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DEMAND PROJECTIONS FOR POULTRY FEEDS: IMPLICATIONS FOR WHEAT AND MAIZE PRODUCTION IN BANGLADESH

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ABSTRACT

Wheat and maize are important components of poultry feeds. The demand for wheat and maize, therefore, is expected to increase with the currently experienced sharp growth of poultry farms in Bangladesh. This analysis carries out projections of demand for poultry feeds and its implications for wheat and maize production in Bangladesh over the next 20 years. Under the scenario of rural consumption data from FMRSP and urban consumption data from HES source, and fixed income elasticity of demand, the Demand Analysis Approach projects the use of total grains (as poultry feeds) as 665, 746, 826 and 898 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively. Under the scenario of trend growth rate of poultry population and commercial farms taken as equal to current population growth rate, the Trend Analysis Approach projects the total grains as 683, 740, 801 and 867 thousand metric tons, for these years respectively.

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 22 and maize accounts for 78 per cent. The requirement of wheat as poultry feed is only 8 per cent of the total domestic production while the requirement of maize as poultry feed is nearly 8 times its domestic production. Our field survey suggests that one of the major reasons of maize production gaining no popularity in Bangladesh relates to lack of incentives on the part of the cultivators. Some motivational steps and market interventions are, therefore, needed in this respect.

I. INTRODUCTION

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

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Poultry farms in Bangladesh are growing fast in recent times. With a high population, income and urbanisation growth, the demand for poultry products is expected to increase appreciably in the future. Hence, poultry farms are also expected to increase over time. Although the use of wheat and maize for livestock and poultry feed is generally growing rapidly in developing countries (Sarma 1986), this has not yet reached to a significant proportion in Bangladesh. Maize in Bangladesh is still a minor crop in terms of acreage, accounting for only 3 per cent of wheat and 0.2 per cent of rice.

The demand for wheat and maize, therefore, is expected to increase with the growth of poultry farms in the country. The demand for both livestock and poultry feeds appear 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-h-vis agriculture sector in Bangladesh.

Against this background and the fact that there exists a large potential (even for export) for the poultry sub-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 aims to estimate the total use of feed as grain by the poultry sub-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 future.

II. METHODOLOGY

2.1 Existing Literature and Major Data Sources

Research on livestock resources in Bangladesh, in general, and poultry sub-sector, in particular, is rather limited. The major contributors include Alam (1995; 1997), Mitchell (1997), Quasem (2001) and the studies conducted by the Department of Livestock from time to time.

The research by Alam (1995), which has been later updated (Alam 1997), is an useful document on livestock resources in Bangladesh, presenting the existing status and the future potential of the sub-sector. The research, concentrating more on cattle and buffaloes, estimated livestock (including poultry) population and products and their growth rates as of 1994-95. The research also delineated the socio-economic aspects of livestock including identifying the constraints to livestock production. Mitchell (1997), which is a policy paper, based on a mission to Bangladesh, outlined the problems and prospects of livestock sector. It also covered consumption and marketing aspects of poultry products in Bangladesh, largely using data generated by 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) discussed the present status of production organisation and technology, concentrating on the poultry sub-sector with special emphasis on disaggregated input-output structure for the sub-sector. This was a background study, aiming at estimating relevant input-

output coefficients for use in the construction of the national input-output table. The study by Quasem (2001), undertaken simultaneously with the present study under Food Management and Research Support Project (FMRSP), discussed survey results showing the principal characteristics of poultry farms and the efficiency of their feeding practices at both household and commercial levels.

This study has also consulted other documents published elsewhere, such as Sarma (1986) and Mink (1987). Sarma (1986), a Research Report published by IFPRI (Washington), is concerned with the analysis and projections (to .2000) of 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 focussed 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 supply of and demand for 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.

2.1.1 Data source

The study is largely based on information from secondary sources; BBS-Agricultural Censuses (1960; 1977; 1983/84; 1996) are the main sources of historical data on poultry population. FAO Yearbook (1997) is also a source in this respect. However, such information are 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.

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 current poultry production system, generated by the field surveys, have been used. The data on various aspects such as feeding practices, feed requirements and farm size by type, collected from the surveys by Quasem (2001), have been used.

A rapid market survey including a few key-informant interviews is 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.

2.2 Estimation Procedures

2.2.1 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, the projection of poultry and poultry products has to be carried out first. In estimating the medium and longterm demand for use of grain as poultry feeds two approaches are employed [2] One approach involves projecting demand derived from the consumption of poultry products (meat and eggs). The approach may be called "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 incorporation of income growth and income elasticities of demand. Preferably, demand for poultry products should be disaggregated by income or socio-ecnomic groups, to allow differential impacts across different groups, in both rural and urban areas. Moreover, in this approach, the factors such as population and urbanisation growth have to be taken into account in the estimation of future feed demand.

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 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 income. Such quantities of poultry products can be translated into feed requirements and finally into projected use of grain and demand for poultry feeds.

2.2.2 Trend Analysis Approach

Future feed requirements can also be projected based on the growth in 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 "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.

In the Trend Analysis Approach, the estimates for 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 population 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 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 year 2005, 2010, 2015 and 2020. The year 2000 is considered as the base year.

2.2.3 Estimate for consumption on poultry products

As already mentioned, there is serious data constraint for 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 [3]. The survey data, however, relate to consumption in rural areas. Following this, consumption data for urban households are compiled from Household Expenditure Survey, which are available from several rounds of HES including 1995/96. The consumption data for the base year 2000 are estimated from trend analysis.

2.2.4 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 are collected from various sources such as Alam (1997), FAO Yearbook (1997), Livestock and Poultry Survey (1988-89) and Department of Livestock Services. Trend estimates are carried out separately for chicken and duck population[4]. Later, chicken populations are combined with duck populations to represent total poultry population.

2.2.5 Estimate for scavenging birds

Poultry production is dominated by commercial farms, located in mostly urban areas, and by chicken of scavenging nature, 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 the estimate of 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 lack of reliable and adequate data on poultry populations. Moreover, whatever data available, are not disaggregated by scavenging and commercial birds, let alone by layer and broiler type. Hence, the only way of estimating the scavenging birds is through seggregating the number of commercial birds from the total poultry population, through use of data collected from the field surveys and key-informant interviews.

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[3] The survey covered 757 householders in 155 villages across 7 districts.

[4] The trend estimates are carried out on 10 observations during 1966-95 by fitting semi-logarithmic models.

The Livestock Department suggests that of all the private commercial farms, about 22 per cent are broiler and 78 per cent layer farms. Our key-informant interviews and expert opinions suggest that 81 per cent of the commercial farms are layers and 19 per cent are broiler farms. Unofficial data compiled from the Livestock Department show that average (weighted) bird size of private commercial farms is in the range of 640 and 485 for layer and broiler type 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 gives the estimate of scavenging birds for various years.

III. ANALYSIS AND RESULTS

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.

3.1 Per Household and Per Capita Consumption of Poultry Products for 2000

Two data sources (FMRSP and 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 potential variations among such groups.

Per capita consumption estimates of poultry products for farm households in rural areas (disaggregated by land categories) are compiled from the first source[5]. Table 1 gives such data on per household and per capita consumption (by land holding categories) in 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. Since 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 analysis.

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, estimated 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

[5] 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.

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.

Table 1: Per household and per capita consumption of poultry products in Bangladesh diet (2000)

Farm's category	Chicken meat		Chicken eggs	
	Estimate 1 Per capita consumption (Kg/Year)	Estimate 2 Per capita consumption (Kg/Year)	Estimate 1 Per capita consumption (No/Year)	Estimate 2 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.

In 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 Kg). However, the estimate for per capita eggs based on BBS-HES data (26.8) differs significantly from that obtained from FMRSP data (18.1).

3.2 Consumption of Poultry Products for the Base Year 2000

Based on the per capita consumption figures, total consumption of poultry meat and eggs for rural and urban households have been estimated, which are shown in Table 2. As can be seen from the Table, the total rural demand for poultry meat in the year 2000, based on FMRSP data, is

estimated as 104 thousand metric tons[6]. 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. Since the FMRSP consumption data for rural households are the most recent and the data for urban households are not available from this source, it is suggested the analysis uses FMRSP data for rural households and HES data for urban households in estimating the total consumption. Thus, the total consumption of meat for the year 2000 is worked out as 172 thousand metric tons while the consumption of 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[7].

3.3 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 analysis uses these figures of income elasticities in the projection exercise[8]. The elasticity for meat (all types) has been used for chicken meat. Average annual income growth per capita, estimated on the basis of past trends, is 2.83 per cent. Projection for human population, disaggregated by rural and urban population, is carried out, (See Table 4).

Starting from the base-year (2000) data for consumption per capita, consumption of poultry products over the years are projected through incorporating growth in population (rural and urban), income and income elasticities (for poultry products). Table 3 presents projected total consumption of poultry products in Bangladesh (Demand Analysis Approach) by poultry and poultry product type. As can be seen from the Table, the projected total consumption of eggs are 4347 millions, 4878 millions, 5397 millions and 5866 millions for the years 2005, 2010, 2015 and 2020 respectively. Thus, the total consumption for eggs is projected to increase by 62 per cent in year 2010 and by 95 per cent in year 2020.

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

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

[8] 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.

Shahabuddin and Zohir (1995) estimated income elasticity of meat (all types) in rural and urban Bangladesh as 1.2 and 1.4 respectively. The estimated income elasticities for Indonesia are 2.2 for chicken meat and 1.6 for chicken eggs (Mink 1987).

Table 2: Consumption of poultry products (2000)

Farm's category	Total consumption of meat (000 Tons/Year)		Total 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:

Poultry includes duck population
Land category proportions, collected from Bangladesh Economic Review, are taken as 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.

Source:
(1) Estimate 1 uses FMRSP (1999) data for rural consumption, and HES data for urban consumption.
(2) Estimate 2 uses BBS (HES) (1998) data for both rural and urban areas.

The corresponding total consumption for meat are projected to be 227, 255, 283 and 307 thousand metric tons for the four selected years respectively[9]. Thus, the total consumption for meat is expected to increase by 48 per cent in year 2010 and by 78 per cent in year 2020. The projected quantity of poultry products can now be converted into feed requirements and finally, into use of grain (maize and wheat), which is discussed later in this Section.

A note of caution is in order in that this projection exercise involves substantial estimation procedures, with many supporting assumptions. In fact, more precise estimates require much 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 chickens, layers and broilers (which consume more grain), ducks and swine. It is also imperative to obtain details of demand characteristics, dependent on quality and tastes for village and commercial poultry meat and eggs. While such detailed information are lacking or quite demanding[10], there are other shortcomings, as well. It is difficult to assess how much of these

[9] Mention can be made of the results of IMPACT model (Mark Rosegrant, 2002, IFPRI), which carries out projection of poultry consumption as 349 thousand metric tons for 2020 for Bangladesh.
[10] The relevant assumptions in this analysis are based on a quick market survey and a few key-informant interviews.

domestic demands of poultry products are met from domestic production and how much from imports.

Table 3: Projected 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 (million No)					
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.

Source:
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 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

3.4 Projections for 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 [11]. Based on the past trend growth rates, chicken population is growing at an average rate of 5.3 per cent per annum (which is more than three times the current population growth rate) while duck population is growing at an average rate of 0.5 per cent per annum. Historical data on exclusively chicken meat were not available. Production of meat (all types) is growing at a 2.8 per cent rate annually.

Current government policies in Bangladesh are centred around market economy where private sector is playing a vital role. This is also true for the private poultry farms, in general which are experiencing a significant growth in recent time. Chicken farms are growing at an annual rate of 1.5 and 6.1 per cent for fowls and rearing categories respectively. Duck farms are growing even rapidly, at an average annual rate of 3.4 per cent and 10.4 per cent for fowls and rearing categories respectively.

Projections of poultry and duck populations and commercial farms, based on the current growth rates, for the selected four years are presented in Table 4. The number of private chicken

[11] Trend equations, estimated separately for chicken and duck population, are based on 10 observations available for the period 1960-1995. Semi-log models are used to estimate trends from time series data. Almost all the equations fit well, at a highly acceptable level of statistical significance.

farms (fowls) are 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 of chicken farms (rearing) are 21,775, 29,555, 40,115 and 54,448 in the four selected years respectively.

Table 5 presents projections of the total poultry population, based on the trend rates of growth, for the four selected years, 2005, 2010, 2015 and 2020. Two estimates are carried out, based on two methods: poultry population trend method and per capita (of poultry) trend method. One can use either of the two, or the mean of the two estimates. In this analysis, mean of the two estimates is worked out, which has subsequently been 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 trend, suggests that the poultry population is expected to increase by 64 per cent in year 2010 and 165 per cent in year 2020.

The figures for average farm size give the estimate for total birds under private farms (disaggregated by layer and broiler type)[12]. The deduction of the commercial birds from the total birds gives the estimate of scavenging birds.

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.
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)

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

At this stage, it is pertinent to say a few words on the use of trend growth rates in the current projection exercise As will be seen later in sensitivity analysis (Tables 8 and 9), the use of such 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 for a recent period from which trends have to be 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, thus, 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 5: Projections of Poultry Population (Trend Analysis Approach)

Method	Base year 2000	Projections of poultry population for selected years (million)			
		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:
Projections of Poultry Population are based on past trend growth rates
Poultry includes duck population
[1] Average represents mean from two estimates, based on two methods: poultry population and 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).

Table 6: Projection of poultry population by scavenging (village) and commercial type in Bangladesh (Trend Analysis Approach)

Poultry type	Base year 2000	Projections of poultry population for selected years (million birds)			
		2005	2010	2015	2020
Village (Scavenging)	128.043	138.62	150.07	162.47	175.88
Layer	34.612	37.479	40.57	43.92	47.54
Broiler	7.398	8.018	8.67	9.39	10.16
Total	**170.05**	**184.10**	**199.31**	**215.78**	**233.59**

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.

3.5 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 four selected years. The projected uses of grain for poultry feeds are estimated by use of feed ingredients and feed coefficients shown in Tables A.1 through A.2 (Appendix Tables). As can be seen from Table 7, adopting Demand Analysis Approach, the projected use of total grains as poultry feeds is 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, the projected use of grain for poultry feeds is expected to increase by 18 per cent in year 2010 and by 42 per cent in 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)			
		Demand Analysis Approach			
		2005	2010	2015	2020
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**

Notes:

The trend growth rates of both poultry population and commercial farms is taken as equal to current population growth rate (1.6%). A 10 per cent mortality rate is assumed. For both layers and broilers, consumptions are adjusted to for annual level. 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. This means, feed demand for 36 weeks is considered in a year. As estimated from field survey, the wheat consumption by scavenging birds is equivalent to 10 per cent of average quantity consumed by layers and broilers. No maize consumption is considered for scavenging birds. Half of scavenging birds are estimated to lay eggs in the whole year.

According to the Trend Analysis Approach (using the current population growth rate as a proxy to past trend growth rate for the projection of poultry population and poultry farms), the projected feeds are 683, 740, 801 and 867 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively. In other words, the projected use of grain for poultry feeds is expected to increase by 17 per cent in year 2010 and by 37 per cent in year 2020.

IV. CONCLUDING OBSERVATIONS

The two estimates involving the two approaches are within a reasonable range (Table 7). In order to derive more concrete conclusions, a sensitivity analysis in various alternative scenarios is carried out., shown in Appendix Tables A.3 and A.4. 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.

As can be observed, 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 15 per cent. 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 Trend Analysis Approach. As can be seen from sensitivity analysis, 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 per cent 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, total poultry feed requirement is approximately one-third of the total grain (wheat and maize) production in Bangladesh. The requirement of wheat as poultry feed is nearly 8 per cent of the total domestic production and the requirement of maize as poultry feed is as high as nearly 8 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 fibre content is not a serious problem, as reported by respondent traders in our field survey. The demands for poultry feeds are currently met largely from imports, at seemingly relatively higher costs. Domestic maize is available only in a particular season of the year whereas demand for maize by poultry farms exists throughout the year. Sustainable supplies of domestic maize throughout the year would contribute significantly to the development of the poultry sector.

Knowledgeable sources also indicate that the poultry sub-sector has significant linkage effects, both backward and forward. There has been tremendous growth of poultry farms over the last few years. Maize forms the major component in total grain requirement (78 per cent) as poultry feeds. Why then the production of maize in the country is not gaining popularity? 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 per cent of wheat and 0.2 per cent of rice area. On the other hand, Bangladesh can hardly afford to import so much of maize for the feed requirement of poultry sector. Additionally, from the viewpoint of 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 may be possible to produce maize throughout the year, maize is currently produced in the country largely in winter season. The major constraint of maize production relates to lack of incentives on the part of the cultivators, which was also observed by Quasem (1999) while he suggested a series of motivational steps and market interventions.

Our survey indicates that poultry farm-owners are not sufficiently aware of the quality and supply of domestic maize production. Even the traders in poultry-feeds are not encouraged to deal in domestic maize presumably because of its irregular and unsustainable supply. Surprisingly, there has been no significant growth of feed mills despite a significant growth of poultry farms in the recent years. It has also been observed that poultry farms, in general, are not encouraged to use domestic maize as poultry feeds. Thus, a substantial number of farms are using ready feeds, which are often of lower quality. It is, therefore, important that the poultry farms be given some orientation in feed-mixing know-how and technology.

Finally, it is pertinent to say a few words on the results of the four alternative scenarios, including merits and demerits' of the two methods adopted in the above analysis. .

In 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. Moreover, in this analysis, the 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 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 have constraints for the supply of commercial birds in rural areas, as the commercial farms are largely concentrated in urban areas. The fact that the scavenging birds are imperfect substitutes of commercial birds has not been incorporated, which is another limitation of this approach.

The second approach, i.e., 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 in determining the growth of poultry. However, the major drawback of this approach relates to lack of a longer and continuous reliable time series data over recent time. 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, (the Demand Analysis Approach) might be more appropriate in projecting the use of grain for poultry feeds in Bangladesh.

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Table A.1: 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 per cent of average quantify consumed by layers and broilers. No maize consumption is considered for scavenging birds.
Sources:
Field Survey and Quasem (2001)

Table A.2: 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)

Table A.3 : 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) Demand Analysis Approach			
			2005	2010	2015	2020
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 A.4: 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) Trend Analysis Approach			
			2005	2010	2015	2020
3	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	866.87
4	Wheat	140.56	149.20	158.37	168.10	178.43
	Maize	490.51	520.66	552.65	586.62	622.67
	Total grain	631.07	669.85	711.02	754.72	801.10
2	Wheat	140.56	159.51	181.03	205.45	233.17
	Maize	490.51	561.77	643.38	736.85	843.90
	Total grain	631.07	721.29	824.40	942.30	1077.07
1	Wheat	140.56	179.19	229.85	295.96	382.06
	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%)