

WORKING PAPER NO: 472

**RISING MILK PRICE – A CAUSE FOR CONCERN ON FOOD
SECURITY**

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Year of Publication-October 2014

Rising Milk Price – A Cause for Concern on Food Security

Abstract

Continuous rise in food prices has been posing a serious policy challenge in India. Milk is a major contributor to the food price rise due to its high growth in demand in the domestic and international markets with domestic supply not keeping pace. Mere market price signal is inadequate for the milk production system to respond. This is due to supply constraints including increasing cost of production. This situation is expected to continue with lower growth in milk producing adult female animal population. Therefore, policy measures need to be relooked at to study and strengthen the entire production ecosystem in terms of technology, access to information, credit availability, improvement in risk cover mechanisms and access to markets to enhance profitability and reduce risk, to incentivise dairy animal rearing and milk production.

Keywords: Milk Price, Milk Production, Food Security, Buffer Stock, Policy Ecosystem

In the recent years, high and persistent food inflation has been a matter of concern and focus of policy discussions, in India. While it undermines the purchasing power of every citizen, the poor are particularly affected as they have limited means to hedge against inflation inflicting a 'hidden tax'ⁱ on them and aggravating their nutritional deficiency status (Deaton and Dreze 2009). The price of milk, an important item contributing to this food inflation, has been steadily rising in the domestic market. Even in the last one year from May 2013 to May 2014, the consumer price of milk has risen by 14.5%ⁱⁱ.

The pressure on the food articles price indices is said to have mostly come from milk, meat products, fruits and vegetables during the period 2005-06 through 2012-13. Policy measures related to fiscal deficit and monetary expansion, domestic supply variable such as rising farm wages and global food inflation explain 98% of the variation in food inflation in India (Gulati and Saini 2013). Demand shocks have also been attributed to the present food inflation by a few studies (Landes 2007) (Gokarn 2010a). Economic policy changes can also cause a shift in demand for farm products and affect their prices significantly (Thompson 1988). Bhattacharya and Rao et. al (2014) attributed the present rise in milk price to an increased demand in domestic market with no commensurate increase in supply indicating a structural problem and aver that post-2009, the price rise of animal proteins, including milk is the major driver of food inflation in India.

Based on earlier studies on the rise in India's food inflation, Bandara (2013) classifies its drivers under four categories of factors of demand, supply, institutions and policy. However, some of the key factors that are specific to milk sector such as role of export and buffer stock and productive population have not been addressed by the researchers. This paper tries to address this gap by systematically examining domestic and international markets for milk individually and then analysing how they are inter-linked.

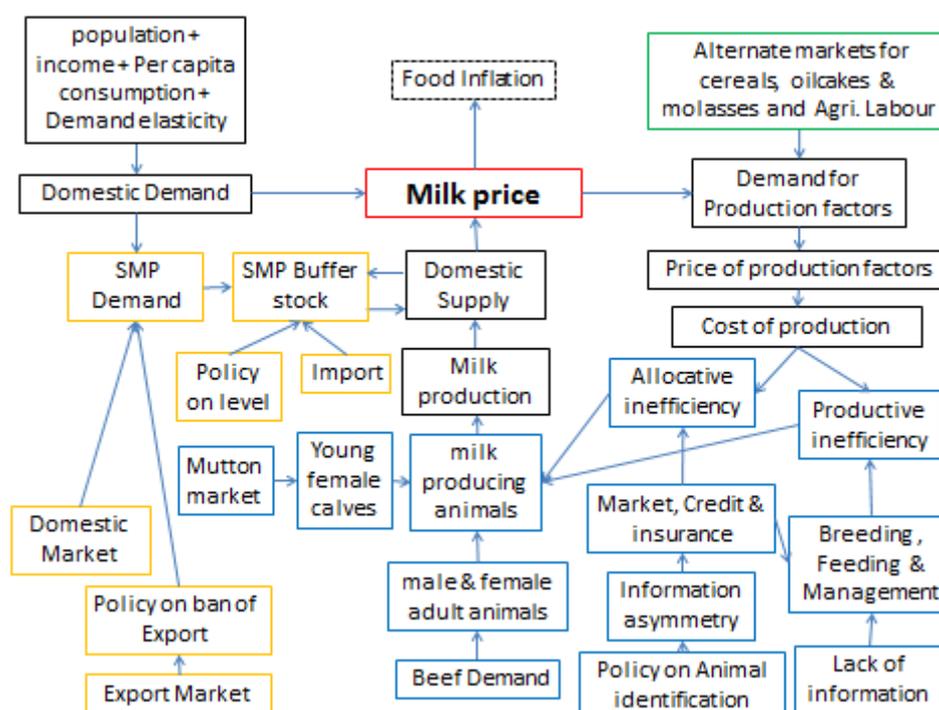
Our analysis is in line with suggestion made by Bandara (2013) that every sector of the Indian food economy needs to be studied independently. Accordingly, we try to correlate the major factors impacting domestic demand and supply of milk and the relationship between domestic and international milk markets, along with the policies on the international trade of skim milk powder (SMP). We follow it with a discussion on increasing cost of milk production by way of feeding cost, wages and energy prices along with major supply side constraints such as credit and insurance and livestock market. Finally, we discuss the possible

negative effect of reduced male animals on productivity of female population as well as the reduction in growth of female animals on growth in milk production, post-2007.

Specifically, we examine how the international prices are transmitted to domestic markets through levels of domestic buffer stock of SMP and why a mere rise in the price of milk is found to be insufficient to incentivise Indian dairy farmers to enhance investments in dairy animal rearing and technology to increase milk supply. The latest USDA Global Agricultural Information Network (GAIN) Report of Oct 2014 also reaffirms its earlier doubts about the ability of the existing initiatives of the government including the National Dairy Plan and the organised milk trade which accounts for only 30% of total milk production to be able to service the growing domestic demand for milk (Mani and Intodia 2014).

The flow diagram (Figure 1) identifies the important factors that influence the domestic price of milk, by way of demand, supply and policy.

Figure 1 Conceptual diagram on factors of Milk Price in India



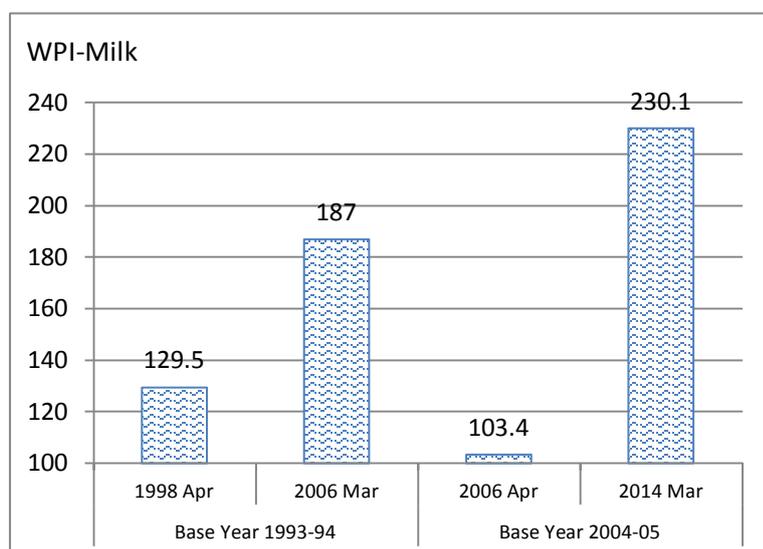
In the recent past, India has been experiencing a strong growth in demand for dairy products estimated at 6% to 8% per annum, whereas growth in supply is only 3% to 4% per annumⁱⁱⁱ. Punjabi (2009) cautioned that the emerging mismatch between demand and supply of milk in India is severely worrisome as it would then become a net milk deficit country and thus rely have to on the world market. Even without considering the export market, Yaron (2014)

cautions that the ever increasing rise in domestic demand for dairy products with a large demand-supply gap could lead India to being a net importer of dairy products in the near future. For the present, the supply is being augmented on a temporary ad hoc basis as and when necessary by way of imports. However, the large volume India requires against the supplies available in the international market has bearing on global milk prices. Further, the international market is highly volatile. Hence, imports as a permanent arrangement seems to be not a solution and would only aggravate the rise in domestic price, further. Therefore, the present sharp rise in exports of dairy products specifically for SMP from India over the last two years in 2012-13 and 2013-14 may not be revealing the true picture of the demand-supply gap for milk. In no foreseeable future is India expected to have surplus for exports. Further, consumption of milk and dairy products in the developing world is expected to continue on a path of rising growth rate, at least till 2030 (Alexandratos 2008). Therefore, there is an urgent need to take a fresh look at the present interventions and areas that need to be freshly addressed, towards increasing growth rate in domestic milk production.

Self-sufficiency in food from domestic supplies has been the prime motive behind the highly interventionist agricultural external trade policies in India (Shreedhar, Gupta et al. 2012). The policy intervention in respect of milk also follows similar lines of allowing or disallowing of free export of SMP while keeping in mind the domestic requirement. It is being argued here that a shortfall in quantity of SMP available for reconstitution to liquid milk arising from exports led to a situation wherein, the rise in the global milk price was fully transmitted to the domestic milk price between 2006 and 2013.

Trend in Milk Price:

Figure 2 Growth of WPI-Milk over two periods



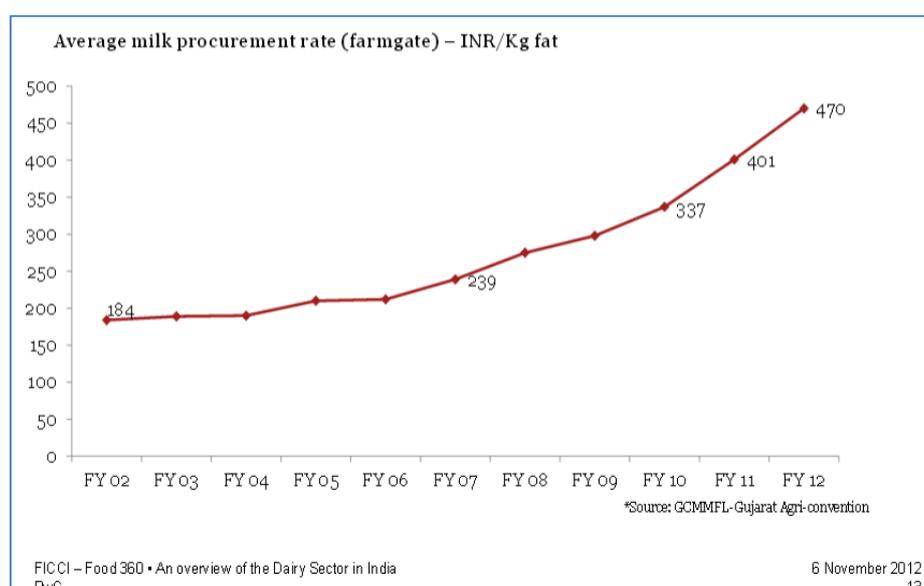
The wholesale price index (WPI) of milk has risen at a Compounded Annual Growth Rate (CAGR) of 10.5% in the last 8 years from April 2006 to March 2014. This is 2.23 times the rise of CAGR of 4.7%, in the previous 8-year period from April 1988 to March 2006^{iv}

(Figure 2). The probable causes for the accelerated rise in the price and its persistence is the focus of discussion of this paper.

Having observed a distinct difference in domestic price rise before and after 2006, we consider this period as a turning point for the Indian dairy industry. Interestingly, analysis of world food price and world cereal price by Bandara (2013) also reveals a distinct change in the upward trend in late 2006.

For understanding the trend in farm gate price of milk, we analyse the average milk procurement price in terms of Rupees per kg of butter fat as paid by the Gujarat Cooperative Milk Marketing Federation (GCMMF). GCMMF is the largest organised player in the Indian dairy sector with a milk processing capacity of 232 lakh litres per day^v, ranked 15th among the top dairy organisations in the world by the International Farm Comparison Network (IFCN)^{vi}. It is also India's largest exporter of dairy products^{vii}. The average price paid by GCMMF has been on a continual uptrend, increasing by 30% (Rs. 184 to 239) in the five-year period from FY 2002 to FY 2007, whereas it increased by 90% (Rs. 239 to 470) in the next five-year period ending FY 2012^{viii} (Figure 3). This again indicates that the period around 2006 was a turning point for the farm gate milk prices also. However, we need to study the prices paid in the flush winter season and lean summer season separately for a better understanding of this rise along with the milk production in these two periods separately as well as their ratio.

Figure 3 Average milk procurement price (Rs./Kg butter fat)



It is pertinent here to understand how milk price was kept under manageable limits in India, in the earlier period and therefore get us a better perspective of the changed situation. Similar to any agricultural commodity, milk production also has a seasonal variation whereas consumption is fairly constant. This necessitates the creation and maintenance of a buffer stock of SMP and butter, till the time of utility which is normally less than one year.

Firstly, there was a ban on export of SMP and import was allowed on ad hoc basis only when necessary and canalised through authorised agencies. It began with the creation of a domestic buffer stock of SMP using the milk powder gifted by US under PL 480^{ix} in the 1970s under the Operation Flood programme. It was this buffer stock of SMP that was used in reconstitution of liquid milk for sale to urban consumers in the lean summer months when supply was less than demand. This enabled the dairy cooperatives to service the urban market, all round the year. The SMP got replenished in the following flush winter season when domestic milk supply was more than demand, using the newly created milk powder plants by the dairy cooperatives under the financial and technical consultancy of the National Dairy Development Board (NDDB). It was this buffer stock of SMP coupled with a ban on export of SMP that provided the leverage required to moderate the rise in domestic milk price. The importance of buffer stock of SMP on milk price rise in moderating the increase in milk price was clearly recognised by the Cabinet Committee in February 2007 and therefore called for creation of a 10,000 MT domestic buffer stock while simultaneously banning exports till the end of lean season in September 2007.

So, the price rise post-2006 may have been caused by a sharp drop in the domestic buffer stock of SMP. This is indicated by the fact that the export of SMP had a tenfold increase from 4,025 MT in 2003-04 to 40,263 MT in 2005-06, effectively drawing down the domestic buffer stock of SMP. Analysis of stock of SMP in the country at the beginning of calendar year from 2004 to 2010 reveals that the variation remained between 5,000 and 15,000 MT^x, indicating that there was no undue build-up of stocks. This rise in export of SMP was triggered by the steep rise in the international market price from Rs.88 per kg in early 2006 to Rs.148 per kg by the end of 2006. Such sudden and high growth in exports indicates that inventory of SMP was readily available in the country as domestic buffer stock. Very little quantity could have come from the previous year's inventory, as shelf life of SMP produced in India is generally less than 12 months. This is at a time when the growth in production was constant and the growth in domestic milk consumption was increasing. However, only a

month-wise analysis of stock of SMP, production and consumption can give us a clearer picture. The WPI of SMP rose at a CAGR of 8% between April 2006 and March 2014.

The attractiveness of the export market for SMP for the domestic manufacturers is due to industry-specific reasons. The industry especially those in the organised sector build their business on the 15–30-day credit line provided to them by their milk suppliers, the dairy farmers and have cash sales at the market end. So, lock-in of working capital by way of finished goods is looked down upon. Further, milk powder plants are capital and power intensive with low capacity utilisation of less than 25%. Secondly, converting liquid milk to SMP entails additional cost towards processing, transport and storage. The lock-in period for SMP between production and sales realisation could be as high as 6–10 months as major portion of requirement for SMP in the domestic market is in summer lean months while production is in the winter flush season. Hence, an international market with higher price and no seasonal variation is found to be attractive to domestic SMP producers, especially at higher price levels^{xi}.

So, with the sudden rise in export of SMP, the domestic industry which uses SMP for recombination for domestic liquid milk market was adversely affected by shortage of SMP in 2006 and early 2007. It is this shortage that is purported to have had a cascading effect causing the domestic milk price to rise at an accelerated pace. Bhattacharya et al (2014) also endorse that by 2008-09, the demand for milk and milk products had overrun the domestic supply.

We find a similar scenario for cereals, wherein the drawing down of buffer stock of cereals in China is said to be one of the factors to have caused the sudden rise in price of cereals in 2008 (Alexandratos 2008).

Having discussed the trend in the domestic price of milk at the wholesale and farm-gate levels and the role played by the buffer stock in moderating price rise, we proceed to analyse the effect of domestic demand and supply factors on domestic price and the linkage with international market.

Domestic Demand:

Food expenditure in India constituted 52.9% and 42.6% for those living in rural and urban areas, respectively in 2011-12^{xii}. Of the food expenditure, share of milk is 8% (Rs.115) for rural and 7% (Rs.184) for urban areas. The urban consumer is spending 60% more on milk

and milk products compared to his/her rural counterpart (Table 1), indicating that urbanisation and rural to urban migration would further the increase in demand for milk.

Table 1 Monthly per capita expenditure in 2011-12

Item	MPCE* (Rs.)		% of Total MPCE	
	Rural	Urban	Rural	Urban
Milk & Milk products	115	184	8.0	7.0
Cereals	154	175	10.8	6.7
Egg, fish & meat	68	96	4.8	3.7
Beverages, refreshments & processed food	113	236	7.9	9.0
Food Total	756	1121	52.9	42.6
Total	1430	2630	100	100

* Avg. Monthly Per Capita Consumer Expenditure_{MMRP} in 2011-12

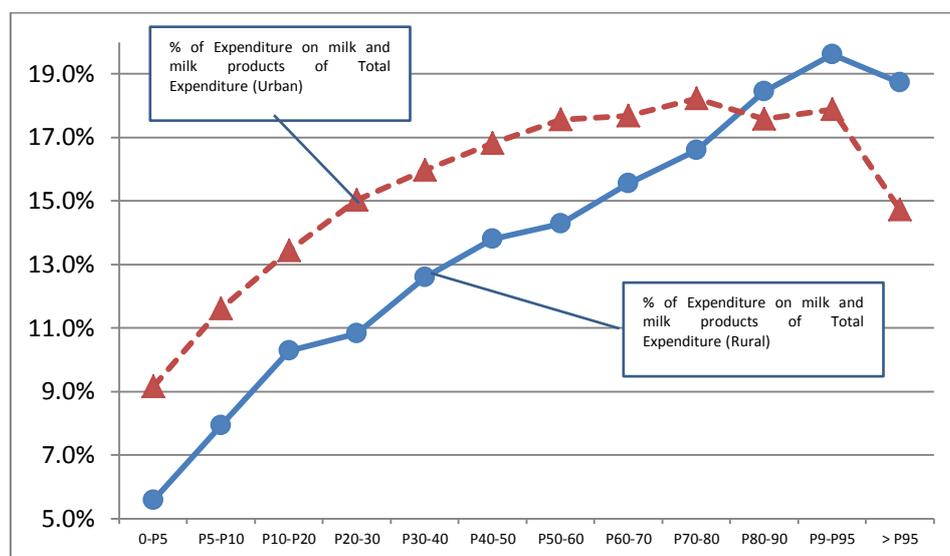
Source: NSS 68th Round Key Indicators of Per Capita Expenditure

The weightage that milk price has on food inflation can be seen from the fact that it forms the second most important food item consumed in terms of money spent. Per capita monthly expenditure on milk and milk products is more than cereals in urban areas, while it is next only to cereals in rural. Therefore, increasing milk prices is likely to have significant effect on food price inflation (Bhattacharya, Rao et al. 2014).

However, the average per capita expenditure masks the high inter-state and intra-state variation^{xiii}. Urban consumers in Chhattisgarh spend 3.83 times more money (Rs. 64 vs Rs.14) than their rural counterparts, while in Haryana, they spend nearly an equal amount (Rs.452 vs Rs.475). From these figures, it is also evident that there is high inter-state variation also in both rural and urban regions.

Between 1993-94 and 2011-12, the proportion of expenditure on milk by consumers has come down from 9.5% to 9.1% for rural areas and from 9.8% to 7.8% for urban areas^{xiv}. However, between 2009-10 and 2011-12, the total per capita expenditure (MPCE_{MMRP}) has increased by 36% and 33% for rural and urban areas, respectively. Fractile analysis of consumer expenditure on milk (MPCE_{MMRP}) in 2011-12 across income groups^{xv} shows decline only for the highest income (>P95), indicating the inelastic expenditure elasticity for milk (Figure 4) for all other groups.

Figure 4 Monthly per capita consumer expenditure on Milk (MMRP) over fractile class of MPCE (All India) in 2011-12



However, we can observe that in the lower income category, particularly up to P70-80, the share of milk total expenditure keeps increasing indicating high expenditure elasticity of milk for 80% of the population. In fact, in the rural areas, the increasing share of milk in total expenditure increases up to fractile P90-95. Georsa and Skoet (2012) also share similar findings while comparing dietary intake from dairy with per capita GDP in 2007 after adjusting for purchasing power parity across 144 countries, showed that there is positive relationship between per capita GDP and dairy consumption, with a declining slope at higher income levels.

There is a distinct upward trend in milk consumption in India, indicating a shift in demand. Between 1983 and 2004, the share of calories from milk in total food calories increased from 1.8% to 2.4% in the very poor income group and from 8.6% to 9.2% in the high income group (Kumar, Kumar et al. 2011). Analysis over a forty-year period for all countries also reveals that the dietary energy intake from dairy products increased from 3.4% to 4.4% (Gerosa and Skoet 2012). Between 1993-94 and 2009-10, the percentage of households consuming milk also increased from 80% to 85% and from 66% to 76% for urban and rural areas, respectively^{xvi}.

Income-elasticity of demand for milk is high especially at the lower income levels in general and more so for developing countries (Gerosa and Skoet 2012). Expenditure elasticity for milk and milk products in India varies from 1.5 (Dastagiri 2004) to 2.185 (Bhattacharya, Rao

et al. 2014). The average income elasticity for milk is 1.64 across all income groups, going up to 2.34 for very poor households (Kumar, Kumar et al. 2011). This shows that an increase in income would lead to more than proportionate increase in demand for milk and milk products and therefore drive up the food inflation.

However, the demand for milk has a high price elasticity of -2.989 in India (Dastagiri 2004) implying high variability in consumption with respect to price changes. This is in contrast to the -0.59 mean price elasticity for milk consumers in a developed economy such as United States of America (Andreyava, Long et al. 2010). Therefore, if for any reason the growth in income level in India reduces and the price of milk increases, a sharp fall in milk consumption level is expected, especially at the lower income level.

Study across countries has also shown a positive relationship between dietary energy intake from dairy products and per capita GDP of income (Gerosa and Skoet 2012), with greater effect of income on consumption at lower income levels. Kumar, Kumar et al. (2011) studying the impact of changes in both income and price have concluded that lower income groups would be more adversely affected by the increasing food inflation. With increased income, milk consumption amongst the lowest 10% income group in China increased by 100% between 1996 and 2003 (Fuller, Huang et al. 2006). Therefore, with increasing income levels in India, this growth trend in percentage of households consuming milk as well as per capita consumption is expected to continue increasing.

An important indicator of growth in demand for milk is the growing demand for SMP as it is mainly used for reconstitution into liquid milk along with butter when fresh milk supply is in short supply, in the lean summer months. Domestic consumption of SMP has grown steadily at a CAGR of 8.1%, from 1.95 lakh MT to 4.25 lakh MT between 2002 and 2013^{xvii}. During this 10-year period, domestic supply has generally remained above demand with a small quantity of buffer stock to carry over to the next year, providing dampening effect to the rise in milk price.

South and East Asia experienced the fastest growth in milk consumption of 4.0% and 5.9% per annum, respectively between 1961 and 2007 in the world. The demand for milk and dairy products excluding butter (fresh milk equivalent) in the developing countries is expected to increase by 27% from 52 kg per person per year in 2005/07 to 66 kg per person per year in 2030. Even this level of consumption would only be 31% of that in developed countries (Alexandratos and Jelle 2012). This indicates the possibility of high growth in demand for

milk and dairy products in developing countries. This is especially true for India, which has predominantly a vegetarian population with preference for milk over meat, as a source of animal protein. Gerosa and Skoet (2012) also affirm that there is scope for consumption growth for milk in developing countries where the per capita consumption is low.

A “secular shift” in food consumption is said to have occurred with preference for high-value agricultural products such as milk (Eapen and Nair 2012). As a result, pressure on the Food Article Price Index came from high value products such as milk (Gulati and Saini 2013) for most of the time from 2005-06 to 2012-13.

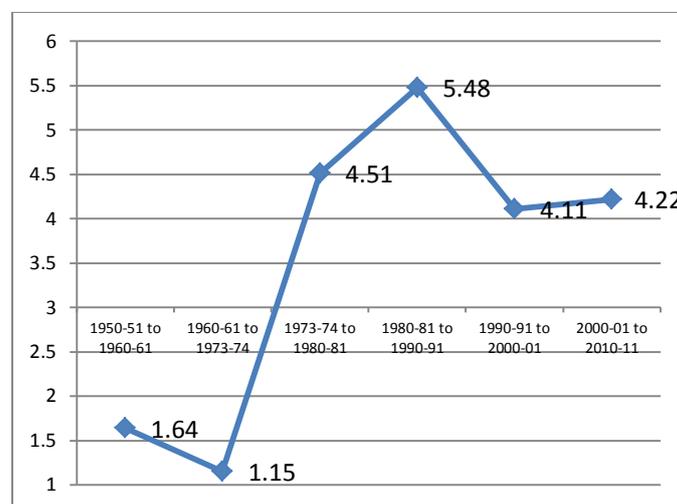
The matter of concern is while growth in consumption is increasing; growth in milk production is declining, at the national level (Gokarn 2010a, Bhattacharya, Rao et al. 2014, Bhattacharya, Rao et al. May 2014). The USDA GAIN report states that consumption growth in the Indian dairy market has been 6.8% per annum, over the last decade^{xviii}. This means that the growth in milk supply has to increase at a minimum of 6.8% on CAGR basis, merely to keep pace with the domestic demand growth, not considering the export market. So, the Government of India’s projected growth of 4.1% in milk production indicates something amiss on the policy front.

We now proceed to analyse the domestic milk supply trend and factors underlying it.

Domestic Supply:

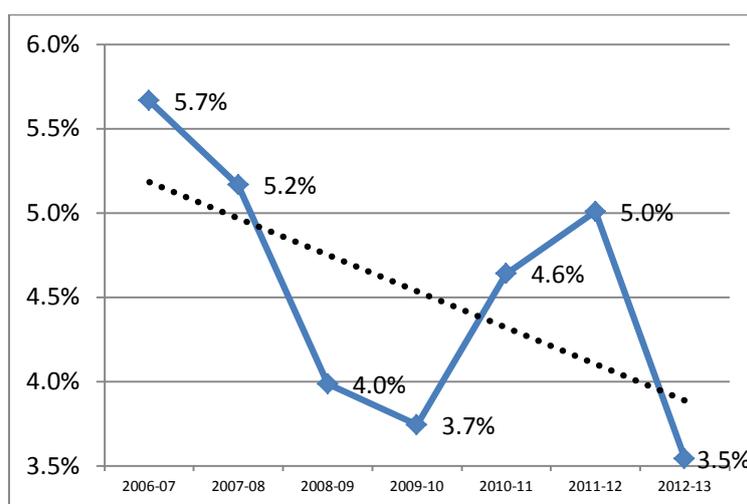
We first examine the past growth level in domestic milk production. The decennial growth rate in milk production has come down from 5.48% between 1980-81 and 1990-91 to 4.2% between 2000-01 and 2010-11^{xix} (Figure 5).

Figure 5 Decennial growth in milk production in India (%)



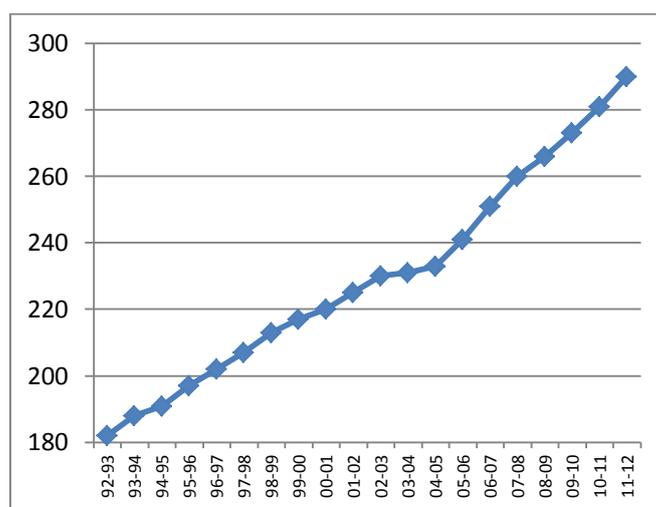
In the short-term too, the annual growth in domestic milk production is exhibiting a distinct downtrend, coming down to 3.5% in 2012-13 from 5.7% in 2006-07 (Figure 6). Gokarn (2010a) while analysing the annual growth rate in milk production, has shown that it is not only declining but also volatile. FAO estimates that the growth in milk production would be 3.9%^{xx} in the calendar year 2014, while the Government of India in December 2013 anticipated a growth rate of 5.5% during the financial year 2013-14^{xxi}.

Figure 6 Annual growth rate in milk production in India



Now, we will have a look at the targets set by the Government of India. It estimates that the domestic demand for milk would reach 191 MT by 2020. This effectively requires an incremental production of 58 MT in the next 9 years from the level of 132.43 MT^{xxii} in 2012-13 with a CAGR of 4.1%. It is to be noted here that the previous incremental quantity of 58 MT of milk was achieved in 15 years. Therefore, the past trend in growth, both in the long and short terms indicates that even this level of 4.1% per annum growth in milk production is difficult to achieve (Mani and Intodia 2014).

The average per capita availability of milk in India reached 296 grams per day in 2011-12 from 178 grams per day in 1999-92^{xxiii}. It is significant to note that the per capita availability of milk has accelerated since 2005-06. During the 7-year period from 2005-06 to 2011-12, it grew at a CAGR of 2.7% as compared to the CAGR of 1.9% in the previous seven-year period (Figure 6). This again indicates that the period around 2006 was indeed a turning point, even for per capita consumption, considering the fact that a very small portion is exported and that the consumption and supply are nearly equal.

Figure 7 Growth in per capita availability of milk (Gm/day)

Delgado (2003) estimated that with an annual growth rate of 3.5%, the per capita consumption in India would reach 288 grams per day by the year 2020^{xxiv}. However, we observe that this level of 288 grams per day has been surpassed nine years earlier, in 2011-12 itself, mainly due to the increased growth in per capita consumption of milk in India after 2005-06.

The per capita consumption of milk in rural areas increased at a CAGR of 1.2% and at 1% in urban areas, between 2004-05 and 2009-10. This accelerated growth in milk availability and consumption is in line with the general trend of increased contribution of livestock products to calorie intake in developing countries (Gerosa and Skoet 2012).

However, as we have seen in milk consumption, there are major regional differences in the level and trend of milk production, across states. For example, in 2011-12, the per capita availability of milk in Punjab was 945 grams per day; whereas in Tripura, it was only 80 grams per day. Similarly, milk production in Punjab grew at a CAGR of 0.9%; whereas in Tripura, it grew at a CAGR of 4%, in the five-year period from 2007-08 to 2012-13. This highlights the need for state-level interventions to enhance milk production.

Milk supply response to high prices is constrained by the biological factors. In the short-run, there is excess capacity to produce more milk from existing breedable adult female animal population. This could be obtained in two ways: directly by higher per capita milk production and indirectly by reduction in reproductive and metabolic problems. With a more balanced nutrition (Kannan, Garg et al. 2011) and reducing negative energy balance status (Butler and Smith 1989, Wathes, Fenwick et al. 2007) and feeding full requirement of proteins (Jain,

Saksule et al. 2012), one could obtain higher milk yield in the short-term. So, in response to the rise in price of milk, a typical firm, farm in our case, increases its output by moving along the short-run marginal cost curve. Higher profit earned encourages increased milk production through higher capacity utilisation, expansion of existing dairy farms and new farmers entering dairy animal rearing.

However, this increases the demand for factors of production such as cattle feed and labour, resulting in rise in their prices. Constituents of cattle feed are mainly cereals, oil cakes and molasses. Demand for these three items arises from other sources also. Oil cakes have high export potential, while molasses used for producing ethanol finds the domestic bio-fuel and liquor market more remunerative. Bhattacharya et al (May 2014) have shown that in the four-year period between 2007-08 and 2012-13, the price of oil cakes rose at CAGR of 13% due to shortfall in oilseed production. Gokarn (2010a), while discussing the rise in the price of proteins in general, also expresses concern on the adverse impact of price of cattle feed on cost of milk production. The oil cakes and molasses are both by-products of agriculture, namely oilseeds and sugarcane, respectively and therefore have a lag response. Further, semi-skilled rural labour force required to manage dairy animals finds alternative socially more valued livelihood such as construction work in urban centres, thus increasing the cost of production.

A main source of increase in milk production is the increase in the number of adult female bovine animals yielding milk. However, we observe that their growth in terms of percentage is on the decline over the last one decade, according to the last three animal censuses (Table 2).

Table 2 Growth rate in female bovine population over three censuses

Female animal type	Year of Census			CAGR		
	2003	2007	2012	2003 to 2007	2007 to 2012	2003 to 2012
Buffaloes						
Young (< 3 years)	27367	29767	34724	2.12%	3.13%	2.68%
Adult (> 3 years)	47574	51375	53855	1.94%	0.95%	1.39%
Indigenous Cattle						
Young (< 3 years)	29281	31086	32579	1.51%	0.94%	2.16%
Adult (> 3 years)	49594	54268	52488	2.28%	-0.66%	0.63%
Crossbred Cattle						
Young (< 2.5 years)	6664	9094	11635	8.08%	5.05%	6.39%
Adult (> 2.5 years)	10836	14571	19636	7.68%	6.15%	6.83%
Young Female Total	63312	69947	78938	2.52%	2.45%	2.48%
Adult Female Total	108004	120214	125979	2.17%	0.94%	1.73%
Number in thousands						
Source: 17th, 18th and 19th Livestock Censuses, GoI						

The annual growth rate of adult female animal population more than halved from 2.17% to 0.94% per annum over the last two census periods. Specifically, annual growth on CAGR basis in adult female buffaloes, indigenous cattle and crossbred cattle has come down from 1.94% to 0.95%, from 2.28% to -0.66% and from 7.68% to 6.15%, respectively.

Further, from the point of future growth in milk production, a high number of young female calves attaining adulthood leads to increased growth. However, their growth rate marginally declined from CAGR of 2.52% to 2.45%. However, this overall growth rate conceals the fact that the growth in adult female animals over the next three years will be derived mainly from buffalo calves as their growth in terms of CAGR has increased from 2.12% to 3.13%. The growth rate of young crossbred cattle has come down from a CAGR of 8.08% to 5.05% and young indigenous cattle down from 1.51% to 0.94%. A reduction in total population indicates that some of the economically weak farmers may be moving out of dairy animal rearing.

It is important to note that this reduction in growth of adult female productive population and a near constant growth in young calves occurred in a period when milk prices were rising at an accelerated pace, at least in nominal terms. Only two situations could explain the reduction in growth of adult female population; one, the attrition rate was high. Second, there was a slowdown in proportion of young stock coming into adulthood, though the actual numbers may have increased. Since there is little reduction in overall growth rate of young stock coming into adulthood, we deduce that the attrition rate indeed is high. A reduction in growth

of number of productive animals adversely affects the growth in milk production, unless and otherwise this is nullified by sufficient growth in productivity per animal. Further, we find that the growth over the next three years is mainly derived from buffaloes and not from indigenous cattle or crossbred cattle. This indicates that there is a perceptible change in growth trend with preference for buffalo rearing as against rearing of indigenous and crossbred cattle. So, the entire institutional system for breeding and breed development may need to be geared to cater to this preference for buffaloes. This preference for buffalo rearing may be on account of the fact that a shift from rearing of indigenous cattle to crossbred cattle involves a paradigm shift in rearing practices. The former is a low-input, low-output and low-risk system while the latter is high-input, high-output and high-risk system. Farmers seem to continue preferring the former type of rearing practice.

However, there is a rationale behind the emphasis on rearing and hence breeding of crossbred cattle over indigenous cattle or even buffaloes, with the former giving a higher milk yield per day than the other two. At the national level in 2012-13, crossbred cattle, buffaloes and indigenous cattle produced an average per day milk yield of 7.02, 4.8 and 2.36 Kg, respectively^{xxv}. As a result, 15% of total number of animals, that is, the crossbred cattle, yielded 25% of total milk produced in the country during 2012-13^{xxvi} (Table 3).

Table 3 Estimates of milch animals and milk yield and milk yield rates in 2012-13

Dairy animal type	Milch animals ('000)		Milk production ('000 MT)		Average milk yield per day (Kg)
	No	%	Quantity	%	
Crossbred cattle	12642	15%	32384	25%	7.02
Indigenous cattle	31870	38%	27421	22%	2.36
Buffalo	38638	46%	67675	53%	4.80
Total	83150		127480		

However, as in milk consumption and per capita availability, there are inter-state variations in average milk yield per animal per day high for all the three categories of dairy animals. For example, milk yield per day of crossbred cattle varies from 11 litres in Punjab to 4.05 litres in Assam; while even the indigenous cattle in Punjab yielded 6.52 litres of milk.

The total number of artificial inseminations (AI) performed in India reached 500.8 lakh, increasing at a CAGR of 10% between 2004-05 and 2011-12^{xxvii}; though it is unclear whether the breakup of their total number reflects proportion of milk-yielding population in terms of cattle and buffaloes. Milk productivity of female animals is being improved through bringing

more number of animals under the AI programme using frozen semen from pedigreed and proven bulls (especially, exotic breeds) and crossbred for cattle. In fact, productivity enhancement is one of the main components being taken up under the National Dairy Plan aiming to bring 50% of breedable adult female animals under AI by 2021-22^{xxviii}.

Price of milk at the consumer end is determined by the level of fresh milk production and stock of SMP available for reconstitution. So, the demand for SMP is a proxy indicator of demand for milk. The annual domestic production of SMP has steadily increased from 1.85 lakh MT in 2002 to 4.5 lakh MT in 2012, growing at a CAGR of 9.3%, as per USDA Global Agricultural Information Network Report on India. India produced 4.7 lakh MT of SMP in 2013 (Mani 2013) and the SMP is expected to go up to 5.2 and 5.5 lakh MT in 2014 and 2015, respectively^{xxix}.

International Scenario:

The international price of milk has risen at a CAGR of 10.67% between January 2006 and January 2014^{xxx}, indicating that the domestic milk price rise of 10.5% merely mirrored the international price rise. However, recently there has been disconnect between the two prices. During the eight-month period between January 2014 and August 2014, the international price of milk fell by 28%, while the domestic price has risen by about 5%.

The international milk price indicated by the FAO dairy price index increased at a CAGR of 9.8% between 2004 and 2013^{xxxi} (Table 4). The year-on-year price changes suggest a high degree of variation, ranging from an increase by 68.9% during calendar year 2007 to a decrease by 33.4% in 2009.

Table 4 FAO Dairy Price Index

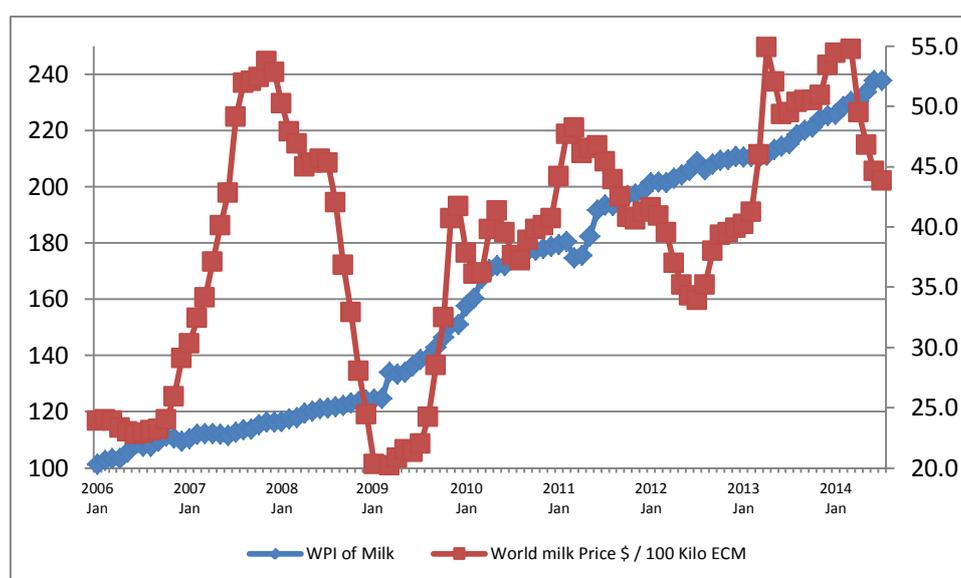
Year	FAO Dairy Price Index	% Change (Y-o-Y)
2004	123.5	
2005	135.2	9.5%
2006	129.7	-4.1%
2007	219.1	68.9%
2008	223.1	1.8%
2009	148.6	-33.4%
2010	206.6	39.0%
2011	229.5	11.1%
2012	193.6	-15.6%
2013	242.7	25.4%

Source:

<http://www.fao.org/worldfoodsituation/foodpricesindex/en/>

Consists of WMP, SMP and cheese price quotations; the average is weighted by the world average export trade shares for 2002-04

However, a month-wise analysis of domestic milk price (using WPI of milk) and international milk price (using the world milk price) in terms of energy corrected milk of 4% fat and 3.3% protein as calculated by the International Farm Comparison Network (IFCN) shows that the rise in their prices follows different patterns (Figure 8).

Figure 8 Comparison of domestic and international milk prices

The steady rise in the domestic prices stands in contrast to the highly volatile growth in the world price (Kumar 2009).

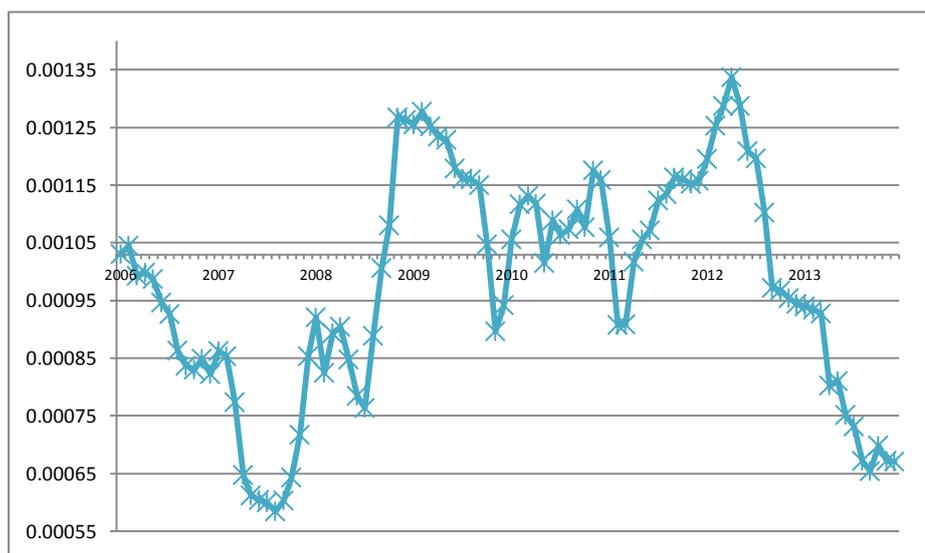
The international price of SMP also rose from a level of around USD 1000 per MT to USD 2000 between 1980 and 2006, growing at a CAGR of 1.2% and rose sharply to above USD 4,000 per MT in 2007 (Kumar 2009). This indicates that there was a demand shock in the international milk market around 2006, resulting in price rise.

India is the largest producer of milk accounting for 17%^{xxxii} of world milk production and is also the largest consumer of milk in the world. According to FAO, India contributed one-third the quantity of milk produced by developing countries and 16% of the total world production in 2009 (Gerosa and Skoet 2012). Only five countries, United States of America, European Union, New Zealand, Australia and India being self-sufficient in milk accounted for all exports of SMP. Amongst these producers, New Zealand and the European Union account for 50% of the world milk trade (FAO 2014). Asian countries accounted for 55%^{xxxiii} of the total milk imports from the international market and is expected to further grow in the next decade due to rising disposable income and increasing population in these countries (Gerosa and Skoet 2012). This is clearly observed from the growth in import of milk and milk products by China, growing over 300% from 38 lakh MT in 2008 to 124 lakh MT in 2013 (FAO 2014).

FAO (2010) while examining the status and trends in the global dairy sector cautions that milk is likely to become one of the most volatile agricultural commodities in the world due to the strong influence that small changes in the quantities available internationally have on the world market prices. There is also time-lag in milk production as a result of price change and delayed reaction of the demand to changing dairy commodity prices. IFCN Dairy Report 2013 also forecasts that the volatility in the international milk market would continue in the near future. This volatility in price cautioned by FAO and IFCN is reflected in the international prices of SMP between 2006 and 2009; the price of SMP with 1.25% butter fat varied from USD 2000–5500 per MT^{xxxiv}. This variation in price of SMP continues to occur, till date. It has in fact come down by 45% in 8 months from USD 4,693/MT in January 2014 to USD 2,600/MT in August 2014^{xxxv}. This sharp fall in the international market price is attributed to reduced purchases by China and Russia and higher production by European Union and New Zealand (FAO 2014). A similar volatility was earlier observed in the 7-month period between November 2006 and April 2007, when the FAO international dairy price index rose by 46% and the price of SMP rose by 56%, where the spike in price of SMP is attributed to depletion of its public stocks in the European Union (FAO 2014). This once again indicates the role of buffer stock of SMP, on maintaining milk price level.

So, such high price variation in the international market (Kumar 2009) and current account deficit of USD 7.8 billion (1.7% of GDP) in the first quarter of 2014-15 for India^{xxxvi}, prevents India from depending on imports as a substitute for enhancing domestic production. Policy support should therefore be provided to improve productivity (Kolhar 2013).

Figure 9 WPI of SMP deflated with international price of 1.5% butter fat (Rs./MT)

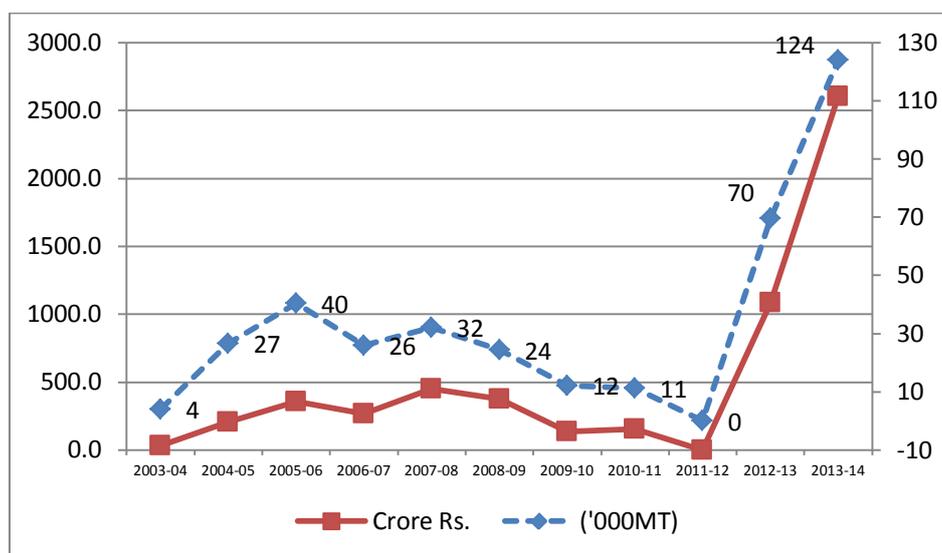


To understand the competitiveness of the domestic market vis-à-vis the international market, post-2006, we perform a simple ratio analysis of WPI for SMP with the international price of 1.25% butter fat SMP, after converting its price into Indian Rupee (INR) at the month's prevailing exchange rate. The figure shows that during 2006 to 2008, the price of SMP in the international market was highly attractive as compared to the domestic price. This scenario repeats itself in the winter of 2009 and 2010 and the whole of 2013 (Figure 9). We need to recognise while analysing this ratio that the domestic demand for SMP in India is seasonal; whereas the international demand is more constant.

Between 2003-04 and 2011-12, India's export of SMP varied between 0 and 40,000 MT with a maximum value of Rs.450 crore in 2007-08. The exports in 20011-12 had reduced to a near zero. This was due to a ban on exports between February 2011 and June 2012. So, the record levels of export occurred during 9 months of 2012-13 and 12 months of 2013-14. In 2013-14, 1.24 lakh MT of SMP valued at Rs.2605 crore was exported^{xxxvii} (Figure 10). This formed 78% of the total value of dairy products exported from India in 2013-14 and about 7% of the total world trade in SMP (FAO 2014). Of this, GCMMF, the major player in the Indian dairy market, contributed 0.20 lakh MT^{xxxviii}. So, all players across the spectrum from conservative

to aggressive were keen to service the highly volatile but remunerative export market for SMP rather than the domestic market, which itself was on the rise in terms of demand but not price. During this period, WPI of powder milk in India had come down marginally from 183.2 in April 2012 to 180.7 in April 2013 but increased to 188.6 by March 2014^{xxxix}.

Figure 10 Quantity and value of SMP exported from India



Imports of SMP are still canalised through a few designated national-level agencies including NDDB. Any quantity imported over and above the Tariff Rate Quota agreed upon by the Government of India entails 60% customs duty (Mani and Intodia 2014). This is essential to protect the domestic sector from cheap imports.

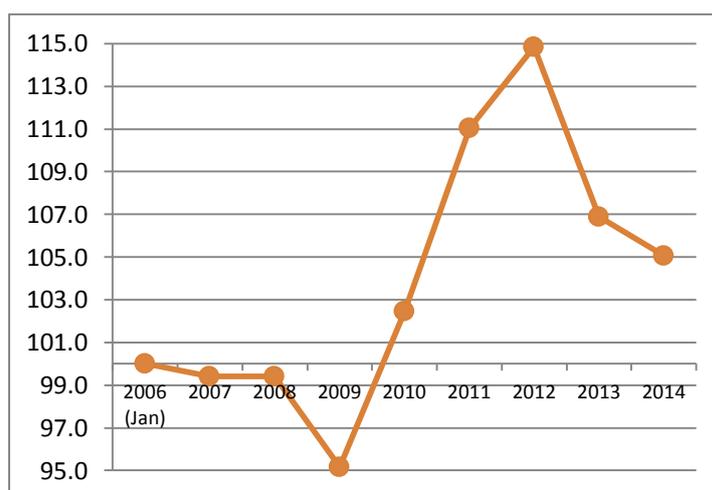
We have so far examined how the nominal price of milk in the domestic and international markets has moved, while briefly assessing the reasons that can be attributed to them. We now analyse how the real price of milk in the domestic market in terms of key inputs has changed over time. For this, we deflate the milk price with cost of inputs such as labour, cattle feed and food-grain.

Milk Price Vs Labour Cost:

We use CPI (General) for agricultural labourer to deflate the WPI of milk, as it more appropriately reflects the price change for the small and marginal farmers who are the major producers of milk. These farmers also face a choice to switch between working as agricultural labourers when they are not working on their farm and rearing dairy animals. The CPI (General) for agricultural labourers which was 357 in January 2006 reached 757 in January 2014^{xl} over a 7-year period (base 1986-87 = 100), growing at a CAGR of 9.85%.

Deflating the WPI of milk with the CPI (General) for agricultural labourers, we find that for the first four years from 2006 to 2009, labour wages increased marginally over WPI of milk; whereas from 2010 onwards the WPI of milk has been increasing substantially at a higher rate than wages (Figure 11).

Figure 11 WPI-Milk deflated with CPI (General) for Agriculture Labourer

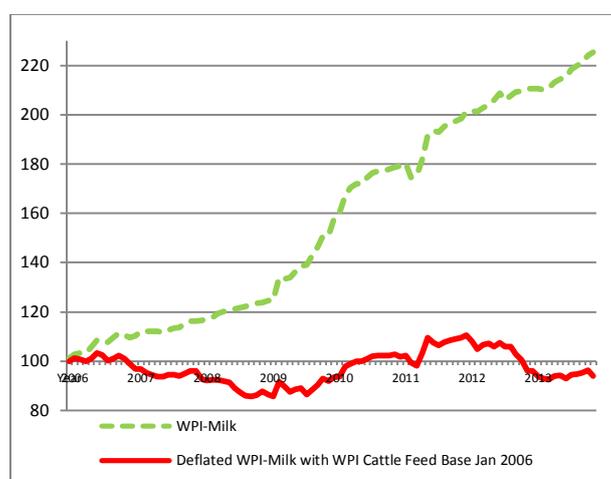


The Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA), which guarantees 100 days of wage employment for one member of a family is said to be one of the reasons for rise in rural wages. Gulati et al (2013) show that introduction of MNREGA in 2006 has acted as a “push factor” leading to a rise in the wages for unskilled labour by way of a 6.8% rise per annum in real wages during 2007-08 to 2011-12 as against a decline in wage rate by 1.8% in the earlier period between 2001-02 and 2006-07. Bhattacharya and Rao et al (May 2014) affirm that a key factor contributing to the rise in the price of food products is the wages of agricultural workers, by way of increased demand for high income elasticity foods such as milk and meat. So, though wage level has risen, the price of milk has grown much higher, effectively nullifying its effect.

Milk price vs Cattle feed price:

WPI of milk has risen 124 basis points over eight years, from 101.3 (January 2006) to 225.4 (December 2013). Deflating it with WPI of cattle feed (with base January 2006 = 100) or a simple ratio analysis of WPI of milk with WPI of cattle feed for this period shows that the rise in the WPI of cattle feed has generally kept pace with the rise in the WPI of milk, effectively nullifying the rise in milk price. Further, during the 3 years from 2007 to 2009 and in 2013, the cost of feed rose higher than milk price (Figure 12).

Figure 12 WPI of Milk deflated with WPI (Cattle Feed)



Feeding cattle is the major recurring expense in dairy animal rearing and cattle feed forms a significant portion of feeding cost. Cereals, oil cakes and molasses form important constituents of cattle feed, quantity and cost-wise. All the three raw materials have demand not just from the cattle feed market but also from other markets leading to a demand shock for them and hence a rise in their prices.

About 36% of world consumption of cereals goes into cattle feed, bulk of it in the form of coarse grains (Alexandratos and Jelle 2012). So, their diversion to bio-fuel production would increase cost of cattle feed production. Kumar and Kumar et al (2011) caution that price inflation in wheat and rice would increase the demand for coarse cereals for human consumption with adverse impact on manufacturing of cattle feed and thus influence rearing of livestock negatively.

Price of oil seed cakes is high, due to high demand in the international market. India exported 54.8 lakh MT of oil seed cake in 2011-12, worth Rs.8300 crore^{xli}. Further, oil seeds being an agricultural produce, their derivative product oilseed cakes are produced only during certain

season of the year, while consumption is spread across the year. This results in a temporal difference between production and consumption leading to storage cost. There is also a spatial difference between source of production and place of consumption, adding to its cost of transport, processing, storage, handling and wastage. Similarly, molasses also has alternative ready markets for the manufacture of bio-fuels and alcohol and therefore commands high price.

Further, a higher level of working capital is needed to buy the same quantity of cattle feed. This is important, for the small and marginal farmers as credit is difficult to be obtained, particularly for working capital.

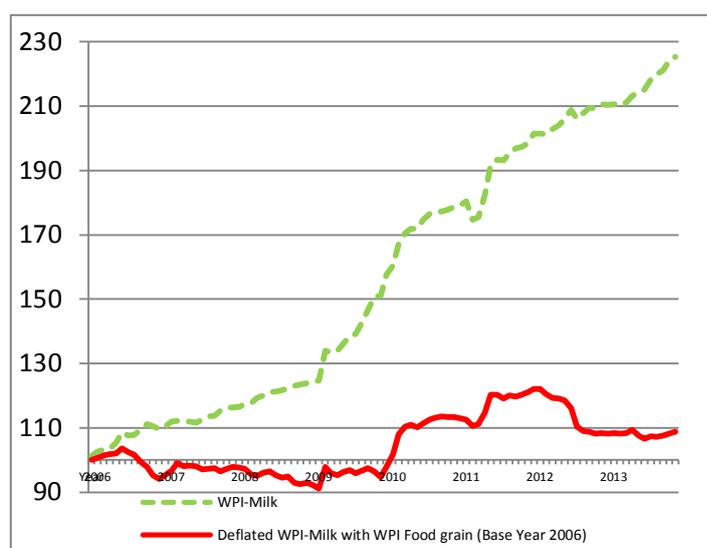
This is one of the reasons dairy cooperatives across India provide cattle feed and other input services on credit to their member farmers. Farmers who are not supplying milk to the dairy cooperative do not have this credit facility. This accentuates the general problem of dairy farmers providing little or no cattle feed to animals that do not yield milk, as it leads to a negative cash flow not just to their business of dairy animal rearing but also at the household level. Experimental trial provides support to the hypothesis that cows fed with diet rich in protein in the last month of pregnancy yield higher and better quality of milk subsequent to calving (Park, Shirley et al. 2002). Therefore, by underfeeding dairy animals in their last stage of pregnancy, farmers lose out on the incremental quantity of milk.

Thus, a rise in the price of cattle feed adversely affects the growth in milk production.

Milk Price Vs Food grain price:

As milk forms part of the overall food basket, it is pertinent to analyse how milk price has moved against the cost of food grains (cereals + pulses).

Deflating the WPI of milk with the WPI of food grains (Figure 13), we find that from 2006 to 2010, milk price lagged behind the rise in price of food grains. However, from 2010, WPI of milk has risen in terms of real price vis-à-vis WPI of food grains (Figure 13). This may be explained by Bennett's Law which states that with an increase in income of consumers in developing countries, there will be a movement away from starchy cereals to other foods such as animal proteins, fruits and vegetables.

Figure 13 WPI Milk deflated with WPI-Food grain (cereals+pulses)**Supply constraints:****Energy Cost:**

In the organised milk trade, high proportion of consumer rupee is spent on energy towards its movement from farm to consumer, temporally and spatially and for cooling, wherein non-renewable energy resources play an important role. The cost involves not just the energy resource as a consumable raw material but the entire infrastructure that needs to be maintained and manned on a 24×7 basis since milk is a perishable commodity. As per the experience of the author, this cost can be up to 10–15% of the margin between the farm gate and retail prices. Bhattacharya and Rao et. al (May 2014) have also highlighted the role of fuel in widening the gap between farm gate and retail food prices. The rise in petroleum prices and the consequent demand for bio-fuel production from cereals through increase in cost of energy has been considered as an important factor for the rise in food prices (Becker and Posner 2008) (Evans 2008). The price of petroleum influences food prices through many channels (Bhattacharya, Rao et al. 2014). India being a large oil-import-dependent country, rise in oil price results in increased fertiliser price and transport cost, directly affecting the cost of food production (Gokarn 2010, Bandara 2013). In fact, increase in fuel price is one of the factors often ascribed by milk marketers to increase the consumer price^{xlii}.

We finally examine the key supply side constraint which is the growth in production capacity that may be causing the milk supply to be sticky.

Milk Production Capacity Constraint:

The shortfall in growth of milk production can result either from a low increase in the net number of adult female animals or insufficient enhancement in the productivity of existing adult milk producing animals. We had earlier observed that there is reduction in growth of adult females of all types with the annual growth coming down from a CAGR of 2.17% to 0.94%, whereas there was no drop in the overall growth of young dairy animals. So, reduced growth rate of the adult productive population may be one of the important factors for constrained growth in milk production. This could be due to high cost or non-availability of credit and risk-cover mechanisms.

Unlike developed nations, India does not have a separate beef^{xliii} industry, i.e., rearing specific breeds of cows or buffaloes for beef. The supply comes from the bullocks of indigenous and crossbred cattle, male buffaloes and non-milk or low milk producing females. Most of the adult unproductive male and female buffaloes are sold and end in slaughter houses for beef production, legally. As, there is ban on cow slaughter across the country except in Kerala and West Bengal, old and uneconomic animals are transhipped to these states and slaughtered.

Sale of livestock is frequently used as a consumption smoothing mechanism, especially among small and marginal farmers (Rosenzweig and Wolpin 1993). So, cash in lump sum often has higher priority over future probable stream of small incomes from milk, particularly for poor people. This gets accentuated when there is a drop in the farm gate price of milk^{xliv} or difficulty in obtaining free green grass due to insufficient rains. Thereby, some of the female adult animals and young calves that still have the capacity to breed and produce milk, along with the male animals, may end up in slaughter houses.

India exported a record quantity of buffalo meat worth Rs.22,627 crore in 2013-14. This was 58.6% more in value and 36.9% more in quantity, over the previous year, becoming the 2nd largest exporter of beef in the international market with 20% market share^{xlv}. It is significant to note here that the value of buffalo meat exports was 8.7 times the value of export of dairy products, in the same year^{xlvi}. Even in the triennium ending 1988, 70.5% of the foreign exchange earnings from the livestock sector was derived from the sale of bovine meat (Kumar 2009).

An equal quantity of bovine meat is said to be consumed in the domestic market. Between April 2005 and March 2014, the domestic price of beef and buffalo meat grew at a CAGR of 9.2%, indicated by the increase in its WPI from 100.9 to 222.8.

In addition, the author's study of sheep and goat rearing in Andhra Pradesh reveals demand for "pseudo-mutton"^{xlvi}, meat from young calves of buffaloes and cattle. From the farmer's perspective, sale of young calves gives immediate capital returns and removes all uncertainty of future cash-flows. The pseudo-mutton is bought mainly by bulk consumers such as roadside hotels and restaurants with attached bars. If this situation is generally prevalent across the country, then it is another reason for the reducing growth rate of milk producing population and therefore constrained growth in milk production.

Our argument on growth in total demand for beef, export and domestic consumption put together is substantiated by the 19th Livestock Census 2012, which shows a reduction of 180.9 lakh in male bovine animals from 2007 to 2012, in rural areas. Males of buffaloes and indigenous and crossbred cattle have reduced by 17.37%, 18.81% and 11.48%, respectively (Table 4). This is of course, in addition to the lower growth rate of female animals, though their actual numbers have increased.

Table 5 Growth in male bovine population in rural region

Type of Male	Livestock Census No. (Year)		
	17 th (2003)	18 th (2007)	19 th (2012)
Exotic/Crossbred cow	44.4	62.9	55.7
Indigenous cow	749.0	749.9	608.8
Buffalo	169.9	187.8	155.1
Source: DoAHDF, Gol, 17th to 19th Livestock Census			

The reduction in male buffaloes is a cause for immediate concern since 53% of the total milk production in the country was derived from buffaloes in 2012-13^{xlvi} and farmers today prefer rearing of female buffalo calves rather than calves of indigenous or crossbred cows. Even today, natural service by local bulls is the default choice by majority of buffalo owning farmers to conceive their buffaloes. It is also well-documented that the presence of adult bulls in a village through pheromone effect ensures that female population of buffalo and cattle attain maturity earlier and conceive faster. Age at first calving and inter-calving period are

two key economic traits directly affecting life-time milk yield and profitability of rearing a dairy animal.

The importance of presence of male buffaloes is evident in Kutch district of Gujarat where the bulls of Banni buffaloes are kept with the female throughout their lifetime, day and night. As a result, the female Banni buffaloes display the lowest age at first calving (36–42 months) and shortest inter-calving period (12–14 months) amongst all buffalo breeds of India^{xlix}. Therefore, reduction in uncastrated male animals in villages leads to longer age at first calving and higher inter-calving period; and adversely affects the life-time milk yield and profitability.

Capital Asset Growth:

In 2011-12, capital asset formation in agriculture and allied sectors as a percentage of agricultural GDP was 19.8%, which is less than half of overall capital formation in the Indian economy of 40%, indicating lack of the much needed fresh investments required for growth of the sector. Of this, 85% was derived from private sources¹. On the formal credit side, reducing investments in dairy sector is indicated by the reducing proportion of total refinance by NABARD for dairy development, coming down from 5.77% in 2011-12 to 4.34% in 2013-14. Hence, credit is one of the reasons for reduced growth rate of adult female animals, either by not being available or available only at high cost. Further, the cost of credit for livestock purchase is high because all formal credit institutions compel farmers to avail insurance for the animal against death at the time of purchase basically to protect themselves from default of loan. Hence, majority of dairy animal purchases are made by only those who have 100% of the required capital in liquid form. Lack or high cost of credit results in growing inequality and poverty (Aghion and Bolton 1997).

The positive effects of livestock credit have been well-established. Credit for livestock purchase increases the rural poor income enabling them to come out of poverty (Abedullah, Mahmood et al. 2009). Credit increases production efficiency indicated by a positive correlation of yield and income with credit (Iqbal, Munir et al. 2003) (Sandika 2011).

As of 2010-11, only about 6% of the total adult bovine population was covered by insurance against death. This is despite the government actively supporting insurance of productive cows and buffaloes with 50% subsidy on the premium amount for two animals yielding above 1500 litres per lactation, per family, for a period of 3 years.

With insurance and credit being fully linked to each other, it can be deduced that credit from formal financial institutions is also limited to around 6% of the total adult animal population. Such low penetration of credit shows that credit is a key supply constraint to enhance milk production. One cannot look at insurance in isolation as a value proposition but in conjunction with credit, farm inputs and services, as a means to enhance productivity and reduce risk (Dick and Wang 2010).

Discussions with credit and insurance agencies reveal that they are averse to increasing their exposure to livestock sector due to moral hazard and adverse selection problems arising from information asymmetry. This is due to lack of proper identification of dairy animals. Further, technical and economic details about an individual animal are simply absent or selectively available, but not shared. On account of information asymmetry, institutions providing breeding and health services are also able to offer only below par services.

With information asymmetry, fraudulent representation of animal quality is rewarded with average price, instead of being penalised (Koontz and Purcel 1997). Information asymmetry by way of adverse selection has a role in price and turnover of the Indian cow market (Anagol 2009). So, there is little or no price incentive by way of animal sale or value for the farmer. Therefore, information asymmetry is also an important constraining factor to growth in milk production.

Investments towards reducing information asymmetry in dairy animal market are highly beneficial but by way of externalities. Therefore, need arises for the state to intervene in creating essential institutions that support rural financial intermediation – institutions that exist to disseminate information regarding market fundamentals and credit rating bureaus (Conning and Udry 2007).

Conclusion:

The reasons for the persistent rise in the price of milk in India were analysed by understanding the causal factors that contribute to its demand and supply.

Between 2006 and 2013, the international price was fully transmitted to the domestic price, resulting in a near similar percentage rise. While this increase came with a high level of price volatility in the international market, the rise in the domestic price was steady and continuous. Since 2006, global price is seen to be transmitted to the domestic price due to a

probable reduction in the level of domestic buffer stock on account of free export of SMP. It was this domestic buffer stock of SMP that had moderated the milk price rise, in previous years. The ban on export was lifted not due to glut in domestic stock of SMP but to enable the SMP manufacturers benefit from the then prevailing high international price.

After 2006, growth in demand for milk in India is rising at twice the growth rate of milk production; 6% to 8% vs 3% to 4%, making that year a turning point for the Indian dairy sector. This is confirmed by the growth in per capita milk consumption, post-2006. The growth in milk consumption in developing countries is expected to continue, offering livelihood opportunity for milk producers in India, especially the small and marginal farmers who own 71% of the productive adult population^{li} (Delgado 2003).

With increased demand for milk and the supply not responding to it, there is a continuous and increasing mismatch between the two, leading to persistence in milk price inflation. The alternative to domestic production is importing of SMP. However, this is not a viable alternative for milk due to its high and perpetual requirement, limited availability and high price volatility in the international market and high current account deficit (Kolhar 2013). Further, demand for milk in many Asian countries which are net-importers of milk such as China has also picked up. With few exporting countries and limited quantity available for international trade, a small increase in the domestic demand could affect the international price disproportionately.

In addition to this demand shock and institutional failure, supply side constraints also act as dampener to the growth in domestic milk production. While these supply constraints are not new, their effect has been magnified due to the increased demand for milk. The full production potential of dairy animals in India is not being realised due to constraints in feeding, breeding, health and management^{lii}. With increase in cost of inputs, the sector seems to have moved into high-cost industry status, undermining profitability and hence experiencing stickiness in supply. The constraints in the supply side in terms of milk production faced by small and landless farmers apart from high cost of feed are lack of credit and risk-cover, availability of health and breeding services and information asymmetry in the market.

In fact, the supply side constraints seem to far outweigh the advantage of a persistent rise in milk price such that farmers have started to withdraw from dairy animal rearing. This is revealed by the reduction in growth of number of adult female stock whose growth rate has

come down from 2.17% per annum between 2003 and 2007 to 0.94% per annum between 2007 and 2012. In the same period, there has also been a drastic fall in total number of male animals by 181 lakh (18%). Such sudden large-scale reduction in population is due to increasing market demand for beef. Apart from increased domestic consumption, India has become world's 2nd largest exporter of beef, that too without breeding of animals exclusively for beef.

This is a serious concern since incremental growth in milk production can come only from an increase in the number of productive population and improvement in productive efficiency of existing dairy animals (Dhas 2010). This reduction in population of males and slowing of growth of females indicate that various interventions made by all parties concerned have not borne fruit especially after 2006. Further, they seem to have targeted only total milk production by way of production per animal and less on increasing productive number of female animals. This is reiterated by the fact that insurance and credit for animal purchase can be accessed by less than 6% of the total population. Thereby, capital asset growth is seriously undermined. All these have cumulatively constrained the growth rate in milk production to around 3% to 4%.

Even the growth rate of total young female stock of dairy animals is also marginally declining except for buffalo calves. In other words, farmers rearing cows and buffaloes within the existing production eco-system are not reciprocating adequately to the milk price which grew at a CAGR of 10.25% but responding more to beef price which grew at a CAGR of 8.8%, on nominal terms, during April 2006 to March 2014. So this reduction in total population indicates that economically weak farmers may be moving out of dairy animal rearing, per se.

The productivity per animal may also be adversely affected by the reduction in male population, especially buffaloes. Serious concerns are being expressed as to whether the present level and scope of interventions concentrating on the organised milk sector which represents only 30% of total milk production would be able to cater to the growing domestic demand^{liii}. This means that given the existing production, eco-system milk production level is on the production frontier and the only way to higher growth is from a change in the factors of the production eco-system itself.

Therefore, without the supply responding more vigorously, milk price is bound to remain in the uptrend causing further strain on food inflation. So, the challenge India is facing today is

in enhancing domestic production (Bandara 2013) by increasing productivity (Gokarn 2011) and ensuring capital asset growth in female animal population.

To make the milk supply system respond better, economic and social incentives could come outside the milk system, which is the animal itself. To achieve growth in numbers especially those with above average quantity of milk yield, unique identification, maintenance of live database of each animal is required. Further it is to be made available for sharing it on a dynamic basis 24×7 in an easily retrievable and readable format to all stake-holders, beginning with the farmer. This would not only enable farmers to reduce their cost of production but also reduce the ill effects of adverse selection and moral hazard of information asymmetry paving way for higher penetration of credit and insurance and enable the development of a vibrant dairy animal market. This is possible only through proactive intervention of the government both at the central and state levels.

Finally, though we have discussed the issue at the national level, there is huge disparity in terms of consumption and production at intra-state and inter-state levels, making it extremely difficult to compare one with another. Hence, there is dire need to perform state and region-wise analysis of the problem of insufficient milk supply response from the perspective of capital, debt, technology, information, input, risk-cover mechanism, institutions as well as outputs. This would enable well-informed choices suited to local conditions from policy makers, for nurturing conditions that would encourage dairy farmers to not only increase productivity but also increase the number of female animals.

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References

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^{xiv} NSS 68th Round Survey Household consumer expenditure in India Table T9 Page 20

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^{xlvii} Young female and male calves of buffalo and cattle are sold as mutton (meat from sheep) to bulk consumers such as roadside hotels and bar cum restaurants. This is possible due to two reasons. From the consumer side, there is a high price differential between the two, with mutton costing nearly twice as much as beef. WPI of mutton has increased at a CAGR of 10.25% whereas WPI of milk increased at a CAGR of 10.5%, over the eight year period from Apr 06 to March 2014.

^{xlviii} Indiastat viewed on 14 Sept 2014

(<http://www.indiastat.com/table/agriculture/2/milkanddairyproducts/167/788614/data.aspx>)

^{xlix} Paper by Yadav, PV, Bhatti, R and Das, S; A note on traditional breeding practices among Maldharis of Banni region of Kutch district of Gujrat viewed on

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^l NABARD Annual Report 2013-14

^{li} As per the NSS 59th Round of survey 2002-03

^{lii} Report of the Working Group on Animal Husbandry and Dairying 12th 5-year Plan (2012-17) submitted to the Planning Commission, Government of India

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