

Economic Value of Breast-feeding in India

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This article reviews the macro-economics of infant feeding and attempts to calculate the economic value of lactation in Indian mothers.

THE importance of mother milk to the health and nutrition of infants is universally recognised [1]. Breast-feeding is associated with reduction in infectious diseases, improved survival, better nutrition, reduced development of allergic illness, improved psycho-social bonding and overall better health in the infant and young child. The lactating mother enjoys immediate benefit from reduced bleeding in the post-partum period [2], a long-term reduction of cancer risk of both breast and ovary [3, 4], and the psychological benefit attendant with successful lactation. It is now recognised that ~~exclusive~~ reduced fecundity than use of all modern methods of family planning [5]. For the individual woman, exclusive breast-feeding can provide six months or more of effective contraception, provided menses do not return before this time [6]. In lactating populations, the lowered fecundity extends for the average woman beyond a year reaching 18 months or more in Bangladesh, Indonesia and other rural populations [7]. All of these effects of lactation on health, nutrition and fertility are reason alone for individual mothers to choose breast-feeding for their child as well as for communities and societies to advocate exclusive breast-feeding for the first four to six months of life and continuation well into the second year as a desirable social norm.

In addition to these benefits, mother milk makes a substantial contribution to the economy of most developing countries. Conventional approaches to measuring national income and GNP take little account of the informal sector and especially the non-market economy. As breast milk is neither traded nor priced, its economic value is lost to economists and planners. In this paper, we calculate the milk production capacity and estimates of actual lactation by Indian mothers. We calculate the quantity and cost of animal milk which would be required if this lactation were reduced or altogether terminated. The value of animal milk or of processed infant formula is compared to various other products in the national economy, as well as to government outlays in the public sector. Additionally, we estimate the number of animals, pasturage, and other related costs associated with a switch from mother milk to animal milk for feeding Indian infants. We review the micro-economics of infant feeding as viewed from the perspective of the family, indicating the cost of artificial feeding and the full savings afforded to the individual family by a mother who breast-feeds.

Considering the substantial protection which breast-feeding provides from diarrhoea, we have calculated the estimated reduction in diarrhoeal episodes afforded by mother milk, and the cost of treating these episodes if other feeding methods were to prevail. In addition, we have calculated the economic value of the fertility reduction afforded by breast-feeding under current patterns in India.

These calculations offer a conservative estimate of the value of human milk to the Indian economy, and demonstrate dramatically in terms that can be understood by economists, planners, and other non-health professionals the important national resource which mother milk represents.

CALCULATIONS AND RESULTS

Breast milk production capacity is the estimated volume of breast milk which could be produced if all women lactated fully. Table 1 shows estimated daily volume of breast milk by age of the child from different parts of the world [8, 9]. Taking a conservative lower daily production estimate it is assumed that an Indian mother would produce about 600 ml per day during the first six months, 500 ml per day during seven to 12 months and about 400 ml per day during 13 to 24 months. Thus, over two years, production would be 346 litres per child.

Various calculations relating to annual production capacity by Indian mothers is shown in Table 2. From the production capacity by age of the child and the surviving number of children in each age group is calculated the total theoretical production capacity, roughly 8,000 million litres per year. This capacity is diminished by the small per cent of women who could not lactate, estimated in the next line, which would give an annual potential production of 6,800 litres. However, not all women who can, do lactate, and the production is further diminished by the percentage of women who actually do not breast-feed their child. Table 3 shows data from various studies in India used to estimate the percentage of infants receiving breast milk by age and rural or urban residence [10, 11, 12, 13]. The consolidated estimates of per cent lactation from Table 2 provide the basis for calculation of the 'annual realistic production' by Indian mothers. Calculated separately for rural (70 per cent of population) and urban (30 per cent of population), the total annual realistic production is 4,411 million litres. Even this production is further reduced by the simultaneous use of supplementary milk

formula or top feeds. Based on various studies [10, 12], it is found that 50 per cent of children are given additional bottle feeds during the first six months and nearly 70 per cent or more from that age onward. This is assumed to result in a loss of breast milk production as a result of decreased breast stimulation. As frequent suckling usually continues, even in these cases, we assume a reduction in breast milk production (for mothers who give milk supplements) of 25 per cent in the first six months, 50 per cent in the second-half of infancy and 75 per cent in the second year. In the absence of experimental data these estimated losses are more an educated guess by experienced observers, and could be readily modified by the curious reader. Breast milk production loss associated with unnecessary top feeds is thus estimated at nearly 1,100 million litres. Thus, we estimate the grand total of breast milk produced annually in India at 3,316 million litres per year. This contrasts to a potential production of more than twice that amount.

This magnitude of mother milk production can be appreciated by comparison with the entire national production of milk from India's extensive dairy industry. Total milk production for 1992 is estimated at 57,000 million litres of which 46 per cent is available as liquid animal milk, 26,220 million litres [14]. Thus, mothers are providing a quantity of milk some 12.6 per cent of total national milk production. Valued at the cost of fresh animal milk Rs 9 per litre, mother milk would have a market value of Rs 2,984.4 crore. Were it replaced by tinned powder milk at a cost of Rs 18 per litre, the value doubles to Rs 5,968.4 crore. Were the milk to be imported to replace mother milk, this should require over US \$ 2,300 million in foreign exchange.

No doubt, human milk does not come without cost. However, the efficiency of conversion of common foods to human milk is extremely high (Table 4). This simple calculation shows the market price for food required for a mother to produce 1 litre of milk is Rs 33. Thus, the food cost of mothers producing 3,300 million litres annually is some Rs 1,090 crore. Were Indian women to cease using top milk for infants

TABLE 1: BREAST MILK PRODUCTION BY AGE

	(ml)		
Age in Months	1-6	7-12	13-24
Western countries	500	400	300
Asian countries	730	600	450

produce their realistic potential of 4,400 million litres, the production cost of Rs 1,452 crore would be reduced from the equivalent value of powdered milk, Rs 7,920 crore, for a net value of human milk production of Rs 6,500 crore each year.

Table 5 places the value of human milk, priced at the cost of powdered milk, in the overall context of the national economy. This, comparable to major central plan outlays in various development sectors, exceeds the value of important food exports such as tea or coffee by a factor of five or more and is roughly equivalent to the import of petroleum products in a single fiscal year. Mother milk production each year has an economic value similar to the combined health and family welfare sector outlays throughout the five years of the Seventh Plan. Imported milk and cream products could increase over 100-fold were Indian mothers to insist on imported formulae to replace their breast milk, a cost exceeding an imported petroleum and oil [15, 16].

The tremendous economic value of mother milk to the nation is reflected in calculations at the household level as well. Viewed from the perspective of the individual family, the costs of bottle-feeding are substantial (Table 6). Some Rs 450 is required to feed a healthy infant each month without calculating the time costs of preparing infant formula. This is equivalent to 50 per cent of the minimum wage for an urban worker and 25 per cent of the income of a class IV employee, one-third of the salary of a private company steno and 10 per cent of the salary of a class II officer. Thus, the substantial cost of artificially feeding an infant must be considered carefully while calculating the household economy of women in the work force. Those who opt for the difficult and undesirable method of bottle-feeding in order to seek work outside the home, may be gaining small fiscal benefit at considerable health and nutritional risk to the infant.

It is not economic costs alone but also substantial environmental pressures which

TABLE 3: PERCENTAGE OF INFANTS RECEIVING BREAST MILK AS PER DIFFERENT INDIAN STUDIES

Months		0-6	7-12	13-18	>18
Gupta et al (per cent)	(R+U)	81	73		
Walia et al	U	77	49		
Gopalan	U	91	77		
	R	90	90		
WHO	U	72	37.3	17.3	7
	R	98.3	71.3	23.3	6
Consolidated Estimate	R	89	78		15
	U	80	67		13

R = rural, U = urban

TABLE 4: COST OF INPUTS TO MAKE ONE LITRE OF HUMAN MILK

	Wt gms	Calories	Proteins	Market price Cost (Rs)
Rice	185	665	14	2.9
Soya	18	77	8	0.4
Efficiency of conversion		0.9	0.55	
One litre human milk		660	12 gms	3.3

TABLE 5: NET VALUE OF HUMAN MILK

	(Rs in crore)
Net Value of Human Milk if Priced at Powdered Milk	6,500
<i>Central Plan Outlays</i>	
Agriculture and allied activities 1992-93	1,879
Rural development 1992-93	2,610
Communications 1992-93	4,890
Railways 1992-93	5,700
Power generation, 1992-93	6,411
7th plan health sector outlay (5 years)	3,392
7th plan family welfare outlay (5 years)	3,256
Family welfare 1992-93	1,099
<i>Exports</i>	
Tea (89-90)	904
Coffee (89-90)	342
<i>Imports</i>	
Petroleum products (89-90)	6,274
Milk and cream products (89-90)	56
Foreign currency reserves 1990-91	4,388

Sources: Planning Commission and Customs at Glance 1990 [15], *Economic Survey 1990-1991* [16]

TABLE 2: DATA ON BREAST MILK PRODUCED

	Age of Child			Total
	0-6	7-12	13-24	
Production capacity per child (litres)	109	91	146	346 litres/child
Surviving children (million)	25	23.5	22	
Total production (million litres)	2725	2138	3212	8075-Annual theoretical capacity
Potential lactation (per cent lactating)	95	85	75	
Potential production (million litres)	2588	1818	2409	6800-Annual potential
Realistic lactation (per cent actually BF)				
	rural	89	78	15
	urban	80	67	13
Realistic production (million litres)				
	rural	1597	1168	337
	urban	654	430	125
Estimated milk loss due to (top feed) (per cent)				
		25	50	75
Percent breast-fed using to feed		50	70	70
Milk loss (million litres)				
	rural	208	409	177
	urban	85	150	66

Total breast milk produced in India annually is 3316 million litres.

result were no other milk not available. Today to produce the roughly 1,000 million litres of milk which are lost due to supplementary top feeds, roughly 15 lakh animals are required. (Taking the average two litres per day per animal yield of national estimates.) Were high-yielding animals available producing 10 kg per day still three lakh animals would be required who would need some 75,000 acres of land for adequate grazing. Daily maintenance costs and grazing fee could exceed Rs 500 crore [14].

Even today, with wide use of bottle feeds in addition to breast milk, the fuel required to boil water to feed 10 million babies on infant formula is tremendous. At 73 kg of wood required annually to prepare the feed for one baby [17] costing Rs 110, over 100 crore worth of firewood is consumed each year. This levelling huge forests. Bottles and nipples require a further investment of year of life with no added morbidity in older ages. Thus, the added cost in health care for diarrhoea associated with bottle-feeding may reach upward from this estimate of nearly Rs 200 crore to something exceeding Rs 1,000 crore per year or even more. Breast-feeding avoids this needless expense.

Breast-feeding is known to cause reduced fecundity for many months. While it may not be a reliable means of contraception beyond six months of exclusive lactation, reduced fecundity is seen in populations for periods ranging upwards of 12 months where lactation is extensive and widely practised [20]. Studies have calculated that breast-feeding contributes more to the length of post-partum, sub-fecundity than all methods of family planning combined. In one recent study it was estimated that breast-feeding is responsible for reducing the potential fertility by 30 per cent throughout Asia [7]. If the current duration of breast-feeding fell by one-half, it was estimated that total fertility could increase by 17 to 37 per cent in different countries of the region [7]. In India, the median duration of lactation is about 10 months with an average lactational amenorrhoea of eight months [12]. Thus, lactational

TABLE 6: COST PER MONTH

Material	Cost in Rs
Feeding bottles (2 per month)	: 40
Nipples (4 per month)	: 4
Fuel (6-7 kgs)	: 10
Milk 22 litres	: 396
Total	450

TABLE 7: USE OF FAMILY PLANNING METHODS IN 1990 IN INDIA

Method	Estimated Users (millions)	Effectiveness	Couple Years Protection (CYP)
Lactation Amenorrhoea (LAM)	25		
Condom	15	0.66	16.5
Oral pills	3.1	0.7	10.3
Intra uterine devices	5.3	0.9	2.8
Sterilisations (annual)	4.1	0.86	4.5
		0.98	4.0

amenorrhoea provide some 16.5 million couple protection years. The family planning effort. This makes lactation amenorrhoea the top contraceptive in the country exceeding IUDs and sterilisation, each by a factor of four (Table 7). The cost of the family planning programme is some Rs 650 crore per year and the cost per couple year of protection is estimated at Rs 300. Thus, the value to the family planning programme of 16.5 million couple protection years from lactational amenorrhoea amounts to Rs 495 crore, nearly half of the family welfare budget.

There are numerous other benefits which could be monetised. Better growth, avoidance of other illnesses in the infant and mother, psychologic bonding with later development and behavioural benefits are all of immense value, but difficult to calculate in fiscal terms. But the value of mother's milk to the economy is obvious from the cost of replacing it with cow milk, from the Rs 276 crore (assuming one bottle and two nipples used per month costing Rs 20 and Rs 1.50 respectively). More than 360 million tin packs of 500 gms each are required and would be discarded as waste into the environment each year. Obviously, the cost today in fuel, environment, needless investment in feeding-bottles and unnecessary pollution are further reasons to support full breast-feeding by Indian mothers.

Breast-feeding contributes extensively to improved health of the young child. The incidence of diarrhoea may be from three to 14 times higher in bottle-fed versus breast-fed children [18]. Here we calculate the costs involved in treating only one additional episode of diarrhoea for each child, a most conservative estimate by any measure. While breast-feeding also reduces the incidence of ARI, malnutrition, cancer risks in the mother and has many more health advantages, these will not be calculated but are of substantial economic as well as health benefit.

Each child in India suffers an estimated 1.6 episodes of diarrhoea per year, each episode costing an average of Rs 30 for treatment sought at the village level [19]. If the child requires hospitalisation an estimate of Rs 400 per day is reasonable. While most studies show an increase of diarrhoea incidence by a factor of three to 10 or more, let us calculate the cost of adding even one episode per year to each infant, a total of 25 million additional episodes of diarrhoea. National studies have shown that more than 65 per cent of families seek treatment outside of the home for an average episode of

diarrhoea. At Rs 30 per episode some Rs 48 crore would be expended for their treatment. If 10 per cent are hospitalised for two days, i.e. 1.6 million infants, the cost of treatment is a further Rs 128 crore. The savings from reduction of one episode of diarrhoea in each infant alone exceeds the annual health allocation in the last Five-Year Plan for all programmes in child health of about Rs 144 crore. But this estimate is made only on the basis of assuming one extra episode per infant in the first environmental pressures that would result, and from the increased costs of health services and fertility control which would be required in the absence of widespread lactation in India.

DISCUSSIONS

The calculations of milk production capacity of Indian mothers in this article have been based on data from numerous studies, surveys and research projects. We have endeavoured to use the most conservative figures by which calculation, the potential production of breast milk by Indian mothers through 24 months of lactation is about 350 litres. This represents the average capacity of each mother were she to follow optimal feeding patterns including exclusive breast-feeding for the first six months, timely introduction of food supplements and continuation of regular breast-feeding until the child reached 24 months of age. Recognising that some mothers would be unwilling or unable to breast-feed, these estimates have been suitably reduced (Table 2), showing the total potential production of breast milk per year of some 6,800 million litres. This potential production level is, however, not even today being reached, as a result of lower levels of breast-feeding in both urban and rural populations. Recent studies have been reviewed from which the average current level of lactation by age of infant is shown in Table 3. Using this data, we calculate that were all Indian mothers to follow rural patterns of lactation, the total production would be some 4,575 million litres per year. Were all mothers in India to follow the urban pattern, this would be reduced to 4,030 million litres per year. Overall current production is estimated much less than either of these figures due to the already widespread current use of top milk by Indian mothers. Estimates on Table 2 indicate that more than 1,000 million litres of top milk are presently being used, much of it from animal milk, the rest processed powder milk. The value of this powder milk alone is Rs 1,800 crore, an expenditure which would be unnecessary, if mothers fully breast-fed to their capacity. Thus, current production of breast milk by Indian mothers is conservatively estimated at about 3,300 million litres. This is less than half of the potential if full breast-feeding were maintained.

The value of this milk expressed in terms of fresh animal milk (approximately Rs 3,000 crore) or in terms of powder milk (approximately Rs 6,000 crore) is tremendous. It can

be seen that under present practices, the value of nearly Rs 2,000 crore is being lost as a result of sub-optimal breast-feeding and use of top feeds.

The extensive contribution of mother milk to the entire national milk production is unrecognised. Women have a potential of contributing fully 26 per cent of the current liquid milk available in India. This falls to nearly 13 per cent when one projects the likely milk production presently by mothers as a result of sub-optimal feeding and the use of top milk. Considering that estimated milk requirements by the year 2000 is 73,000 million litres [14] the contribution of mother milk to this major production challenge is substantial.

The cost of human milk production should, of course, be considered. In Table 4, we calculate the raw materials in the diet and efficiency of conversion to make a litre of mother milk. Assuming these inputs to cost some Rs 3.3, the cost of production of 4,400 million litres, is Rs 1,452 crore. So the net value of human milk presently being produced is about Rs 6,500 crore. This is valuing human milk at the price of powder milk in the market, even though there is no question that human milk has many more advantages, is more nutritious and provides immune protection for the child.

Table 5 provides an interesting comparison of the economic value of milk with other services and products in the Indian economy. We see in the table that the annual value of milk production is comparable or indeed exceeds many of the central plan outlays in major sectors of the economy. It is roughly equivalent to the combined health and family welfare sectors of the Seventh Five-Year Plan. Its economic value would appear to be similar to that of petroleum imports and roughly equivalent to the total national foreign currency reserves 1990-91.

The decline in breast-feeding, often seen with urbanisation and already underway in this country, must be made good with increased production of animal milk. We have shown that with average national yields, the requirement for animals in terms of capital, land and processing cost of animal milk that would be required to replace 1,000 million litres mother milk in the national economy are: 75,000 acres of land, Rs 300 crore of capital and another Rs 500 crore in simple recurring cost.

In the economy of a single family, the individual costs for feeding-bottles, nipples, fuel and milk, consume roughly 50 per cent of the minimum wage of an urban worker. This ignores the cost to the family of increased illness and, in many cases, nutritional deterioration. The cost of not breast-feeding is a substantial burden on all but the wealthiest families.

But breast-feeding offers more than the economic value of the milk that is produced. Breast-feeding improves health and is shown to reduce diarrhoea rates anywhere from three to 14 times by comparison with bottle-fed babies. We have made calculations of the

extra money that would be required to treat diarrhoea, not even considering the worse outcome and increased number of deaths that would be associated if mother milk is all replaced by bottle-feeding. Not only the Rs 176 crore of additional public expenditure on treating these cases but the obvious increase in morbidity, malnutrition and eventual death show the dramatic value of breast milk to the health system.

Finally it is been pointed out by many observers that throughout much of world, fertility reduction associated with lactation contributes more to reduced fecundity than all the modern contraceptives put together. Calculations in Table 7 show the importance of lactational amenorrhoea to overall couple protection in India. Again the effectiveness of breast-feeding in providing nearly 17 million couple protection years is comparable to the entire investment in family planning methods in India in 1990. The cost of this protection at current rates would be nearly Rs 500 crore.

Replacing breast milk with any other feeding method for infants and young children results in high costs to the individual families, to the society, and to the overall economy. Replacement feeding methods place stress on the environment, contribute to environmental pollution, and directly exacerbate population pressures through increased fecundity in the young child-bearing population. A move away from mother's milk entails extensive health costs, even for those who do survive. This national resource is currently severely threatened by trends in modernisation and urbanisation towards bottle-feeding. These are not only physiologically undesirable and place our youngest citizens at high risk of illness and death but they cost the economy substantially. All efforts to preserve, promote and encourage breast-feeding should be taken and every measure necessary to reduce the regrettable trend towards bottle-feeding in our country is in order [21]. Appropriate legislation should be enacted immediately to protect the public from the onslaught of commercial interests attempting to replace mother milk with expensive, less nutritious, and more dangerous substitutes. Mother milk is indeed a major national resource of India.

[The opinions expressed in this article are those of the authors and do not necessarily reflect policies or programmes of their employing organisations. We wish to acknowledge the secretarial help rendered by Uma Shankar and Dorothy Rodrigues.]

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