



Prof. S. Kannaiyan Memorial Oration - 2019

*delivered during
11th NABS-National Conference
on*

**“Climate Change Driven Challenges on Indian Biodiversity:
Innovative Solutions for Sustainable Development”**

26-09-2019

at

Convention-cum-Cultural Complex, Pondicherry University



The Bumpy Journey of Food and Nutrition Security

Prof. Dr. A.K. Srivastava

Member (AS), Agricultural Scientists Recruitment Board
Krishi Anusandhan Bhawan-I, Pusa Campus, New Delhi 110 012

Formerly: Director & Vice Chancellor,
ICAR-National Dairy Research Institute, Karnal (Haryana)

E-mail: aksrivastava.asrb@gmail.com

memberasrb.as@gmail.com

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Prof. (Dr.) VA Parthasarathy, President, National Academy of Biological Sciences, Prof. (Dr.) T. Marimuthu, Secretary, National Academy of Biological Sciences, Members of Executive Committee of National Academy of Biological Sciences, Distinguished Scientists, Participants of National Conference on "Climate Change Driven Challenges on Indian Biodiversity: Innovative Solutions for Sustainable Development", Delegates, Students, ladies and gentlemen. It is indeed a great honour and a pride moment for me to deliver the prestigious Prof. S. Kannaiyan Memorial Oration today on 26.09.2019. At the outset, I would like to take this opportunity to pay my revered tributes to Prof. S. Kannaiyan for his esteemed contribution to society through development in science, innovation, education and research.

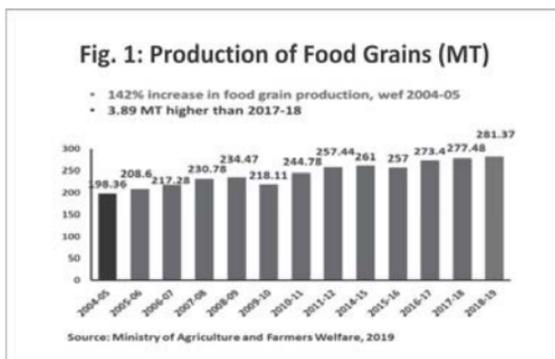
Food security means "When all people at all times, have physical, social and economic access to safe, nutritious and sufficient food to meet their dietary needs for an active and healthy life". Today, the problem of food security of India does not pertain so much on availability of food but with distribution of food and knowledge of healthy food, nutrition and hygiene to consumers. Despite significant increase in agricultural production and productivity, very high level of undernutrition and malnutrition in different form continue to persist in India and other developing countries. India, even after 72 years of independence, is the country with one of the highest prevalence of malnutrition like stunting, wasting, anaemia, vitamin deficiency, obesity osteoporosis etc. Article 47 of the Indian Constitution provides that it is the "duty of the State to raise the level of nutrition and the standard of living and to improve public health".

Indian Food Production: From "Deficiency" to "Sufficiency"

India has moved from 'Food deficient' and 'Food Import' country, with frequent droughts and famines in 1947 to a 'Food Self-sufficient' and 'Food Export' country in 1980. The tragic Bengal famine of 1943 is still remembered, where 40 lakh people died because of starvation.

During the initial post-independence period i.e. in 1966, India was producing a mere of 75 MT and had to import food for feeding her population. But, now India take pride that country is capable to feed the population with the National Food Security Act (NFSA)

already in place, from last six years since its inception in 2013 that reserves the right of citizens of this nation to food with home grown food grains. This has been possible due to agricultural research and innovation, and various Food Policies adopted by Government of India time to time. During the initial years of independence, there was a need to combat the problems

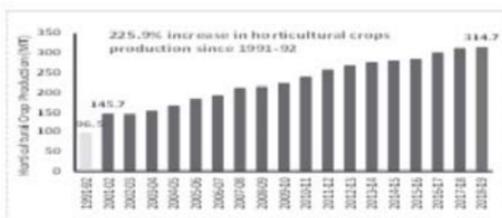


associated with lack of food. Thus, high yielding varieties of rice and wheat were introduced together with massive public investment in agricultural research. The agricultural practices have changed from 'Conventional Farming' to 'Technology-led agriculture' and this approach has resulted in Green, White, Blue and Yellow revolutions with an increase in the production of various food commodities. From 1951 to 2018-19, food grain, horticultural produce, and fish production have increased from 51 to 281.37 MT, 40 to 314.67 MT, and 0.75 to 12.60 MT (2017-18), respectively (Fig. 1, 2(A&B) & 3).

The production of the food grains (MT) of the last decade has shown

a constant increase from 198.36, 208.6, 217.28, 230.78, 234.47, 218.11, 244.78, 257.44, 261, 257 MT to 273.4 MT and 281.37 MT in the years 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, 2009-10, 2010-11, 2011-12, 2014-15, 2015-16 to 2016-17 and 2018-19, respectively (Fig. 1). In terms of productivity (kg/ha.) Punjab is the leading food grain producer state with an average of 4409 followed by Haryana (3854), West Bengal (2732), Andhra

Fig 2 (A). Horticultural Crops Production in India



Ministry of Agriculture & Farmers Welfare 2019

Fig. 2 B. Production and Productivity of Horticultural Crops (Tonnes/ha)

- 95 million tonnes fruit (3% higher than previous year).
- 181 MT vegetables (5% higher than previous year)
- Productivity of horticultural crops increased by 3.45% in 2016-17, as compared to 2015-16.

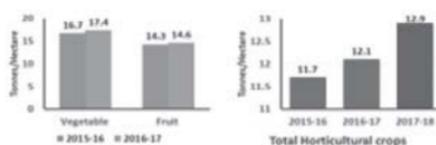
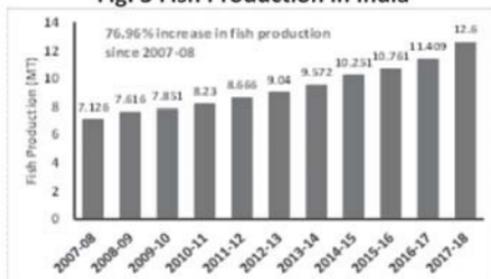


Fig. 3 Fish Production in India



DAHDF, 2017-18

Pradesh (2641), Uttar Pradesh (2474), Tamil Nadu (2396), Uttarakhand (2101), Bihar (2001), Assam (1971), Gujarat (1952), Jharkhand (1917), Karnataka (1874), Madhya Pradesh (1622), Odisha (1617), Rajasthan (1364) and Maharashtra (1198). Table 2A shows the very significant jump in production of horticultural crops from 96.5 MT in 1991-92 to 314.7 MT in 2018-19. The production of fruits and vegetable has been reported to be 96.75 million tonnes and 187.47 million tonnes, respectively in year 2018-19 with 4.1 and 5.2% higher production than the year 2016-17. The productivity of horticultural crops (Tonnes/ha) has increased by 3.45% in 2016-17, as compared to 2015-16 Table 2B).

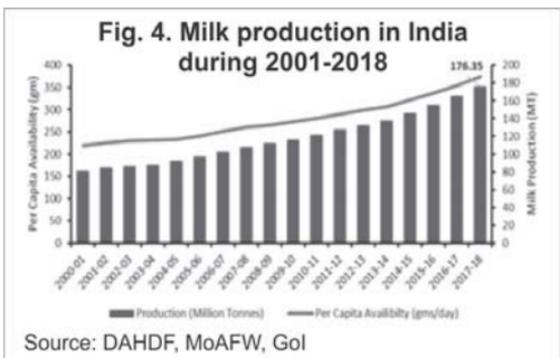
This rise in the production has led to increase in the per-capita availability of food. This appreciable rise is due to interaction of technology, innovations, services, public policies, farmer's enthusiasm and political will. In fact, Indian farmers achieved as much progress in wheat production in four years (1964-68), as was achieved during the preceding 4000 years. The prime mover for farmer's enthusiasm was assured and remunerative market. The NFSA provides a legal entitlement, to receive 5 kg of food grains every month at a subsidized rate, to 75% of the rural and 50% of the urban population. It also has provisions for providing nutritional support to pregnant and lactating women and children in age group of 6 months to fourteen years. As such India has continued to feed its people since the last 6 decades. Now the goal of India should be achieving the next higher objective of providing nutritional security to all the people of this nation, with various schemes of fortification of different food commodities.

Indian Rich Agrobiodiversity

India is endowed with rich biodiversity in flora and fauna and accounts for 17% animal, 12% plants and 10% fish genetic resources of the globe. India is a home to more than 17% of world's human and 12% of livestock (16% of cattle, 57% of buffalo, 17% of goats and 5 % of sheep) population, with a meagre 2.3% of world's land and 4.2% of the global water. In India, 52% of total land is arable as against 11% in the world and has all 15 major climates of the world. Out of the total land, 142 ± 2 million hectare area of India is cultivated, while 60 million hectare is

net irrigated. The cropping intensity is 137%. There are 20 agro-climatic zones in India and out of 60 soil types, 46 are available in the country. Longer sunshine hours and day length perfectly suit for round the year cultivation of crops. However, it is estimated that the land, water and biodiversity will shrink by 30-50% by 2050. Here it is important to note that around 52% of the population of India earns livelihood from agriculture.

Animal Food: Milk, Meat, Eggs and Fish



India ranks first in milk production, accounting for 18.5 per cent of total world milk production. The growth rate in milk production during 2013-14 was 6.3 per cent while the growth rate during 2014-15 was 9.6 per cent. The milk production in the country increased from 137.69 million tonnes (mt) in 2013-14 to 146.31 m t in 2014-15 to 155.5 m t in 2015-16 and to 176.35 MT in 2017-18 (Fig. 4).

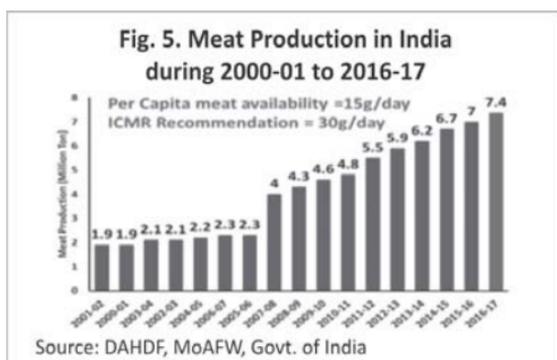
The per capita milk availability during 2016-17 was 355g/day, which has increased to 375g/day in 2017-18, which is well above the ICMR recommended level. Buffalo contributed to 49 per cent of the total milk produced in the country, while cattle contributed to 48 per cent. Indigenous buffaloes (13 recognized breeds) produced about 73% of the milk produced from the buffaloes, while the remaining was from non-descript. Among cattle, exotic and crossbred cattle contributed to 56.3% of the total cow milk produced in the country. The contribution of indigenous breeds was to the extent of 25% while the non-descript cows contributed to 19% of the total milk produced by cattle.

In India, considerable growth has been recorded in production of goat meat and milk. During the last decade, the goat meat production has doubled (9.3% to 18.3%) and goat milk production has shown a growth rate of 31.53%. The country stands first in

goat milk production and is the second largest goat meat producer in the world sharing 26.31% goat milk and 10.41% goat meat production. The meat production from sheep and goat in India as estimated are 485.53 and 942.91 million kg, respectively, that constitutes 7% and 13% contribution to more than 7000 million kg of total meat produced in country. Share of sheep meat towards total meat production of the country has been quite stagnant since last few years with 7.33% in 2007-08 to 7% in 2015-16. The per capita availability of meat in India is only about 15g/person/day against the ICMR recommendation of 30g/person/day.

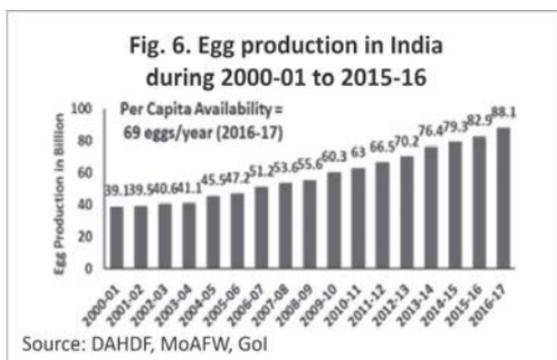
Thus it is apparent that there exists a huge gap between demand and availability of meat. Moreover, by 2050, it is expected that the population in India would increase by 34% and to fulfill the dietary recommended levels of the livestock products, as per Indian Council for Medical Research (ICMR) for a population of 1.7 billion people, the livestock sector should produce 186.2 million tons of milk, 18.7 million tons of meat and 306 billion eggs per annum.

India is the largest exporter of buffalo meat and third largest exporter of meat after Brazil and Australia. India started exporting meat since 1969 and exports both fresh and frozen meat to several countries, of which the major buyers of Indian bovine meat are Vietnam, Malaysia, Thailand, Australia, UAE, Saudi Arabia and Egypt. Among Indian states, Uttar Pradesh has emerged as the major exporter of buffalo meat, followed by Punjab and Maharashtra. The meat production



showed a good growth rate during the last decade. According to the Department of Animal Husbandry, Dairying and Fisheries, the total meat production was only 2.1 million ton (MT) during 2003-04, which increased to 7.4 MT during 2016-17 (Fig. 5).

Bovines are the second largest source of meat in India after poultry, and ahead of goat and sheep. In 2015-16, Poultry contributed 3.26 mt, followed by bovine meat (1.94MT), chevon (0.94 mt) and mutton (0.49 mt). Pork accounted for 0.39 mt.



Egg production showed an impressive growth during the past few decades. During 1980-81, the country produced only 10 billion eggs; during 2000-01 the egg production increased to about 39 billion. In the year 2015-16, the egg production reached to about 83 billion which further increased to 88.13 billion in 2016-17 (Fig. 6).

At present the annual production of eggs amounts to about 24 crore eggs every day of the year. If 60 per cent of India's population were to eat an egg every day, the production would have to grow three-fold. Nationally, around 19 per cent of the egg production is from backyard poultry enterprises, in which 64 per cent are produced by indigenous (desi) fowl. Ducks contribute about 7 per cent of the eggs. The organized and commercial sector contributes about 81% of the eggs produced. On the same line, the total fish production in India was 7.13 MT in 2007-08, which has increased to 12.6 MT in 2017-18 (77% increased).

It is fact that wef the year 1990, because of economic (liberalization, privatization and globalisation) reforms, India welcomed and opened its economy to free trade and privatization and it became one of the fastest growing economy.

During this journey no doubt the food production has increased but, the inequality deepened and the class divide continue to shadows the country progress. Now, according to global hunger index, 2018, India ranks 103 out of 119 countries and suffer from burden of hunger and malnutrition.

Growth and Contribution of Agricultural Food Commodities

Post-independence era has witnessed a remarkable growth in almost every sphere of agriculture and allied sector. India produces more than 450 MT of food materials of plant and animal origin. The real agricultural and allied GVA grew by 2.9% between 2011-12 and 2017-18. Livestock and fisheries sectors have registered sustained rise in growth. Observing annual growth trends, from 5.2% over the year in 2012-13, livestock sector growth has risen to 7% during 2017-18. The fisheries sector has surpassed the livestock sector, growing from 4.9% to 11.9% during these years.

Thus, an increasing tendency of diversification and their role in sustaining agricultural growth is clearly visible. The different agricultural commodities have shown a very interesting trend in the contribution of Agricultural GDP. In the year 1999-2000, cereals was the major contributors followed by milk, fruits and vegetables, fish and meat, while in the year 2014-15, milk was the leading contributor towards Agricultural GDP followed by fruits and vegetables, cereals, meat and fish. Table 1 Present the contribution of agriculture and livestock in total gross value added.

Livestock and Nutritional Security: The role of livestock in nutritional security is also immense. Animals provide huge amount of proteins and essential nutrients to the human population. They are an important source of food, particularly of high quality protein, minerals, vitamins and micronutrients. The importance of dietary animal protein can be well recognized because it contains essential amino acids that are deficient in cereals. Eating even a small amount of animal products corrects amino acid deficiencies in cereal-based human diets.

Further, animal proteins are more digestible and metabolized more efficiently than plant proteins. Meat, milk and eggs provide proteins with a wide range of amino acids that match human needs, as well as many bio-available micro-nutrients such as iron, zinc, vitamin A, vitamin B12 and calcium, for which many malnourished people are deficient. At present,

India is among the top most producers as well as consumer of food grains, fruits & vegetables, milk, poultry, spices & herbs; egg and fishes. Apart from main agricultural crops there is significant achievement in production of coarse cereals specially the millets, and plantation crops such as coconut & spices.

Table 1. Percentage Contribution of Agriculture & Livestock in Total Gross Value Added

Year	Gross Value Added (GVA) at Constant Prices (2011-12)		
	GVA - Agriculture	GVA - Livestock	
	% to total GVA	% to total GVA	% to Agriculture
2011-12	12.1	4	21.8
2012-13	11.5	4	22.6
2013-14	11.4	4	22.6
2014-15	10.3	4	24.3
2015-16	9.3	4	25.7

Livestock sector is growing faster than any other agricultural sub-sector. By 2020, this sub-sector is predicted to produce more than half of total agricultural output.

Food Demand Projections: Are we prepared to meet the challenge?

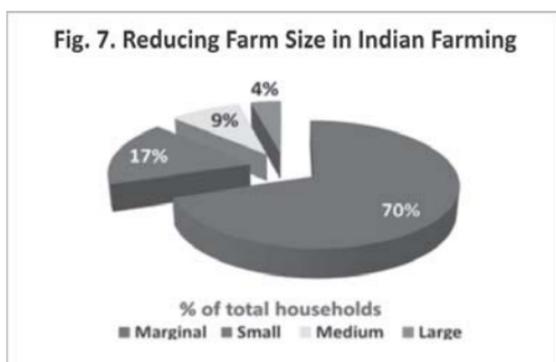
By 2020, India has to provide food and nutrition to 1439 million people, while by 2050 the number will reach to 1619 million. The demand of food grains, edible oil, sugar, vegetables, fruits, milk and meat & fish by the year 2030 is expected to be 311, 21, 39, 192, 103, 185 and 26 million tonnes, respectively. Although, the projected food grain production in 2020 and 2050 are 297 and 450 million tonnes, respectively.

Some important issues of food production system are that

- Nearly 40% of the marginal and small farmers are most vulnerable, marginalized and food insecure.
- The agricultural farms are diverse and unorganized.

- There has been a tremendous decrease in the availability of per capita arable land. The per capita land availability in India by 2050 would be 0.09 hectare which means there is need to produce more from less (land) for more (population).
- With the changing climate the reduction in the Indian Agricultural productivity is estimated to be about 25%.
- There is very poor emphasis on food safety and quality management systems across the value chain that is one of the major reasons for dismal presence of Indian food products in International market.
- There is lack of hygiene in production, storage, processing and marketing of foods.
- The newer threats like, depleting water table, poor input use efficiency, increasing incidences of pests and insects and decreasing nutritional status of soil are emerging fastly.

As such on priority we have to address the several important issues of agriculture food production system such as stagnation, under performance, lack of diffusion of technologies poor investment in R&D, impact of climate



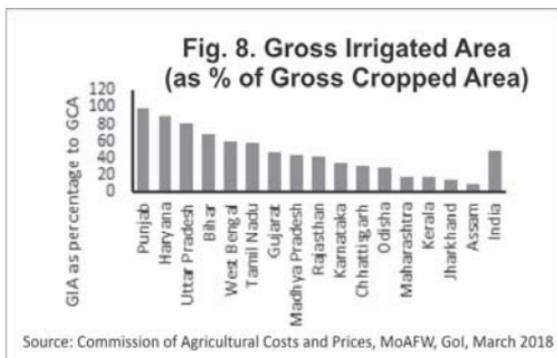
change, huge post-harvest loss, decrease in per capita land availability and lack of enthusiasm in rural youth for agriculture. As per data of agricultural census, the average land holding of farmers is decreasing year after year. At present about 68-70% farmers are marginal owning less than 1 hectare of land with average land size of 0.38 hectare land. About 17-18% are classified as small farmers with average land holding of 1.41 hectare (Fig. 7).

The second important issue is that till date Indian agriculture is largely dependent on monsoons, failure of which leads to

agriculture distress. As given in Fig. 8 only 48.6% of total arable land is irrigated.

There has been a tremendous change in the consumption pattern of different foods in rural and urban population, as reflected

with respect to percentage of total food expenditure on different categories of food items over the period of time. For urban sector, it has been observed that the total food expenditure (%) on food grain and edible oils has correspondingly decreased from 31.5% to 24.9% and 8% to 7%, respectively during 1993-94 to 2011-12, while there has been an increase in the expenditure (% of total expenditure on food) on milk and dairy products, and egg, fish & meat products from 17.9% to 20.3% and 6.2% to 7.3%, respectively. Rural population has also shown the similar pattern.



Indian Food Processing Industries and Post-Harvest Loss

Food Processing Industry (FPI) in India has gained a great importance in the last two decades. Food processing sector is growing at faster rate per annum. Government is also promoting establishment of specialized agro-processing sector through its various schemes. Allocation of MoFPI is doubled from Rs. 715 crore in 2017-18 to Rs. 1400 crore in 2018-19. There was considerable growth in FPI because of easy availability of raw materials, changing consumption pattern and industry favourable policies. FPI is an important bridge between the agriculture produce and manufacturing sector. If this bridge is strengthen it would reduce the wastage of agricultural raw materials. Further it will enhance the value of agricultural produce by increasing the nutritive value of the food products through fortification, increase the shelf-life, and also ensure remunerative prices to farmers as well as affordable prices to consumers. Large consumer base in our country offers newer opportunities for Indian food processing sector. India's food processing industry is one of the largest industries in the

country and it is ranked fifth in terms of production, consumption, export and expected growth. During the last five years, the growth rate of Indian food processing sector has reached to an impressive figure of 13.7%. However, the Indian food service industry landscape is dominated by unorganized sector, but is experiencing a gradual shift with the expansion of organized sector.

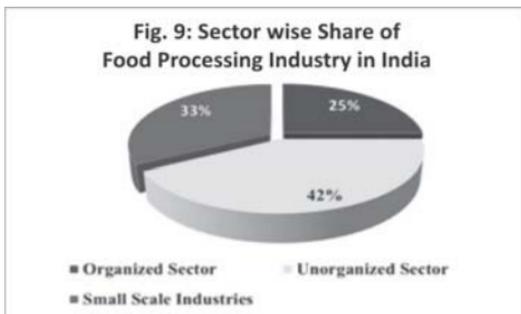
The organized food service sector has grown at a CAGR of 10.8 % from approximately Rs.750 billion in 2013 to approximately Rs. 1020 billion in 2016. It is expected to capture over 41% of the Indian food service market by 2021. Although, the presence of Indian agricultural produce as well as processed foods in International market is negligible, but country has the competitive edge in terms of variety of raw material, vast pool of skilled manpower and labour. The major trends that are pushing the food service industry towards a high growth include increasing preference for convenience to eat out, innovations in traditional menu options, growing internet penetration and technological tools in food delivery system leading to easier and faster availability of food-on-order, etc.

Since, food processing operations involve conversion of raw material into wide range of value added foods, it often generates various by-products. The disposal of these bio-wastes (defatted rice bran, defatted corn germ, fruit waste, whey, broken germ, offales, bones, blood, etc) from agricultural food processing activities is a serious problem.

According to an estimate, agricultural by-products from all crops, livestock and fisheries sector amounts to be about 750 million tonnes annually. At present by-product utilization is approximately 25% and by applying appropriate strategic interventions these can be converted into nutritional food products. There is great potential for conversion of these industrial by-products into value added products for various purposes. Indian dairy sector has set an example to be followed by other allied agricultural fields by utilizing whey- the largest by-product of dairy industry both in terms of volume and milk solids. Whey derivatives are becoming popular day by day as quality food ingredients in food and pharma industry. Effective extraction and modification of by-products from agricultural

commodities can be implemented as an idea of 'food for food', in turn reducing the environmental hazard associated with the bio-waste and also providing job opportunities and healthy food alternatives for the people.

Cold storage facilities are used by all sub-sets of Indian food industry especially for the perishable products. The food service outlets are also required to maintain necessary ambient conditions (temperature, humidity, etc.). The Indian cold storage market is reportedly growing rapidly at about 20% annual since 2011. The cold chain network is fragmented (3500 companies engaged in cold chain operations in India) with organized players contributing minimum to the total cold chain market in India (Fig. 9). There is uneven distribution of total cold chain storage capacity with 65% share being contributed by only two states i.e. Uttar Pradesh and West Bengal.



Post-Harvest Management Biggest Challenge

- Huge post-harvest loss: estimated to be more than Rs. 92,651 Crore annually
- In India, cold storage requirement is for 61 million ton of food against present capacity of 32 million ton.
- Work force engaged in registered and unregistered food processing sectors are 17.41 and 47.9 lakh, respectively
- Government will promote establishment of specialized agro-processing sector.
- Allocation of MoFPI is doubled from Rs 715 crore in 2017-18 to Rs 1,400 crore in 2018-19.

The problem gets worsened because more than 75% being dedicated to storage of only potatoes, while 25% is for other products like fruits, vegetables, pharmaceuticals and processed foods. Approximately, 104 million tonnes of perishable commodities are transported annually and out of this only 4 million tonnes move through refrigerated mode, while rest via non-refrigerated mode. Out of the total facility available, more than 80% of refrigerated transportation is being used by dairy products. Thus, there is a need to establish end-to-end supply

chain with modern structures including integrated cold chain solutions, last-mile connectivity, logistics parks, etc. Investments in the cold storage industry should be the first priority and it need to be encouraged through PPP (Public-Private Partnership) and BOT (Build-Operate-Transer) models, with increased incentives and subsidies for the investors. To conclude, it is said that the Indian food industry offers ample scope for large investments in processing technologies, skills and equipment, packaging, and storage infrastructure.

The post-harvest management is the biggest challenge owing to highly inefficient supply chain. The post-harvest loss is estimated to be more than Rs. 92651 crore annually. The losses in dairy, food grains and horticultural sector being 0.8%, 10% and 30-40%, respectively (Table 2).

Table 2: Conservative Estimate of Post-Harvest Loss in India

Commodity	Total Loss	
	%	Value (Rs. Crore)
Fruits and Vegetables	4.6-15.9	40811
Cereals	4.6-6.0	20698
Oilseeds	3.1-10.0	8278
Pulses	6.4-8.4	3877
Marine Fish	10.5	4315
Inland Fish	5.2	3766
Poultry Meat	6.7	3942
Egg	7.2	1320
Meat	2.7	1235
Milk	0.92	4409

Source: CIPHET Report

Hunger and Malnutrition: A Blot on Humanity

Over the couple of years, it is assumed that hunger has been declining because of increasing global wealth, but it is not true. The income inequality is increasing day by day, and hence the ability to access food has reduced for certain groups of people. As per the recent report of Times of India-Delhi "Learning with

Times; why hunger around the world is rising again" (17/09/2018) it is estimated that in 2017, 10.9% of the world's population was undernourished. And this translates to 821 million people, which is at the same level as that in 2010. The number of undernourished people has declined in China, India, Nepal and Sri Lanka but has increased in Pakistan, Afghanistan and Bangladesh. However, India still accounts for the world's largest population of undernourished people and is home to about one in every five undernourished persons. According to the recent estimate of UNO-FAO, around 854 million people worldwide are undernourished out of this about 200 million are in India. The undernourishment in Indian population can be seen from corresponding figures of average consumption of micronutrients. In the urban population, 56%, 60% and 83% of requirement of RDA of Zinc, Vitamin A and Iron is met while; the corresponding figures for rural population are 65%, 58% and 90%, respectively. This can also be co-related to the micronutrient deficiency in Indian soils (48% and 12% deficiency in Indian soil for Zinc and iron, respectively).

The Status of the child health of a country is considered a key indicator for measuring the access to nutritious food. Unfortunately, for India, the latest estimate shows that India is the home of more than 50% of the world's 'wasted' children (child underweight for his/her height) and more than 30% of the world's stunted children (child shorter for his/her age).

Table No. 3: Number of undernourished (Million)

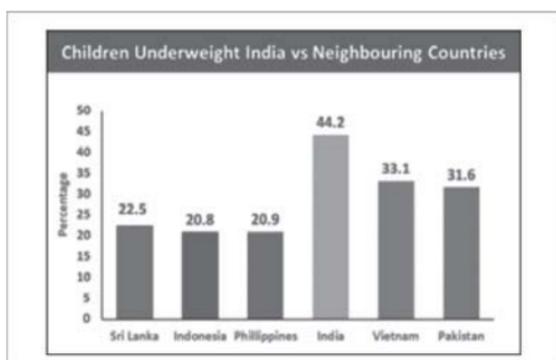
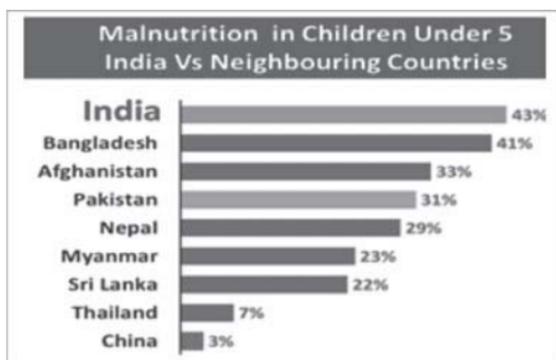
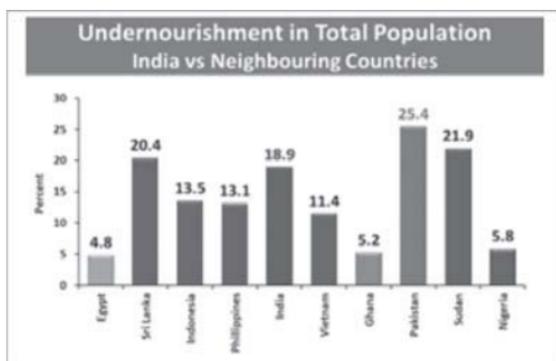
Country	2004-06	2015-17	% Change
India	253.9	195.9	-22.8
China	206	124.5	-39.6
Pakistan	35.9	39.5	10.9
Bangladesh	23.8	24.8	4.2
Afghanistan	8.3	10.5	26.5
Nepal	4.1	2.8	-31.7
Sri Lanka	3.6	2.3	-36.1

Source: FAO Report: The state of Food Security & Nutrition in the World, 2018

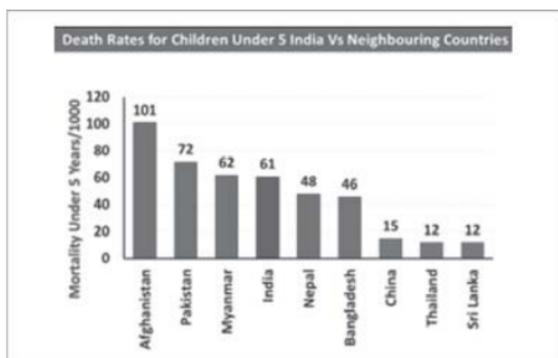
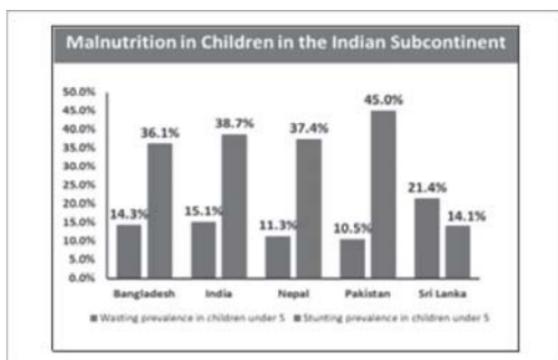
Not only in India, in whole developing world, the malnutrition in infants and young children is one of the most serious health problems. It influences the normal physical and mental growth and development that resulted in increased mortality and morbidity. Across the world about 32 percent of children below the age of 5 years suffer from being underweight and 39 percent from stunting.

Among the developing countries, 44.2% children in India are underweight followed by Vietnam (33.1%) and Pakistan (31.6%). Asia and Africa continents have the highest share of all forms of malnutrition viz. stunting, wasting and obesity. As per the National Family Health Survey of India, 55 percent of children living in rural areas suffer from malnutrition while the corresponding figure for urban areas is 45 percent.

As per another report 43% of Indian children under 5 are suffering with malnutrition followed by Bangladesh (41%), and Afghanistan (33%). 58 percent of Indian children aged between 6 and 59 months (urban: 56%, rural: 59%) are anaemic and the prevalence of Low birth weight (LBW) is nearly 30%.



The poor state of malnutrition in Indian children could be attributed to the lack of diversity in food and lesser emphasis on complementary feeding. During complementary feeding, most of the mental and physical developments occur, therefore, introduction of semi-solid foods at the expense of breast milk must provide adequate nutrients to the children for the rapid phase of growth and development. Poor feeding practices as well as lack of suitable complementary foods are responsible for under-nutrition to children. More than 100 million children under 5 years are unable to realize their full socio-economic and human potential. Only 23% of Indian toddlers and infants get a balanced diet. Educating women can help change that.



According to UNICEF-WHO-WBG Joint Report (2017), across the world, number of stunted children decreased from 198.4 million to 154.8 million during last two decades while children suffering from wasting diseases increased from 30.4 million to 52 million. Addressing the burden of wasting will require a multipronged approach, including prevention, early identification, and treatment.

Children with low weight-for-height (wasting) have an increased risk of mortality. In 2017, about 7.5% of children under 5 years were affected by this form of undernutrition, with regional prevalences ranging from 1.3% in Latin America to 9.7% in

Asia. Malnutrition is the leading cause of death worldwide in children under the age of five and accounts for deaths of 2.6 million children every year and it leaves millions more life-long impairments.

Table 4. Levels and Trends in Child Nutrition

Region	Number (Million)		
	Stunted	Overweight	Wasted
World wide	155	41	52
Latin America and Caribbean	6	4	1
Africa	59	10	14
Asia	87	20	36
Oceania	0.5	0.1	0.1

Source: UNICEF, WHO, WBG Joint Report (2017).

The mortality rate of children under 5 years of age in India is reported to be decreased from 114.2/1000 to 61.3/1000 during past 25 years while India is at 12th position for new born mortality rate with 25.4/1000 live births (Global Nutrition Report 2016).

Newborn Mortality (Deaths in first 28 days of life) deaths per 1000 live births India 12th Worst with NMR of 25.4			
Worst Countries		Best Countries	
1. Pakistan	45.6	Japan	0.9
2. Central African Republic	42.3	Iceland	1.0
3. Afghanistan	40.0	Singapore	1.1
4. Somalia	38.8	Finland	1.2
5. Lesotho	38.5	Estonia	1.3
6. Guinea-Bissau	38.2	Slovenia	1.3
7. South Sudan	37.9	Cyprus	1.4

8. Cote d'Ivoire	36.6	Belarus	1.5
9. Mali	35.7	Republic of Korea	1.5
10. Chad	35.1	Norway/Luxembourg	1.5

In our country, a significant percentage of population is also vulnerable to hidden hunger. A very high mortality occur due to coronary heart-diseases (CHDs), cancer and diabetes, all related to diet and life style. Obesity and overweight prevalence in India has also shown considerable increase during the past two decades. According to the surveys of the National Nutrition Monitoring Bureau in 9 states, 7.8% men and 10.9% women are overweight or obese when a cut off value of BMI 25 is used. However, currently a lower BMI of 23 is suggested, because above BM123, the susceptibility to hypertension increases. With this cut off value of BMI of 23, the percentage of overweight and obesity were reported to be 17.2 in men and 19.2 in women. A fourth of Indian adults have hypertension, and 5-6% have impaired glucose tolerance or diabetes. These statistics may be taken as alarm bells, and an urgent action is needed to reduce the burden of under-nutrition. Further, action is also required to control diseases like obesity, diabetes, hypertension, cardiovascular disorders, cancer and arthritis. India is considered to be the diabetic capital of the world.

Lower middle income group has been observed with highest increase in obesity cases with 53% prevalence, followed by low-income group (37%) and high income group (12%). Due to lack of diversity in Indian food basket people often deprived off the nutrients from the diet. Presence of anti-nutrients and inhibitors in many staple foods further affect the bioavailability of certain key nutrients. The other possible reasons for infant malnutrition are (i) Decreasing Breastfeeding, which deprived the children for strengthening of critical immune system & growth promoting bio-actives, and (ii) Lesser emphasis on weaning (nutritionally inadequate and inappropriate). Health concerns are attributed to poor nutrition in low-income segments of the population, whereas the well-off strata of the society need to address the health issues primarily due to the changing life-style, food habits and unhealthy behaviour.

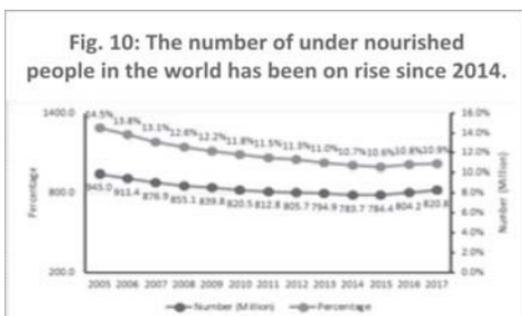
Iron deficiency is considered to be the commonest worldwide nutritional deficiency and affects approximately 20% of the world population. Women and young children are at great risk. 70% women and children are suffering from iron deficiency anaemia. According to National Family Health Survey (2016), prevalence of anaemia in India is 35.7% in underweight children, 38.4% in stunted children and 21% in wasted children. This problem of Fe deficiency is partly due to consumption of only plant-based diets, containing low levels of poorly bioavailable iron. Further, iodine deficiency disorders, and vitamin A deficiency continue to be the public health problems, though prevalence of goitre has declined and blindness due to vitamin A deficiency has been eliminated. Vitamins B (riboflavin, folic acid and perhaps B12) deficiencies are still very common. Despite tropical sunlight, reports of vitamin D deficiency in adults and children are appearing. Osteoporosis in women, perhaps due to calcium and vitamin D deficiencies has become a public health problem. The National Family Health Surveys (2016) also show that there are marked interstate variations. The southern states, mainly Kerala, and Tamil Nadu, were better than states like Bihar, Madhya Pradesh, Uttar Pradesh, Rajasthan, and Orissa. Interestingly, the State of Jammu and Kashmir has shown some improvement in women's health as judged by decline in anaemia from 60% to 54% between year 1995-96 and 2005-06, whereas in all other states anaemia in women has remained unchanged or increased over the same period.

Global Position and Trend in Food and Nutrition Security (UNICEF-WHO, 2018)

- In recent years there was evidence that in world, after a prolonged decline, the hunger was increased. An estimated 821 million people (approximately one out of every nine people in the world) are undernourished Fig. 10.
- Undernourishment and severe food insecurity appear to be increasing in almost all regions of Africa, as well as in South America, whereas the undernourishment situation is stable in most regions of Asia.
- The trend of increasing hunger and food insecurity are a alarm that there is considerable work to be done to make

sure that we "leave no one behind" on the road towards a world with zero hunger.

- Significant progress has been made on reducing child stunting. However, in the world about 22 percent were still stunted in 2017. Over 38 million children under five are overweight: stunting is declining too slowly while overweight continue to rise fast since 2000. In Africa the number of overweight children under 5 has increased by nearly 50%.
- Prevalences of anaemia in women and obesity in adults are increasing. More than one in eight adults in the world is obese and one in three women of reproductive age is anaemic.



- Adequate nutrition during pregnancy and early childhood is essential to ensure the growth, health and development of children to their full potential.
- The 1000-days window of time which starts from woman's pregnancy to her child's second year of age is highly crucial for the nutrition security of children.

India's Efforts to Address Malnutrition

From 1975, India has the Pan India Programme "the Integrated Child Development Services (ICDS) Scheme", which is one of the world's

Target Groups and Services from Different Food and Nutrition Schemes

Target Groups

Pregnant and Lactating months, Children (0-3) & (3-6); School going children (6-14 yrs); Adolescent girls, adult and communities.

Major Services from Schemes

Supplementary nutrition; Counselling on diet, for breast feeding and for spacing between child; Nutrition education; Weekly iron

and folic acid supplementation; Immunization; Promoting institutional child delivery; New-born care & post-natal care; Growth monitoring; Health education of mothers for child care; Promotion of infant and young child feeding; Home based counselling on nutrition; Referral and follow-up of under-nourished, severe mal-nourished and sick children; Deworming; Cashless treatment for first month of child; Care of children of working mothers; Non-formal pre-school education; Knowledge dissemination on nutrition by including nutrition related topics in syllabus; Promotion of use of iodized salt; Mid-day meals and food subsidy.

largest early childhood care programme. Its main objective is supplementary nutrition to children (6 months to 5 years) and pregnant women & lactating mothers. However, this programme became more visible and evident when India launched the "National Nutrition Policy" in 1993 and "Mid-day Meal Scheme" in 1995. Since then there has

Some Important On-going Schemes of Govt. of India: Addressing Mal-nutrition and Hidden Hunger

1. Integrated Child Development Scheme
2. Janani Suraksha Yojana
3. Indira Gandhi Matriya Sahyog Yojana
4. Reproductive Child Health (RCH and RCH-II)
5. National Rural Health Mission (NRHM)
6. Rajiv Gandhi National Crèche Scheme
7. Serva Siksha Abhiyan
8. Mid-Day Meal
9. Kishori Shakti Yojana
10. Women Welfare and Support Programme
11. Old and Infirm Person Annapurna
12. Total Sanitation Campaign (TSC)
13. National Rural Drinking Water Programme
14. Scheme for Empowerment of Adolescent Girls
15. TPDS

been more focus on nutrition with the several new schemes like National Nutrition Plan of Action (1995), National Nutrition Mission (2001), and many new nutrition-specific policies like Policy on Infant and Young Child Feeding (2004), Policy on Control of Anaemia (2004), Guidelines for Administration of Zinc Supplements (Diarrhoea Management; 2007), and many other as given in Tables. In 2013, India announced the National Food

Security Act (NFSA). This act doesn't focus only on food security but also aims to provide the nutrition security. It discusses both-food's adequate quantity and quality. Recently India has started moving in the direction of food fortification. In 2016, a draft of Food Safety and Standards (Fortification of Foods) Regulations, 2016 was released. Since then several consultations on fortifying various foods have occurred. In 2018, a long-awaited development happened and India launched the National Nutrition Mission, more famously known as Poshan Abhiyaan (Dr. Prachi Singh 2018).

Government Funding to Address Malnutrition

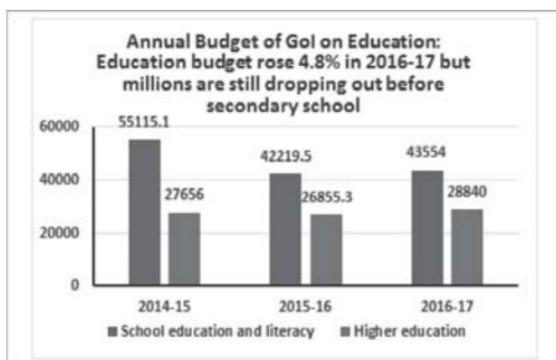
It is needless to emphasize that, adequate public funds are required for the successful implementation of the nutrition scheme of Govt. of India. The Central government is emphasizing that the State governments should play a pro-active role in combating the hidden hunger and malnutrition, and generate funds from their resources for this purpose. With respect to centrally supported schemes ICDS, data show that the budgetary allocations have decreased over time. Between 2014-15 and 2015-16, financial allocations were reduced from Rs. 166 billion to Rs. 83 billion. However, in 2016-17 and 2017-18, no doubt the allocations have been further increased in absolute terms, the annual rate of change is down to 12.76 percent (Table 5).

Table 5. Central Budget for ICDS

Financial year	Budgetary allocations (in Rs. Billions)
2013-14	163.12
2014-15	165.61
2015-16	83.36
2016-17	148.50
2017-18	167.45

Source: Ministry of Women and Child Development. Press Information Bureau releases, 19 March 2015 and 1 February 2017.

Now it has been acknowledged that to address malnutrition in India Education of consumers will prove the most important index. As such, Govt. of India is having good intension to enhance budget on Education. It is said that secondary education will empower India in the 21 century.



According to budget data, the central government budget for the year 2016-17 of Rs. 72,394 crore on school education, higher education and adult literacy programmes is 4.8% rise over 2015-16. Still, the 2016-17 budget amount is 12.5% less than the 2014-15 budget estimate. Further, the government spent 16% less than the original budgeted amount of Rs. 81,771 crore in 2014-15.

Strategies to Reduce Infant Malnutrition

The ultimate aim is that all children should be free from all forms of malnutrition

WHO and UNICEF's global recommendation for optimal infant feeding, recommended as Global Strategy are:

1. Exclusive breastfeeding for 6 months (180 days): Even after introduction of complementary foods, breast feeding remains a critical source of nutrients and immunity for young infant and child. In addition to immunoglobulins, breast feeding provides about half of the infant's energy need upto the age of one year, and one third during the second year. Studies reported that the risk of death from diarrhoea of partially breast fed infants of 0-6 months of age is 8.6 times more than the risk for exclusively breast fed children.

Mother's Milk is Nature's Perfect Food: Breast milk or mother's milk is probably the first and most diverse kind of functional food which a new born consumes. It is designed

by nature to provide all essential nutrients and therapeutic components in desired amount and also in best bio-available form. The bioactive components present in colostrum and milk include nutrients, minerals, trace elements and pre-vitamins as well as immunoglobulin, hormones, growth factors (Insulin-like growth factors), cytokines, prostaglandins, lactoferrin, transferrin, nucleotides, polyamines and human milk oligosaccharides (HMO). Breastfeeding continues to offer health benefits into and after toddler-hood. These benefits include; lowered risk of Sudden Infant Death Syndrome (SIDS), faster mental development, lowered incidences of cold & flu, lowered risk of asthma and eczema, decreased risk of obesity later in life, and decreased risk of developing psychological disorder. Breast milk provides a wide variety of proteins that have unique compositional and physico-chemical characteristics that is highly suitable for neonates. In addition to these, they also exhibit several extra-nutritional roles to promote the development and well-being of infants.

- 2. Complementary feeding after 6 months:** Complementary foods, commonly known as weaning foods, are semi-solid or solid foods that are used to transition infants from breast milk to an adult diet. In the first year of life, infants undergo periods of rapid growth when good nutrition is crucial. Energy and nutritional requirements of infant after 6 months of age, exceed what can be supplied by breast milk alone. Complementary foods should be nutritionally adequate, safe and appropriately fed in order to meet the young child's energy and nutrient need. Generally cereal components are mainly given as complementary foods, which are inferior in nutrients, has low digestibility and less energy dense. A composite of milk-cereal-fruits and vegetables-pulses could be formulated for complementary feeding employing various processing techniques and may be fortified as per the need of the growing children.

Milk Nutrients in Health and Well-being

Milk has been considered as nature's perfect food and universally accepted as a "food with ability to module body's functions". The

healing power of milk nutrients is known for centuries and recent scientific investigations have proved the disease preventing or alleviating properties of milk nutrients. Research is continuously revealing an over-accumulating range

of physiological benefits associated with milk constituents or its active metabolites, emphasizing the positive role of milk in programming of the human health. Milk nutrients and their metabolites have well defined role in influencing the body immune and vital systems. Continuous milk mining is going on to discover new milk molecule with certain positive health impact. Recently, milk and milk constituents have gained prominence because of increasing scientific evidence pertaining to their health promoting and disease alleviating virtues. The significance of milk nutraceuticals assume altogether different dimension in our country where rapid rise in malnutrition and incidences of non-communicable diseases is posing newer challenges. It is costing not only 1-2% to National GDP, but adversely affecting the quality human resource as well. Among the functional foods, dairy based products occupy an important place, probably because of the well perceived health benefits associated with consumption of milk and milk nutrients. Milk, dahi and ghee are the three dairy products which has been part of our food and have been mentioned for their disease preventing abilities in ancient literatures. With changing life-style, globally, there has been increase in the number of chronic diseases at alarming rate. One of the common reasons for these diseases could be attributed to impaired or weak immune system. Role of milk nutrients specially the minor milk proteins such as β -Lactoglobulin, α -Lactalbumin and lactoferrin, in modulating the immune system is well documented.

Milk Nutrients for Nutritional Security

- Milk accounts for 9.2% and 12.4% of protein intake in rural and urban areas, respectively
- Important source of Ca, Mg, P, K, Iodine, Se, Vitamin A, D, B₁₂, K, Riboflavin, Biotin, Pantothenic acid
 1. Calcium: Improving bone health, hypertension, colonic anticarcinogenic
 2. Carotenoids: anti-oxidant, vision improvement
 3. SCFA (Butyric acid): regulation of neuron cell growth & anti-tumor activity
 4. Lactose: development of brain, prebiotic
 5. Milk and whey proteins minor components and bioactive peptides have therapeutic values

Casein, lactose and milk lipids the major milk nutrients often serve as base materials for the production of active metabolites having positive influence on physiological system and can be termed as nutraceuticals. Richness of milk protein particularly whey proteins, in sulphur containing amino-acids like cysteine and methionine assist in enhancing the level on natural antioxidant i.e. glutathione. Serotonin, a biomolecule production is also mediated by milk protein amino-acids.

Bioactive lipids mediated compounds including prostaglandins; leukotriene and thromboxane also are produced in requisite amounts. Galactose, the hydrolytic product of lactose is essential for the development of vital organs including retina and brain. GMP, a by-product present in cheese whey modulates the biosynthesis of cholecystokinin, the satiety hormone.

Milk phospholipids have attracted the attention of researchers because of their effect on brain health. Fusion trend has also influenced the dairy food formulations and blending of raw materials from different food groups for better nutritional status. And it has also gained momentum in last few decades. Further, among more than 1000 phytochemicals few such as carotenoids, flavonoids, phytosterols, phytoestrogens, glucosinolate and soluble fibres have been utilized in certain dairy products.

The major focus in development of milk based nutraceuticals and therapeutic products has been towards the incorporation of probiotic microorganisms that harbour our gastro-intestinal (GI) tract and are frequently associated with health promoting attributes such as anti-microbial, anti-mutagenic & anti-carcinogenic effect, modulation of immune response, anti-diarrheal and anti-allergenic reactions. Further, the fermented dairy products have been found the best food matrix for administration of probiotics. It has been established that several species of Lactic acid bacteria (LAB) assist in maintenance and improvement of gut health besides providing several other health benefits. It has been exploited all over the world for the development of probiotic dairy foods.

Thermal treatment (heating or pasteurization) of milk is not only effective in improving the digestibility of milk proteins, but heating of milk is also known to produce various

intermediates as Maillard reaction products. Many of these Maillard reaction products have been identified with anti-oxidant potential. Biologically active peptides from milk are of particular interest for food and pharma industry because they have been shown to play many beneficial pharmacological effects, including opioid like activity, antimicrobial, immunomodulatory and antihypertensive.

Finally it can be summarized that science led growth and development in food and agriculture will continued to feed future India. But a "Mission Mode" action is required to address the malnutrition. In this regard, dairy, fishery and horticulture may play major role as now the focus should be not on calorie centric but balanced nutritional diet. Let us work together towards the common National goal to provide food and nutritional security for every citizen of the country.

- Child must be provided very good nutrition during initial 2 years after birth (i.e. 1000 days from conception of pregnancy. If child is not provided good nutrition during this period, in later age he/she will remain epigenetically exposed with syndrome 'X' disease that include diabetes, hypertension and dyslipidemia.
- "Community participation, ownership taking responsibility by society and consumers for of health and nutrition would play the most important role to fight against malnutrition". People will have to take on the responsibility to improve their as well as their family health and nutrition.
- "The health food require a substantial dietary shifts. Double the consumption of fruits, vegetables, nuts and legumes, and reduce the consumption of red meat and sugar by more than 50%.
- The diet rich in plant-based foods and with fewer animal source foods will lead both improved health and environmental benefits."

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Notes :



National Academy of Biological Sciences

NABS-Secretariat, Room No. 209, Second Floor
CAS in Botany, University of Madras, Guindy Campus
Chennai- 600 025, Tamil Nadu, India Mobile : +91-94436 73155
E-mail : secretarynabs@gmail.com Visit : www.nabsindia.org