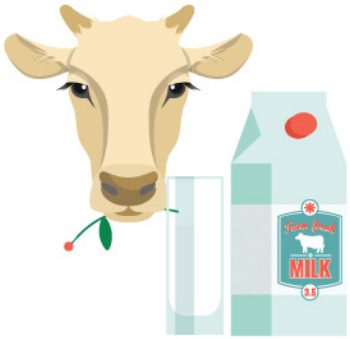
IMPROVING NUTRITION FOR BANGLADESH

RESEARCH PAPER



HOME LIVESTOCK:
COSTS AND BENEFITS OF ENHANCING RURAL DIETS BY IMPROVING HOMESTEAD FOOD PRODUCTION OF ANIMAL SOURCE FOODS

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Home Livestock: Costs and Benefits of Enhancing Rural Diets by Improving Homestead Food Production of Animal Source Foods

Bangladesh Nutrition

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Introduction

Demand for animal-source food items tends to increase with income. The income elasticity of demand for animal-source foods (ASFs) is likely to be more than 0.5 in developing countries of the world, although it has been quite low, about 0.1 in developed countries (FAO 2012). With the growth of the economy, it is expected that the consumption of animal-source foods will increase in Bangladesh as well. Income is one of the most important drivers of animal-source food consumption and therefore, animal-source food will become increasingly important in the diet even without homestead production of animals and animal-source food items. The purpose of this paper is to estimate the benefits and costs of homestead food production of animal-source foods. The idea is to look not only at the income generated by the livestock and poultry farming at the household level but also other effects created by home production of these food items. Although consumption of meat has increased over time, home production of ASFs may not affect meat consumption directly. Among the poor households in Bangladesh, meat consumption is not an important part of the diet (see Household Income and Expenditure Survey 2010) but other ASFs like milk and egg are important and becoming increasingly more important over the years.

Background

According to the 2010 Household Income and Expenditure Survey of Bangladesh (BBS 2012), 54.8% of total household consumption expenditure was allocated to food. The importance of ASFs has increased over the years and in 2010 about 10.3% of food expenditure was due to expenditure on meat and poultry and another 3% was due to consumption of milk. The meat consumption as a percent of food expenditure was higher while consumption of dairy products was lower in Bangladesh than the average values for South Asia (FAO 2012). Percent of food expenditure allocated to meat and poultry increases from about 6% for the lowest income groups to about 16% for the highest income group, again indicating relatively high income (or expenditure) elasticity of ASF consumption. In 2000, about 8% of food expenditure was due to meat and poultry consumption. Consumption of ASFs is expected to grow with the increase in income of the population. It is interesting that the percent of food expenditure allocated to milk and milk products has actually declined slightly over the years in Bangladesh, from 3.95% in 2000 to 3.02% in 2010. In 2010, per capita calorie consumption per day was 2318 Kcal and meat/poultry and eggs contributed about 34 calories and milk/milk products contributed about 27 calories (representing less than 3% of calorie consumption). Effective prices per calorie from cereals, meat/poultry/eggs and milk were 1.30 Tk., 18.29 Tk. and 6.75 Tk respectively in 2010. Even though calorie from meat is expensive, it provides other nutrients that are important for health and nutrition.

The FAO report mentioned a number of benefits of consuming ASFs. The "ASFs are energy-dense, contain high-quality protein and are good sources of a number of micronutrients. … These characteristics make ASFs important for population groups with limited food intake capacity relative to their needs such as young children, pregnant and lactating women, and people with HIV/AIDS" (pp.12).

More than 50% of households in Bangladesh are involved in the production of animal-source foods. This is a very high level of involvement but further expansion of homestead production of ASF is possible. It should be possible to increase the proportion of households involved with ASF production as well as increase intensity of production per household. The mean herd/flock size in Bangladesh was only 0.9 Tropical Livestock Units (TLU) around 2010 and therefore, opportunities for increasing the scale of operations at the household level exist.

Extra Benefits of Homestead production

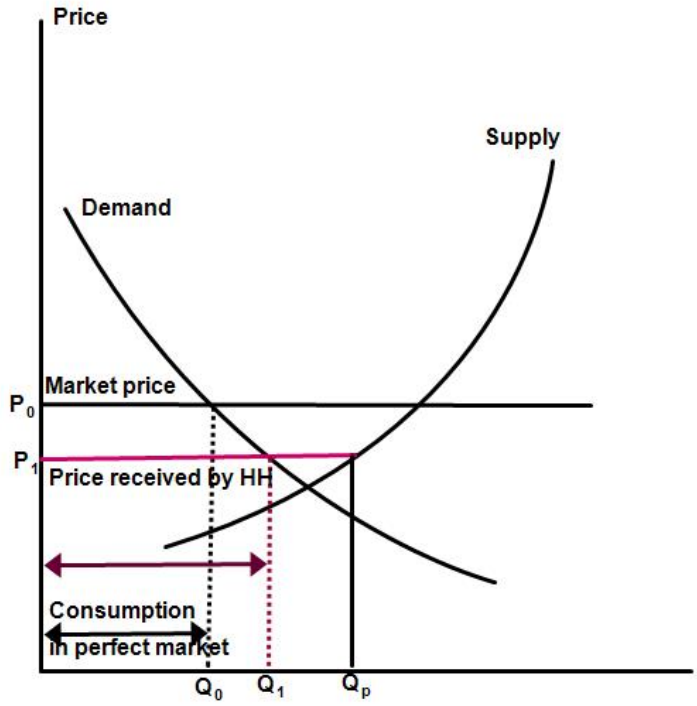
Increase in income of households affects the food and non-food consumption pattern as well as diversity of food consumption (which takes into account consumption of cereals, vegetables, animal sourced food, etc.). Economic growth is likely to increase consumption of animal source food irrespective of homestead production of ASFs. In developing countries of the world, homestead production of ASFs generates a number of significant additional benefits.

Benefits related to cost of production: In developing countries, homestead production of certain items becomes significantly lower than producing the items through market-based specialized production units. The outputs that show significant economies of scope allow efficient production of these outputs in combination rather than producing them separately. Home production activities (e.g., cooking, childcare, maintaining the house) and keeping livestock or poultry in the homestead are examples of productive activities that generate considerable economies of scope. Caring for livestock and poultry can easily be combined with other "home" activities. Home production activities like child care, cooking, repairing and maintaining the residential home and taking care of livestock are fully compatible in the sense that available labor within the household can be used in both these activities without any adverse effects in outputs. In Bangladesh, raising livestock and poultry within the household allows women and other members involved with home activities to use some of their time in taking care of livestock. This implies that the opportunity cost of time used in livestock and poultry production activities should be very low when combined with home production activities. Production of these supplementary activities at home should reduce the cost of production and improve the rate of return from livestock farming.

Lower transportation cost: Since the production happens within the household and more than 50% of households in Bangladesh are involved with livestock or poultry farming, the number of producers in a geographic area is usually quite high. The presence of a large number of producers in an area reduces the marketing cost. Traders buying animal source food items are more likely to procure the items from areas where a significant number of suppliers are present. Another advantage is that distributed production means being closer to potential consumers as well, which again reduces the cost of marketing.

Higher use-value of byproducts: Livestock rearing produces manure, which can be used directly in crop production activities. Homestead production of ASFs will increase the use of manure in agricultural crop production, reducing the need for purchased chemical fertilizers. The use of organic fertilizers also helps in maintaining long-run fertility of land. It also creates significantly lower water pollution.

Use of animals as source of power for agriculture: Homestead production of ASFs may also increase the availability of animal power for use in the traditional crop production system. Although milking cows are rarely used as source of power for crop production, the availability of the animals within the household allows for the use of animal power, if needed.



Increased consumption of ASFs: Home production of livestock and poultry (or any other food) encourages higher level of consumption, given the prices and income. This is because the market prices of food items are almost always higher than the net price received by the producers. Marketing any item requires time and other resources (the products need to be brought to the market and the producer will have to wait for the potential buyers) and the net price received by producers may be significantly lower than the market price. In fact, the smaller the production unit, the higher the price difference between the market price and the net price received. This situation is shown in graph 1 below. Since marketing homestead production involves

some costs, price received by producers is P_1 rather than the market price P_0, the price the households pay to buy the food items. If the household is purchasing the item from the market (given the income), consumption level will be Q_0. However, when the household is a producer of the product, self-consumption will increase to Q_1 and the remaining output Q_1Q_p will be sold in the market. Therefore, homestead production of animal source food is likely to increase the level of consumption of the food items, given the market price and income.

Another reason for increased consumption out of home production is the uncertainty about the quality of milk and milk products available in the market in developing countries. This means that, if the quality of milk available in the market is not considered as good as the quality of homestead production of milk, the demand curve for market procured milk (and other ASFs) will be lower than the demand when uncertainty about quality is not there. The divergence between these two demand curves (demand for market procured and homestead produced ASFs) encourages households to consume homestead produced ASFs. In fact, this divergence tends to reduce the market price of ASFs, unless quality of the products can be assured through some other mechanisms.

Improved wealth status: Livestock represents stock of capital and livestock rearing improves the wealth status of households. In Bangladesh, land is highly scarce and livestock is an important asset for land-poor households. Improved wealth status creates a number of positive effects: increased food consumption at any specific level of income, high level of risk-taking in production, higher level of use of medical care and educational services.

Reducing seasonality of nutrient consumption: Livestock farming reduces the seasonality of food availability in the household. Home production of crops and vegetables are highly seasonal but livestock outputs are not seasonal. Homestead production of ASFs therefore can reduce the seasonality of production, income and food consumption for households.

Insurance against risk of food insecurity and other economic and health shocks: Since livestock is a store of capital, it can be sold when households face severe economic and health shocks. In that sense, the capital stock in livestock can be used as an insurance against a lack of availability of liquid assets.

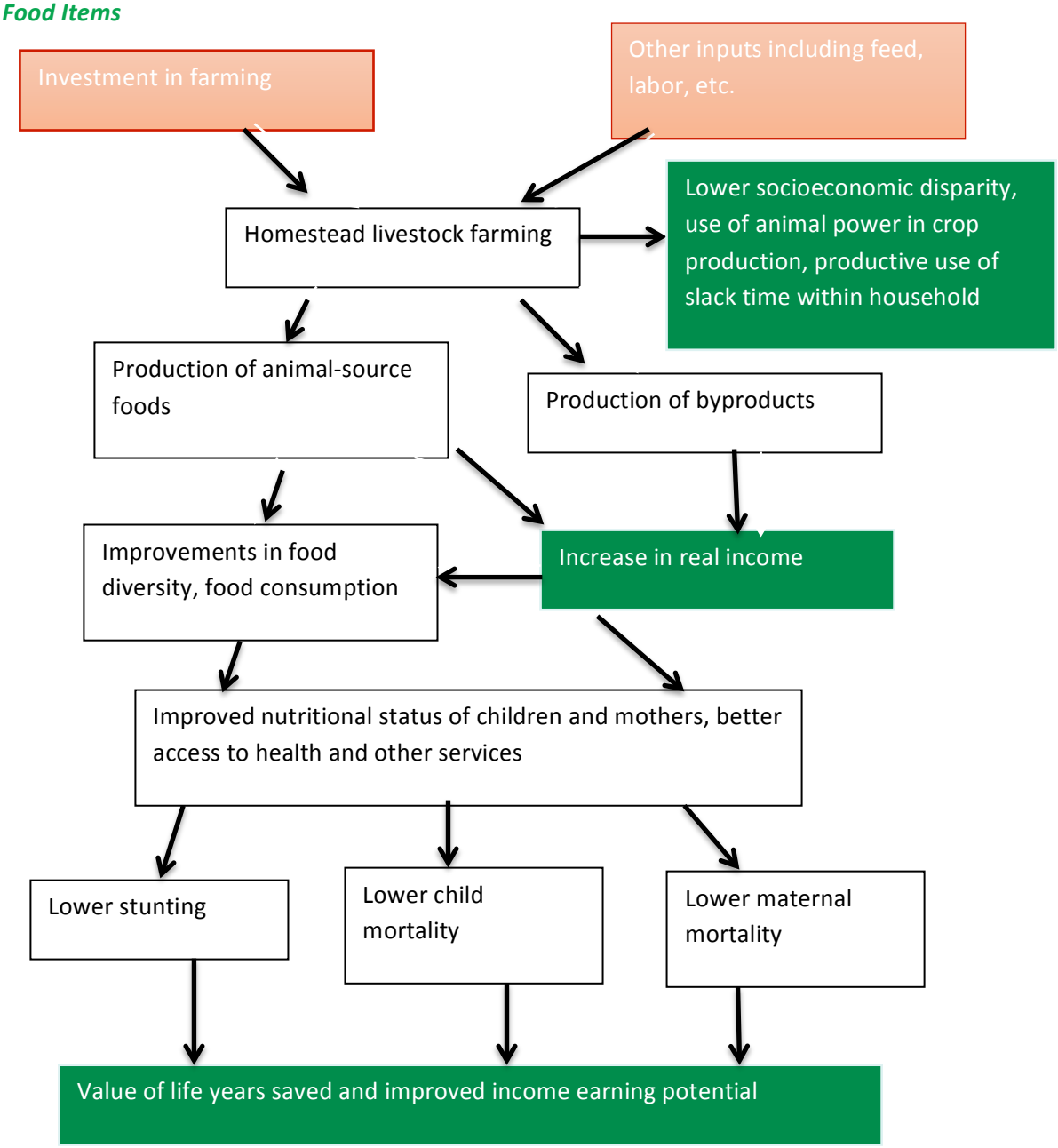
Reduction in income inequality: Encouraging livestock and poultry farming at the household level has the potential for reducing income inequality. Livestock and poultry farming is more attractive to poorer households because of the availability of slack time among individuals involved in home production and lack of agricultural land. Productivity of livestock farming is significantly higher for

very small holders (see the FAO report 2012). Reduced inequality has other social benefits which are difficult to quantify.

Conceptual Framework

The generalized conceptual framework for the benefit-cost calculation of homestead production of animal source food is presented in chart 1. The cost items are shown in red squares and the benefit items are shown by green. Not all the cost and benefit items were estimated either because the items are relatively small, unlikely to affect the final benefit-cost ratio or the items are likely to be zero.

Chart 1: Conceptual Framework for Benefit-Cost Calculation of Homestead Production of Animal Source Food Items



Benefits of homestead production of animal-source food

Value of outputs produced

This analysis is based on the following assumptions: (a) proportion of households keeping livestock to be increased by 10%, (b) average number of animals per farm will be increased by 25%, from about two cow equivalents to 2.5 cow-equivalents.

Out of 1000 households, the number of households with animals is assumed to be 600. Increasing this by 10% will imply 660 households per 1000 will have homestead production of ASFs. The

average holdings per farm will increase from 2.0 cow-equivalents to 2.5, implying that the number of cows per 1000 households will increase from 1200 to (660*2.5) or 1650. In Bangladesh, average milk production per cow is about 938 liters per year (based on various numbers mentioned in different published articles and reports). The estimate of income from livestock rearing at the household level was derived using a study on financial aspects of small-scale livestock rearing in the households (Hafeez and Rahman 2014).

Due to the increased number of cow-equivalents made available by the assumed program, milk production will increase by: 938 liters*(1650-1200) =422,100 liters. The price of milk in the market in 2015: 68/kg Tk. (BBS, Bangladesh Statistical Bulletin 2015) and therefore total value of increased milk produced will be: 28,702,800 Taka in 2015 prices. The value of byproducts in Taka will be: 14,020 Tk. per farm *225 (increase in equivalent farms)= 369,861. Household farms also sell some of their livestock and based on Hafeez and Rahman (2014), the value of animal sales can be derived as follows: Animal sales: 25,750 Tk. per farm*225 *1.11 (price of beef increased from 270 Tk. in 2012 to 300 Tk in 2014-15)= 6,437,500 Tk.

Total value of outputs produced by the home livestock farming = 28,702,800 Tk + 369,861 Tk + 6,437,500 Tk.= 35,510,161 Tk.

Cost per day per animal: 82.05 Tk. (allowing a 5% increase in cost per years over the three years from 2012 to 2015. See the cost of raising livestock section below for the adjustments made to costs)

Total recurrent cost of production per year for 1000 households: 13,477,117 Tk.

Total capital expenses per year for 1000 households: 1,760,400 Tk. (see cost calculations below)

Total cost of livestock rearing for 1000 households: 15,237,517 Tk.

Total income per year per 1000 households: 20,272,644 Tk.

Increase in income per household: 20,273 Tk. or about 4,505 Tk. per capita per year.

Benefits through reduction of stunting among children

A very interesting recent study by J. Hoddinott et al. (2015) found that cow ownership shows a significant impact on milk and milk product consumption by children in Ethiopia. Cow ownership was also found to be associated with an achievement of linear growth in children and a reduction in the stunting rate in the 6-24 month age group, with the effects being quite large. As the authors have indicated, this may be due to market imperfections in the milk market in rural Ethiopia, encouraging households to consume the products produced by them. In fact, if the market is highly imperfect, virtually the only way to get milk and milk products for the household members will be to produce

these items within the household. In this situation, rearing animals will reflect the underlying demand for ASFs. Since the demand for ASFs is likely to be associated with income, the decision to raise animals should be associated with economic status of households as well. In the models estimated, it is not clear whether the cow ownership itself is influenced by economic status of households (and rearing animals also increase income, adding to the complexity). Moreover, the estimated functions with consumption, height and stunting as dependent variables should control for economic status of households and it is not clear if adequate controls for economic status were incorporated in the econometric models (footnote of table 2 does not indicate the inclusion of income or economic status representing variable other than land area cultivated and educational attainment).

In Bangladesh, a number of data sets collected information on animal ownership, food consumption patterns and the nutritional status of children. Targeting the Ultra Poor program of BRAC also collected information on animal ownership, the nutritional status of children and food consumption. This data set is being analyzed now and the results are not available at this point in time. In 2014, Sustainable Agriculture, Food Security and Linkages (SaFaL) project of Bangladesh collected household level data from the project's intervention areas and control areas. The data was collected from 750 households in five districts of Bangladesh (Khulna, Bagerhat, Narail, Jessore and Satkhira), with 500 households from the program area and the remaining 250 households from the comparison area. We have access to some of the variables of this survey including anthropometry of children, wealth scores of households and ownership of animals and/or poultry birds (unit of analysis is children under the age of five years). A simple multivariate logistic model with prevalence of undernutrition (stunting, wasting and underweight) as the dependent variable and animal ownership, age of child and wealth scores as independent variables show little or no effect on child nutritional status.

Dependent variable: Child is stunted (stunted=1)				
	Odds Ratio	Std. Err.	Z	P>z
Wealth scores	0.827933	0.016463	-9.5	0
Household owns animals	1.089321	0.042264	2.21	0.027
Age of child in months	1.022949	0.001129	20.56	0
Constant	0.701113	0.029208	-8.52	0

*Ownership of any type, including small ruminants.

~ Number of observations (children) 12,889. LR χ^2 =539. Gender of child had no statistically significant impact.

The following table shows the results when the ownership of animals is disaggregated into a number of mutually exclusive variables. A variable on ownership of poultry birds was also added in the model.

Dependent variable: Child is stunted (stunted=1)				
	Odds Ratio	Std. Err.	Z	P>z
Wealth scores	0.821726	0.016702	-9.66	0
Age of child in months	1.02293	0.001129	20.54	0
HH owns large animals	1.09198	0.043404	2.21	0.027
HH owns poultry birds	1.073676	0.043885	1.74	0.082
HH owns small animals	0.941786	0.054284	-1.04	0.298
Constant	0.67478	0.032509	-8.16	0

As expected, an incidence of stunting reduces with wealth scores and increases with the age of the child. Ownership of large animals by households (cows, buffalos, etc.) shows small positive effect on stunting incidence among children. It is possible that market for animals and ASFs in Bangladesh is quite different from the market in Ethiopia. However, the result does not necessarily imply that animal rearing had only indirect effects on child nutrition through its impact on income.

A study (Islam and Biswas 2015), using secondary information, examined the prevalence of stunting by income quintiles. The relationship between stunting and income appears to be a straight line for all income groups, with the exception of the highest income quintile. Using the average income of the quintiles from the 2010 Household Income and Expenditure survey and converting the income levels to 2015 price levels, the numbers indicate that the stunting prevalence declines by 0.412 percentage points with 1000 Tk. increase in income (in 2015 prices) per capita. Income increase per capita due to more intensive and extensive production of livestock rearing will be about 4,500 Tk., implying a reduction of stunting by 1.86% points.

A higher consumption of ASFs improved the diversity of diet, which should reduce stunting further and go above and beyond the reduction in stunting due to income effects of animal rearing. Given the income of households, the food variety index tends to improve the nutritional status of children. Darapheak et al. (2013) reported that consumption of animal source food and food diversity reduced the prevalence of stunting in Cambodia. In Bangladesh, after accounting for the income of households, food diversity improvement from low to average reduced stunting by about 7% from the current level, implying a reduction of about 2.3%. Therefore, stunting should reduce by 4.16% due to increased farming of livestock in Bangladesh. According to the 2014 Bangladesh Demographic and Health Survey (MOHFW 2016), 10.3% of population in the country is below the age of five years.

Given the average household size of 4.47, number of children in 1000 households would be about 460. 36% of children in Bangladesh are stunted and the income increase due to homestead production of animal source food and effect of homestead production on food diversity will reduce stunting rate to 31.8% (36% minus 4.2%). Therefore, number stunted per 1000 households will reduce by 19.1.

Following Hoddinot et al. (2013), we assume that these children will start working as adults when they reach 18 years of age and productivity improvements over the working life from age 18 to 60 will reflect the benefit of preventing stunting. The discounted value of years of working life would be 15.85 years at 3% discount rate. Preventing stunting for 19 cases at childhood implies an improved income earning potential of these individuals over 303 years of working life (discounted value). By using the estimate of percentage increase in income or the consumption of individuals who were not stunted as children (Hoddinot 2013) and allowing for a 50% of productivity increase due to more intensive use of capital, the extra earnings amount to 35,410 Tk. per year using the 2015 per capita income as the basis (Tk. 95,864). Therefore total lifetime increase in income earning potential becomes (35,410 Tk.*303 years) or 10,723,135 Tk. per 1000 households.

Benefits due to reduction of under-five mortality rate

The under-five mortality rate declines with improved income. Around the median level of household per capita income, an increase in income by 1000 Tk. reduces under-five mortality by 0.91 per 1000 live births using the Demographic Health Survey estimates of under-five mortality and linking wealth scores with income quintiles. Since the income increase per capita due to increased adoption of homestead rearing of livestock is about 4,500 Tk., under-five mortality will decline by 4.1 per 1000 live births. The child mortality rate in Bangladesh is about 46 per 1000 live births or approximately 9.2 per 1000 under-five children. The number of children per 1000 households (as calculated above) is about 460 and therefore, the increase in income due to homestead production of animal source food is expected to reduce number of under-five deaths from 4.2 deaths to 3.85 deaths, a reduction by 0.38 deaths per 1000 households. Years of life saved = (0.38*31.2 years at 3% discount rate)=11.86 years. Each year of life is valued at Tk. 95,864 and the total value of 11.86 years of life becomes Tk. 1,136,947.

Maternal mortality related benefits

Conceptually, it can be argued that consumption of animal source food will improve the nutritional status of women and will lead to a reduction in maternal mortality. However, the Bangladesh Maternal Mortality and Health Care Survey of 2010 did not find any systematic relationship between the economic status of households and the maternal mortality ratio, even though the consumption

of ASFs increases the income of households. Since ASF production and consumption may not affect maternal mortality significantly, we have considered this potential benefit as zero. It is possible that household level consumption of ASFs does not improve women's consumption. Also, it appears that the principal factors associated with maternal mortality are related to the availability and access to health services rather than the household economic status or the educational status of women.

Cost of Homestead Production of ASFs

Fixed costs associated with livestock production

Livestock rearing in the household requires investments in livestock as well as other related capital items. The average price of a dairy cow in Bangladesh in 2009 was 19,012 Tk. (BBS 2010). We have approximated the price of a cow in 2015 by using the market price of beef since 2009. The price of beef increased from 210 Tk. per kg in 2008-2009 to 300 Tk. in 2014-2015 (BBS, Bangladesh Statistical Bulletin 2015). If the ratio of beef prices for 2015 and 2009 is used, the price of a dairy cow should be 27,160 Tk. in 2015 prices. Assuming a loan of this amount over 10 years at a 7.25% interest rate (long term interest rate in Bangladesh in 2010-15), the annualized cost for a cow becomes 3,912 Tk. As mentioned earlier, the estimates are based on increased livestock production and procurement of 450 cow-equivalents per 1000 households targeted by the program. Therefore, the annualized fixed cost of the program per 1000 household should be (3,912 Tk.* 450) or 1,760,400 Tk.

Other recurrent expenses

The recurrent expenses of livestock farming are taken from the literature on homestead animal rearing in Bangladesh (Hafeez and Rahman 2014). Since the recurrent expenses were issued in 2012, an annual rate of increase in cost by a 5% rate was used to derive the expenses in 2015 prices. A number of adjustments were made in the estimates of costs presented in the paper. First, since the study collected information from urban areas, lower estimates of the costs were used. It is also not clear from the article how the labor costs were evaluated when estimating the cost of dairy cow rearing, although it mentions that both household labor and hired help was used. There are two cost items where household labor should be important: labor cost of rearing livestock (excluding veterinary cost) and labor cost of milking the cows. Since the opportunity cost of household labor is likely to be low (as discussed above), we can assume that the opportunity cost will be 50% of the costs indicated in the paper, at least for poor rural households.

Allowing this adjustment, the labor cost of animal rearing in 2012 prices should be reduced from about 20.86 Taka to 10.43 Taka. This reduces the cost of rearing one animal per day to 70.88 Tk. from 75.52 Tk. Allowing a 5% rate of growth of prices over the period of 2012 to 2015, the estimated

cost of rearing an animal becomes 82.05 Tk. per animal, per day. Converting this cost to per year terms and using the addition of 450 cows per 1000 households, the total recurrent cost of livestock rearing for households becomes about 13,477,117 Tk.

Benefit-cost ratio

From the above calculations, the benefits of animal rearing at the household level per 1000 households can be listed as follows:

1. Increase in revenue from animal farming per 1000 households: 35,510,161 Tk.
2. Increase in income earning potential due to lower stunting: 10,723,135 Tk.
3. Benefits from reduction of child mortality: 1,136,947 Tk.

Total benefit per 1000 households targeted by livestock program: Taka 47,370,243 Tk.

Total cost per 1000 households: Recurrent cost 13,477,117 Tk. plus fixed cost 1,760,400 Tk.= 15,237,517 Tk.

Benefit-cost ratio: 47,370,243 Tk./ 15,237,517 Tk.= 3.11

The benefit-cost ratio turns out to be relatively small, at 3% rate of discount. With higher rate of discount, the ratio will be even smaller.

It should be mentioned that a number of benefits could not be included in the analysis. The food security benefits, benefits associated with employment of women, equity implications of animal raising were not considered here. The inclusion of these additional benefits will alter the BCR but the extent to which the ratio will be affected depends on the value society assigns to these benefits.

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