Feeds (by Poultry Type) in Bangladesh

Grain by poultry type	Base year 2000	Projected use of grain for poultry feeds (000 Tons)			
		2005	2010	2015	2020
Demand Analysis Approach					
Scavenging					
Wheat	-	100.99	113.36	125.47	136.42
Maize	-	-	-	-	-
Layer					
Wheat	-	38.09	42.75	47.31	51.44
Maize	-	500.59	561.87	621.85	676.11
Broiler					
Wheat	-	8.63	9.69	10.72	11.66
Maize	-	16.56	18.59	20.58	22.38
Wheat	**140.56**	**147.71**	**165.80**	**183.50**	**199.52**
Maize	**490.51**	**517.15**	**580.46**	**642.43**	**698.49**
Total grain	**631.07**	**664.86**	**746.26**	**825.93**	**898.01**
Trend Analysis Approach					
Scavenging					
Wheat	79.70	86.28	93.41	101.13	109.48
Maize	-	-	-	-	-
Layer					
Wheat	34.02	36.83	39.87	43.16	46.73
Maize	438.98	475.24	514.49	556.99	602.99
Broiler					
Wheat	26.85	29.06	31.46	34.06	36.88
Maize	51.53	55.79	60.40	65.39	70.79
Wheat	**140.56**	**152.17**	**164.74**	**178.35**	**193.08**
Maize	**490.51**	**531.03**	**574.89**	**622.38**	**673.78**
Total grain	**631.07**	**683.20**	**739.63**	**800.73**	**866.86**

Note: The trend growth rate of both poultry population and commercial farms is taken as equal to current population growth rate (1.6%).

As can be seen from Table 7, according to the Trend Analysis Approach (taking current population growth rate as the trend rate of growth), the projected feeds are 683, 740, 801 and 867 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively. In other words, in this approach the projected use of grain for poultry feeds is expected to increase by 17 percent by the year 2010 and 37 percent by the year 2020.

CONCLUDING OBSERVATIONS

As can be seen from Table 7, the two estimates involving the two approaches are within a reasonable range. In order to derive more concrete conclusions, a sensitivity analysis in various alternative scenarios was carried out. The results are shown in Tables 8 and 9. In all, four estimates under four scenarios have been compared. The first scenario for each of the two approaches relates to the basic scenario referred to in Table 7.

At this stage, it is important to say a few words on the results of the four alternative scenarios including merits and demerits of the two methods adopted.

In the first approach, that is, the Demand Analysis Approach, demands derived from the consumption of poultry products are dependent on factors such as income growth and income elasticities, urbanisation and population growth. Ideally, separate elasticities for village and commercial poultry products, and separate income growths for rural and urban areas should have been estimated and used. Additionally, in this analysis, factors such as tastes and, more crucially, perhaps, relative product prices could not be incorporated. In Bangladesh, this issue is particularly important. Seasonal price fluctuations following non-availability of grain as poultry feeds throughout the year should be taken into account to estimate the total poultry feed requirement because grains are very often replaced by substitute feeds as a result of a rise in prices. Hence, non-incorporation of price elasticity of demand is a major limitation of this analysis.

Unfortunately, data on these aspects are neither available nor reliable. Particularly, the data that can identify the demand characteristics for commercial, as opposed to scavenging poultry meat and eggs are not available. In rural and even in urban areas, it is still a widespread notion that the scavenging poultry meat and eggs are superior in terms of tastes and nutritional contents. On the other hand, there appear to be constraints for the supply of commercial birds in rural areas, as commercial farms are largely concentrated in urban areas. This suggests that the scavenging birds have imperfect substitutions with commercial birds.

The second approach, that is, the Trend Analysis Approach, may be more appropriate in projecting the use of grain for poultry feeds when the supply constraints are more likely to dominate demand characteristics in determining the growth of poultry. However, the major drawback of this approach relates to a lack of a longer and continuous reliable data series over recent time. The trend estimates carried out on a discrete data series with a small number of observations are likely lead to overestimation of growth rates. Moreover, the trend growth rates, which demand appropriate and adequate policy supports to sustain, may not be applied to a projection over the next twenty years. Under these circumstances, despite its limitations, the first approach, that is, the Demand Analysis Approach might be more appropriate in projecting the use of grain for poultry feeds in Bangladesh.

As can be seen from the sensitivity analysis presented in Table 8, the alternative scenarios for the Demand Analysis Approach relate to the use of consumption data (for poultry products) from two sources, FMRSP and HES, and fixed and declining income elasticities. The four projection estimates of poultry feeds under four alternative scenarios are within a reasonable range, differing by less than up to 15 percent. Following this, one can also use the mean of the four estimates derived from the four scenarios.

For the obvious reason of relatively much higher grain-consumption, the figures for commercial farms account for the main difference in the total feed requirements in the case of the Trend Analysis Approach. As can be seen from the sensitivity analysis presented in Table 9, the alternative scenarios for this approach relate to various trend growth rates of poultry population and commercial farms. Keeping aside the projection under the fourth scenario (which is clearly an outlier), which incorporates the past trend growth of poultry population and commercial farms, the three projections of poultry feeds under the other three alternative scenarios differ by up to nearly one-third. Under these circumstances, one can also use the mean of the three estimates derived from the three scenarios.

The use of grain for poultry feeds for the base year 2000 is estimated to be 631 thousand metric tons. Of this, wheat accounts for 141 thousand metric tons and maize accounts for 491 thousand metric tons, accounting for 22 and 78 percent of total grain requirements in the base year respectively. Current production levels for wheat and maize in Bangladesh are in the range of 1800 thousand and 65 thousand metric tons respectively. Thus, the total poultry feed requirement is approximately one-third of the total wheat and maize production in Bangladesh. The requirement of wheat as poultry feed is nearly 8 percent of the total domestic production and the requirement of maize as poultry feed is about 7.6 times its domestic production.

Our survey indicates that there is no marked difference in quality between domestic and imported maize except that the former has a little higher moisture and fiber content. There appear to be no significant price differences, either. Rather, the import price of maize is reported to be often on the higher side. Nonetheless, the issue of moisture and fiber content is not a serious problem, as reported by respondents in our field survey.

The demands for both livestock and poultry feeds are currently met from only imports, at seemingly relatively higher costs. Domestic maize is available only in a particular season of the year whereas demands for maize by poultry farms exist throughout the year. Sustainable supplies of maize throughout the year are thus crucial for the development of the poultry sector.

Knowledgeable sources also indicate that the poultry sector has significant linkage effects, both backward and forward. There has been a tremendous growth in poultry farms over the last few years. Maize forms the major component in poultry feeds. Why then is the production of maize in the country not picking up? Maize ranks second to wheat in world cereal production, but in Bangladesh it is still a minor crop in terms of acreage, accounting for only 3 percent of wheat and 0.2 percent of rice area. From the viewpoint of value, for both human food and livestock feed, and its role in agro-ecological balance, maize production is critically important in a country like Bangladesh. Although it is possible to produce maize throughout the year, maize is currently produced in the country largely in winter season. Why has maize production not yet gained popularity? Is it due to lack of motivation? Is maize production unprofitable and thus cannot substitute for other crops? Are the poultry farm-owners not sufficiently aware of the quality and supply of domestic maize production? Is there any need for market intervention? Why has there not been any growth of feed mills? Why are the poultry farms not encouraged to use domestic maize as poultry feeds? Why are a substantial number of farms using ready feeds, which are often of lower quality? Do the farm owners need some orientation in feed-mixing technology? These are some of the questions, which deserve pursuit in future research in maize.

Table 8 — Projected Use of Grain (Wheat And Maize) for Poultry Feeds in Bangladesh (Demand Analysis Approach): Under Various Scenarios

Scenario	Grain	Base year 2000	Projected use of grain for poultry feeds (000 Tons)			
			2005	2010	2015	2020
Demand Analysis Approach						
1	Wheat	140.56	147.71	165.80	183.50	199.52
	Maize	490.51	517.15	580.46	642.43	698.49
	Total grain	631.07	664.86	746.26	825.93	898.01
2	Wheat	140.56	145.04	162.80	173.16	188.27
	Maize	490.51	506.75	568.78	604.70	657.47
	Total grain	631.07	651.79	731.58	777.86	845.74
3	Wheat	140.56	157.12	175.35	185.45	200.62
	Maize	490.51	559.54	623.65	658.45	711.45
	Total grain	631.07	716.66	799.00	843.90	912.07
4	Wheat	140.56	160.21	178.79	196.79	212.86
	Maize	490.51	571.84	637.30	700.55	756.87
	Total grain	631.07	732.05	816.09	897.34	969.73

SCENARIO 1: Using rural consumption from FMRSP and urban consumption from HES source (Table 2) and fixed income elasticities:
EGG: 2.00 (during 2000-2020)
MEAT: 1.23 (during 2000-2020)

SCENARIO 2: Using rural consumption from FMRSP and urban consumption from HES source and declining income elasticities:
EGG: 1.67 (during 2000-2010); 1.30 (during 2010-2020)
MEAT: 1.14 (during 2000-2010); 0.83 (during 2010-2020)

SCENARIO 3: Using both rural and urban consumption data from HES source and declining income elasticities as above.

SCENARIO 4: Using both rural and urban consumption from HES source and fixed income elasticities:
EGG: 2.00 (during 2000-2020)
MEAT: 1.23 (during 2000-2020)

Table 9 — Projected Use of Grain (Wheat and Maize) for Poultry Feeds in Bangladesh (Trend Analysis Approach): Under Various Scenarios

Scenario	Grain	Base year 2000	Projected use of grain for poultry feeds (000 Tons)			
			2005	2010	2015	2020
		Trend Analysis Approach				
	Wheat	140.56	152.17	164.74	178.35	193.08
3	Maize	490.51	531.03	574.89	622.38	673.78
	Total grain	631.07	683.20	739.63	800.73	866.87
	Wheat	140.56	149.20	158.37	168.10	178.43
4	Maize	490.51	520.66	552.65	586.62	622.67
	Total grain	631.07	669.85	711.02	754.72	801.10
	Wheat	140.56	159.51	181.03	205.45	233.17
2	Maize	490.51	561.77	643.38	736.85	843.90
	Total grain	631.07	721.29	824.40	942.30	1077.07
	Wheat	140.56	179.19	229.85	295.96	382.06
1	Maize	490.51	615.18	792.35	1050.41	1435.29
	Total grain	631.07	794.37	1022.20	1346.37	1817.35

SCENARIO 1: Trend growth rate of both poultry population and commercial farms taken as equal to current population growth rate (1.6%)

SCENARIO 2: Trend growth rate of both poultry population and commercial farms taken as equal to future population growth rate (1.2%)

SCENARIO 3: Half of past trend growth rate of poultry population (2.5%)& half of that of commercial farms (2.75%)

SCENARIO 4: Past trend growth rate of poultry population (5%) and past trend growth rate of commercial farms
(5.5%)

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APPENDIX

Table A.1 — Estimated Trend Equations for Relevant Indicators

Estimated model	Annual growth (%)	Adj R^2	F sig. level
Duck population:			
LOG (DCKPOP) = -6.669 + .004646 T	0.5	.95	.00
Chicken population:			
LOG (DENACRE)= -101.564 + .05331 T	5.3	.99	.00
Production of meat (all type):			
LOG (PRODMEAT) = -50.548 + .02846 T	2.8	.99	.00
Per capita availability of meat:			
LOG (CAPMEAT) = -12.538 + .00698 T	0.7	.99	.00
Chicken farms (fowls):			
LOG (PFARM1) = -18.991 + .0146 T	1.5	.26	.38
Chicken farms (Rearing):			
LOG (PFARM2) = -112.517 + .0611 T	6.1	.69	.05
Duck farms (fowls):			
LOG (DFARM1) = -58.711 + .0342 T	3.4	.77	.03
Duck farms (Rearing):			
LOG (DFARM2) = -198.789 + .1040 T	10.4	.88	.01
National per capita income growth:			
LOG (CAPINC) = -47.934 + 0.0283 T	2.83	.98	.00

Sources: Estimates are based on data collected from (1) Agricultural Census 1960 (2) Agricultural Census 1977 (3) Agricultural Census 1983/84 (4) Agricultural Census 1996 (5) Livestock and Poultry Survey (6) Department of Livestock Services, GOB (7) Alam (1997;1995) (8) FAO Yearbook (1997) (9)UN (1998a) (10)UN(1998b) (11) BBS(1998); (12) Household Expenditure Survey (1997); T=Time

Table A.2 — Household Structure and Proportions of Sample Households Consuming Poultry Birds and Products by Land Holdings

Farm category	No. of sample farmers	% of Total	HH size	% HH owning chicken	% HH owning duck	% HH consuming chicken meat	% HH consuming egg
Landless	236	32.2	4.8	69.5	25.8	16.8	36.6
Marginal	160	21.8	5.1	84.4	39.4	24.3	47.1
Small	280	38.1	5.5	86.4	50.4	25.0	41.1
Medium	43	5.9	6.5	86.0	60.5	26.7	46.7
Large	15	2.0	7.1	73.3	33.3	45.5	81.8
Total	**734**	**100.0**	**5.3**	**80.2**	**39.1**	**21.9**	**40.8**

Notes: Farmers are categorized according to operated land. Consumption refers to that in the previous month of the time of the survey.

Land categories:

Marginal - 0.01 - < 0.50 acres
Small - 0.50 - < 2.5 acres
Medium - 2.5 - < 5.0 acres
Large - > 5.0 acres

Sources: Flood Impact Study (1999), FMRSP, Dhaka

Table A.3 — Farm Size by Chicken Type by Division

Division	Average birds per commercial farm	
	Layer	Boiler
Dhaka	800	500
Chittagong	600	500
Barisal	300	200
Khulna	300	250
Rajshahi	300	200
Average[(1)]	**640**	**485**

Notes: [(1)] Averages represent weighted average, the weights being the number of farms in each Division. Data for Sylhet Division is not available.

Sources: Compiled from Livestock Department

Table A.4 — Use of Grain (Wheat and Maize) for Producing Eggs and Meat in Bangladesh (2000)

Type of poultry	Average use of grain per 1000 eggs (Kg)			Average use of grain per 1 Ton of meat (Kg)		
	Wheat	Maize	Total	Wheat	Maize	Total
Scavenging	14.310	-	14.310	615.56	-	615.56
Layers	5.877	77.130	83.007	267.50	3518.75	3786.25
Broilers	-	-	-	457.14	877.55	1334.69

Notes: The wheat consumption by scavenging birds is estimated to be 20 percent of average quantify consumed by layers and broilers. No maize consumption is considered for scavenging birds.

Source: Field Survey and Quasem (2001)

Table A.5 — Consumption of Grain (Wheat and Maize) for Poultry Feeds in Bangladesh (2000)

Feeds	Average consumption (Grams/per week/bird)	% of grain consumption
Scavenging		
Wheat	13.3	100.0
Maize	-	-
Total grain	13.3	100.0
Layer		
During first 20 weeks		
Wheat	12	7.2
Maize	155	92.8
Total grain	167	100.0
Remaining 32 weeks		
Wheat	26	7.0
Maize	343	93.0
Total grain	369	100.0
Average over 52 weeks		
Wheat	21	7.2
Maize	271	92.8
Total grain	292	100.0
Broiler		
Wheat	112	34.3
Maize	215	65.7
Total grain	324	100.0

Notes: For scavenging birds, only wheat consumption is applicable.
For layers, feed consumption (per week) level applies for the life cycle of 78 weeks, from which that for 52 weeks is estimated. For broilers, average feed consumption (per week) applies for the life cycle of 6 weeks. In all, 6 batches of broilers in a year are considered. That means, feed demand for 36 weeks is considered in a year.

Sources: Field Survey and Quasem (2001)