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INDIA'S White Revolution

Achievements and the Next Phase

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India's White Revolution Achievements and the Next Phase*

Introduction

Dairy sector in India has shown very impressive growth since the beginning of Operation Flood launched in 1970. Before this, milk production was not even keeping pace with the growth in population in the country. Because of this, per capita milk output declined from 132 grams in 1955-56 to 110 grams in 1973-74. This led to serious shortage of milk and milk products in the country, like shortage of staple food during mid 1960s which led the country to go for adoption of green revolution technology.

There are many parallels between Green Revolution and White Revolution both of which have played laudable role in the socio-economic transformation of the country especially of rural areas. This paper discusses and compare achievements of white and green revolution and significant developments in other segments of agriculture to draw lessons for future growth and development of dairy sector. The second part of the paper briefly presents the roadmap and vision for the next phase of dairy sector.

MAJOR ACHIEVEMENTS IN AGRICULTURE

The bitter experience of food shortages during mid and late 1960s coupled with unreliability and high cost of food import brought agriculture to the centre stage of policy and development strategy in the country. This led to significant decisions in favour of technology, institutional set up, infrastructure, policy support, favourable regulation, and series of farm friendly initiatives in almost all segments of agriculture. This policy support and other measures yielded quick results and India achieved significant improvement in self-sufficiency in staple food (rice and wheat) – the import of cereals was reduced to almost zero by mid 1980s.

The green revolution initially covered wheat and rice. These two crops, even after initial phase of their adoption, occupied around one third of gross cropped area and constituted one fourth of value of agriculture (crop plus livestock) in early 1980s. Thus, initial spread and success of green revolution covered only small segment of food and agriculture though with big impact. Thus, simultaneous efforts were started in early 1970s to increase productivity and production of other crops and livestock especially dairy and poultry. A big initiative named “Operation Flood” was launched in year 1970 to increase milk production in the country.

Like shortage of cereals during 1960s, India became very heavily dependent on import of edible oils during 1980s. Then national Oilseed Mission was launched in 1986

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Disclaimer: Views expressed in the paper are personal.

which resulted in doubling of oilseeds production in the country within a decade. This was termed as yellow revolution, though this growth momentum could not be maintained for long.

A little later i.e. during 1990s and 2000s the country started witnessing accelerated growth in fruits and vegetables, representing variety of colours, which exceeded growth in traditional green revolution crops. Of late, India witnessed very high growth in fish production which is called blue revolution. All these achievements put together constitute what can be described as “rainbow revolution”. Though most of the development literature identifies India’s achievements in agriculture with food grains, which is often equated with green revolution, actually the growth is very diversified and spread over range of products and more pronounced in horticulture, livestock, and fishery.

Growth performance of major segments and major commodities of agriculture and allied sector during the last five decades is presented in Table 1. The table includes growth rate in total output of major food products during the 50 years since 1970-71, divided into two sub periods of 25 years each. Another indicator of performance of agri-food sector is its growth in output relative to growth in human population. This is captured by estimates of per capita production.

Among the three major segments of agriculture, highest growth rate was observed in the case of fishery and lowest in the case of crop sector. Livestock comes in between. During the first 25 years of green revolution highest growth was achieved in egg production followed by milk production. Wheat crop rank third with annual growth rate of 4.21%. These items along with fish followed annual growth rate of more than 4%. Within crop sector lowest growth was observed in case of pulses whose output increased by less than 1% per year which was less than half of growth rate in population recorded at 2.18%. Oil seed, sugar (sugarcane) and fruits showed annual growth rate of 3.84, 3.25 and 3.62 per cent respectively. Total food production in the country increased by close to 3% each year between early-1970s and mid-1990s. This was higher than population growth by 0.8 percentage points. During the next 25 years, ie after mid-90s, total food production accelerated and population growth rate decelerated to 1.53%. Growth rate of rice and wheat and all cereals decelerated in the second phase of green revolution, i.e. during TE 1996-97 to TE 2021-22, but remained higher than population growth. Among cereals, growth rate of maize picked up to 4.8% per annum. Pulses production also showed much better performance in this period which is better than even cereal. Egg and meat production recorded 6.24 and 6.72% annual growth during 25 years after mid-1990s. Fish and milk recorded growth rate of 4.37 and 4.71% per annum. Horticulture crops also witnessed accelerated growth around 4% per year.

As a result of higher growth in food output compared to population, per capita production of total and major food products, except pulses, show moderate to very high increase. Acceleration in growth rate in food output accompanied by slowdown in population increase resulted in significant increase in per capita food output in India. The country produced average 1 kg food per person per day around 1970-71. This increased

to 1.22 kg by mid 1990s. The next 25 years witnessed much higher increase in per capita food production which reached 1.83 kg around year 2020-21.

Per capita maize production fell to 10.5 kg in mid1990s, but, more than doubled in the next 25 years. On per capita basis, India produced 92 kg rice, 80 kg wheat and 208 kg total cereal during triennium 2019-20 to 2021-22. Pulse production at 18.6 kg per person is lower than what it was in the beginning of green revolution. Per capita egg production increased three-fold in the last 25 years while milk production increased 2.16 times. India produces 220 kg fruits and vegetables and 155 kg milk per person. Meat and fish production, though small, shows very high increase.

Table 1: Growth rate in major food items and per capita food production 1969/70 to 2021/22

Item	Compound growth rate in output %		Per Capita Production Kg./Year)		
	TE 1971/72 to TE 1996/97	TE1996/97 to TE 2021-22	TE 1971-72	TE 1996-97	TE 2021-22
Rice	2.63	1.77	77.4	86.4	91.7
Wheat	4.21	2.02	43.3	70.8	80.0
Maize	1.89	4.80	11.2	10.5	23.2
All Cereals	2.61	1.89	171.5	190.6	208.6
All Pulses	0.63	2.54	21.3	14.5	18.6
Oilseeds	3.84	1.84	16.3	24.4	26.4
Sugar Equ.	3.25	1.43	24.2	31.5	30.7
Fruits	3.62	3.82	30.5	43.3	75.6
Vegetables	2.79	4.13	66.3	76.9	144.8
Milk	4.52	4.71	40.6	71.5	154.9
Egg (No.)	6.06	6.24	11.4	29.0	90.0
Meat	3.84	6.72	1.3	1.9	6.6
Fish	4.12	4.37	3.2	5.2	10.3
Total Food	2.98	3.17	367.8	446.5	666.9
Population	2.18	1.53	--	--	--

Source: Author's estimates based on data taken from:

1. Agricultural Statistics at a Glance, GOI, various issues.
2. National Accounts Statistics, CSO, GOI, 2011-12 series.
3. Basic Animal Husbandry Statistics, 2022 and other issues, GOI.

Share in Growth

Another way to look at performance of various commodities and groups is their share in the increase between two points of time. This is presented in Table 2 and uses value of output at constant prices (base 2011-12) to present share of various sub sectors and commodities in total growth in agri-food output between 1970-71 and 2020-21. This should be useful to comprehend and compare achievements of various types of revolutions in agriculture mentioned in the beginning.

All cereals crops taken together account for 13% of total addition in output of agriculture and allied sector during the last 50 years. Out of this, 6.66% was on account of paddy/rice and 5.54% on account of wheat. It looks surprising that contribution of

fishery in agriculture growth of the last five decades is higher than that of paddy or wheat.

Table 2: Growth in different sectors and major products of agriculture and their share in sectoral growth between 1970-71 and 2020-21

Item	Share (%) in total increase in agri & allied output
1. All crops	52.59
Cereals	13.23
Paddy	6.66
Wheat	5.54
Maize	1.32
Pulses	2.36
Oilseeds	4.58
Condiment & spices	3.61
Fruits total	10.64
Vegetable total	6.08
2. Livestock	37.11
Milk	25.26
Poultry	6.30
3. Fishery	7.81
4. Forestry	2.49
5. Total Agriculture and allied	100.0

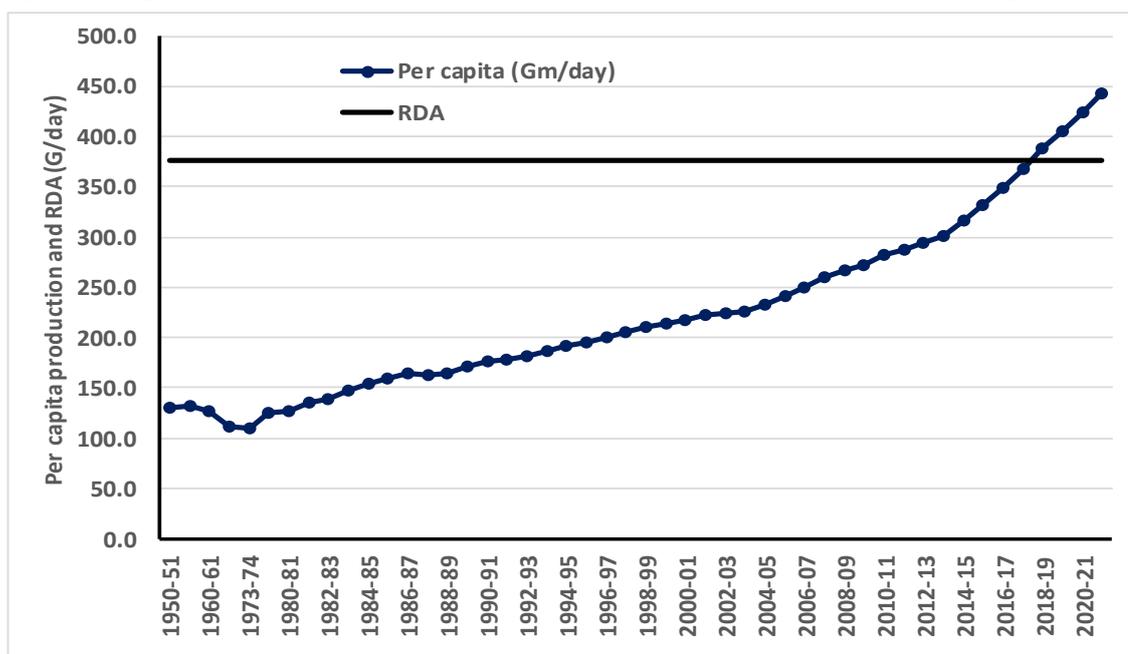
Source: Author's estimates based on data taken from: National Accounts Statistics, CSO, GOI, 2011-12 series.

Milk alone is credited with one fourth of the increase in total output of agriculture and allied sectors between 1970-71 and 2020-21. The share of fruits and vegetables in incremental value of output of agriculture and allied sector was 16.72% which is higher than food grains. These changes show the prominent role of dairy and livestock sector in growth of agriculture in the country. While crop sector still exceeds livestock sector in terms of contribution to food, the latter has made larger contribution to the growth in last 50 years.

White Revolution

Milk output in India increased by meagre 1.36 per cent per year during 1950-51 to 1973-74 which was lower than population growth rate. As a result, per capita availability of milk in the country dropped by 15 per cent in this period resulting into increase in milk deficiency in the country. The shortage was met partly through import and aid in the form of milk powder. GOI launched operation flood in 1970 to achieve breakthrough in milk production. This produced quick results and milk production outpaced population growth after 1973/74 (Fig.1). Fast growth in milk output enabled India to raise per capita milk production to 387 gram per person per day by year 2018-19 which is higher than average Recommended Dietary Allowance for the country.

Fig.1: Per capita milk production in India 1950-51 to 2021-22, and RDA for milk. Gram/person/day



Source: Basic Animal Husbandry Statistics, 2022 and other issues, GOI.

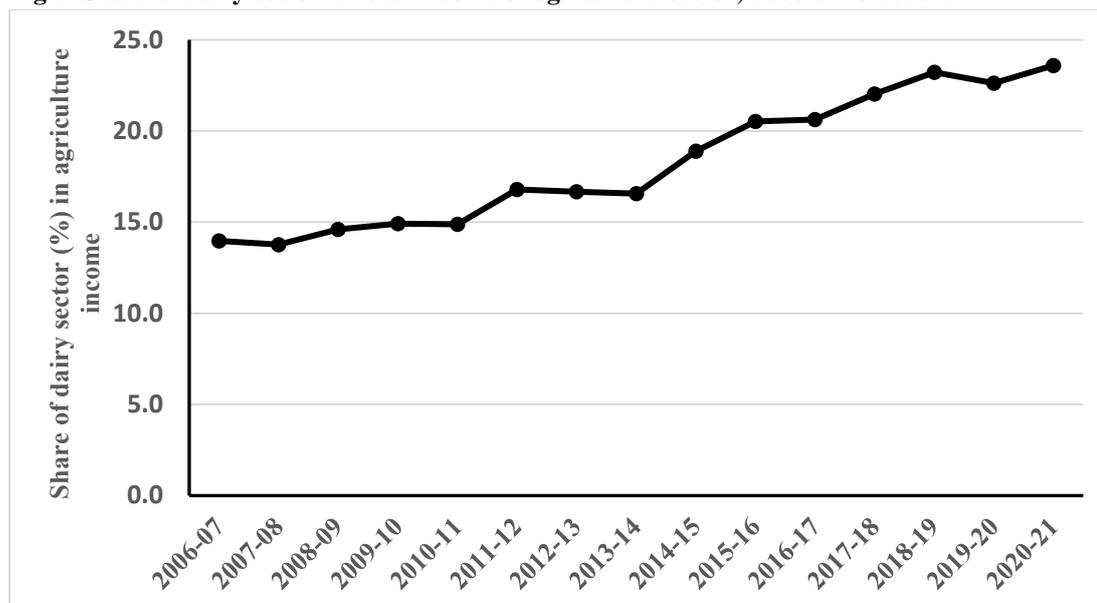
The recent data on milk output shows annual growth rate of 5.3 per cent. It is important to mention that growth rate in milk production accelerated after 2005 when the emphasis has shifted from exotic breeds to indigenous breeds. What is special about growth of dairy sector is the nature and quality of growth. The growth of dairy sector has been pro-poor and pro-women besides being resilient. Second, growth of milk did not require particular endowments, like irrigation, good soil etc. It only required efficient marketing of milk. Where ever, marketing outlets were set up to mop up milk, dairy sector witnessed impressive growth. Cooperatives have played major role in this.

Since the beginning of green revolution, dairy sector has shown higher growth than crop sector throughout. There is enough evidence to show that white revolution has been stronger than green revolution in India. The lead taken by dairy sector over crop sector has increased after liberalisation of domestic and international trade. Further, our milk production is increasing at more than 5 per cent per year and has the potential to grow at even higher rate for a long time, as, productivity of India's milch animals is very low in most of the states of the country.

Till mid-1990s, US topped all countries in milk production. In next 25 years India started producing more than 2 times the milk produced in USA. The share of India in world milk output has almost doubled in last 25 years and the country now produces close to one fourth of world milk output. Other attractive aspects of growth in dairy sector are that it is pro poor and pro women and helping the county to make fast progress towards SDGs. What is more astonishing is that dairy sector is growing without input subsidies and output price support. These achievements are spectacular and no less than a miracle. India needs to draw lessons from the success of dairy sector for replicating similar success in other segments of agriculture and other sectors of economy. Dairy sector contributes

one fourth of the total income generated in agriculture sector and this share has been rising.

Fig 2: Share of dairy sector in total income of agriculture sector, 2006-07 to 2020-21



Source: Author's estimates based on data taken from:
National Accounts Statistics, CSO, GOI, 2011-12 series.

Major factors which contributed to the success of white revolution in India are:

- (i) Institution of cooperatives especially for marketing of milk
- (ii) Investments in milk processing
- (iii) Artificial insemination in cows and
- (iv) Absence of restrictive regulations on milk marketing and trade.

CHALLENGES

Dairy sector faces three major challenges: (i) low productivity of milch animals (ii) increased emission of greenhouse gases by the ruminants, having detrimental effect on climate change and (iii) very low share of export.

Much of the growth in milk output during last 50 years is due to increase in population of dairy animals. This has serious ecological and environmental implications. The number of female bovines in India increased from 122.7 million in 1972 to 246.7 million in year 2019. Thus, while the base of dairy in the country doubled, the base for crop production has not increased (net sown area has remained around 140 million hectare). When this is factored in, the edge that dairy sector has over crop sector reduces significantly but still remains quite large.

Doubling population of female bovine means GHG emission by dairy animals has doubled in the last 50 years. Future emphasis should be to achieve growth in milk output through growth in productivity and moving towards food system approach. This will require improvement in quality of breeds, feeding material and practices, better

upkeep and health of livestock. Increase in productivity is also important from efficiency and competitiveness angles.

Per capita absorption of milk and milk products in the country has almost doubled during the last 20 years. This growth along with the level of intake implies that milk has made highest contribution to improve nutrition in the country.

The success of dairy revolution in India is not translated into export. Dairy export constitutes only 2.6 per cent of India's agri export reported by APEDA (crop plus livestock) which is much lower than 24% share of milk output in value of crop and livestock output. The situation has shown big change in recent years as volume of export of dairy products has increased four times in four years after 2017-18. Dairy export doubled in 2021-22 to reach Rs. 4742 crore and increased by 64 per cent in volume. Still exports are less than 0.5 percent of total domestic production of milk.

THE NEXT PHASE

Per capita production of milk in India has now exceeded the recommended dietary allowance, as recommended by NIN-ICMR, which is 377 gram per person per day. This herald a new phase in India's dairy development. India has already emerged as the largest milk producing nation in the world. Milk production is poised to remain on high growth trajectory as milk yield per animal is very low in most of the states of India.

According to FAO, milk yield of Indian cow is only 2/3rd of the World average (Table 3) and it is much less compared to milk yield in developed countries. World average milk yield per cow is 7.2 kg and India average is 4.87 kg. Even though India is biggest producer of milk the milk yield is quite low. According to GOI estimate average daily milk yield in the country is 5.15kg for cows and 5.9 kg for buffaloes. There is very wide variation in milk yield across states (Table 3). Milk yield of cow range from 1.49 kg in Assam to 13.31 kg in Punjab. Similarly, daily milk output per buffalo varies from low of 1.61 kg in Odisha to 9.63 kg in Haryana. These variations indicate scope to substantially raise cow milk yield in Assam and most of the other NE States, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha and West Bengal.

Increase in productivity needs breed improvement, improved breeding practices like AI, better feeding, and better maintenance and health care of livestock.

The country needs two-pronged strategy on demand side. One, improving nutrition remain priority of the country. This cannot be achieved through cereals as consumers do not show preference to increase intake of cereals. In contrast to this, income elasticity of demand for milk and dairy products is quite high. This shows that preference for milk and other dairy products remain high. Therefore, milk and dairy can help in addressing nutrition deficiency and health outcome especially in children and women.

Table 3: Milk yield per cow and buffalo in various states and World average

State	Cow Milk Yield (Kg/day)	Buffalo Milk Yield (Kg/day)
Assam	1.49	3.45
Arunachal Pradesh	1.67	2.40
Meghalaya	1.73	1.85
Chhattisgarh	2.46	5.21
Jharkhand	2.47	3.66
Manipur	2.53	3.31
Tripura	2.61	3.16
Odisha	3.00	1.61
West Bengal	3.77	4.88
Madhya Pradesh	3.80	4.79
Bihar	4.11	4.67
Uttar Pradesh	4.19	4.50
Nagaland	4.27	3.50
Telangana	4.34	5.60
Himachal Pradesh	4.47	4.13
Uttarakhand	4.67	4.87
Sikkim	5.36	--
Mizoram	5.90	--
Rajasthan	6.28	8.32
Karnataka	6.32	4.31
Maharashtra	6.38	5.26
Tamil Nadu	6.63	3.54
Gujarat	6.82	5.29
Goa	7.01	3.76
Andhra Pradesh	7.63	7.77
Haryana	8.49	9.63
Kerala	9.96	5.20
Punjab	13.31	9.46
India	5.15	5.90
FAO data		
World	7.18	5.31
India	4.87	5.75

Source: 1. Basic Animal Husbandry Statistics, 2022 and other issues, GOI.
2. FAO Stat

Milk production is projected to grow at 6 per cent per year in the country as seen in the last decade. With per capita milk intake already above RDA and population growth falling below 1 per cent, domestic milk demand in future is likely to grow at a lower rate than that witnessed in the recent past. Second, growth in domestic demand is also likely to be lower than growth in production which is quite robust. This will generate some surplus of milk over normal demand and supply. Dairy industry must prepare for channelizing some domestic production to overseas market. It is better if it is done after processing in various products rather than liquid milk alone. This will require some change in investment in dairy industry, including value chain. India can also tap some high-end markets if it can address milk quality and livestock health.

Some countries require compliances with high sanitary and phyto sanitary standards for import of dairy products. There is also requirement in terms of vaccination

and disease-free areas like FMD free areas. Central and State governments are taking some measures in this direction. They need to be upscaled and expanded.

Export of dairy products necessitates India's dairy to be globally competitive. India's dairy industry has been opposing any free trade agreement that involves liberalisation of trade (import) in dairy products. However, if we have to capture overseas markets for disposal of future surplus of milk in the country then we must be export competitive. Being export competitive require higher competitiveness than competing with imports. A country cannot be export competitive if it is unable to compete with imports. This issue is crucial for future growth of dairy Industry in India.

Integrated livestock and crop system have sustained farming in India for centuries. This complementarity and synergy should not be ignored in future development of agriculture sector and dairying. Rather, there is a need to adopt food system approach. It is also important to mention that India is emphasizing shift towards natural farming and organic farming. That seems impossible without using animal dung and urine. Using by products from dairy to produce organic and bio inputs is a win win situation for dairy as well as crop sector.

Dairy industry has not fully harnessed consumer preference for various types and traits of milk. Many consumers in cities want fresh or unprocessed milk. Some want only cow milk. I feel there is scope to develop value chain to meet such demand.

So far, fat content in milk is used as the sole criteria for pricing of milk. Like the measurement and standards developed around fat, it will be worthwhile to develop measurement and standards around other traits like SNF.

In commercial dairy, chemicals are used indiscriminately. This is affecting quality of livestock and milk and also has implications for environment. Studies have shown that urine and dung of animals with chemicals affect soil microbes and greenhouse gas emissions. There is a need to monitor presence of antibiotics in the milk and check it appropriately.

Thanks to various phases of Operation Flood, India is now producing more milk than recommended dietary allowance of 377 gram per person per day. The country has already emerged as largest producer of milk in the world with one fourth of global production. But India's share in global export of dairy products is awfully low. World dairy export in year 2021 was valued at US\$ 63 billion whereas India's export was only \$ 392 million (0.62% of world total). The goal and vision of dairy Industry for the next 25 years, i.e. during *Amrit Kaal*, should be to make India largest exporter of dairy products. This is a tall order, but, looking at the past achievements of dairy sector, it looks attainable though challenging.
