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## **CONSUMPTION PATTERN OF MILK AND MILK PRODUCTS IN BANGLADESH**

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### **ABSTRACT**

In recent years, production and rural consumption of milk and milk products have decreased while import and urban consumption have increased. This paper shows that population pressure on land, increased draught use of cows and improper government food production policy are responsible for decreased production and rural consumption. Aggregate urban consumption has increased due to larger size of the urban population and faster increase in urban income. Detailed analysis of a sample of 191 households shows that milk products are more income elastic than milk. Moreover, actual consumption pattern of milk is influenced by, in addition to income, religion, age composition of family members, and ability to produce milk at home. It is concluded that government food production policy should be corrected by giving more emphasis on foods of animal origin including milk.

### **I. INTRODUCTION**

Milk is considered an ideal food by the people of Bangladesh. Though reliable and adequate data are not available, there are indications that in recent years production and rural consumption of milk and milk products have decreased while import has substantially increased to meet rapidly increasing urban demand. The main objectives of this paper are (a) to briefly outline the reasons for declining production and rural consumption, (b) to analyze the pattern of consumption and to measure the effect of income on consumption of milk and milk products in a selected urban area. The implications of the results for production and import policy for milk are also indicated.

Production and rural consumption pattern are discussed in section II while urban consumption pattern is discussed in section III. Rural people consume little purchase milk products. On the other hand, urban consumers consume a lot of purchased milk products in addition to home made milk products. However, because of data limitations, purchased milk products have been subjected to detailed analysis only for the urban consumers.

### **II. PRODUCTION AND CONSUMPTION IN RURAL AREAS**

Milk is considered an ideal food by the people of Bangladesh as in the other societies having adult lactose tolerance, a characteristic which is not considered normal for the species mammalian including man. However, pastoral man acquired this

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characteristic because of his long dependence on foods of animal origin and Bangladeshis acquired this characteristic because of their long association with migrants and invaders from pastoral societies of Central and West Asia into India.

In the traditional subsistence production framework of the Indian economy, most farming families would produce milk for their own consumption. Milk was not only liked by a majority of the people, a higher social value was attached to its consumption. This was evident in the fact that when expansion of crop cultivation was constrained by the shortage of draught power, slaughter of cattle was banned and beef eating was made a religious taboo by the Hindus but the cow was given the status of a mother and was exempted from hard work so that milk production did not suffer (Mukherjee 1938, p. 125; Crotty 1989, P. 167). After the spread of Islam in the middle ages this restriction was not applicable to the Muslims yet they also did not use productive milk cows for draught.

The situation has changed in recent times and milk production has significantly decreased. For example, yearly production of milk and milk products decreased from 1010,000 tons in the early 1960s (Ali 1973) to 683,000 tons during 1972-76 (Bangladesh 1977) to 606,000 tons during 1977-80 (Bangladesh 1982). The following are the reasons:

1. Population pressure on land has drastically reduced farm size, common grazing land and the capacity of the vast majority of small farmers and landless to rear milk cows. A survey in 1981 in three villages in Mymensingh revealed that out of a sample of 500 farm households (excluding landless), 72 percent had no milk giving cow at the time of the survey (Table 1).

**Table1:** Average Production and Consumption of Milk in Selected Farms in Mymensingh, 1981.

Extent of milk production/ consumption	Sample	Farms	Average holding, acres	Daily milk output, kg/day	Per caput output, gm/day	Per caput consumption, gm/day
	No	Percent				
No milk output	360	72.2	2.61	—	—	—
Entire output						
Consumed	84	16.8	5.01	0.79	104	104
Part of output sold	21	4.2	2.89	4.17	164	65
Entire output sold	34	6.8	2.20	0.92	162	—
All Farms <sup>a</sup>	500	100.0	3.00	0.37	51a	27a

a. If landless households were taken in the sample, production and consumption would be very much lower.

Source: Jabbar and Green 1983, P.56.

2. Until the partition of India in 1947, farmers in Bengal would not use milk cows for draught; and shortage in draught bullock would be met by import from the adjoining

provinces. After 1947, this natural source of supply has been lost and legal trading of cattle has not been established with India. Though some cattle are smuggled into the country, shortage of draught bullock has continued to grow and since the 1950s, and increasing number of small farmers are using milk cows for draught. About 50 percent of the adult cows are currently used for draught (Bangladesh 1981). Farmers use milk cows for draught to meet their immediate power problem in the production of crops but the long run consequence is to reduce fertility and milk production of these cows (for empirical evidence see, Jabbar and Green 1983).

3. During the last two decades, the main objective of food production policy of the government has been to achieve self-sufficiency in food grains, the main source of calorie. Expansion of seed-fertilizer technology has been adopted as the strategy to achieve this goal. Less emphasis has been given on production of foods of animal origin because demand for such foods being income elastic was expected to grow slowly in a situation of widespread poverty and slow growth in income. Although self-sufficiency in food grain has not yet been achieved, expansion of the seed-fertilizer technology has seriously affected animal feed supply resulting in decreased production of livestock products including milk (Jabbar and Green 1983).

Declining production has led to reduced consumption in the rural areas. Nutrition surveys have shown that between 1962-64 and 1975-76, average consumption of foods of animal origin including milk has decreased by 23.3 percent while consumption of cereals and vegetables has decreased by only 2.5 percent each (DU 1977). The effect of declining production on consumption has been more severe on landless and small holdings. For example, the 1973-74 rural household expenditure survey shows daily per caput milk consumption of 29 gm but two thirds of the sample representing low income earners consumed less than the average (Bangladesh 1977).

The production consumption balance of the previous subsistence economy has been broken by many factors. For example, draught use of cows by small farmers and consequent loss or reduction in milk output means they are sacrificing milk for cereals production and they may not have adequate income to buy back milk. In fact, many small farmers sell their meager amount of milk for cash to buy subsistence needs (Table1). Commercialization is generally considered a vehicle for increased income and level of living of the subsistence farmers but in Bangladesh increased commercialization of commodities like milk represent more of a desperate economic situation than of prosperity. It seems that the vast majority of rural people who once lived on 'milk and rice' (Dudhe Vate) will have to wait until the economy has developed enough to give them adequate income to buy and consume milk again.

### **III. CONSUMPTION IN URBAN AREAS**

Declining production has led to reduced consumption in the rural areas but aggregate consumption in the urban areas has rapidly increased over the years because of the following reasons: (a) the number of urban population has substantially increased, (b) average income in the urban areas has increased at a faster rate than rural income, so the economic demand for milk has increased rapidly, (c) urbanization and economic

upliftment has created an increasing and stable demand for various milk products, e.g. sweets, ghee, butter, yoghurt, (d) there is an increasing tendency among urban women to avoid breast feed their babies and to depend on cow milk, mostly processed baby food.

The increasing urban demand has been met by larger flow of milk from rural to urban areas and by increased import. Previously low social value was attached to selling milk, so few farmers other than some special categories of people would sell milk. The norm of the society has changed, and it has been shown earlier that many small and medium farmers now sell milk for cash to meet other needs. Moreover, a special programme has been launched in the 1960s through the establishment of the Eastern Milk producers' Cooperative (Milk Vita) to promote production and sales of milk by farmers in the country's milk shed area (parts of Dhaka, Tangail, Pabna and Faridpur districts) with a view to meet the needs of milk and milk products in the Dhaka city.

However, supply from domestic sources has failed to keep pace with the rapidly increasing urban demand, so yearly import of milk and milk products has increased from about 2500 tons in 1960-61 to about 7,000 tons in 1968-69 (Ali 1973) to over 30,000 tons in recent years. Most of the import is in the form of full or half cream milk powder and baby food, so the fluid equivalent of the import is much larger, accounting for 25-30 percent of domestic production of fluid milk.

### **Factors Influencing Consumption Pattern**

It may be reasonably assumed that urban demand for milk and milk products will continue to increase rapidly but domestic production is unlikely to improve in the near future, so import has to be increased rapidly. However, projection of production and import requirement is likely to be facilitated by knowledge of present pattern of urban consumption, particularly the effect of income on consumption. Some data in this respect has been generated by a survey conducted during January-April 1984 in Mymensingh town including the Bangladesh Agricultural University Campus. A total of 191 purposively selected families were surveyed. The objective was to take a reasonable number of families from various income levels and professions to permit meaningful analysis rather than try to take a representative sample of the population in the study area. As such, income group specific results are more meaningful than the overall sample averages.

The distribution of the sample families, their average size and monthly income are shown in Table 2. The sample families spent, on average, Taka 39.41 per caput per month on milk and milk products (Table 3). Per caput income of the highest income group was 7.5 times higher compared to the lowest income group but per caput expenditure on milk and milk products of the highest income group was 5.5 times higher. Of the total expenditure, 69.3 percent was on milk, 13.8 percent on sweets, 10.3 percent on ghee and butter oil, 5 percent on yoghurt and 1.4 percent on butter. The proportion of expenditure on milk generally decreased and that on milk products increased at higher income levels.

**Table 2:** Distribution of Sample Families, Their Averages size and Monthly Income

Monthly Family income Tk.	Sample Families		Persons per Family	Monthly Income (Taka)	
	No.	%		Per family	Per caput
Up to 1000	35	18.3	4.94	744	151
1001-1500	34	17.8	5.65	1221	216
1501-2000	23	12.0	5.75	1780	308
2001-2500	32	16.8	5.66	2290	405
2501-3000	29	15.2	6.62	2774	419
3001-3500	14	7.3	5.93	3207	541
3501-4000	11	5.8	5.91	3739	633
4001&above	13	6.8	6.31	5282	837
All	191	100.0	3.76	2192	581

Source: Survey in Mymensingh town, 1984.

**Table3:** Per Caput Monthly Expenditure on Milk and Milk Products, and its Distribution

Monthly household income, Tk.	Per caput monthly Expenditure (Taka)	Distribution of expenditure on individual items				
		Milk <sup>b</sup>	Sweets	Ghee & Butter oil	Yoghurt	Butter
Up to 1000	9.93	78.6	8.6	6.3	6.5	—
1001-1500	20.70	76.4	9.4	6.6	7.2	0.4
1501-2000	38.75	72.6	14.6	9.1	3.7	—
2001-2500	45.23	68.7	15.8	9.4	4.7	1.6
2501-3000	47.73	72.3	10.2	10.1	5.5	1.5
3001-3500	53.12	73.5	9.8	11.7	4.1	0.9
3501-4000	74.11	66.5	17.7	9.4	2.2	4.2
4001+	73.22	54.5	19.5	16.4	7.2	2.5
All	39.41 <sup>a</sup>	69.3	13.8	10.3	5.0	1.5

a. This average would be lower if a proportionate representative sample were taken from each income group (see text).

b. Part of the milk has been processed at home into various milk products. This is not shown, i.e. milk products mentioned in this report are those purchased from the market.

Members of the sample families consumed 3.91/kg milk per caput per month which is equivalent to 130 gm per caput per day. They also consumed 0.23 kg sweets, 0.078 kg ghee and butter oil, 0.121 kg yoghurt and 0.019 kg butter per adult unit per month (Table 4). Inequality between and lower income groups is greater in the consumption of milk products than in the case of milk.

**Table 4:** Average monthly consumption of milk and milk products at various income levels

Monthly family income, Taka	Per caput <sup>a</sup> monthly consumption (kg)				
	Milk	Sweets	Ghee & Butter oil	Yoghurt	Better
Up to 1000	1.15	0.057	0.015	0.064	-
1001-1500	2.41	0.089	0.019	0.092	0.003
1501-2000	3.69	0.274	0.060	0.096	-
2001-2500	4.34	0.322	0.099	0.138	0.020
2501-3000	4.80	0.240	0.125	0.149	0.019
3001-3500	5.73	0.269	0.145	0.136	0.018
3501-4000	6.84	0.595	0.128	0.064	0.086
4001+	6.29	0.616	0.221	0.278	0.053
All	3.91	0.253	0.078	0.121	0.019

a. In case of milk, per member in the family; in case of milk products, per adult unit estimated by assuming two persons below 12 years as equivalent to one adult unit. This has been done because children do not consume milk products to the same extent as they consume milk.

Source: Survey in Mymensingh town, 1984

All the families having average monthly income above Taka 2500 consumed milk but some families in the lower income groups did not consume milk (Table 5). In case of milk products, non-consuming families were found in all income groups but in general, proportion of consuming families increased at higher income levels.

**Table 5:** Proportion of Families Consuming Milk and Milk Products According to Income Group.

Income group, Tk.	Products						
	Milk	Sweets	Yoghurt	Butter	Ghee only	Butter oil only	Gee & butter oil
-- Percent families in each income group consuming--							
Upto1000	83	31	23	—	14	14	—
1001-1500	97	53	38	3	23	12	9
1501-2000	91	78	45	—	26	17	17
2001-2500	97	88	53	22	16	34	13
2501-3000	100	76	52	14	38	28	10
3001-3500	100	93	36	14	29	21	21
3501-4000	100	91	36	55	36	18	27
4001 +	100	92	69	38	43	23	15
All	94	69	42	13	26	21	11

Source: Survey in Mymensingh town, 1984

Mymensingh is one of the cities where the Hindu communities constitute a significant portion of the population and it is well known that they have special preference for milk and milk products. As mentioned earlier, a proportionate

representative sample was not taken, but 35 Hindu families were included in the sample. An analysis of the consumption pattern of Hindu and Muslim families revealed that per caput consumption of milk, butter oil and butter were higher for the Muslim while per caput consumption of Sweets, ghee and yoghurt were higher for the Hindus (Table 6). But at lower income levels the Hindus consumed more milk than the Muslims while at higher income levels the Muslims consumed more sweets and yoghurt than the Hindus.

**Table 6:** Monthly Consumption of Milk and Milk Products According to Income and Religion.

Item/ Reli- gion	Income Groups								
	Up to 1000	1001 - 1500	1501 - 2000	2001- 2500	2501- 3000	3001- 3500	3501- 4000	4001 +	All
<b>--Monthly consumption per caput (kg)--</b>									
<b>Milk</b>									
Hindu	1.17	2.71	4.43	2.63	5.34	5.76	–	6.07	3.37
Muslim	1.18	2.37	3.50	4.89	4.72	5.21	7.36	6.33	4.04
<b>Sweets</b>									
Hindu	0.07	0.17	0.81	0.27	0.38	0.71	–	0.43	0.34
Muslim	0.03	0.07	0.13	0.34	0.21	0.16	0.55	0.66	0.23
<b>Yoghurt</b>									
Hindu	0.08	0.14	0.19	0.17	0.22	–	–	0.24	0.15
Muslim	0.04	0.08	0.08	0.12	0.13	0.15	0.06	0.28	0.11
<b>Butter</b>									
Hindu	–	–	–	–	–	–	–	–	–
Muslim	–	0.001	–	0.01	0.01	0.01	0.04	0.03	0.01
<b>Ghee</b>									
Hindu	0.01	0.02	0.05	0.02	0.09	0.02	–	0.06	0.04
Muslim	–	0.01	–	0.02	0.02	0.051	0.06	0.10	0.03
<b>Butter Oil</b>									



Hindu	0.00	0.02	0.021	0.020	—	0.08	—	—	0.02
Muslim	0.02	0.01	0.06	0.10	0.11	0.010	0.08	0.17	0.07

--None/not applicable.

Source: Survey in Mymensingh town, 1984

There are three other aspects with respect to milk consumption pattern. First, 20.9 percent of the families reported rearing milk cows but 11.5 percent had cows in milk at the time of the survey (table7). At lower income levels, families having cow in-milk sold a portion of their milk output yet they consumed more milk than those not having cow in-milk. At higher income levels, families not having cow in-milk consumed more milk than those having cow in-milk but consumption level of the latter group would be higher if they did not sell a part of their output. Secondly, powder milk and baby food constituted 37.8 percent of the total milk consumed by the sample families (Table8).

**Table 7:** Per caput consumption of milk according to income group and source of milk

Income group, Tk.	% families having cow in-milk	% families having cow in-milk	Per caput monthly Production, kg	Per caput total monthly consumption (kg)	
				Having cow in-milk	Not having cow in-milk
Up to 1000	28.6	11.4	3.24	2.22	1.04
1001-1500	26.5	11.8	9.57	3.49	2.29
1501-2000	21.7	17.4	7.56	6.40	3.23
2001-2500	12.5	—	—	—	4.34
2501-3000	20.7	17.2	6.24	4.24	4.96
3001-3500	14.3	14.3	7.01	4.04	5.58
3501-4000	9.1	—	—	—	7.36
4001 & above	23.1	23.1	6.58	5.79	6.52
All	20.9	11.5	6.67	4.49	3.82

Source: Survey in Mymensingh town, 1984.

Higher income groups generally consumed more powder milk than lower income groups but share of powder milk in total milk consumption did not consistently increase throughout the income range. The share of powder milk was higher for those income groups which included a higher proportion of Hindu families and/or a lower proportion of families having cow in-milk. Eighty percent of fluid milk was purchased and the extent of purchase depended mainly on whether there was cow in-milk at home.

**Table 8:** Monthly Per caput consumption of fluid and Powder Milk According to Income group

Income group, TK.	Fluid milk (kg)	Powder <sup>a</sup> milk (kg)	Total milk (kg)	% of total milk as powder	% of fluid milk purchased	% of all milk purchased
Up to 1000	1.04	0.11	1.15	10.6	79.1	81.0
1001-1500	1.85	0.57	2.42	30.8	81.0	85.6
1501-2000	2.85	0.83	3.68	29.2	64.7	76.2
2001-2500	3.16	1.18	4.34	37.4	100.0	100.0
2501-3000	3.04	1.76	4.80	58.3	70.0	81.2
3001-3500	4.03	1.29	5.32	32.0	83.0	87.2
3501-4000	4.22	3.15	7.37	74.6	100.0	100.0
4001 & above	5.36	0.92	6.28	17.1	64.4	70.9
All	2.83	1.07	3.90	37.8	79.9	85.4

a. Figures in liquid milk equivalent.

Source: Survey in Mymensingh Town, 1984.

Thirdly, 52 percent of the members of the sample families consumed some amount of milk and the proportion of members consuming milk increased with income level. At higher income levels, all the children and a reasonably high proportion of adults consumed milk while at lower income levels few children and adults consumed milk (Table 9). Share of powder milk in total milk consumption, and proportion of babies and children at various income levels consuming milk probably indicate that breast feeding is less practiced at higher income levels. However, it is quite possible that some breast fed babies at higher income levels are given cow milk as supplement while at lower levels breast fed babies may not get such supplement, so reported as not consuming cow milk.

**Table 9:** Proportion of Family Members Consuming Milk According to Income and Age of Members.

Income group, Tk.	Age Group (years)					Per caput consumption (Kg)	Consumption/ consuming member (Kg)
	Under 1	1-4.9	5-9.9	10+	Total		
--% members in each group consuming milk—							
Up to 1000	71	37	30	26	29	1.15	3.92
1001-1500	100	96	71	37	51	2.41	4.65
1501-2000	50	85	63	49	55	3.69	6.80
2001-2500	86	92	68	33	40	4.34	9.02
2501-3001	100	100	83	50	58	4.80	8.30
3001-3500	100	100	89	54	62	5.73	9.33
3501-4000	100	100	100	54	62	6.84	10.85
4001+	na	100	87	68	73	6.29	8.59
All	83	83	68	41	52	3.91	7.50

na- Not applicable.

Source: Survey in Mymensingh town, 1984.

## Income Elasticities for Milk and Milk Products

Various functional forms may be employed to measure income elasticities. Using U.S. consumer panel data, Purcell and Raunika (1967) estimated quantity-income elasticities and found logarithmic form to be more appropriate for commodities exhibiting nearly constant elasticities at different income levels. Using expenditure survey data from rural Bangladesh, Islam (1966) estimated expenditure-income and quantity-income elasticities and found that for most commodities logarithmic form gave better fit when all households including non-consumers were taken while simple linear form gave better fit when only consuming households were taken. Chowdhury (1982) estimated expenditure-income elasticities for various commodities using expenditure survey data employing log-linear function but found low  $R^2$  for milk and milk products.

It has been shown above that in addition to income factors such as religion, age composition of family members; ability to produce milk at home also influenced the pattern of consumption of milk and milk products in the sample families. Therefore, instead of a logarithmic function, quantity-income relationships for milk and milk products have been estimated by least square technique from a linear function of the form:

$$Y = A + BX + U$$

Where, Y is per caput consumption,

X is per caput income,

U is a random variable incorporating all the variables other than income. It may be mentioned that most of these variables cannot be easily quantified in the form suitable for inclusion in a linear function.

Assuming U to have a normal distribution with zero mean and constant variance, the above equation has been estimated as  $y = a + bx$ . Then income elasticity has been derived in the usual manner by the procedure:

$$e = \frac{dy}{dx} \cdot \frac{\bar{x}}{\bar{y}} = b \frac{\bar{x}}{\bar{y}}$$

Where, e is income elasticity for a commodity,

$b$  is the estimated regression coefficient,

$\bar{y}$  is the average quantity consumed by the sample families,

$\bar{x}$  is the average income of the sample consumers.

When elasticity is measured for a particular income group,  $\bar{y}$  and  $\bar{x}$  refer to the averages for that group.

Estimated regressions for milk and milk products are shown in Table 10. Only consuming families were considered for estimation. The high values of  $R^2$  for butter and butter oil indicate that income was the most important factor influencing the level of consumption of the commodities. The lower value of  $R^2$  for the other commodities also appeared to be reasonable because non-income factors were earlier found to influence their level of consumption.

**Table10:** Estimated Regressions Showing Quantity-Income Relationships for Milk and Milk Products.

Commodity	No. of consuming Families	Estimated equations	R <sup>2</sup>
Milk	181	$y=2.4371+.004873 X$ (.000526)	.57
Sweets	132	$y= 0.0754+.000583 X$ (.000062)	.09
Yoghurt	81	$y= 0.1915+.000191 X$ (.000067)	.78
Butter oil	62	$Y= 0.1506+.000611X$ (.000042)	.26
Ghee	71	$y= -0.0253+.000097 X$ (.000020)	.90
Butter	25	$y= -0.108+.000360 X$ (.000024)	.40

Figure in the parentheses are standard errors. All the coefficients are significant at less than 5 percent level.

Estimated income elasticities for different products at various income levels are shown in Table 11. Butter and butter oil appear to be vary highly income elastic while sweets and ghee are also highly income elastic. Elasticity at various income levels appear to be quite variable for all the commodities but the variability has no definite pattern most probably because of influence of non-income factors on consumption levels.

**Table11:** Income Elasticities for Milk and Milk Products by Level of Income.

Income group (Tk.)	Products					
	Milk	Sweets	Butter	Ghee	Butter oil	Yoghurt
Up to 1000	.5144	.5668	n.a	.5976	1.5824	.1630
1001-1500	.3996	.8946	1.0224	.5619	2.3747	.2040
1501-2000	.3454	.5933	n.a.	1.2938	1.1114	.3109
2001-2500	.4223	.7287	1.7211	.5242	1.6769	.3283
1501-3000	.3070	.8458	1.2240	.6046	1.2180	.3149
3001-3500	.4300	1.0315	1.8342	.6581	1.6418	.3164
3501-4000	.4212	.6658	1.4628	.7762	2.4394	.6935
4001& above	.6060	.8245	2.4682	.6116	1.6908	.4456
All	.4328	.7941	1.7059	.6606	1.7676	.3289

n.a = Not applicable.

#### IV. CONCLUSIONS

Milk and milk products are preferred food items for the people of Bangladesh. But in recent years declining domestic production and increasing import have contributed to widen the rural-urban gap in the consumption of these commodities. Production consumption balance of the subsistence economy has been broken. Few farm households can now afford to rear milk cows, many of those having cows use them for draft thus milk production is reduced. Moreover, the meager milk output is sold for cash to buy other necessities. On the other hand, urban income has been growing faster than rural income, so demand for milk and milk products have been rapidly increasing. This demand is being met by increased flow of milk from the rural areas and also by increasing import. A survey of 500 households in three villages in Mymensingh in 1981 revealed that per caput daily consumption of milk averaged 29 gm while a survey of 191 households in Mymensingh town in 1984 revealed that per caput daily consumption of milk averaged 130 gm. The urban households also consumed a large amount of purchased milk products such as sweets, yoghurt, ghee, butter oil and butter.

In addition to income, religion, age composition of family members, ability to produce milk at home influenced the pattern of urban consumption of milk and milk products. Estimated income elasticities show that milk products are more income elastic than fluid milk.

The present food production policy gives inadequate emphasis on milk production in relation to its demand, so import is rapidly increasing. The growing process of urbanization and economic upliftment demands that more emphasis should be given on the production of foods of animal origin including milk.

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## **Consumption Pattern of Milk and Milk Products in Bangladesh- A Comment**

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In a recent article published in this journal Jabbar and Raha (1984) (henceforth JR) attempt to analyze the consumption pattern of milk and milk products in Bangladesh. Their analysis is based on a cross-sectional data of 191 purposively selected households in Mymensingh. Using a linear functional form JR have estimated quantity-income relationships for milk and five mil products and their income elasticities for eight different income groups. They essentially performed a special Engel curve analysis. Although the obvious place to start such an analysis would have been "The Theory of Consumer Behavior" which is quite rich to provide useful directions in any applied consumption analysis, JR have followed a purely empirical approach devoid of any explicit theoretical consideration. The scientific roles of theoretical and empirical work are complimentary in economics as in any other branches of scientific enquiry. But such complementarity can not be realized if applied work lacks theoretical content, especially when there already exists a strong theoretical basis for the research problem at hand. The second concern of this paper is about the adequacy of JR's econometric analysis. The rest of the paper is organized as follows: Section two provides a very brief theoretical discussion of the problem. The implications of linear Engel curves and JR's empirical results are examined in section three. Section four concludes the comment.

### **II. The Theory**

The neoclassical theory of consumer behavior under static conditions postulates that a consumer attempts to maximize his preferences for a set of commodities with given prices, subject to his budget constraint. In symbols,

$$\begin{aligned} \text{Max. } U &= U(X) \\ \text{Subject to, } Y &= P'X \end{aligned}$$

where,  $X$  is vector of  $m$  commodities ( $x_1 x_2 \dots x_n$ );  $P$  is the vector of their prices, and  $Y$  is consumer's disposable income. This constrained optimization yields,

$$x_i = x_i(P, Y) \quad i = 1, 2, \dots, n.$$

which are consumer's demand functions for the set of  $n$  commodities. Now, if the time period is too short for the prices to vary and expenditure on the  $i$ th commodity is used as the dependent variable, we get the following expression:

$$q_i = p_i x_i = \phi_i(Y)$$

where expenditure on the  $i$ th commodity is a function of income only. This relationship is known as Engel curve after Ernst Engel of Germany. Engel curves can be viewed and demand functions with prices held constant. The above formulation is based on the following assumptions:

- i. Consumer's preference function remains unchanged with changes in his income.

- ii. The spending habits of a consumer are independent of the sources of his income.
- iii. The influence of all non-economic variables on expenditure remains unchanged.

To ensure that the estimated Engel curves are theoretically plausible, the researcher has to make sure that the general restrictions of demand theory are satisfied. These restrictions include homogeneity, symmetry, negative own substitution effect, and adding-up condition (Philips, 1983). When prices are constant, all restrictions in terms of price derivatives disappear, and we are left with only the adding-up condition. The adding-up condition says that the sum of the marginal budget shares has to be equal to unity at all income levels.

The original expenditure-income formulation has been expanded to include household size (N) as a second independent variable in the function. In addition to expenditure on a good, its quantity and quality have also been tried as dependent variables (Prais and Houthakker, 1971; Hassan and Lu, 1974).<sup>1</sup>

### **III. Implications of Linear Engel curves**

Since economic theory rarely provides adequate information about any particular nature of relationship among economic variables, the choice of a functional form has been at the centre of many controversies in applied consumption analysis. In fact, the present paper also originates from the author's dissatisfaction with the linear Engel curves in JR's article. Instead of allowing the data to speak for an appropriate functional form, JR has selected a linear functional form for their analysis. They argued that Chowdhury (1982) used log-linear functions and found low  $R^2$  values for milk and milk products, and that cross-tabulations indicated the influence of religion, age composition of family members, ability to produce milk at home etc. on the consumption pattern of milk and milk products. Since JR's data set is completely different the data set used by Chowdhury (1982), the first argument does not help. Secondly, the non-economic variables like religion, age composition of family etc. are supposed to be used to classify the households to ensure desired homogeneity within each group of household (Houthakker, 1957). Besides these ineptitudes, is a linear formulation appropriate for Engel curve analysis?

Linearity of Engel curves implies that consumers' preference function is characterized by a Stone-Geary utility function (Pollak, 1971). And of course, the linear function has the beauty of its simplicity. However, if we examine other economic implications of linear Engel curves, it would become clear that the simplicity of linearity is not without its costs, and the costs are, indeed, more fundamental. As presented in table 10 of JR's paper, some intercepts of the estimated Engel curves are positive while the others are negative. For linear and positively sloped Engel curves, a positive intercept ( $a > 0$ ) implies that:

- (i) The average budget shares decrease when income increased; and,
- (ii) The income elasticities are smaller than one, and approach to one as income increases.



With a negative intercept ( $a < 0$ ), however, the average budget shares increase when income increases; the income elasticity is greater than one and it decreases and approaches to unity as income increases<sup>2</sup>.

Are the above implications of linearity satisfactory from an economic point of view? We have seen that luxury goods ( $a < 0$ ) have an income elasticity greater than one that declines with increases in income while the reverse is true when  $a > 0$ . This is contrary to economic intuition. A 'Luxury good' is defined as one with an income elasticity of demand greater than one, and as income rises the demand for such goods increases proportionately more. So by definition, if income elasticity is greater than one it can not decline as income increases.

The above discussion makes it clear that linear Engel curves can not be justified on economic grounds.<sup>3</sup> If the results of their econometric analysis are to make economic sense, JR will have to re-estimate their income elasticities after selecting an appropriate functional form.<sup>4</sup> Given the prices of milk and milk products and the extent of income disparities in Bangladesh, having milk and milk products are indeed luxuries for low income households. For people at higher income brackets milk and milk products are essential components of their daily food. In view of these facts, a Semi-log functional form appears to be a viable alternative. Only this functional form makes it possible for a good to appear as a luxury at low income levels and a necessity at higher income levels. It also exhibits the desirable property that income elasticity declines as income increases.

#### Note:

1. For the purpose of economic analysis expenditure-income formulation is more relevant than quantity-income formulation, because it focuses on demand from the view point of 'purchasing power' and provides information about consumer's propensity to consume.

2. A mathematical proof of these implications is given below:

Let the expenditure-income relationship for the its commodity be:

$$q_i = a + bY$$

Where  $q$  is the expenditure on its commodity, and  $Y$  is consumer's disposable income.

The average budget share is given by:

$$q/Y = a/Y + b$$

$$\frac{d(q/Y)}{dY} = \frac{-a}{Y^2} < 0, \text{ if } a > 0$$

$$\frac{d(q/Y)}{dY} = \frac{b}{Y^2} > 0, \text{ if } a < 0$$

The income elasticity is given by:

$$e_{iy} = \frac{dq_i}{dy} \cdot \frac{Y}{q_i} = b \cdot \frac{Y}{q_i}$$

After a little algebra we can write:

$$e_{iy} = \frac{Y}{a/b + Y} \quad ; \text{ if } a = 0, \rightarrow e_{iy} = 1.$$

$$\text{if } a > 0, \rightarrow e_{iy} < 1, \text{ and approaches to 1 as } Y \text{ increases.}$$

Similarly, if  $a < 0 \rightarrow e_{iy} > 1$ , and income elasticity declines and approaches to 1 as  $Y$  gets larger and larger. If the expenditure-income relationship be represented by a Semi-log function of the following type:

$$q_i = a + b \ln Y$$

Taking total differential of this function, we get:

$$dq_i = b \frac{1}{Y} dY$$

So,  $e_{iy} = b/q_i \dots\dots\dots (1)$

Now, how does income elasticity change due to changes in income? To see this, we partially differentiate (1) with respect to income. That is,

$$D(e_{iy})/dY = - \frac{1/y}{(a/b + 1ny)^2} < 0$$

So in this case income elasticity declines as income increases.

3. This is also true for quantity/quality dependent Engel curves.
4. Historically, it is interesting to note that despite its simplicity Engel did not use a linear functional form, but used a log-log function in his pioneering work. Since Allen and Bowley (1935), no applied economist has used linear Engel curves.

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**CONSUMPTION PATTERN OF MILK AND MILK PRODUCTS IN  
BANGLADESH-A REPLY**

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We very much appreciate Sarker's belated comments on our article. His main objections to our article are two fold:

- (i) We have followed a purely empirical approach devoid of any explicit theoretical consideration,
- (ii) We have used a linear consumption function which was untenable on theoretical and economic grounds.

We would like to posit that the deficiency of our paper lies neither in following an empirical approach nor in measuring quantity-income relationship using a linear consumption function but in an inadequate explanation of our reasons for doing so. Sarker's entire criticism is focused on the measurement of income elasticity which has occupied a marginal place in our paper. In fact, we started our analysis by trying to fit a consumption function (an Engel curve) but the scatter plot of our data clearly indicated that quantity-income relationships were not at all smooth. This means that non-income variables had substantial influence on quantities consumed-a condition which is contrary to the basic assumption of an Engel curve. We then dug deep into our data and identified several non-income variables influencing consumption. By presenting these findings in a detailed manner in an empirical fashion we tried to draw the attention of those who start from standard theory, play around models to find the one that fits their data best and then go on interpreting their results on theoretical-rational basis but rarely dig their data to discern realities of the economies like Bangladesh. However, we did not made this intention clear anywhere in the paper.

It may be mentioned in this connection that nearly smooth Engled curves are sometimes obtained from aggregated and grouped data based on national sample surveys. In our sample we also found the degree of scatterness to decrease slightly when the data were aggregated into groups but we did not use aggregate data to measure elasticity because there would be too few observations to permit reliable estimate and the influences of non-income variables would remain hidden.

An important characteristic of the sample is that most of the households consumed milk but very few households consumed different milk products. When we plotted the quantity income relationships for only the consumers, the distributions in the case of butter and butter oil showed a linear tendency but the functional forms for other products still remained unclear obviously because of the influences of the non-income factors. This background and Nurul Islam's earlier finding that linear form gave better fit when only consumers were considered, led us to use a linear consumption function. We did not consider a semi-log function (as suggested by Sarker) more suitable given the characteristics of our data. The  $R^2$ s of the estimated functions show that the linear form is suitable for some functions but may not be so for others.

The intercepts of the functions for milk and sweets were positive while the intercepts of the functions for yoghurt, butter oil, butter and ghee were negative. We did not at all

explain the rationality of these results and Sarker is right in raising questions about their validity on theoretical grounds. But let us now use Sarker's suggested principles to see whether these results at all make any sense. Sarker suggested that for linear and positively sloped Engel curves, positive intercept implies that the income elasticities are smaller than one, and approaches to one as income increases. The functions for milk and sweets showed positive intercept and income elasticities less than one but the elasticities did not monotonically approach unity as income increased (because of the influence of non-income factors at various levels of income).

He suggested that with a negative intercept from a linear and positively sloped Engel curve, the income elasticity is greater than one and it decreases and approaches to unity as income increase. The functions for Yoghurt, butter oil, butter and ghee showed negative intercept, the elasticities for butter and butter oil were greater than one and those for yoghurt and ghee were less than one, but in no case did they monotonically approach unity. The reasons for these discrepancies should be sought in the basic characteristics of our data which, as we have emphasized earlier, did not conform to the usual characteristics of the Engel curve.