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**Milk production in India rises by a historic 6.25% in
2014-15: A boon or a bane?**

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**Milk production in India rises by a historic 6.25% in 2014-15:
A boon or a bane?**

Abstract:

Milk production in India has risen by a historic 6.25% in 2014-15, reaching 146 million tonne. This increase is indeed a boon if it can be sustained as there is an urgent need to increase the growth rate in milk production, to meet the growing domestic market for milk and milk products and ensure that India remains self-sufficient in milk. However, this high incremental growth rate was limited to only three states while the largest milk producing state Uttar Pradesh showed a constant but below the national level of growth. Further, growth in population of adult female bovines seems to be tapering off with a very low increase in productivity per animal. Hence, this is a good time and opportunity to analyse the growth in milk production. We analyse the growth in terms of supply, demand and price of milk as well price and buffer stock of skim milk powder and its role in maintaining the price at consumer and farmer end. In the short-term, with no immediate market for the incremental quantity within or outside India, much of the incremental quantity is being processed and stored as skim milk powder and butter. This is causing financial strain on the milk purchasers forcing them to reduce their demand and price for fresh milk. As a result, this high growth may be only strengthening the oligopolic market power of milk processors and/or marketers the market structure gives them, over both consumers and milk producers. The constant increase in consumer price is also not expected to be transmitted to the producer, as in a perfectly competitive market. Therefore, this high rate of growth in milk production is boon in the long term helping India remain self-sufficient in milk. However, as the farm gate prices have not only reduced but also become highly volatile making dairy animal rearing high risk venture with uncertain, it is a bane in the short term.

Keywords: Milk Production, Growth, Milk price, Skim milk powder

Introduction:

As per Economic Survey 2015-16, milk production in India has risen by a historic 6.25% to reach 146.3 million tonne (MT) in 2014-15 against 137.7 MT in 2013-14ⁱ, marginally higher than the target of 145.8 MT (Indiastat, 2015). This is the highest growth rate achieved in the past surpassing the previous high of 5.7% in 2006-07. India has now set itself an ambitious target of 9.6% increase over the achievement in 2014-15 to produce 160.36 MT of milk in 2015-16ⁱⁱ.

As India is in a demand-led growth scenario for milk, increasing supply is the only way to curb food inflation (Gokarn, 2011) and for the country to be self-sufficient (Lagos and Intodia, 2015). Working Group of the Planning Commission, Government of India of the 11th 5-Year Plan in 2007 also had drawn attention to the need for enhancing growth rate in milk production and support overall growth of livestock and rural economy. Hence, this higher growth in milk production is in the direction of fulfilling the growing domestic demand for milk at the national level.

Lagarde (2016), Managing Director, IMF states that, "India's high rates of inflation have been underpinned chiefly by high and persistent rates of food price". Mishra and Roy (2016) aver that milk is one of the primary drivers of food inflation in India. An important factor that has been identified for food inflation is supply side constraints in agriculture. This essentially means that supply side constraints for production of milk are a matter of concern and an increase of growth in milk production could mean that at least some of these constraints are being tackled and overcome.

Self-sufficiency in food from domestic supplies has been the prime motive behind the highly interventionist agricultural external trade policies in India (Shreedhar et al., 2012). This is in addition to policy of managing food inflation within acceptable levels. Therefore, the present increase provides us an opportunity to review the Indian dairy industry in a holistic manner from the point of milk production looking at the various factors of production at the macro and micro-level.

We begin by examining the overall market structure of the Indian dairy industry.

Market structure:

The market structure of milk supply chain is such that power is skewed towards a few milk processors cum marketers and hence are price makers. Milk consumers and producers being dispersed and large in number are compelled to be price takers. Hence, there is an innate tendency for the organised milk marketers to act as an oligopoly when selling (Wann and Sexton, 1992) and as an oligopsony when buying. This situation is similar across developing countries such as Brazil, China, Sudan, Thailand and India (Mu et al., 2014). Even in developed countries, food sector is characterised as oligopolistic, wherein vertical restraints are used by the processors or marketers as part of their supply chain management strategy (McCorriston, 2002).

So, vertical restraints are common in the food sector and are specific to the country, type of food type and agent and the Indian dairy sector is not an exception. These vertical restraints have been modified for the Indian dairy sector for the organised and unorganised sectors separately and shown as dotted lines in Figures 1 and 2.

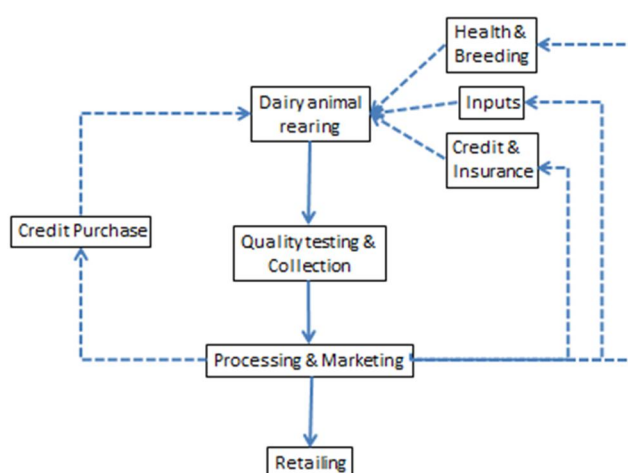


Figure 1 Vertical restraints used by the organised sector

The organised sector consists of milk processors from the cooperative or private operating with over 10,000 litres per day capacity, in the cooperative and private sectors. 30% of the total marketable surplus milk is handled by this sector. Private players are more aggressive in their growth as compared to cooperatives and are becoming bigger players.

The primary restraint used by the organised sector is by buying milk against credit, wherein, payment for milk is made once in 7 to 15 days. This credit period can be extended by the milk purchasers unilaterally, as per their convenience. In fact, in the case of Chittoor district cooperative milk producers' union, it unilaterally extended its credit line gradually to over 6 months and finally closed as a sick unit in the 1980s, leaving behind dues to its own member farmers. Till date, the money has not been paid and the plant in the heart of Chittoor town remains still shut as proof. The second is by providing inputs like concentrate and providing in-house veterinary health and breeding cover services, on credit. Thirdly, they assist farmers in availing credit and insurance for dairy animals, at concessional rates. The second and third restraints kill competition in each of those respective markets, whose growth individually and collectively could have benefitted dairy farmers and encouraged higher growth in milk production.

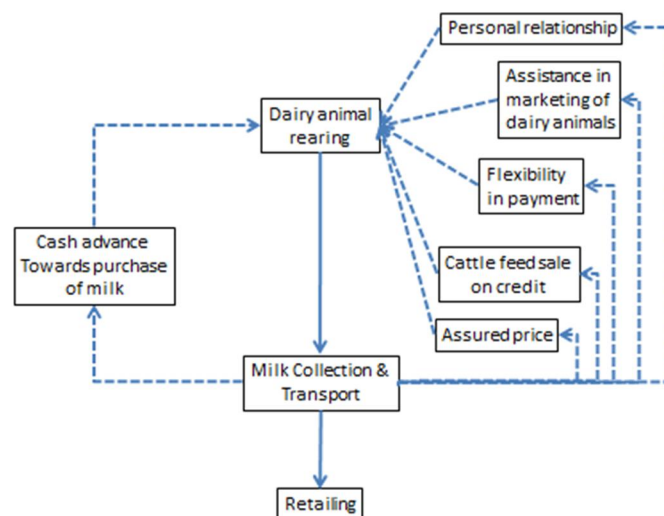


Figure 2 Vertical restraints practised by the unorganised sector

The unorganised sector consists of cash rich milk traders collecting about 100 to 500 litres per day from a group of villages. They continue to handle 70% of the marketable surplus milk in the country, as in Ethiopia (Ahmed et al., 2004) and Kenya (Omoro et al., 2004).

The primary vertical restraint used by these traders is advance payment for milk to dairy farmers. It is sometimes given even before the animal comes into milk. They also have a very flexible payment system as per the needs of the farmer and develop a personal relation with each farmer. They also provide cattle feed and other inputs required by the dairy farmers. Since convenience of the farmer is being met, the price at which they buy milk or the price at which they sell inputs become secondary. Some of the milk traders also act as market facilitators in the purchase and sale of animals of all age groups, productive and unproductive. In the absence of any other alternative these traders are doing service to the dairy farmers, so they claim.

Interestingly, the two are not mutually exclusive. There is a grey area wherein, the unorganised sector represented by the local milk trader acts as an interface between individual dairy farmer and the organised sector, buying from the farmer and selling to the latter. This grey area is indicated by the dotted line in Figure 3. The grey area exists as farmers are able to benefit from the best of organised and unorganised sectors. It may be on account of this that the unorganised sector is still able to continue sourcing 70% of the marketable surplus of milk from farmers.

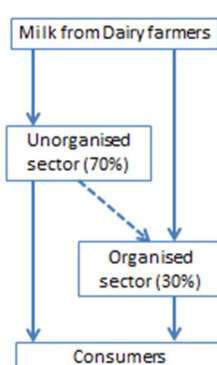


Figure 3 Relation between Organised and Unorganised milk sector

These restraints in general are not only constraints to the farmer but also prevents competition to set in these services.

Farmers supplying milk to the organised sector are said have a higher income on account of higher milk yields while farmers supplying milk to the unorganised sector receive a higher price (Sharma, 2015). Small dairy farmers who are the largest in number in India and the mainstay of milk production are being consciously excluded by the modern private sector which has nearly doubled between 2002 and 2011 after deregulation of the Indian dairy sector, as against the cooperative sector which was more inclusive (Sharma, 2015).

Small holders benefit from mainstream markets by entering into contracts (Costales and Catelo, 2009) individually and as a collective. India has experimented with different types of collectives of dairy farmers, for selling their marketable surplus milk on a day-to-day basis. Cooperatives, multi-state cooperatives, producer companies in the dairy sector are some of the organisational means of entering into a contract. Milk processors encourage such a situation as this builds peer pressure to reduce behaviours such as side selling (Fafchamps, 2004) and establish a trust-based relationship nurtured over time and act as an enforcement mechanism (Fafchamps and Minten, 2001), thus ensuring their regular supply of milk.

For the farmer supplying milk, three issues are of paramount importance. First is the availability of a ready market. Second is the surety of the price realised and finally the credit line required to realise the sales amount. Once a buyer is fixed, it is difficult for an individual farmer to change the buyer as he faces the vertical restraints discussed earlier. As a result, price and credit line availed are given by the marketer. Though many dairies may procure milk from the same village, they operate as oligopsony to lock in their milk supply from farmers over time, using various vertical restraints. This is true of both organised and unorganised sectors, as discussed earlier.

In general, food industry market structure reveals that food product markets are not perfectly competitive (Wann and Sexton, 1992). Gohin and Guyomard (2000) have also shown that the food retailing sector in France is characterised by skewed market power. McCorriston et al. (1998) have shown that market power in the food sector reduces the degree of price transmission from the farm to retail stages, wherein the consumer benefits little from lower farmgate price of agri produce. McCorriston et al. (2001) in their meta analysis of literature on agricultural markets conclude that if downstream markets are

imperfectly competitive, price transmission will be less than complete and the intermediate stages in the food chain stand to benefit.

It needs to be highlighted here that while their discussion is focused on reduction in price of agricultural produce being transmitted from farmer to consumer; our discussion with regard to the Indian dairy sector is about transmission of price in the reverse direction, that is, transmission of the increased consumer price to the farm gate. Only a consistent if not a higher proportion of the consumer rupee to the farmer will encourage him to produce more. For example, Mysore district cooperative milk producers' union has been able to transfer 70% to 80% of the consumer rupee to its member farmers as price of milk (Mymul, 2015). This is in contrast to less than 50% of the consumer rupee being transmitted to dairy farmers in developed countries.

We see clearly here that the demand as experienced by the dairy farmer has very little to do with the demand of the consumer. Hence, any change or shift in the demand curve of the consumer has little or no effect on the farm gate price of milk and hence the production function of milk.

We now proceed to analyse the growing demand for milk in India.

Growing demand:

Private consumption in India has risen at about 8.5% per annum between 2005-06 and 2011-12, as against the 5% average growth rate during the earlier period from 1998-99 to 2004-05. In addition to the domestic demand pressure, surge in global commodity prices is also contributed significantly to the rise in relative food prices (Anand et al., 2016). Hence, any growth in supply that was sufficient for the earlier period is clearly insufficient at present.

India is the largest consumer and producer of milk accounting for 17% of the world's total milk production and self-sufficient, as of now. Domestic demand for milk is estimated to be growing at 4.8% in 2015 (Mani and Intodia, 2014) while supply is growing only at a lower rateⁱⁱⁱ. This mismatch between demand and supply of milk in India has been expressed as worrisome as India would turn into a net milk deficit country and have to rely on the world market (Punjabi, 2009), if the growth in supply does not increase. Yaron (2014) also avers

that the ever increasing rise in domestic demand for dairy products combined with a large demand-supply gap could make India a net importer of dairy products in the near future.

Consumption of milk and dairy products in the entire developing world including India and China which have a major portion of the world's population, is expected to continue rising till 2030 (Alexandratos, 2008). Hence, the present rise in the growth rate in milk production to 6.25% in 2014-15, is indeed a ray of hope that higher growth rate is possible.

Causes for increase in demand for milk have been well-identified and defined (Sharma, 2003) as growth in population, urbanisation, changing demography, increasing per capita GDP, widespread and 24 × 7 availability of liquid milk and milk products, changing food consumption patterns, high income elasticity of demand for milk and regional imbalances in income/consumption. Anand et al. (2016) conclude that food inflation in India indicates demand pressures, driven by a strong consumption growth. The share of calories from milk in total food calories increased from 1.8% to 2.4% in very poor income group and 8.6% to 9.2% in the high income group between 1983 and 2004 (Kumar et al., 2011), indicating a shift in demand for milk. This shift in demand is expected to be of long-term nature and expected to continue till date as analysis over a forty-year period for all countries reveals that the dietary energy intake from dairy products increased from 3.5% to 4.4% (Gerosa and Skoet, 2012). Further, the number of households consuming milk in India has increased from 80% to 85% and from 66% to 76% for urban and rural areas, respectively.

The enormous possibility for future growth in consumption in India is indicated by the fact that while India had a per capita consumption of 68.7 kg per year in 2007, developed nations had over 380 kg per year with even Brazil having a per capita consumption of 125 kg per year, as per FAO^{iv}.

Income elasticity of demand for milk is high, especially amongst lower income levels in developing countries (Gerosa and Skoet, 2012). Expenditure elasticity for milk and milk products in India varies from 1.5 (Dastagiri, 2001) to 2.185 (Bhattacharya et al., 2014). (Kumar et al., 2011) have found that while the average income elasticity for all classes of households is 1.65, it is as high as 2.34 for poor households. One study across countries has shown positive relationship between dietary energy intake from dairy products and per

capita GDP (Gerosa and Skoet, 2012). Hence, as income levels rise, demand for milk and milk products will go up and if sufficient supply is not forthcoming, it would drive up food inflation.

Milk supply:

Between 1998 - 99 to 2014-15, milk production in India has grown at a compounded annual growth rate (CAGR) of 4.25%, growing from 72.1 MMT to 146.3 MMT. The highest growth rate of 6.25% seen in 2014-15 surpassed earlier highest growth achieved in 2006-07 of 5.7% (Figure 4). This production level is above the set target of 145.77 MMT and compares well against the estimated milk production of 147 MMT in 2015 (Mani and Intodia, 2014) and 154 MMT in 2016 (Lagos and Intodia, 2015).

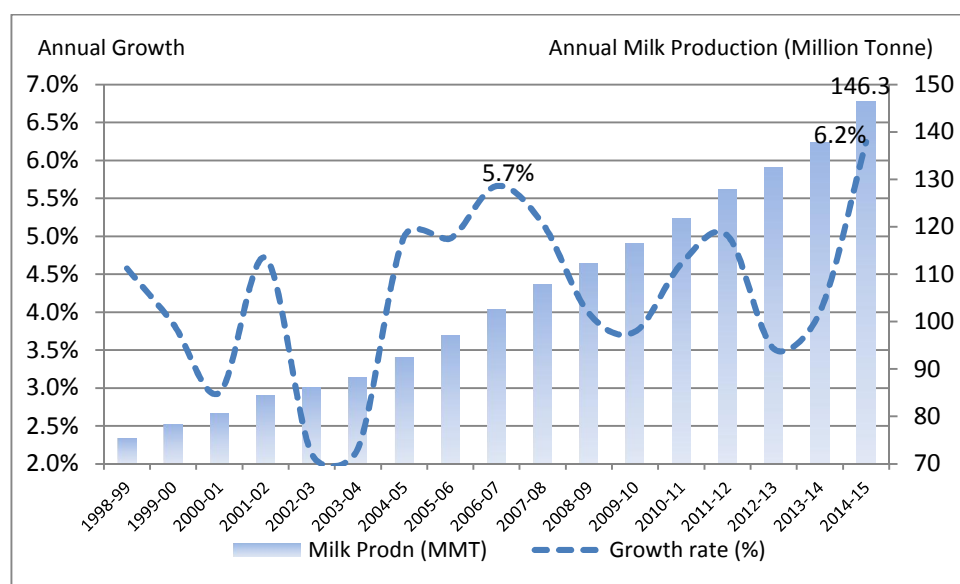


Figure 4 Milk Production Quantity and Year-on-Year growth rate

The general trend at the national level of milk production by the three types of bovines is shown in Table 1. The proportion of milk from crossbred cows has increased from 17% to 25% between 1997-98 and 2012-13. This 8% increase has been from the decline in proportion of milk equally from Indian cows (4%) and from buffaloes (4%). As of 2012-13, 53% of total milk production was contributed by buffaloes while the remaining 47% came from cows.

State-wise analysis of growth in milk production of top 14 states shows that they accounted for 92% of total milk production in the country in 2014-15, lower than 96% in 2007-08. As

the remaining states and union territories are not expected to make much impact on total production at national level, we limit and concentrate our analysis to these 14 states.

Year	Milk from				Total milk quantity (MMT)
	Crossbred cow	Indigenous cow	Total Cow	Buffalo	
1997-98	17%	26%	43%	57%	67.84
2012-13	25%	22%	47%	53%	127.48

Table 1 Proportion of milk from 3 types of bovine animals

The proportion of milk from various types of bovines varies across states. For example, as of 2012-13, 98% of milk was from crossbred cows in Kerala. In Bihar, 95% of milk came from cows, shared equally by crossbred cows (45%) and Indian cows (50%). On the other hand, 85% of milk in Haryana was from buffaloes. Hence, the trajectory of growth in milk production varies across and may be even within the major states (Table 2). Prior to 2014-15, the highest growth rate achieved by any of these states is 9.0% in 2000-10 by Andhra Pradesh which then included Telangana.

Sl. No.	State	08-09 Vs 07-08	09-10 Vs 08-09	10-11 Vs 09-10	11-12 Vs 10-11	12-13 Vs 11-12	13-14 Vs 12-13	14-15 Vs 13-14
1	Uttar Pradesh	3.6%	3.4%	4.1%	7.3%	3.4%	3.7%	4.2%
2	Rajasthan	4.9%	3.3%	7.3%	2.1%	3.2%	4.5%	16.2%
3 & 4	Andhra Pradesh + Telangana	7.2%	9.0%	7.4%	7.9%	5.6%	1.9%	6.6%
5	Gujarat	6.0%	5.5%	5.4%	5.3%	5.1%	7.7%	5.2%
6	Madhya Pradesh	4.3%	4.6%	4.8%	8.5%	8.5%	8.6%	12.3%
7	Punjab	1.1%	0.0%	0.4%	1.4%	1.8%	2.9%	3.4%
8	Maharashtra	3.4%	3.0%	4.8%	5.3%	3.1%	4.1%	5.0%
9	Haryana	5.6%	4.5%	4.3%	6.3%	5.7%	5.7%	6.2%
10	Bihar	2.6%	3.2%	6.4%	1.9%	3.0%	5.1%	8.0%
11	Tamil Nadu	1.7%	2.0%	0.6%	2.0%	0.5%	0.6%	1.2%
12	Karnataka	6.9%	6.3%	6.1%	6.5%	5.0%	4.9%	2.1%
13	West Bengal	2.2%	3.0%	4.0%	4.5%	4.0%	1.0%	1.1%
14	Kerala	8.3%	2.8%	5.4%	2.7%	2.7%	-4.9%	2.1%
	India total	3.9%	3.8%	4.7%	5.0%	3.5%	4.0%	6.3%

Table 2 Year-on-Year growth rate of milk production, state-wise

Three states have shown remarkable increase in milk production during 2014-15, as against their average increase over previous six years (Figure 5). They are Rajasthan (16.2% vs. 4.2%), Madhya Pradesh (12.3% vs. 6.5%) and Bihar (8.0% vs. 3.7%). The growth rates achieved by Rajasthan and Madhya Pradesh in 2014-15 are also well above their own target^v of 4.7% and 8.6%, respectively. The largest milk producing state Uttar Pradesh which

accounted for 17% and Gujarat accounting for 8% of total production increased by 4.2% and 5.2% respectively, well below the national level of 6.25%.

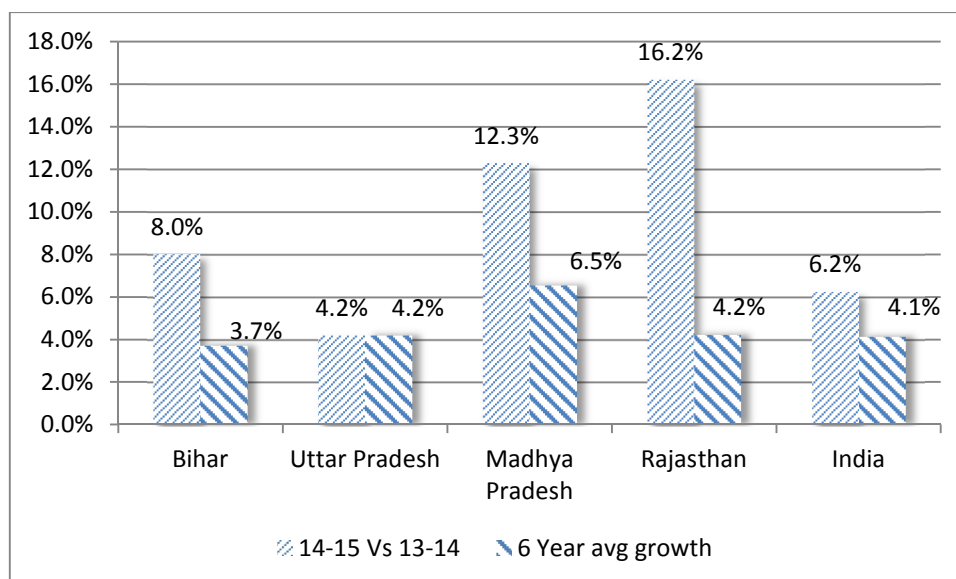


Figure 5 Comparison of % growth in milk production 2014-15 vs previous 6 year period

Detailed analysis of the 16.2% growth of Rajasthan in 2014-15 reveals milk production of crossbred cows, buffaloes and indigenous cows increased by 96%, 17% and 3%, respectively. The average growth rate of milk production in Rajasthan between 2000-01 and 2013-14 was 5.3% with the highest growth of 18.3% in 2006-07. Even after this 96% increase in crossbred cow milk production, buffalo milk continued to be the mainstay contributing 59.4 % while crossbred milk formed only 12% of total milk from bovines in 2014-15.

An abnormal increase in the percentage of animals bred using artificial insemination in these three states in the previous two years could give support and have been a contributory factor to the increased milk production in 2014-15. Analysing the artificial insemination figures of these states, we find little support for any such abnormal increase in the previous two years.

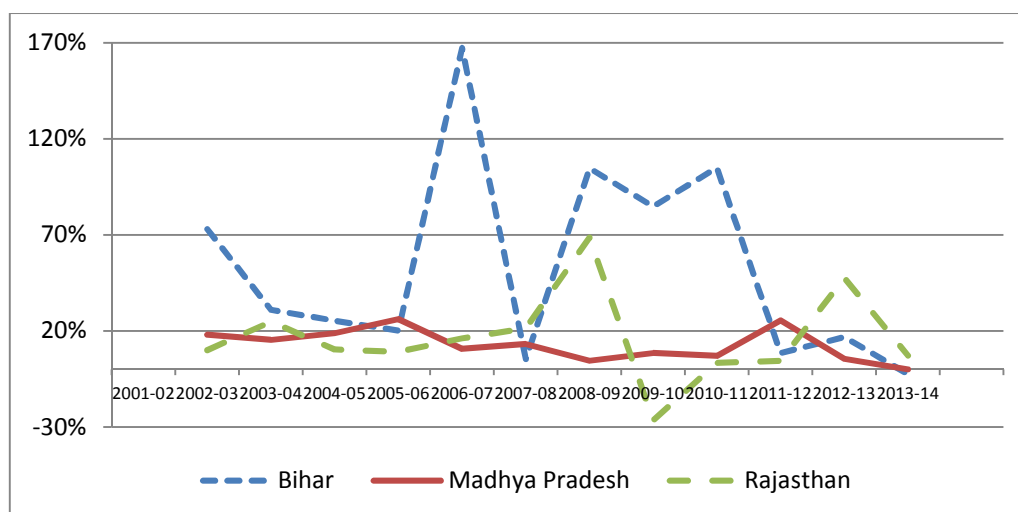


Figure 6 Growth pattern in artificial insemination carried out in 3 states

The variation in growth rates in milk production across states is possible as the animals and farmers in each state are subjected to different factors of production especially rain. Productivity and milk production in India have been operating under the constraints of low farmer knowledge/expertise, declining water table, insufficient fodder (Mani and Intodia, 2014). In addition, lack or high cost of credit and insurance to small holders may be acting as dampeners from achieving higher growth and broad basing dairy farming.

Pricing strategy at the farm gate is expected to have little implications on milk supply in the short-term as it is biologically not possible to bring more number of animals under production. Even for improving productivity of existing animals in the short-term, technology, skills and money are required. Hence, the short-run elasticity of milk supply is different and smaller than the long-run elasticity. Short-run elasticity varied from 0.07 to 0.16, whereas long-run elasticity varied from 0.14 to 2.43 indicating that long-run effects are more pronounced (Chavas and Klemme, 1986). However, if there is frequent variation in the farm gate price, farmers get a confusing price signal rather than a consistent one and hence its effect on the incremental growth in milk supply may tend to become unclear, in the short-term and long-term.

The predominance of buffalo milk in the total milk production of the country is expected to continue in the near future as female buffalo population was 46% of total female bovine population (Rajeshwaran et al., 2014). Further, they have also shown improvement in their

productivity, yielding 4.8 litres per day in 2012-13 (Table 4). In 2012-13, milk produced by crossbred cattle, indigenous cattle and buffaloes was in the ratio of 25:22:53 while their population was in the ratio of 15:38:46, respectively (Table 1).

Dairy animal type	Animals in milk ('000)		Milk production ('000 MT)		Average milk yield (kg/day)
	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		

Source: MoA, GoI

Table 3 Bovines in milk, milk production and average milk yield in 2012-13

However, there is a serious issue as regards its population growth. Export of carabeef, meat from buffaloes has shown a consistent increase over the last few years. India is today the world's largest exporter of frozen meat from bovines followed by Brazil and Australia^{vi}. Officially, cow slaughter is banned in 24 states and India exports only carabeef, that is meat from buffaloes. Export of meat from bovines increased by 205% in quantity and by 441% in value, over a 6-year period from 2009-10 to 2014-15^{vii}. It was the largest product sold from India with an export value of Rs. 28,027 crore, second only to rice which was valued at Rs. 48,026 crore^{viii} in 2014-15 (Table 4). Its export in 2015-16 had declined by about 20% and worth 4 billion USD^{ix}. Commenting on the decline in exports, the Minister of Commerce and Industry, Government of India assured in the Parliament on 11 May 2016 that the government shall make efforts to increase export of meat and meat products from India.

The danger to the growth in buffalo population is also corroborated by the fact that the lifting of ban on export of buffalo tallow in December 2014^x, led to an export of 2.7 million tonnes of the tallow between April and August 2015^{xi}.

Year	Quantity (Lakh MT)	Value (Rs.'000 crore)
2009-10	4.64	5.18
2010-11	7.16	8.51
2011-12	9.65	13.48
2012-13	10.55	16.63
2013-14	13.88	25.17
2014-15	14.16	28.03
2015-16 (upto Dec)	9.68	19.82

Source: Ministry of Commerce, GoI

Table 4 Export quantity and value of beef from India

Hence, future growth rate in domestic milk production may be constrained by reduction in female buffaloes, due to high rate of culling. However, buffalo may gain preference over cow as their male calves and unproductive females are saleable commodities.

It is to be mentioned here that the domestic market for animal proteins is also on an upward trend and beef is the first alternative for red meat especially for those in the low income group as it is highly price competitive compared to mutton or chevon.

To get a better perspective of the growth in milk supply, we look at another metric used to measure growth which is per capita milk consumption.

Per capita milk availability

India is said to have crossed the milestone of the world average per capita availability of 295 grams per day per person^{xii}, reaching 322 grams in 2014-15. From 2009-10 and 2014-15 it grew at 3.4% on CAGR basis ^{xiii xiv}, whereas the estimated growth rate in consumption for 2015 is 4.8%^{xv}. This again indicates that the present growth in milk production is sufficient to meet the increased needs of growing population for more animal proteins including milk. For a more detailed analysis of the growth in milk supply, we need to understand its two major factors: increase in herd size and improvement in productivity.

Female dairy animal population

As our discussion is focused on growth in milk production, we restrict our analysis to only female bovine population. As per the Quinquennial census, the CAGR of total adult female animal population reduced from 2.17% to 0.94% per annum during the periods 2003 to 2007 and 2007 to 2012, respectively^{xvi}. Specifically, the CAGR of adult female buffaloes,

indigenous cattle and crossbred has come down from 1.94% to 0.95%, from 2.28% to – 0.66% and from 7.68 to 6.15%, respectively. Similarly, growth in young female stock also came down except for buffalo which increased from 2.1% to 3.1% (Figure 6). So, even though there is an increase in the total number of female bovine animals by 147.6 lakh between 2007 and 2012, the 19th Livestock Census (2012), clearly indicates a 1.5% reduction in the CAGR of both adult and young female stock during the period from 2007 to 2012 against the earlier period of 2003 to 2007.

The halving of growth rate of adult female buffaloes is a matter of serious concern as more than 53% of milk production in India comes from buffaloes and any reduction in the growth of their number can be a serious deterrent to the expected incremental growth in total milk production in the country.

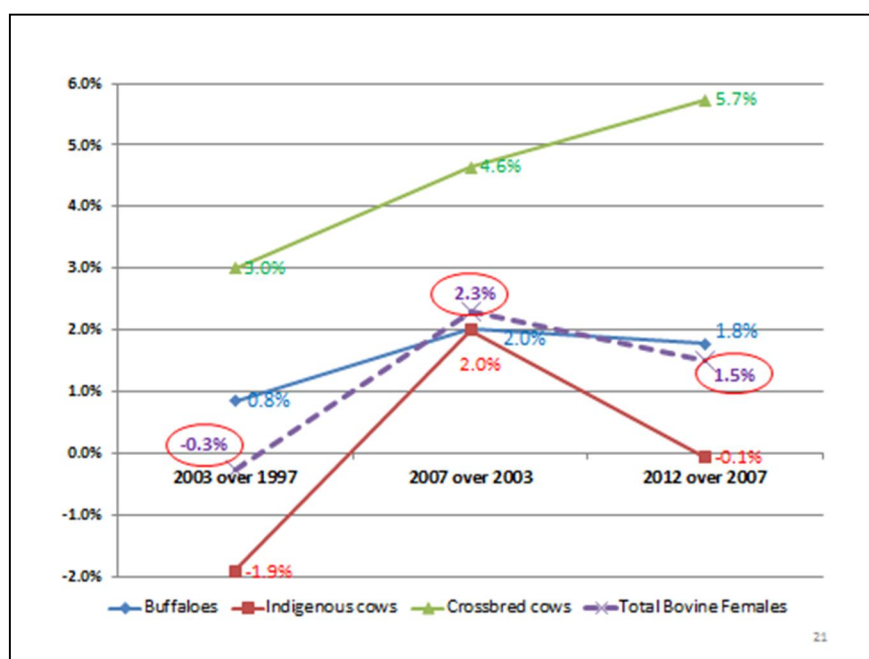


Figure 7 Growth rate of female bovine female animals

Galukande et al. (2013) from their meta-analysis of breeding programmes across the world conclude that crossbreeding would continue to be an important livestock improvement tool in the tropics, especially where farmers are able to provide higher input and managerial requirements and there is ready access to the milk produced. Their conclusion is supported

by data on milk procurement by the Mysore district cooperative milk producers union, where the crossbred cow population in 2012 was 47% and contributed 64% of the milk^{xvii}.

Requiring higher managerial and technical inputs these high producing animals are concentrated with big farmers. In October 2016, the Union collected 1.5 lakh kg of milk per day from 8807 number of dairy farmers who are its members, from the H.D. Kote taluka. Decile analysis of the milk supplied from this taluka shows that bottom 10% of farmers supplied less than 1% of total milk whereas the top 10% of farmers supplied nearly 36% of total milk. The decile ratios and the Lorenze curves indicate a high inequality in terms of income from milk. This inequality in terms of Gini coefficient is 0.49.

Cross-breeding was used for breed improvement in the tropics more than 300 years ago when exotic cattle were introduced into Sri Lanka. (Buvanendran and Mahadevan, 1975). Galukande et al. referring to earlier studies with a special mention about India, clearly caution that despite impressive improvement in milk yield combined with high demand for milk in the tropics, well-organised and successful breeding programmes remain few in number.

This may be the reason though crossbreeding programme has been well-established in India for over 50 years, only 15% of adult female cows in milk are crossbred and contributing 25% of total milk production in the country. Buffaloes continue to be the mainstay for milk in India.

The growth in number of female animals could also be adversely affected by high number of distress sale especially by small farmers who may find it unremunerative to rear them, either because of lower income or high cost or a combination of both. Further, an increase in the scrap value of the animal can lead to increased sale for slaughter and negatively affect the growth in female bovine population.

Productivity per animal

The second factor of growth in milk production is the rise in productivity per animal. During the 12-year period from 2000-01 to 2012-13, it increased at a CAGR of 0.77%, 1.82% & 1.32% for crossbred cows, indigenous cows and buffaloes, respectively. We find that the

indigenous cows have shown maximum growth rate while buffaloes showed a moderate growth rate, indicating their untapped potential of their germplasm in milk production. The crossbred cows have shown the least growth rate in improvement in productivity of less than 1% per annum, although it is the crossbred cow that gains maximum attention of policy makers, in terms of large-scale implementation of artificial insemination network. In 2012-13, their average milk yield per day was 7.02, 2.36^{xviii} and 4.8 kg per day.

Productivity growth from another perspective has two major components (Good et al., 1993), of which technological progress played a major role and technical efficiency a minor role (Ahmad and Bravo-Ureta, 1995).

Blayney and Mittlehammer (1990) find in their study of USA where intensive system of rearing of animals is practiced, that even when the profitability is adversely affected by increased input costs and decrease in milk price, milk production did increase by 2.6% per annum due to shift in production function and efficient input allocation in response to technology-induced opportunities. Such an outcome may be difficult to come by in India as majority of our animals are reared under extensive farming system. Small dairy farmers with little or no land, graze their animals on common pasture lands. In fact, grazed pasture is a major source of nutrients for dairy animals in most parts of the world due to its near zero cost (Doyle and Stockdale, 2011).

Feeding of concentrates to such grazed animals has been found to have a positive effect on milk production (Leddin et al., 2009). Hence, some proportion of the incremental growth in milk supply in 2014-15 could have come from feeding high cost concentrate feeds. However, the increase in milk yield to the quantity of concentrate fed to a cow is not linear but a quadratic function. So, additional growth in milk yield from feeding of concentrates is going to become more costlier and may be even cost-ineffective as reduced marginal milk production responses have been reported beyond a certain level of feeding (Stockdale et al., 1987; Walker et al., 2001).

The diminishing returns could also be due to inefficiencies in rumen fermentation when high levels of grain are ingested quickly (Dixon and Stockdale, 1999; Wales et al., 2000) and ruminal pH levels goes below 6.0 impairing digestion (Leddin et al., 2010) and reducing milk production (Doyle et al., 2005). In fact, some farmers in India rearing high yielding crossbred

cows are known to feed regularly sodium bicarbonate to neutralise the acidity created by feeding high level of concentrates.

Milk Price:

We now move our discussions to the price of milk, which is the meeting point of demand and supply at the market place. There are three price lines for milk operating independently, indicating a broader policy concern. First is the price as received by the farmer, the farm gate price. The second is the price as faced and paid for by the consumer, the retail price. The third is the wholesale price which is the spot market rate of processed milk purchased in bulk, by milk marketers from milk processors. The Government of India tracks builds and tracks the Wholesale Price Index (WPI) for milk at the national level and the retail price in major towns and cities. Little or no data on the farm gate price received by farmers is captured on a regular basis.

We first analyse the movement of WPI for milk at the national level.

Wholesale Price Index:

Wholesale price (WPI) is the price of milk traded in bulk between processors and marketers and is highly competitive. The Government of India tracks the wholesale price of milk city-wise, across the country and calculates the WPI of milk. It has risen at a CAGR of 10.5% in the 8-year period from April 2006 to March 2014. This is more than twice the rise in the previous 8-year period from April 1988 to March 2006^{xix} of CAGR of 4.7% (Rajeshwaran et al., 2014).

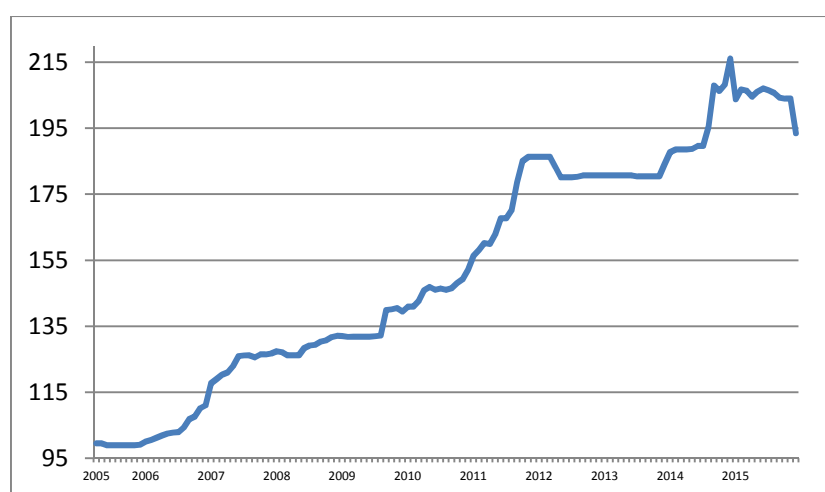


Figure 8 Wholesale Price Index of Milk 2005 to 2015

This accelerated and unprecedented rise post 2009 upto 2012 (Figure 8) can be attributed to disparity between growth in domestic production and consumer demand. This was triggered by lifting the ban on export of skim milk powder (SMP) in 2007-08 and permitting unlimited export, without ensuring a minimal domestic buffer stock required to maintain the price line. Thus, the country by the summer of 2009 was left with less than the required stock required for reconstitution to liquid milk to cater the domestic market and hold the price line.

The recent softening in the rise of WPI Milk is on account of a glut in domestic market for SMP due to reduction in its price in the international market by 50%. During the two-year period from April 2014 to February 2016, the price has risen only by 4.5% on CAGR basis. From August 2014, the WPI of milk has infact barely risen. While the rise of WPI milk has come down to 4.5% from a historic high of 20% on Year-on-Year basis, its fall-out effect on the consumer price still continues.

Consumer price:

Consumer price of milk has been on a steady and continuous uptrend without even a single down tick. Such is the strong hold of the oligopsonic market. As an example, we analyse the retail sale price of toned milk of Mysore milk union. It moves up in a staircase like motion from Rs.13 in Jan 2005 to Rs.33 per litre. There are two periods of stagnation (Figure 9) but the price has never dropped. The period between 2010 and 2014 shows the maximum increase.

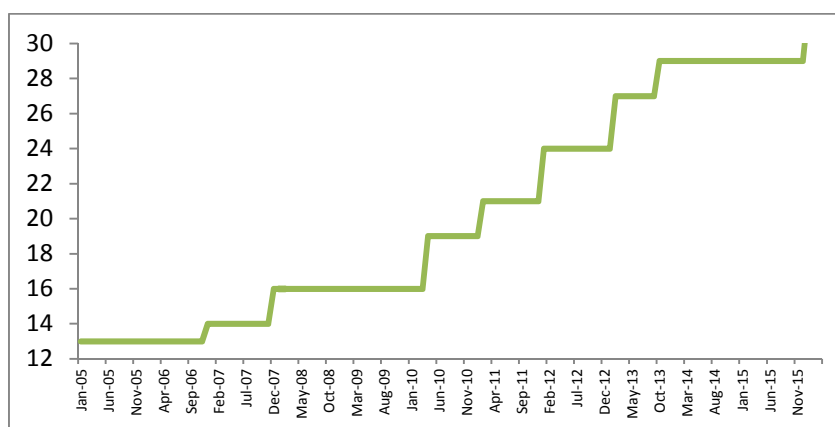


Figure 9 Retail price of Toned Milk in Mysore (Rs./lt)

Today, processed and packed milk is generally available in all major cities, towns and even villages at all times of the day. Hence, it is only the milk price or rather the price inflation of milk that is of importance and concern to the consumer. Consumer price of milk is not affected by increased milk supply (production) due to the oligopsonic structure of the market. As a result, the demand of the consumer does not get translated to the demand faced by the producer. Hence, the uni-directional increase in consumer milk price has only a minimal role, if any in enhancing milk production. The last rise in the retail price by the Mysore cooperative milk union was effected in Jan 2016, when it was increased by 14%, Rs.4 per litre

The consumer price of standardised milk (4.5% fat and 8.5% SNF) in various parts of the country varies from Rs.37 to Rs.49 per litre, whereas full cream milk price varies from Rs. 42 to Rs. 50 per litre for the milk sold by the cooperative dairies in Jan 2016 (NCDFI, 2016). The private dairies generally charge a premium of Rs. 4 to 10 per litre over and above the price charged by the cooperatives.

Farm gate price of Milk:

Farm gate price of milk, as received by the dairy farmer is the most important factor at the micro level that affects the total milk production in the country, both in the short term and long term. The price varies from state to state, district to district and over time and is also dependent upon the type of milk purchaser. Hence it is difficult to correlate the farm gate price received by farmers at the micro-level with the macro-level growth in total milk production in the country.

Recently, farm gate prices are said to have reduced by 25% to 30% by some private dairies in North India. From a price of Rs. 40 per litre of buffalo milk, it is said to have reduced to Rs. 30 per litre. In Maharashtra, where farmers were receiving Rs. 27 per litre, the price reduced to Rs. 19 per litre by April 2015. This was expected to have further come down by Dec 2015^{xx}. The recent drop in price has caused much concern amongst farming community and attributed to the lower price realisation of SMP.

As an example of farmgate price, we analyse the nominal farmgate price as received by farmers in Mysore district. We find that there is a high variation, especially in the recent

past. This volatility sends out confusing signals to the dairy farmer with regard to production of milk in the short term and rearing of animal itself, in the long term indicating that dairy animal rearing is becoming more risky as the price of milk itself is not assured. In contrast, as seen earlier, the consumer price of milk has shown a steady increase, indicating a clear disconnect between the two.



Figure 10 Farm gate price of milk received by Mysore milk union members

It is to be mentioned that the price indicated in the farm gate price figure includes the milk production incentive being paid by the Karnataka State Government for milk supplied by dairy farmers to dairy cooperative. It was Rs.4 per litre in March 2016.

If we deflate the nominal price with the Consumer Price Index for Rural Labour in Karnataka to obtain the real farm gate price, the real price received by the farmer, in December 2015 was Rs.10.20 per litre of which Rs.2.70 in real terms was the state Government incentive.

The caveat here is that a nominal rise in milk price is a necessary but not sufficient incentive for farmers to rear more number of dairy animals and produce more milk, as there are other constraining factors (Rajeshwaran et al., 2014).

We finally proceed to analyse the most important macro-level factor that determines milk prices both at the consumer and farmer end, as well as in the short term and long term, which is the domestic buffer stock of SMP.

Buffer stock of SMP:

The importance of buffer stock in managing a food commodity price is well-brought out by Anand et al. (2016), while analysing the rise in the price of wheat in India. The reason for the sustained rise of wheat price is attributed to the level of buffer stock in the central pool, which had come down to 50% of the norm required, by mid-2007. The inflationary pressure on wheat price is said to have been aggravated long after global prices fell, by policy decisions on fertiliser subsidy and minimum support prices. As a result, the domestic price continued to rise. They surmise in their study that during 2007-10, food inflation outpaced non-food inflation by nearly 30% amounting to an additional 7.5 percentage points per year. We have a similar situation in the case of milk, wherein milk price inflation was caused by a drop in the domestic buffer stock of SMP arising from removal of ban on export leading to a drastic fall in the domestic buffer stock. Here also, as in the case of rice, WPI of SMP continued to rise long after its international price fell and only after August 2015 do we see its pace slow down.

The importance of buffer stock of SMP on milk price rise was clearly recognised by the Government of India. In Feb 2007, after a 10-fold increase in export quantity of SMP, the cabinet committee called for the creation of a 10,000 MT domestic buffer stock and banned exports till the end of lean season in September 2007. Simultaneously, a ban on export of SMP was also enforced, specifically to control the domestic milk price rise^{xxi}. This ban was lifted on 8 June 2012^{xxii} and export of SMP then touched a record high of 1.24 lakh MT in 2013-14^{xxiii}.

The WPI of SMP in India has grown at a CAGR of 6.9% from December 2005 to December 2015. It had peaked at 216 in December 2014 and come down to 193 in December 2015. It is expected to further come down, in line with the softening of its price in the international market. This in addition to a high level of unsold stock of SMP (Krishnamoorthy, 2015) may be causing a negative impact on farm gate milk price (Basu, 2015).

Analysis of domestic stock of SMP in the country for the calendar year from 2004 to 2010 reveals that the variation remained between 5,000 and 15,000 MT, indicating that there was

no undue build-up of stocks. The export was triggered by a 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.

We also find support for the rise in milk price as a result of fall in buffer stock of SMP, again from a study on sudden price rise for cereals in China in 2008 (Alexandratos, 2008).

As of now, all SMP exporting countries including India are burdened with unsold stocks of SMP. Exports from India though permitted are also near zero, on account of global glut in SMP and its low price level^{xxiv}. The present growth rate of 6.25% in milk production may also have contributed to this high stock level as it results in lock up of working capital for the milk processors and even loss of capital, if they are spoilt or sold under duress. This may be one of the reasons why farmers are receiving reduced farm gate price.

Conclusion:

India has achieved a historic high growth rate of 6.25% in milk production in 2014-15 reaching 146.3 million tonnes. This is indeed an achievement for a country that is the world's largest milk producer and consumer contributing 17% to the world total and with a high demand growth and managing to remain self-sufficient in general. To the extent that this growth would go to meet the growing demand for milk and milk products is a good indicator and a boon. This growth in milk production has to be viewed against the average increase at 3.93% on CAGR basis, over the previous period from 2006-07 to 2013-14.

For this level of growth of over 6% per annum to continue in a consistent manner and benefit vast rural number of households, it needs to be more broad based spread and over more number of states. For this, we need to study and analyse the dairy sector specific policies and strategies adopted by these two states, analysing milk production by buffaloes, Indian cows and crossbred cows, individually in terms of number of female adult animals and productivity increase.

The matter of concern in this historic growth is that only two states Rajasthan and Madhya Pradesh with 17.5% of total production have contributed maximum showing a growth of over 12%. Further the reduction in growth rate of adult female bovine population as indicated by the 2012 quinquennial report is also to be considered as it may have an adverse effect on the growth of milk production.

This growth is a bane, as it is causing a negative backlash on the demand for fresh milk on account of large quantity of unsold stock of skim milk powder produced in the previous year, due to lower price realisation than cost of production. This is especially in view of the low international price and unlimited import / export. So, unless and otherwise some means of disposing of this stock of powder is found and adopted, this high growth in milk production would not be in the interest of dairy farmers and consumers in India.

India today is in an advantageous position of having the necessary skills, manpower and infrastructure to process milk across the country and has a fast growing private sector with own funds. Further, it has a large population of bovine animals to produce milk and their full potential still remains largely untapped (Nimbkar and Kandasamy, 2011), with low production levels and few farmer owned and managed local breed improvement programmes and no proper animal identification and information system. Most importantly, there is a seasonal variation in the quantum of milk produced with a near constant but growing milk consumption enabling the industry to produce the SMP required domestically in the flush season and use it in the subsequent lean season. In fact, this is the very foundation on which the entire modern Indian dairy industry was built and by which India became self-sufficient inspite of being the largest consumer of milk in the world.

Therefore, the factors that led to high growth in the three states need to be studied and learnt from for replicating in the other states. Only this ensure that India remains self-sufficient in milk catering to the growing in domestic demand, as priority.

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