DAIRY ECONOMY OF INDIA: STRUCTURAL CHANGES IN CONSUMPTION AND PRODUCTION

Ramphul Ohlan, Institute of Management Studies and Research
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Ramphul Ohlan
Maharshi Dayanand University, Rohtak, India

Abstract: India remains the world’s largest producer and consumer of milk. The present study empirically evaluates the transformations in demand and supply of dairy products in India, identifying that the share of dairy products in the food basket has significantly increased among both rural and urban consumers. While demand for dairy products is highly elastic and related to income, the analysis also shows large regional disparities in production and per capita availability of milk in India. After examining various aspects of dairy consumption and production patterns in India, the article also includes policy considerations to improve dairy production. It suggests that to stimulate dairy sector development and reduce inequality in dairy products consumption in India, milk and milk products should be included in the diet provided through the Midday Meal Schemes for primary education children. Overall, to meet the growing demand for dairy products, given their role in food security, the Government of India should continue to aim for sustained growth.

Keywords: Agrarian development, consumption, dairy sector, food security, India, livestock, Midday Meal Schemes, milk market, rural economy

Introduction: Importance of the Dairy Sector
The dairy sector is undoubtedly an important component of India’s rural economy in terms of income, employment, equity, socio-economic development, nutritional food security, women’s empowerment and also foreign exchange earnings. The sector has opened new income opportunities for rural households and is an important instrument to fight poverty and improve the nutritional intake of rural families (Government of India, 2011). Dairy products contributed about 6.4 per cent of calorie intake in rural and 8 per cent in urban India in 2009–10, while their contribution in protein intake was 9 per cent in rural and 13 per cent in urban areas for the same period.
Milk and dairy products are a major source of cheap and nutritious food to millions of Indians (Ohlan, 2012a).

The dairy sector in India has witnessed remarkable growth, which is demand-driven, inclusive and pro-poor. India is the world's largest producer and consumer of milk. With a production of 121.8 million tonnes in 2011, it accounted for 16 per cent of the world's total milk production (Ohlan, 2014a). In 2010–11, 29.64 per cent of India's agricultural gross domestic product (GDP) originated in the livestock sector, with the dairy subsector accounting for approximately 70 per cent of livestock output. India's vast resource of livestock plays a vital role in improving the socio-economic conditions of the rural masses. In addition, the dairy sector provides a large window of self-employment opportunities, particularly for women. More than 60 per cent of families involved in dairying belong to the small and marginal farming sector or are even agricultural labourers. Estimates of employment in animal husbandry suggest 11.44 million persons in principal status and 11.01 million in subsidiary status, which is 5.50 per cent of the total workforce in the country. Out of these 22.45 million persons engaged in animal husbandry, 16.84 million (75 per cent) are women, showing that the dairy sector fuels much-needed women's empowerment and inclusive growth. As India is also a net exporter of dairy products, in the emerging liberalised farm trade order, the dairy sector holds great promise as a major source of foreign exchange earnings, with India's dairy exports valued at ₹54,797.42 lakh in 2010–11 (Ohlan, 2014b).

It is because of rapidly increasing disposable incomes, market development, population growth, urbanisation, changes in lifestyles and dietary preferences, increased health, nutrition and diet concerns, together with the growing popularity of dairy products that the demand for milk and milk products has been growing fast in India (Ohlan, 2013a). There is still greater need for butter, ghee, cheese, skimmed milk and other dairy products. It is well documented that consumption patterns in India have been undergoing dramatic shifts in food demand, away from staple food grains to high-nutrition higher-value commodities like fruits, vegetables, milk, meat and eggs (Ali, 2007; Tripathi & Srivastava, 2011; Wiley, 2011). In terms of the share in consumers' monthly total food consumption expenditure, dairy products rank second after cereals with a share of 19.16 per cent in urban India in 2009–10 (NSSO, 2012).

As a chief source of incomes and nutritious food for the majority of India's rural poor (Verma et al., 2007), the dairy sector is also crucial for food security. About 70 per cent of India's population lives in rural areas. In 2007–08, about 73 per cent of rural households owned livestock. Small and marginal farmers account for three-quarters of these livestock-owning households, raising 56 per cent of the bovine and 66 per cent of the sheep population. Dairying has been considered one of the activities aimed at alleviating poverty, especially in rural areas in rainfed and drought-prone regions (Ohlan, 2011). Rural poverty is less in states like Punjab, Haryana, Jammu & Kashmir, Himachal Pradesh, Kerala, Gujarat and Rajasthan where dairy accounts for a sizeable share of agricultural income and employment. For small and marginal producers, the dairy sector also serves as a productive store of wealth, providing drought power...
and organic fertilisers to improve crop production. Given milk’s nutritional quality, growing evidence exists on the role of dairy foods in reducing risks of numerous medical disorders (Sarkar, 2008). The nutritional value of milk is especially high as part of the diets of growing infants and lactating mothers. Continuing population growth and rapid inclusive economic growth are expected to drive dairy product demand up sharply.

India has the world’s largest dairy herd, comprised cows and buffalos and the dairy sector is expected to contribute as an engine of agricultural growth in India’s 12th Five-Year Plan (2012–17) and beyond, given the rapid growth in demand for animal and food products. India’s programmes of rural development and economic liberalisation open significant market-led opportunities for the dairy industry. For example, flagship programmes such as the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA), with an annual union budget allocation of US$ 6.6 billion in 2012–13, created income opportunities at the bottom of the economic pyramid, which is likely to have contributed to increasing demand for milk and milk products. Overall, as Indians become more affluent, the demand for dairy products is expected to increase. To meet the fast growing demand for milk and milk products, milk production in India needs to be increased.

OECD-FAO (2012) in their joint outlook estimate the average growth rate of global milk production for the next decade, 2012–21, at 2 per cent, only slightly below the 2.1 per cent increase witnessed in the last decade. Most of this growth is anticipated to come from developing countries and India and China alone account for nearly 40 per cent of these anticipated gains. Dairy product use, expected to increase by about 30 per cent by 2021, is driven by increasing population, income levels and the growing influence of retail chains and multinational companies, which facilitate improved consumer access to such products. Such cross-sector connections confirm that in-depth understanding of the dynamics of India’s dairy product distribution and consumption is invaluable for academic exploration as well as policy formation.

Improving the milk production growth rate to meet projected demands is a key developmental challenge facing the Indian dairy sector today (Government of India, 2012b). But how can this growth rate be enhanced? And, even if India achieves the targeted milk output levels, is the availability of milk across various regions symmetric? More importantly, is dairy product consumption across various income groups equally distributed? What are the recent trends in domestic prices of dairy products in India? Are changes in composition of the livestock population desirable? A comprehensive study to address these key questions is lacking and an evaluation of India’s milk and milk products consumption pattern with the latest available data is warranted. As the Indian dairy sector is characterised by high fragmentation and is dominated by the unorganised sector, comprising 70 million rural households, it will also be informative to explore how the unorganised sector may be converted into a more organised one. Against this comprehensive backdrop of concerns and questions, the modest objective of the present study is twofold. First, to analyse significant recent structural changes and inequality patterns in the consumption of dairy products in India needs to be increased.
India, and second, to investigate the supply-side changes in the dairy sector in India. The concluding analysis aims to introduce some new ideas for improving access to milk and milk products.

Methodology and Sources of Data

The impact of changes in disposable income on consumption of dairy products in India was analysed by estimating the Engle curve in the log-linear form over a period of four decades, 1970–71 to 2009–10. In order to quantify the inequality in dairy products consumption across different income classes in both rural and urban areas in India, we applied two most widely used measures of inequality, the Gini coefficient and the Robin Hood Index. Details of these econometric methods and of the results are not presented here, however, and may be obtained directly from the author.

The current study is based on using various primary and secondary data. The data on milk and milk products consumption and consumer’s expenditure (proxy of income) were collected from India’s National Sample Survey Organisation Report (NSSO, 2011). The data on dairy production in India were taken from the official websites of the Food and Agriculture Organization (see OECD/FAO, 2012). The annual data on milk production and per capita availability at both national and state levels were taken from government statistics about basic animal husbandry (Government of India, 2012b). Data on domestic prices of dairy products in India were harvested from the official website of the Office of the Chief Economic Advisor, Ministry of Commerce and Industry, Government of India, New Delhi. The period under analysis for various aspects of dairy economy is selected based on the availability of the requisite latest data. The data used here have a high reputation and large acceptance in research and policy analysis.

Food Consumption Patterns

Examining the transformation in demand for dairy products in India, we use the NSSO (2011) data. A useful mechanism to predict the possible future changes in demand for dairy products is to study the temporal change in the expenditure on milk and milk products across the country. Table 1 illustrates trends in the estimates for food consumption patterns in India on a rural–urban basis in terms of percentage share of various food items in total monthly per capita consumption expenditure (MPCE) for all income classes over the period 1987–88 to 2009–10.

Table 1 reveals that food continues to dominate consumer expenditure. Within food items, cereals remain dominant in both rural and urban areas; however, their share in consumers’ total food expenditure has continued to fall throughout the last three decades (see also Ali, 2007). This decline is largest among all the item groups, from 41.25 per cent to 29.29 per cent in rural India and from 26.77 per cent to 22.36 per cent in urban India. Similarly, the share of food expenditure in total consumer expenditure has registered a marked decline from 64 per cent in rural India and 56.4 per cent in urban India in 1987–88 to 53.6 per cent in rural India and 40.7 per cent in urban India in 2009–10, a decline of 10.4 and 15.7 percentage points respectively.
## Table 1  Consumption Pattern of Food Items, 1987–88 to 2009–10

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk &amp; milk products</td>
<td>13.44</td>
<td>15.03</td>
<td>14.79</td>
<td>15.43</td>
<td>16.04</td>
<td>16.84</td>
<td>17.92</td>
<td>18.16</td>
<td>18.59</td>
<td>19.16</td>
</tr>
<tr>
<td>Cereals</td>
<td>41.25</td>
<td>38.45</td>
<td>37.48</td>
<td>32.85</td>
<td>29.29</td>
<td>26.77</td>
<td>25.78</td>
<td>25.89</td>
<td>23.76</td>
<td>22.36</td>
</tr>
<tr>
<td>Grams</td>
<td>0.31</td>
<td>0.32</td>
<td>0.17</td>
<td>0.18</td>
<td>0.37</td>
<td>0.35</td>
<td>0.37</td>
<td>0.21</td>
<td>0.24</td>
<td>0.25</td>
</tr>
<tr>
<td>Pulses &amp; products</td>
<td>6.25</td>
<td>6.01</td>
<td>6.39</td>
<td>5.63</td>
<td>6.90</td>
<td>6.03</td>
<td>5.48</td>
<td>5.85</td>
<td>4.94</td>
<td>6.63</td>
</tr>
<tr>
<td>Fruits &amp; nuts</td>
<td>2.50</td>
<td>2.69</td>
<td>2.86</td>
<td>3.45</td>
<td>2.99</td>
<td>4.43</td>
<td>4.94</td>
<td>5.01</td>
<td>5.18</td>
<td>5.16</td>
</tr>
<tr>
<td>Sugar</td>
<td>4.53</td>
<td>4.91</td>
<td>4.03</td>
<td>4.36</td>
<td>4.48</td>
<td>4.26</td>
<td>4.39</td>
<td>3.34</td>
<td>3.53</td>
<td>3.69</td>
</tr>
<tr>
<td>Salt &amp; spices</td>
<td>4.53</td>
<td>4.27</td>
<td>5.04</td>
<td>4.54</td>
<td>4.48</td>
<td>4.08</td>
<td>3.66</td>
<td>4.59</td>
<td>4.00</td>
<td>3.69</td>
</tr>
<tr>
<td>Beverages, etc.</td>
<td>6.09</td>
<td>6.65</td>
<td>7.06</td>
<td>8.17</td>
<td>10.45</td>
<td>12.06</td>
<td>13.16</td>
<td>13.36</td>
<td>14.59</td>
<td>15.48</td>
</tr>
<tr>
<td>TFE (Rs/month)</td>
<td>101.2</td>
<td>180.8</td>
<td>289.3</td>
<td>307.9</td>
<td>510.8</td>
<td>141.0</td>
<td>254</td>
<td>410</td>
<td>469</td>
<td>755</td>
</tr>
<tr>
<td>TFE as % of TCE</td>
<td>64.0</td>
<td>63.2</td>
<td>59.5</td>
<td>55.1</td>
<td>53.6</td>
<td>56.4</td>
<td>54.7</td>
<td>47.9</td>
<td>42.5</td>
<td>40.7</td>
</tr>
</tbody>
</table>

Source: Author’s calculation based on NSSO (2011) data.

Notes: TFE = total food expenditure, TCE = total consumer expenditure.
The research undertaken here confirms that milk and milk products are the second most important items in consumer food expenditure. They commanded a share of 16.04 per cent in rural and 19.16 per cent in urban India in 2009–10, up from 13.44 per cent in rural and 16.84 per cent in urban India in 1987–88. It turns out that the expenditure on milk and milk products has grown in both relative and absolute terms. Furthermore, dairy products constitute a larger share in consumer expenditure in urban centres than in rural areas. On average, growth in dairy product consumption in urban areas is steady and higher, compared with rural areas.

The reverse has been observed for pulses and grams. This confirms that urbanisation has led to lower total pulses consumption, but higher dairy product use. This increased share of milk and milk products in total food expenditure has been accompanied by growing shares of beverages, fish, meat, vegetables, fruits and nuts, perhaps partially due to higher inflation in the prices of fish, meat, vegetables and fruits. Other major items in the consumer food basket include edible oils and sugar. Over the last two decades, the share of milk and milk products in consumers’ food expenditure has clearly increased in both urban and rural areas. These results, indicating that with increasing income levels the composition of food consumption has witnessed considerable changes, too, lend further support to the finding of Jones et al. (2003), who argue that income changes affect not only the level, but also the composition of food consumption. In parallel, Table 1 also shows that within total consumption expenditure, Indian consumers spend more on non-food items such as durables and services. The shares of non-food items rose from 36 per cent to 46.4 per cent for the rural population and from 43.6 per cent to 59.3 per cent in urban areas since 1987–88.

As reported by the Government of India on nutritional intake in India (NSSO, 2012), between 1993–94 and 2009–10, the contribution of milk and milk products to protein intake rose from 3 per cent in the lowest decile class to 15 per cent in the highest in the rural sector and from 5 per cent to 18 per cent in the urban sector among the same income deciles. Similarly, the share of milk and milk products in total calorie intake grew by about 1.4 per cent in urban sectors and 0.6 per cent in rural sectors during the same period. Likewise, rural sectors record an increase of about 1 per cent in the contribution of milk and milk products to protein intake, while the corresponding urban figure is 2 per cent. This confirms that dairy products have become increasingly important food items in both rural and urban areas in India during the last two decades.

Concerning state-level variations in dairy products consumption, it has been observed that 4 of the 17 major states have a rural population with per capita expenditure markedly higher than the national rural average. Rural Haryana has nearly four times the national average, rural Punjab more than three times and rural Rajasthan and Gujarat each show one and a half times to over twice the national average. Rural Uttar Pradesh and Madhya Pradesh have per capita expenditures close to the all-India average. In all other 11 major states, the per capita expenditure of the rural population on milk and milk products is appreciably less than the national average.
An analysis of information on cereal consumption patterns against total consumer expenditure by population deciles (NSSO, 2011) shows that with upward movements in consumption deciles the share of dairy products in total food expenditure increases considerably, whereas the share of other food items declines in rural areas. Similarly, the share of total food expenditure of the top income decile consumer in his total consumption expenditure is low. Expenditure on dairy products increases from ₹14.84/month to ₹213.33/month as expenditure (proxy of income) rises from ₹404.6/month to ₹2,330.6/month, a 1337.53 per cent jump. It may be noted here that in absolute terms also, this figure is highest among all other food items. This indicates buoyant dairy products demand with income growth. Different types of food products indicate quite different consumption behaviour in relation to income. Dairy products, in particular, show sustained rise with higher incomes.

For urban areas, however, regarding consumer expenditure at bottom decile, the share of milk and milk products in consumers’ total food expenditure as noted is higher than in rural areas. At higher levels of consumer expenditure, dairy products become major food items. As in rural areas, in urban zones as well, the share of dairy products in consumers’ total food expenditure increases significantly with an increase in expenditure levels. Expenditure on dairy products increases from ₹34.25/month to ₹295.32/month as expenditure rises from ₹554.7/month to ₹5,608.19/month, a 762.25 per cent growth. In absolute terms, too, spending on dairy products is much higher in urban areas than in rural areas, irrespective of expenditure decile. Given this evidence that in both rural and urban areas, dairy product consumption has risen significantly with growing income levels, economic development and poverty alleviation everywhere, particularly in rural areas, will have a large positive effect on dairy product demand in India. Demand growth would be sharper if incomes of the upper deciles of the population were to rise significantly.

Milk Utilisation Patterns in India

Analysing now the product-wise milk utilisation pattern in India, Table 2 shows that, in various forms, milk has long been an integral part of local food ways and confirms that the share of liquid milk has significantly increased.

This table confirms above all the significant position of liquid milk as an important component in Indian diets. Apart from drinking milk directly, Indian tea and coffee consumers use plenty of milk. Nearly 46 per cent of the total milk produced in India is consumed as liquid milk, while the remaining 54 per cent are converted into various dairy products, both traditional and Western, such as butter, milk powder, ice cream, cheese and condensed milk, or is used for making various kinds of sweetmeats, with distinct regional preferences. Traditionally, much milk was converted into ghee, used as a cooking medium mainly in the Indian sub-continent, and also the chief dairy product exported from India. The share of traditional Indian dairy products is about 50 per cent. The rather low 4 per cent share of Western dairy products reflects that for lower income groups in particular, preference for traditional Indian dairy products remains strong.
The responsiveness of demand for dairy products with respect to change in income was also analysed using time series data derived from various NSSO rounds of household consumption surveys from 1970–71 to 2009–10. Details of these analyses are not reproduced here and may be obtained from the author. The income elasticity of demand worked out to be less than one in both rural and urban areas. This finding reveals that over time, milk and milk products consumption would rise significantly with income growth, especially in rural areas. These results are sharply different from those reported in Gandhi and Zhou (2010) and Rakotoarisoa and Gulati (2006). Clearly, though, income growth is likely to translate into a sizeable demand for milk and milk products.

Movements in Domestic Prices of Dairy Products

We first note that the domestic price index of all dairy products has exhibited an uninterrupted rising trend. It picked up from 99.4 in 2005–06 to 165.69 in 2011–12. As shown in Table 3, this upward movement in the dairy products price index is equal to a compound annual growth rate of 9.13 per cent. According to our estimates, during 2005–11, the price of raw milk has grown faster than other dairy products, showing a compound annual growth rate of 11.44 per cent. It is closely followed by ghee, with a compound growth of 11.35 per cent a year.

The annual growth in price index was registered as 8.98 per cent for butter, 8.84 per cent for powder milk, 5.40 per cent for condensed milk, but notably only 2.90 per cent for ice cream. The domestic prices of dairy products are influenced by a

<table>
<thead>
<tr>
<th>Dairy Products</th>
<th>Powder Milk</th>
<th>Ghee</th>
<th>Butter</th>
<th>Ice Cream</th>
<th>Condensed Milk</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>*<em>1943</em></td>
<td>8.84*</td>
<td>11.35*</td>
<td>8.98*</td>
<td>2.90*</td>
<td>5.40*</td>
<td>11.44*</td>
</tr>
</tbody>
</table>

Source: Author’s calculation.
Note: * indicates that growth rate is statistically significant at 1 per cent level.
number of factors, including: (1) the cost of production and domestic supply of milk, (2) the consumer demand for milk and its various product forms, (3) seasonality in milk production and (4) dairy products import and export policies. No one of these dominates in the pricing of dairy products but each contributes in some measure to the complex dairy products pricing process. A comparison of domestic price index of dairy products with that of the international price index brings out that international prices of dairy products have fluctuated over the years, while domestic prices in India exhibited a consistent rise. The fact that the fluctuations in international prices of dairy products have not been transmitted into the Indian markets may partially be due to government regulation on the trade of dairy products in India. Overall, it may be concluded here that the international prices of dairy products have been more volatile than Indian domestic prices. This offers some security to the milk producers.

**Transformations in India’s Dairy Products Supply**

As outlined in the introductory section, the performance of the dairy sector in India during the last four decades has been really impressive. From being a recipient of massive food aid from the World Food Programme and the World Bank, India has rapidly positioned itself as the world’s largest producer of milk, progressing from a situation of scarcity to one of plenty. Milk production in India, including the milk of cows, buffaloes, goat, camel and sheep, has grown steadily, increasing from 17 million tonnes in 1950–51 to 31.6 million tonnes by 1980, then jumping to 128.9 million tonnes in 2011–12, a 304.75 per cent increase. Credit for this goes largely to the successful implementation of the White Revolution, in conjunction with other dairy development programmes implemented by state and central governments. This transformed India from a country of acute milk shortage to the world’s largest producer and has elevated the per capita availability of milk from 112 gm/day to 289.4 gm/day during the same period. This is now comparable with global per capita availability of milk at 289.31 gm/day for the same period (Ohlan, 2014a). Still, this is insufficient for a large lacto-vegetarian populated country like India. Backed by strong domestic demand, per capita availability of milk is anticipated to reach 336 gm/day in 2017 (Ohlan, 2014b).

As reported by the Government of India (2012a) in the National Dairy Plan-Phase 1, by the end of the 12th Five-Year Plan in 2017, demand for milk is expected to increase to 155 million tonnes, reaching 200 million tonnes by 2020–21. To achieve these targeted output levels, the required growth rate of milk production would be over 5 per cent annually for the next 15 years, while milk production grew by about 3.5 per cent per year in the recent past (Ohlan, 2013b). Unless milk production increases significantly, as planned, there may be adverse effects on self-sufficiency. A larger demand–supply gap could lead India to become a net importer of dairy products in the near future. The growth trends in production and per capita availability of milk in India during the last six decades are shown in Figure 1.
Figure 1  Trends in Production and Per capita Availability of Milk in India

Source: Author's calculation.
Ohlan: Dairy Economy of India

It is seen from this figure that throughout the 1950s and 1960s, India's milk production was virtually stagnant, and annual production growth was negative in many years. Thereafter, however, it has grown substantially, so that overall, Figure 1 above reveals a substantial growth momentum in milk production, which results in higher availability of milk and milk products for India’s growing population. The per capita availability of milk, which increased slightly from 130 gm/day in 1950 to 132 gm/day in 1955, started to decline in 1960 and dropped to 110 gm/day in 1973. Thereafter, however, it started to improve, increasing substantially during the 1980s and 1990s, to reach 222 gm/day in 2001. The per capita availability of milk has reached a level of 281 gm/day in 2010, still slightly lower than the world average of 284 gm/day. In 2011–12, it stands at about 289 gm/day, just comparable to the world average (Ohlan, 2014a), but not considered sufficient for the large lacto-vegetarian population of India.

Table 4 provides the decade-wise compound annual growth rates of total milk production in India over the period 1950–2010. Throughout the 1950s and 1960s milk production in India was virtually stagnant and annual production growth was negative in many years.

The compound annual growth rate of milk production was 1.64 per cent per annum during the decade of 1950s, declining to 1.15 per cent during 1960–73. As discussed, this resulted in a downward trend in per capita availability of milk, which was already quite low. The growth rate of milk production then increased from 1.15 per cent per annum during 1960–73 to 4.51 per cent per annum during 1973–80 and further to 5.48 per cent per annum during 1980–90. It declined again slightly to 4.11 per cent per annum during 1990–2000 and improved again to 4.5 per cent per annum during 2000–10.

It seems that the resulting expansion of the dairy sector in India has been achieved through two noteworthy evolutions: First, the successful implementation of the White Revolution programme in conjunction with other dairy development programmes implemented by the state and central governments. Second, growing demand was driven, as indicated in the introduction, by increased population, higher incomes, growing urbanisation, rural development programmes like the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA), export opportunities and changing food habits, including heightened awareness about the benefits of milk consumption. This development was accompanied by an even more marked increase in the number of dairy species and improvement in milk yields. It represents sustained growth in the availability of dairy products for the increasing

Table 4 Compound Annual Growth Rates of Milk Production in India

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<tr>
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</thead>
<tbody>
<tr>
<td>Growth Rate</td>
<td>1.64*</td>
<td>1.15*</td>
<td>4.51*</td>
<td>5.48*</td>
<td>4.11*</td>
<td>4.5*</td>
</tr>
</tbody>
</table>

Source: Author’s calculation.
Note: * indicates that growth rate is statistically significant at 1 per cent level.
population of the country, apart from being an important source of income for the rural poor.

Regarding the cost of milk production, India is a competitive producer in the world. India’s average cost of milk production on a farm of two cows was reported to be US$ 23 per tonne in 2006. The corresponding figures for Switzerland and Finland were US$ 86 and US$ 72 per tonne, respectively. However, India’s milk processing industry is not price-competitive, which is why India needs import regulations for dairy products (Ohlan, 2012b).

Concerning annual growth trends in production of dairy products, we note from the available data that the production of butter and ghee has not seen any setback during the last decade in terms of volume, which increased more than threefold, from 1.04 lakh tonnes in 1990 to 3.38 lakh tonnes in 2011. The production of skimmed milk powder (SMP) has also exhibited a rising trend, but witnessed a marked fluctuating trend over the last decades. It increased from 30,000 tonnes in 1990 to 90,800 tonnes in 1996. Afterwards, it jumped from 132.93 in 1998 to its peak of 165.88 in 1999, before declining again to 128.58 in 2001. Thereafter, it again began to grow and reached 163.01 thousand tonnes in 2008. During 2009–11, SMP production in India has experienced a declining trend, dropping to 132.62 million tonnes in 2011, which may partially be due to a ban on export of SMP.

Decomposition of Milk Growth

The relative contribution of the number of milch animals, their yield and the interaction with changes in milk production in India in percentage term are presented in Table 5. The results of the decomposition analysis suggest that during 1980–2011, on average, growth in milk production has mainly been because of an increase in the numbers of dairy species, a contribution of 40.62 per cent, rather than yield.

During the 1990s, the animal effect declined to 27.29 per cent, and consequently the milk production growth rate also remained sluggish at 4.60 per cent per annum for the same period. During the 2000s, the compound annual growth rate of number of animals improved slightly from 1.31 per cent during the 1990s to 1.83 per cent during the 2000s, but yield declined faster from 3.24 per cent to 2.20 per cent during the same period. Therefore, the compound annual growth rate of milk

Table 5 Decomposition of Milk Production Growth in India, 1980–2011

<table>
<thead>
<tr>
<th>Time</th>
<th>Yield Effect (%)</th>
<th>Animal Effect (%)</th>
<th>Interaction Effect (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980–2011</td>
<td>27.86</td>
<td>40.62</td>
<td>31.52</td>
</tr>
<tr>
<td>1980–90</td>
<td>17.28</td>
<td>73.78</td>
<td>8.94</td>
</tr>
<tr>
<td>1991–2000</td>
<td>62.05</td>
<td>27.69</td>
<td>10.27</td>
</tr>
<tr>
<td>2001–11</td>
<td>37.80</td>
<td>48.52</td>
<td>13.68</td>
</tr>
</tbody>
</table>

Source: Author’s calculation.
production has not increased. It is abundantly clear, then, that to accelerate the growth tempo of milk production, India urgently needs to increase the number of dairy animals and their yield. While milk production in India has overall increased significantly during the last three decades, there remains much room for qualitative improvement. Additionally, it is imperative to understand the regional patterns of milk supply growth in India.

**Regional Patterns of Milk Growth**

In this regard, we note large variations in milk production within the country. The chief contributors are the northern and western regions, together accounting for almost 65 per cent of India's total milk production. The contribution from the East is extremely low at 12 per cent in 2010. The Basic Animal Husbandry Statistics (Government of India, 2012b) show that over the last decade, the northern and southern regions have experienced a decline in their relative contribution to national milk production, while the share contributed by the eastern region has increased. The western region has maintained its position.

An analysis of state-wise shares of milk production shows that over 80 per cent of India's total milk production comes from ten states, namely Uttar Pradesh, Andhra Pradesh, Rajasthan, Punjab, Gujarat, Maharashtra, Madhya Pradesh, Bihar, Haryana and Tamil Nadu. There have been some notable shifts in the shares of different states. In 2000–01, the top five milk producing states were Uttar Pradesh (17.19 per cent), Punjab (9.65 per cent), Rajasthan (9.25 per cent), Maharashtra (7.26 per cent) and Andhra Pradesh (6.85 per cent), accounting for more than half of India's total milk production. In 2010–11, Uttar Pradesh remained the largest producer (17.95 per cent) with about 20.2 million tonnes, followed by Andhra Pradesh (10.4 million, 9.27 per cent), Rajasthan (9.5 million, 8.48 per cent), Punjab (9.3 million, 8.34 per cent) and Gujarat (8.8 million, 7.86 per cent). The shares of Uttar Pradesh, Andhra Pradesh, Gujarat, Madhya Pradesh, Bihar, Jharkhand, Delhi and Nagaland increased between 2000–01 and 2010–11, while the share of Rajasthan, Punjab, Maharashtra, Haryana, Tamil Nadu, Karnataka, West Bengal, Kerala, Orissa and all other smaller states and territories declined during this period. The major milk producing regions in the country have good resource endowment and infrastructure. As noted, the eastern region is still lagging behind in terms of dairy development.

Overall, there are large variations in the contribution of different states in total milk production in India. Table 6 illustrates the distribution of leading milk producing states according to average annual growth rates in milk production during the 1980s, 1990s and 2000s.

During the 1980s, none of the major milk producing states witnessed less than 3 per cent growth rate, and five states had a growth rate of 3–5 per cent, while 12 states experienced more than 5 per cent growth in milk production. However, during the 1990s, there was a deceleration in the milk production growth rate and five states
registered a growth rate of less than 3 per cent. During the 2000s, the number of states that witnessed less than 3 per cent growth rates increased from 5 during the 1990s to 11 during the 2000s. These include: Uttarakhand (2.7 per cent), West Bengal (2.5 per cent), Tamil Nadu (2.4 per cent), Punjab (2.3 per cent), Haryana (2 per cent), Chhattisgarh (2 per cent), Jammu & Kashmir (1.9 per cent), Himachal Pradesh (1.8 per cent), Assam (1.2 per cent), Karnataka (0 per cent) and Kerala (–0.8 per cent).

As noted above, the compound annual growth rate at the national level is recorded at 4.5 per cent. In Madhya Pradesh (4.4 per cent), Uttar Pradesh (4.3 per cent), Rajasthan (3.2 per cent) and Maharashtra (3 per cent), the milk production growth rate was between 3 to 5 per cent. Only Bihar (12.1 per cent), Orissa (8.4 per cent), Andhra Pradesh (7 per cent), Jharkhand (6.6 per cent) and Gujarat (5.6 per cent) recorded more than 5 per cent compound annual growth rate. The average annual growth rate of milk production is higher in eastern states and lower in northern states. Overall, the above discussion confirms that the growth rate of milk production in India has been sluggish during recent years.

Table 6  Compound Annual Growth Rates of Milk Production in Major Milk Producing States, 1981–2010

<table>
<thead>
<tr>
<th>Growth Rate (%)</th>
<th>1980s</th>
<th>1990s</th>
<th>2000s</th>
<th>1981–2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>–</td>
<td>Assam, Bihar, HP, MP and WB</td>
<td>Uttarakhand, WB, TN and Punjab, Haryana, Chhattisgarh, J&amp;K, HP, Assam, Karnataka and Kerala</td>
<td>WB, TN, HP, Assam and Kerala</td>
</tr>
<tr>
<td>3–5</td>
<td>AP, Assam, Haryana, Orissa and Rajasthan</td>
<td>Gujarat, Haryana, Kerala, Maharashtra, Punjab, Rajasthan, TN and UP</td>
<td>MP, UP, Rajasthan &amp; Maharashtra</td>
<td>UP, J&amp;K, Rajasthan, MP, Maharashtra, Punjab, Haryana and Karnataka</td>
</tr>
<tr>
<td>5</td>
<td>Bihar, Gujarat, HP, J&amp;K, Karnataka, Kerala, MP, Maharashtra, Punjab, UP and WB</td>
<td>AP, J&amp;K, Karnataka and Orissa</td>
<td>Bihar, Orissa, AP, Jharkhand and Gujarat</td>
<td>Bihar, AP, Gujarat and Orissa</td>
</tr>
</tbody>
</table>

Source: Author’s calculations.
Notes: Andhra Pradesh (AP), Himachal Pradesh (HP), Jammu & Kashmir (J&K), Madhya Pradesh (MP), Tamil Nadu (TN), Uttar Pradesh (UP) and West Bengal (WB).
The average per capita milk availability remains lower in eastern and southern states and higher in northern states. This may partially be attributable to (a) food habits, (b) density of bovine population, (c) agricultural practices and (d) human population pressure. The average per capita availability of milk during the triennium ending in 2010 was highest in Punjab (952 gm/day), followed by Haryana (642 gm/day), Gujarat (402 gm/day), Rajasthan (401 gm/day), Jammu & Kashmir (377 gm/day), Uttarakhand (364 gm/day), Himachal Pradesh (357 gm/day), Andhra Pradesh (319 gm/day) and Uttar Pradesh (278 gm/day). Only nine states had higher than national per capita availability of milk.

According to official figures (NSSO, 2011), in 2009–10 the average per capita expenditure on consumption of milk and dairy products was lower in rural areas (₹80.55) as compared to urban areas (₹137.01). This may partially be due to lower prices of milk and lower per capita incomes in rural areas. However, the relative share of milk products in the total per capita monthly expenditure in rural areas (7.64 per cent) is likely to be higher than in urban areas (6.9 per cent), also given the larger presence of the informal sector at that level. Generally, these results indicate considerable disparities in the level of milk production and per capita availability across different states, and they are consistent with an earlier study (Sharma, 2004).

However, the level of per capita milk availability provides only a statistical picture, which is not likely to be directly valid for any group of people. It is therefore instructive to examine the extent of inequality in dairy products consumption. This was analysed by the author using the Gini coefficient and Robin Hood Index. Again, details of this are not provided here and may be obtained from the author. It was found that inequality in dairy products consumption was higher in rural areas than in urban areas. A comparison of Gini coefficients from the 2009–10 survey with those obtained from the survey of 2004–05 brought out that intersection disparity in dairy products consumption slightly declined in both rural and urban areas of India over the last decade, but the gap was still wide.

**Growth of Livestock Population in India**

This section discusses the growth pattern of livestock population in India, which owns one of the largest livestock populations in the world. According to the most recent livestock census undertaken in 2007, the country has about 199.1 million cattle and 105.3 million buffaloes. The Basic Animal Husbandry Statistics (Government of India, 2012b) indicate that with 56.7 per cent of the world’s buffaloes, 12.5 per cent of cattle, 20 per cent small ruminants, 2.4 per cent camels, 1.4 per cent equines, 1.5 per cent pigs and 3.1 per cent poultry India ranks first in respect of buffaloes, second in cattle and goats, third in sheep, fifth in ducks and chickens and tenth in camel population in the world.

According to those figures, between 1951 and 2007, India’s livestock population increased from 292.9 million to 529.7 million. The cattle population increased from
155.3 million to 175.1 million during the same period. A decline in the total cattle population has been observed during 1992–2003, however. Notably, this was mainly due to a reduction in the population of male cattle, probably due to increasing mechanisation of agriculture in India.

Right since 1970, when the ‘Operation Flood’ programme was introduced by India’s National Dairy Development Board (NDDB), the share of adult female cattle in the total cattle population has exhibited a rising trend (Gautam & Pathak, 2010), confirming the importance given to maintaining adult female cattle for milk production. The adult female cattle population grew by almost 0.6 per cent per year between 1951 and 2007, while the adult female buffalo population grew more than four times faster (2.8 per cent per year) during the same period. The adult female buffalo stock witnessed a particularly significant acceleration in growth tempo (4.06 per cent per year) during 1982 to 1987. The rate of increase in the adult female cattle (3.29 per cent per year) population was highest between 2003 and 2007 among all the periods considered. It appears that the importance of adult female buffaloes in the Indian dairy sector is increasing. The buffalo share in the total bovine population increased from 11 per cent in 1951 to 18 per cent in 2007. On average, the total livestock population has grown faster than the bovine population, whose share in total livestock population has come down from 68 per cent in 1951 to 57 per cent in 2007.

Ohlan (2013b) observed that in 2009–10, India’s major milk species were buffalo (53 per cent), cow (43.3 per cent) and goat (3.7 per cent). While buffaloes yield less milk than crossbred cows, the buffalo population recorded a faster growth rate than cattle. Nevertheless, the faster increase in yield from increasing adoption of crossbreed cows has resulted in the relative share of cows and buffaloes remaining constant. Based on the foregoing analysis, it may be argued that adoption of crossbred cows can provide a valuable growth momentum to milk output in India. It may be added here that milch animal holding is far more equitable than land holding and, as noted, the cost of milk production by smallholders in India remains competitive. Overall, it may be concluded here that in order to foster the growth of milk production in India, there is an urgent need for increase in the growth rate of female cattle.

**National Dairy Plan**

To increase the depth of analysis and connect the subject to national policy planning, a brief introduction to India’s National Dairy Plan (NDP) is pertinent here. To meet the projected national demand of 150 million tonnes of milk by 2016–17, the Government of India, with assistance of the World Bank, has launched a National Dairy Plan (NDP) with an outlay of ₹1,760 crore,4 out of which ₹1,584 crore come from International Development Association (IDA) credit and ₹176 crore is the Government of India’s share. The NDP envisages increasing the productivity in existing herds through a focused programme for breeding and feeding. The first phase of the NDP will be implemented over a period of six years, during 2012–13 to 2018–19, with two main
objectives: (a) to increase the milk production by improving productivity through scientific breeding and nutrition and (b) to enhance the market access of small rural milk producers through the organised milk-processing sector for sale of surplus milk. The NDP will focus on 14 leading milk producing states, namely Punjab, Haryana, Andhra Pradesh, Maharashtra, Gujarat, Kerala, Uttar Pradesh, Rajasthan, Karnataka, Odisha, West Bengal, Bihar, Madhya Pradesh and Tamil Nadu. The scheme will be implemented by the National Dairy Development Board through End Implementing Agencies (EIAs) located in the states. Under the NDP, steps will be taken to expand village-based procurement systems by strengthening existing cooperatives and facilitating the setting up of Producer Companies or New Generation Cooperatives. The plan is expected to put in place a scientific approach and a systematic process that will take the country on the path to improving the genetics of milk producing animals and encourage the use of modern, proven technologies in milk production. The government’s important schemes/programmes for meeting the growing demand for milk include (1) an intensive dairy development programme, (2) strengthening infrastructure for quality and clean milk production, (3) assistance to cooperatives and (4) a dairy entrepreneurship development scheme.

Concluding Remarks and Outlook

This article evaluated the recent transformations in demand and supply of dairy products, investigated regional patterns of milk growth and per capita availability, trends in domestic prices of dairy products, the impact of changes in income levels on consumption of dairy products in both rural and urban areas and the variations in dairy product consumption at various income levels in India. The study documents a constant rise in demand for dairy products in India. The consumption patterns of dairy products illustrate increased consumption of milk and milk products in both rural and urban areas, with the average consumer expenditure remaining lower in rural than in urban areas. As consumer expenditure on dairy products rises rapidly with expenditure levels in both rural and urban areas, at higher expenditure level, milk and milk products dominate consumer food expenditure, while within the dairy products group, liquid milk continues to hold a dominant share. The prices of dairy products have witnessed a sharp upward movement during the last decade and demand for dairy products is shown to be highly responsive to changes in disposable incomes in both rural and urban areas. One may conclude overall that the performance of the dairy sector in India has been very impressive during the last three decades. Milk production and per capita availability have increased more than three and twofold, respectively. However, the growth in milk production declined during the 1990s compared to the 1980s, and did not fully recover even during the 2000s.

Large variations in production and per capita availability of milk exist across various regions. The northern and western regions account for almost two thirds of the total milk production, while the contribution from the East is extremely low. However, the
average annual growth rate of milk production in eastern states has been increasing and has outpaced that of northern states during the last decade. Nonetheless, the average per capita milk availability is still lower in eastern and southern states and higher in northern states. This implies untapped milk growth potentials in eastern and southern regions, suggesting that especially in the eastern region, milk production may still be increased.

Finally, we observe that in recent years, the growth tempo of the adult female cattle population has declined while that of the adult female buffalo population has improved. Overall, the share of bovines has declined while that of bovines has increased during the last five and a half decades (see also Ali & Pappa, 2015). Significantly, the male bovine population has declined whereas the number of productive female bovines has increased, showing a shift towards bovines as milch animals. Faster adoption of crossbred cows may further augment the supply of milk in India. The implication is that there is an urgent need to develop a long-term appropriate breeding policy.

The article also identified that the utilisation patterns of milk in India is very different from that in many Western countries, the primary reason being conventional dietary habits of Indian households. Consumption of milk in India is skewed towards liquid milk, with around 46 per cent of milk consumed in liquid form, while around 50 per cent of total milk production is converted into various dairy products and only 4 per cent of total milk production is used for Western dairy products.

Regarding the benefits of milk consumption, an important further policy connection is made here regarding the provision of milk for school children. It is well known that with a view of achieving universal primary education of satisfactory quality for all schoolchildren below the age of 14, enhancing enrolment, retention, attendance and simultaneously improving nutritional levels is a desirable policy. India runs Midday Meal Schemes for primary schoolchildren, mainly through government-owned schools. It is widely documented that government-run schools in India are dominated by children from low-income families, girls, low caste children and other underprivileged children (Aggarwal, 2000; Kumar et al., 2005: 1551). In order to reduce inequities, including the inequality in dairy product consumption across various income levels, milk and milk products should be included in the diet provided through the Midday Meal Scheme under the National Programme of Nutritional Support to Primary Education. This would help to alleviate malnutrition among children in India.

Finally, it may be added here that the world dairy market is very thin, as 86 per cent of the world’s milk production does not enter international trade (Ohlan, 2012c). Based on the present findings, it may be suggested that to meet the growing domestic demand of an increasing population for milk and milk products, the Government of India should continue to focus on sustained growth of milk production. To increase overall milk supply in India and speed up dairy product generation, Ohlan (2012c) earlier suggested several key measures which have lost none of their relevance: (1) increase in the adoption of crossbreed cows, (2) developing farmers’ own milk processing and packaging capacity, (3) developing dairy hubs for smallholder farmers, (4) remunerative prices to milk producers, (5) strengthening and expanding village-level
infrastructure for milk procurement, (6) providing milk producers greater access to the market in the dairy sector, (7) use of scientific practices, (8) strengthening infrastructure for quality and clean milk production, (9) upgrading of veterinary health services, (10) improvements in fertility, (11) adequate availability of feed and fodder in all seasons and (12) building market institutions to commercialise dairy production.

Notes
1. One lakh is 100,000.
2. On changing household consumption patterns, see Mathew and Goyari (2011).
3. Even if one considers the supply of synthetic milk, prepared by emulsifying vegetable oils with appropriate amounts of detergent and urea products in Indian dairy markets, it may be concluded that India has not yet achieved self-sufficiency in milk production despite being a net exporter.
4. One crore is 10 million.

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**Ramphul Ohlan** is an Assistant Professor (Stage II) of Economics in the Institute of Management Studies and Research at Maharshi Dayanand University in Rohtak, Haryana, India. He holds a PhD in Economics from Kurukshetra University and has contributed to several international journals. His main research interests lie in international trade laws, WTO, dairy economics and equity in South Asia.

Address: Institute of Management Studies and Research, Maharshi Dayanand University, Rohtak 124001, Haryana, India. [e-mail: ramphul.ramphul@gmail.com]