

## Food Supply and Security

Reddy, A. Amarender; Babu, Suresh; Kumar, Parmod; Kumar, Soora Naresh

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# Food Supply and Security

# 2

Anugu Amarender Reddy, Suresh Babu, Parmod Kumar,  
and Soora Naresh Kumar

## Abstract

India's total food grain production in 1950–1951 was low at 50.8 million tonnes, with a population of 361 million. Thus, the food grain production in 1950–1951 was 140.7 kg per person per annum or 0.39 kg per day. Thanks to Indian farmers and agricultural scientists who worked hard to increase the food grain production through new crop varieties and production technologies, along with the supportive policies of the governments that paved the way for the Green Revolution in Indian Agriculture. Achievements of the green revolution further led to achievements in other agricultural and allied sectors like the white revolution with substantial gains from milk production, followed by the yellow revolution with a significant increase in edible oilseed production, and the pink revolution with an increase in meat and poultry production to a significant extent.

This chapter mainly discusses where does India stand today in terms of its agriculture when compared to its independence in 1947? As the data for 1947 for most of the indicators is not available, 1951 is considered the base year and compared the various indicators for the year 2021.

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A. A. Reddy (✉)

Section of Design & Analysis, ICAR-Central Research Institute for Dryland Agriculture,  
Hyderabad, India

e-mail: [amarender.reddy@icar.gov.in](mailto:amarender.reddy@icar.gov.in)

S. Babu

International Food Policy Research Institute (IFPRI), Washington, DC, USA

P. Kumar

Giri Institute of Development Studies (GIDS), Lucknow, India

S. N. Kumar

ICAR-Indian Agricultural Research Institute, New Delhi, India

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## 2.1 Introduction

India's total food grain production in 1950–1951 was low at 50.8 million tonnes, with a population of 361 million. Thus, the food grain production in 1950–1951 was 140.7 kg per person per annum or 0.39 kg per day. Thanks to Indian farmers and agricultural scientists who worked hard to increase food grain production through new crop varieties and production technologies, along with the supportive policies of the governments that paved the way for the Green Revolution in Indian Agriculture. Achievements of the green revolution further led to achievements in other agricultural and allied sectors, like the white revolution with substantial gains from milk production, followed by the yellow revolution with a significant increase in edible oilseed production, and the pink revolution with an increase in meat and poultry production to a significant extent.

This chapter mainly discusses where does India stand today in terms of its agriculture when compared to its independence in 1947? As the data for 1947 for most of the indicators is not available, 1951 is considered the base year, and compared the various indicators for the year 2021.

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## 2.2 Period-Wise Food Security Strategies and Approaches

Broadly, the overall period from independence to 2021 is divided into: Phase-I, Preegreen revolution period (1947–1965); Phase-II, Green Revolution Period (1965–1980); Phase-III, Post-Green Revolution Period (1980–1991); Phase IV, Economics reforms period (1991–2015); and Phase V, One nation, One market (2015 onwards). The problems faced, strategies, and approaches followed in different periods are presented in Table 2.1.

### 2.2.1 Pre-Green Revolution Period (1947–1965)

When India became an independent nation on August 15, 1947, India's population was just 330 million, mostly living in villages with poverty and low life expectancy. Agriculture had very low productivity, mostly led by self-sustaining small farmers. The marketed surplus was very limited, and mostly marketed in weekly markets along with other daily necessities. The share of coarse cereals and pulses was much higher in the food basket. The trading was mostly done by informal and unregulated petty village traders, who purchased from the farmers and sold to aggregators or in weekly markets with limited postharvest processing like cleaning, grading, and packaging. Slowly different state governments started regulating the agricultural markets through the formation of Agricultural Produce Market Committees (APMCs) at the block level with twin objectives of regulating the malpractices of traders and commission agents to ensure reasonable prices to farmers and also to maintain reasonable prices for consumers. This period is characterized by frequent famine-like situations. Traders frequently hoarded and speculated on food grains to

**Table 2.1** Problems, strategies, and approaches followed since independence

Phase	Status and approach
Phase-I: Pre-Green Revolution Period (1947–1965)	Problem: Deficit in food production
	Strategy: “Grow more food” campaign and improved food security
	Approach: Marketing system designed to handle deficit, regulate interstate trade, manage food security, APMC Acts and ECA Act, 1955, PL-480
Phase-II: Green Revolution Period (1965–1980)	Problem: Self-sufficiency in food grains, ushering in “green revolution” (wheat and rice) and “operation flood” (milk sector)
	Motive: Ensure food security
	Approach: Usage of technology and high yielding varieties (HYVs) to boost production and distribution through procurement. Number of important institutions set up (FCI, APC, MSP, CWC, and SAUs)
Phase-III: Post-Green Revolution Period(1980–1991)	Status: Diversification toward high-value crops.
	Strategy: Enhance the value of the output
	Approach: Focus on commercial agriculture, setting up National Horticultural Board (NHB) and agricultural and processed products export development authority (APEDA)
Phase IV: Economics reforms period (1991–2015)	Problem: Approaching surplus
	Strategy: Improving the functioning of markets and greater international market access for export and imports
	Approach: Signing of Agreement of Agriculture of WTO; rapid growth of poultry and milk production; Initiation of consultations on Market reforms: Report of Committee on Strengthening and Developing of Agricultural Marketing under the chairmanship of Shri. Shankerlal Garu submitted on 29.06.2001, Model APMC Act 2003 to increase private sector participation in marketing and processing; Model APMC Rules, 2007. Some states adopted the Model Act.
Phase V: One nation, one market (2015 onwards)	Problem: Food secure, but the problem of plenty emerges especially in cereals
	Strategy: Enhance farmers’ income with freedom to market access with one nation, one market strategy
	Approach: Toward a National unified Electronic National Agricultural Market (e-NAM), the Model Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017 (APLM) allows for the operation of alternative markets and unified national markets; GST rollout, streamline interstate trade

Source: Ministry of Agriculture and Farmers Welfare (2018) Report of the “Committee on Doubling on Farmer’s Income,” Ministry of Agriculture and Farmers Welfare, Government of India <https://agricoop.nic.in/en/doubling-farmers>

take advantage of high price fluctuations. To control speculative and large-scale hoarding of food grains, the government of India passed the Essential Commodities Act (ECA Act), 1955, to impose stock limits maintained by the middlemen and traders and release excess stocks into the market for sale in the times of famines and food shortages. Further, during this period, India relied on supplies of food grains from the United States under Public Law 480 (PL-480) against rupee payments, as India did not have much foreign exchange to buy large quantities of food in international markets. During the peak years, under PL-480, India imported 10 mt of food grains, this huge import dependence on basic necessities like food was a humiliation to the government; hence the government started taking steps to become food self-sufficient.

### **2.2.2 Green Revolution Period (1965–1980)**

During the late sixties, the government gave special emphasis on food self-sufficiency to reduce dependency on PL-480 imports. India imported 18,000 tonnes of high-yielding varieties (HYV) of wheat from Mexico in 1966 and ushered in the Green Revolution. Improved technologies (HYV seeds, water, and fertilizers) and innovation in institutional development (like the cooperative movement ushered in the white revolution) have been the driving force of the green revolution. Although seeds originally came from outside the country (as with the short duration high yield varieties of paddy and wheat). But the farmer-entrepreneur takes the risk of adopting these seeds and technologies, puts in his/her best efforts, and the nation reaps a rich harvest to feed its citizens. Measures were taken during the green revolution (1960s to 1980s): like FCI, PDS, and their impact.

### **2.2.3 Post-Green Revolution Era (1980–1991)**

The last phase could be the period of the post-green revolution, where a lot of focus was being provided on improving productivity and quality with the objective of enhancing farmers' income. Green revolution of paddy and wheat spread to other states like Andhra Pradesh, Karnataka, Tamil Nadu and also western states like Gujarat. To some extent, there was a shift to commercial crops and increased use of fertilizers for increasing productivity. This period saw the success of the yellow revolution meant for self-sufficiency in oilseeds (the Technology Mission on Oilseeds).

### **2.2.4 Economic Reform Period (1991–2015)**

The growing private sector participation especially in the seed sector and with Bt cotton seeds from large private-sector companies such as Mahyco and Monsanto and the spread of basmati rice varieties like Pusa basmati and several hybrids of maize

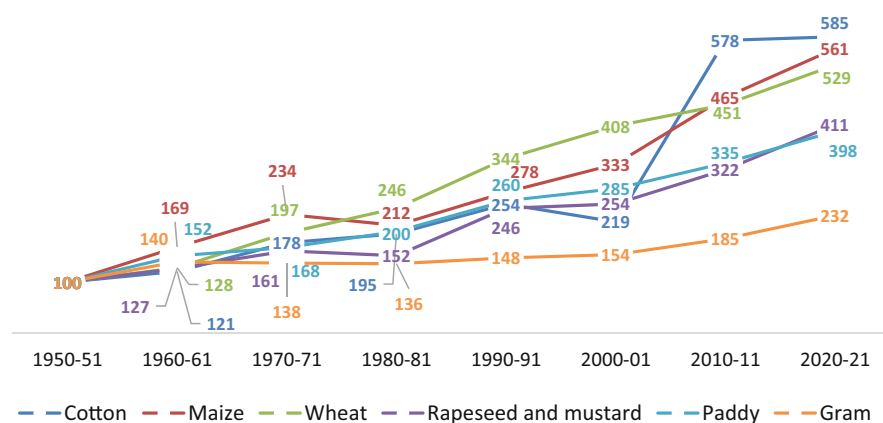
became popular among farmers during this phase. The exports of many agricultural commodities started picking up, especially basmati rice, oil cake (meal), meat, and fish.

### 2.2.5 One Nation, One Market (2015 Onwards)

The Government of India focuses on one nation, one market with sweeping reforms in agricultural markets, strengthening market infrastructure, and encouraging private markets and public–private partnerships. With all these efforts, the agricultural sector showed astonishing resilience during the COVID pandemic. Agriculture was the only sector that grew at a comfortable rate of 3.5% during 2020—the COVID year, while all other sectors suffered negative growth. Even during the strict lockdown, there was no shortage or no price hike for essential food items like rice, wheat, fruits, and vegetables. The supply chains evolved themselves to overcome logistical bottlenecks. It is now the responsibility of the policymakers and government to build and support these resilient supply chains.

## 2.3 Evolution of Technological and Institutional Provisions (1951–2021)

Technology has been the main driver of change over the years, whether it is the green revolution led by wheat and rice, or maize productivity led by hybrids or cotton production led by Bt technology. Fig. 2.1 shows the changes in the yield index with 1951 as the base year. From the last 70 years, the highest yield increase was recorded in cotton (yield index increased from 100 to 585), indicating 5.8 times increase in yield, mostly after 2001 with the introduction of Bt cotton varieties; the next highest



**Fig. 2.1** Index of yields of major crops from 1951 to 2021. Source: Agriculture at a glance, various issues

increase was in maize (from 100 to 561), indicating 5.61 times increase over 70 years, followed by wheat 5.29 times, rapeseed and mustard (4.11 times), paddy 3.98 times and 2.32 times in gram. These are some of the success stories from the last 70 years. Although yield played a major role in the overall increase in production and availability of food items, the increase in the area also played a major role. For example, there is a significant increase in cotton areas in response to increased demand and prices.

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## 2.4 Changes in Food Availability (1951–2021)

An increase in food production is the first indicator of food available for consumption by the population. While the population has grown from 361 million in 1947 to almost 1.403 billion in 2021, that is by almost 3.9 times; our cereal production has increased by almost 6.73 times (from about 42.4 mt in 1951 to 285.3 mt in 2021) (Table 2.2). Pulses production has gone up by three times (from 8.4 mt in 1951 to 25.5 mt in 2021), oilseeds production by 6.9 times (from 5.2 mt to 36.1 mt), cotton by more than 12 times (from 3.0 million bales to 36.1 million bales), milk by 12.4 times (from 17 mt to 210 mt), meat by more than 7.3 times (from 1.2 mt to 8.8 mt), poultry by 43 times (from 0.1 mt to 4.3 mt), eggs by 64 times (from 2 billion to 128 billion), and fish by 18.1 times. It indicates India performed in terms of the availability of various food items even after discounting for population growth (Fig. 2.2).

It indicates the highest growth in production was in eggs, followed by poultry, fish, milk, and cotton with a more than tenfold increase, while the increase is limited in the case of pulses, cereals, oilseeds, and meat. However, in the case of pulses, production growth is less than the population growth, resulting in a decrease in per capita availability of pulses in 2021 compared to 1951, even after accounting for import growth.

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## 2.5 Changes in Per Capita Availability (1951–2021)

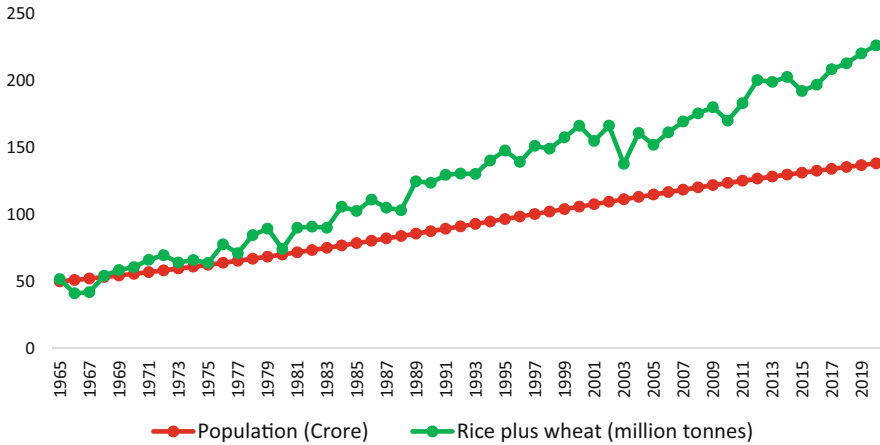
Except for pulses and coarse cereals, the net availability of all other food items increased over the last 70 years. Per capita availability of rice increased from 58 kg to 73 kg (25.9%), wheat increased from 24 kg to 65 kg (171% increase), and total food grains (cereals plus pulses) increased from 144 kg to 187 kg (an increase of 30%). Edible oil availability increased from 3 kg to 19 kg (533% increase), milk per capita availability increased from 130 g/day to 427 g/day (228% increase), and meat availability increased from 3.3 kg to 6.5 kg (97% increase). The spectacular performance was seen in poultry and eggs from 0.2 kg to 3.1 kg (1450% increase) and from 5 to 91 (1720% increase), respectively (Table 2.3).

**Table 2.2** Annual production (mt) from 1951 to 2021

Year	Cereal	Pulse	Oilseed	Cotton*	Milk	Meat	Poultry	Egg (billion nos)	Fish	Population (million)
1951	42.4	8.4	5.2	3.0	17.0	1.2	0.1	2	0.8	361
1961	63.4	10.4	7.0	5.6	17.5	1.7	0.1	3	0.9	439
1971	79.2	9.3	9.6	4.8	19.6	2.1	0.1	7	1.6	548
1981	105.2	9.0	9.4	7.0	29.3	2.7	0.1	10	2.2	683
1991	142.7	12.1	18.6	9.8	45.8	3.7	0.5	21	3.4	846
2001	165.3	12.0	18.4	9.5	66.1	4.3	1.0	37	5.1	1029
2011	185.8	17.3	32.5	33.0	98.2	5.2	2.2	62	7.2	1211
2021	285.3	25.5	36.1	36.0	210.0	8.8	4.3	128	14.5	1403
Increase (times)	6.73	3.0	6.9	12.0	12.4	7.3	43.0	64.0	18.1	3.9

Source: Agricultural statistics at a glance, various issues. Note: \*Million bales of 170 kg each





**Fig. 2.2** Trends in India's population (crore) and food grain production (million tonnes). (Source: Agricultural statistics at a glance, various issues)

## 2.6 Evolution of Institutional Framework

India has transformed from a famine-like situation in the 1940s and 1950s to a food-surplus economy over the years. Now it is a leading agricultural exporting country. During the shortage period, the government of India came out with new regulations and institutional framework to ration food grains so that there would not be any spike in prices of essential food items. First among the regulations is the establishment of regulated markets at the block level under Agricultural Produce Market Committee (APMC) Act to eliminate speculation and malpractices by the traders and commission agents and to provide a platform for farmers to sell their produce at reasonable prices. The Essential Commodities Act of 1955 was to impose stock limits on traders to curb hoarding and speculation. With the onset of the green revolution, to procure grain in green revolution states and distribute in food deficit states, a plethora of institutions evolved, of which the Food Corporation of India (FCI) in 1964, the Warehousing Corporation of India (WCI) 1962, Agricultural Price Commission (APC) in 1965 were established. However, after this initial phase, there was stagnation in reforms in the agricultural sector. Then after a long gap, Model APMC Act 2003 was distributed to states to reform their agricultural markets through (i) the introduction of private markets, (ii) contract farming, (iii) electronic national markets, (iv) direct marketing, etc. This model act is changed as per the new information and consensus (Box 2.1 for details of institutional and legislative developments related to agriculture and food).

**Table 2.3** Per capita net availability of food grains (per annum) in India (kilograms per year)

Year	Rice	Wheat	Other cereal	Cereals	Pulses	Food grains	Edible oil	Cotton (meters)	Milk (g/day)	Meat	Poultry	Egg (number)	Fish
1951	58	24	40	122	22	144	3	8	130	3.3	0.2	5	2.1
1961	73	29	44	146	25	171	3	15	126	3.9	0.2	7	1.9
1971	70	38	44	152	19	171	4	16	110	3.8	0.2	13	3.0
1981	72	47	33	152	14	166	4	17	128	3.9	0.2	15	3.2
1991	81	60	29	171	15	186	6	24	176	4.4	0.6	25	4.1
2001	70	50	21	141	11	152	8	31	217	4.1	0.9	36	5.0
2011	66	60	24	150	16	171	14	44	263	4.3	1.8	51	5.9
2021	73	65	31	170	18	187	19	47	427	6.5	3.1	91	10.3
% increase	25.9	171	-23	39	-18	30	533	488	228	97	1450	1720	390

Source: Agricultural statistics at a glance, various issues. Note: \*Million bales of 170 kg each

### **Box 2.1 Historical Legal and Regulatory Framework Related to Food Markets (Laws and Orders)**

#### **Big role for the government**

- Berar Cotton and Grain Market Act of 1887.
- Agricultural Produce Marketing (Grading and Marketing), Act, 1937.
- AGMARK, 1937.
- Public Distribution System(PDS), 1945.
- The Essential Commodities Act, 1955.
- State Trading Corporation of India, 1956.
- National Cooperative Development Act, 1962.
- The Warehousing Corporations Act, 1962.
- Food Corporation of India Act, 1964.
- Agricultural Price Commission, 1965.
- Prevention of Black Marketing and Maintenance of Supply of Essential Commodities Act, 1980.
- The Bureau of Indian Standards Act 1986.

#### **Liberalization of agricultural markets**

- Model APMC Act (Agricultural Produce Marketing Committee) Act 2003.
- Forward Contract (Regulation) Amendment Act 2006.
- The (Warehousing Development and Regulation) Act, 2007.
- National Food Security Act, 2013.
- Model Agriculture Land Leasing Act, 2016.
- Model Agricultural Produce and Livestock Marketing (promotion and facilitation) Act, 2017.
- Electronic national agriculture markets (eNAM).
- Model Contract Farming Act, 2018.

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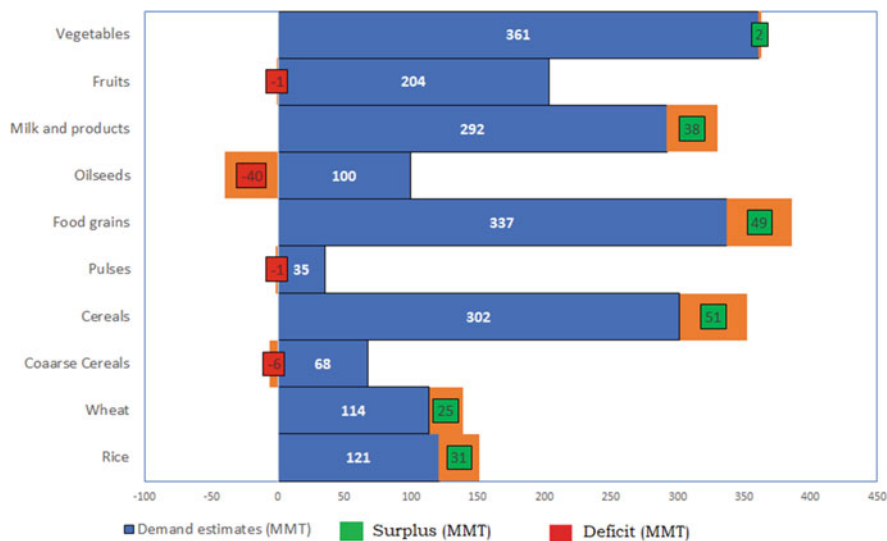
## **2.7 Demand and Supply Projections 2033**

With the current trend of growth in technology and incentive structure, by 2033, there will be a huge surplus in food grains, especially cereals, i.e., wheat and rice. There will be a surplus also in milk and its products and vegetables. But there is likely a deficit in oilseeds, coarse cereals, pulses, and fruits (Fig. 2.3).

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## **2.8 Evolution of Public Distribution System (PDS)**

It is not the availability of food grains, but its distribution to the most vulnerable population, low-income households, and the poorest of the poor and disabled people that cause persistent hunger and malnutrition, and thereby their proper distribution is



**Fig. 2.3** Aggregate demand and supply projections, 2032–33. (Source: NITI Aayog 2018)

**Table 2.4** Net availability, procurement, and public distribution of food grains (in million tonnes)

Year	Net production of food grains	Net imports	Net availability of food grains	Procurement	Public distribution
1951	48.1	4.8	52.4	3.8	8.0
1961	72.0	3.5	75.7	0.5	4.0
1971	94.9	2.0	94.3	8.9	7.8
1981	113.4	0.7	114.3	13.0	13.0
1991	154.3	(-)0.1	158.6	19.6	20.8
2001	172.2	(-)2.9	156.9	42.6	13.2
2011	213.9	(-)2.9	203.1	64.5	47.9
<b>2021</b>	276.4	-20.6	253.4	56.8	53.8 (in addition 29.9 mt under PMGKAY) = 83.69

Source: [https://www.indiabudget.gov.in/budget\\_archive/es2000-01/app1.19.pdf](https://www.indiabudget.gov.in/budget_archive/es2000-01/app1.19.pdf)

Source: Lok Sabha unstarred question No. 1614 answered on 8th December 2021

crucial. Keeping the recurrent famines during and after the second world war, the Public Distribution System (PDS) scheme was first started on 14 January 1945 and was launched in its current form in June 1947. The introduction of rationing in India dates back to the 1940s Bengal famine. This rationing system was revived in the wake of acute food shortage during the early 1960s, before the Green Revolution. It involves two types, RPDS and TPDS. In 1992, PDS became RPDS (Revamped PDS), focusing the poor families, especially in far-flung, hilly, remote, and inaccessible areas. In 1997 RPDS became TPDS (Targeted PDS) which established Fair Price Shops for the distribution of food grains at subsidized rates (Table 2.4).

Another major push for food security and PDS was in 2013 with the enactment of The National Food Security Act 2013 (also the 'Right to Food Act'). It is an Indian Act of Parliament that aims to provide subsidized food grains to approximately two-thirds of the country's 1.4 billion people. It was signed into law.

The National Food Security Act, 2013 (NFSA 2013) converts into legal entitlements for existing food security programs of the Government of India. It includes the Midday Meal Scheme, Integrated Child Development Services scheme, and the Public Distribution System. Further, the NFSA 2013 recognizes maternity entitlements. The Midday Meal Scheme and the Integrated Child Development Services Scheme are universal in nature, whereas the PDS will reach about two-thirds of the population (75% in rural areas and 50% in urban areas). As per the latest data, 79.72 crore persons were covered under the NFSA. A total of 5.44 lakh fair-price shops exist across the country for the distribution of food grains to the NFSA beneficiaries.

Under the provisions of the bill, beneficiaries of the Public Distribution System (PDS) are entitled to 5 kg per person per month of cereals. Rice is sold at ₹3 per kg; wheat at ₹2 per kg, and coarse grains (millet) at ₹1 per kg. Pregnant women, lactating mothers, and certain categories of children are eligible for daily free cereals.

To meet the COVID situation, Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY) was launched to ensure that the targeted beneficiaries (including migrant workers) do not face any issues of food security on account of the pandemic. PMGKAY provided for additional allocation of food grains @ 5 kg per person per month free of cost for all the beneficiaries covered under the Targeted Public Distribution System (Antyodaya Anna Yojana & Priority Households). This was over and above the monthly benefit provided under the National Food Security Act 2013 (Table 2.4).

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## 2.9 Malnutrition

To address anemia and micronutrient deficiency in the country, the Government of India approved a Centrally Sponsored Pilot Scheme on "Fortification of Rice and its Distribution under Targeted Public Distribution System (TPDS)" for a period of 3 years beginning in 2019–2020. The Pilot Scheme is intended to focus on 15 Districts. Under this scheme, state governments have started the distribution of fortified rice. Mid-Day Meal (MDM) and ICDS are covered under the provisions of NFSA.

The government has notified Food Security Allowance Rules, 2015, under this, pregnant women and lactating mothers and children in the age group of 6 months to 14 years are entitled to meals as per prescribed nutritional norms under Integrated Child Development Services (IGDS) and Mid-Day Meal (MDM) schemes. Higher nutritional norms are prescribed for malnourished children up to 6 years of age.

## 2.10 Children

As per the World Bank (2013), approximately 60 million children in India were underweight, about 45% were stunted (too short for their age), 20% were wasted (too thin for their height, indicating acute malnutrition), 75% were anemic, and 57% were vitamin A deficient. The numbers keep increasing over the years. The majority of them belong to the most vulnerable sections of society living in rural areas. To cater to this section, Anganwadi Centres were created.

It was also observed that the AWCs, especially the ones in tribal hamlets, lacked proper Teaching and Learning Materials, had no LPG cylinder connection, no drinking water facility, no mats or furniture, etc., and were in deplorable conditions.

Now is the time to change the narrative and reimagine the whole framework of working of AWCs in light of digital interventions. Technology has already paved its way in AWCs. The AWCs have been provided with smartphones, and the supervisors with tablets for recording the data accurately and digitally. In 2015, the NITI Aayog recommended providing better sanitation and drinking water facilities, improved power supply, and basic medicines for the AWCs.

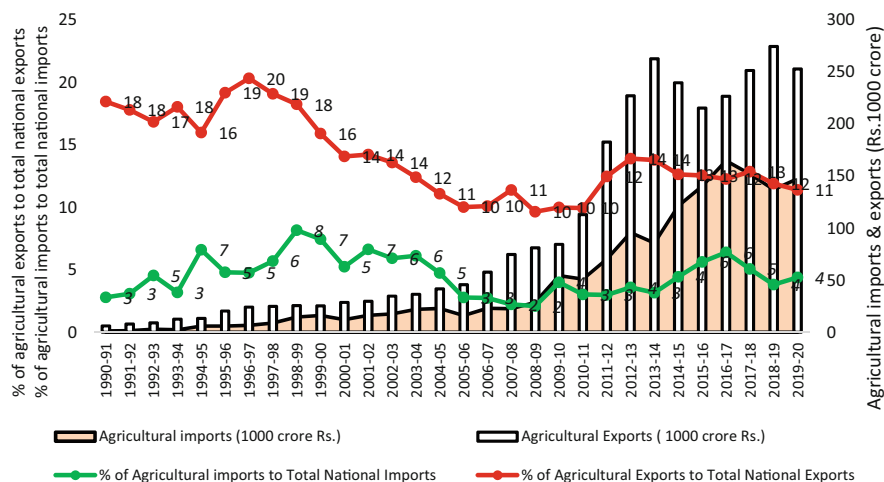
Women empowerment is a prerequisite for child development. Many studies on intra-household food consumption pointed out that economic contributions, physically strenuous work, cultural beliefs and social status, concerns about fair allocation, decision-making power, household-level food sufficiency, wealth, and seasonality will determine the food and nutrition status of a child. A number of studies pointed out that women and men have different priorities when controlling income, with women more likely to invest in children's education, nutrition, and health (Masamha et al. 2018; Agarwal 2021).

The increasing presence of undernutrition, obesity, and micronutrient deficiencies simultaneously in the same households results in a triple burden of malnutrition (Béné et al. 2015). In this context, it would be wise to reconsider the inclusion of healthy food commodities such as pulses, nutri-cereals, biofortified rice, etc., in the PDS basket.

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## 2.11 Increasing Exports

There was a significant improvement in the food surplus situation and exports after the 1990s in India. Globally more countries are opening up their domestic economies, providing greater opportunities for India's exports. Exports of agricultural commodities steeply increased since 1991 and started rapidly increasing after 2006–2007. Overall exports of India also increased during this period with the industrial liberalization and free export and import policies to align in line with WTO commitments. Although agricultural exports increased steeply, their relative share decreased from the peak of 20% of total national exports to 12% in 2019–2020. At the same time, India's agricultural imports remain very low, below 10% of total national imports. With the growing surplus of many agricultural commodities, there is a need for increasing agricultural exports by identifying new export commodities



**Fig. 2.4** Agricultural exports and imports from 1990–1991 to 2019–2020. Source: Agricultural statistics at a glance, various issues

and countries and strengthening existing commodity groups to the existing destinations. This can be done through long-term export contracts or by joining different trade groups like SAAFTA (Fig. 2.4).

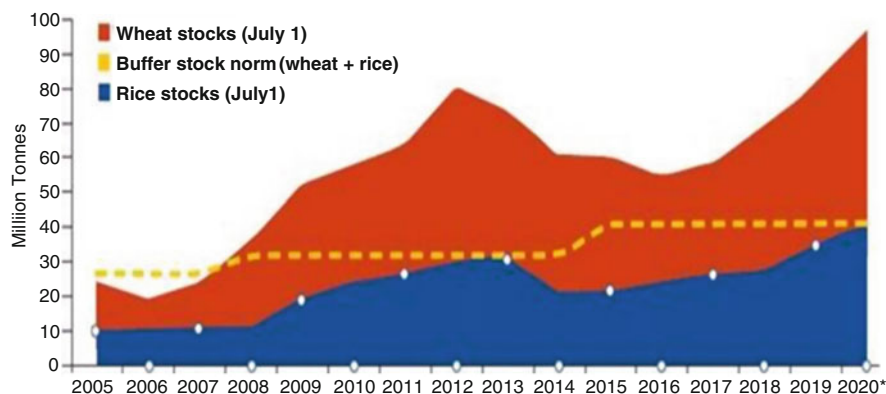
## 2.12 Inefficiencies in Procurement and PDS

Every year, the government of India spends huge amounts of money, up to 2–4 lakh crore, toward food subsidies and public distribution systems. Although procurement operations at Minimum Support Price (MSP) of paddy and wheat and distribution through ration shops for the needy served its purpose of remunerative prices to farmers and food security for the majority of Indians, inefficiencies have built up in the system over the years.

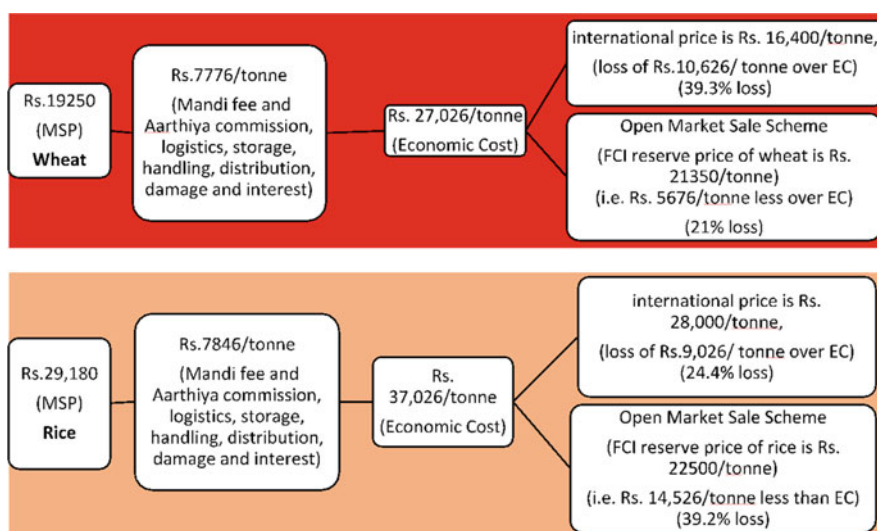
The buffer stock of food grains in 2020 is more than three times the existing buffer stocking norm (Fig. 2.5). Except for a few years, stocks have been much higher than buffer norms in the recent past. There is about 50 mt excess stock worth about 1.5 lakh crore blocked with no use to either farmers or consumers.

On the supply side, owing to the rise in the MSP, the government has become the sole buyer of paddy and wheat in states like Punjab, Haryana, and Telangana. On the demand side, the expanding food grain commitments under the National Food Security Act pressure the FCI to intensify its procurement drive. Consequently, the government procured a major share of paddy and wheat in the market.

The grain management cost includes acquisition cost, which covers pooled cost, procurement incidentals, and distribution cost. Combining the MSP with the cost of logistics, storage, handling, and distribution, the economic costs for rice and wheat are estimated at ₹37,026 and ₹27,026 per tonne, respectively (Fig. 2.6). The cost of



**Fig. 2.5** Open-ended procurement operations. (Source: Reddy (2021a, 2021b))



**Fig. 2.6** Economics of buffer stock operations for the year 2021. Source: Reddy (2021a)

maintaining strategic stocks or buffer carrying costs is rising, which is attributed to increased procurement incidentals (such as storage, handling, transportation, and other charges), and acquisition and distribution costs. Prices of both rice and wheat in the Open Market Sale Scheme (OMSS) of FCI came down because of excess supply. The price of rice in OMSS is ₹22,500 per tonne in 2020 against ₹27,850 per tonne earlier 3 years back. In the same way, the OMSS price of wheat has also come down to ₹21,350 per tonne against ₹22,450 per tonne earlier. These OMSS prices of both rice and wheat are significantly lower than the economic cost. The reduced sale price of grains for OMSS is due to the excess buffer stock and the shortage of storage. The poor demand for grains in the open market in recent years is also



another reason. Therefore, the increasing gap between costs and revenues has strained the finances of the FCI as they lose 39.2% for rice and 21% for wheat in OPSS. The same thing happens for international prices also (Fig. 2.6).

The practice of procuring more than stipulated buffer quantities leads to certain imbalances. It requires offloading the excess stock in the international or domestic market, which could lead to a price crash. Also, it could lead to a loss when the international market prices or domestic prices are lower than the actual economic cost of the stock.

Table 2.5 indicates the vast difference in the share of the procurement of grains against the total production in the case of rice, wheat, and pulses. In case of pulses, procurement is generally below 10% of the production, while in the case of paddy and wheat, it is 43% and 36%, respectively. The neglect of pulses, oilseeds, and nutri-cereals with a focus on only paddy and wheat disrupts a balanced diet among the poor consumers who depend on PDS for their consumption requirements. This needs to be rectified with more procurement of pulses, oilseeds, and other crops to enhance balance in food systems at the national and household levels.

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### 2.13 FAO-Based Food and Nutrition Security Indicators

According to a currently accepted definition (FAO 2000), “Food Security” is achieved when it is ensured that “all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life.” Food is here defined as any substance that people eat and drink to maintain life and growth. As a result, safe and clean water is an essential part of food commodities. The nutrition focus adds the aspects of caring practices and health services and healthy environments to this definition and concept. This aims at what is more precisely called “Nutrition Security,” which can be defined as adequate nutritional status in terms of protein, energy, vitamins, and minerals for all household members at all times (Quisumbing et al. 1995 p. 12).

Now, after incorporating nutrition aspects, “Food and nutrition security is achieved, if adequate food (quantity, quality, safety, sociocultural acceptability) is available and accessible for and satisfactorily used and utilized by all individuals at all times to live a healthy and active life.” This definition combines food and nutrition security (FNS) and emphasizes several aspects, i.e., “Availability,” “Accessibility,” and “Use and Utilization” of food. The inclusion of the use and utilization aspect underscores the fact that “Nutrition Security” is more than “Food Security.”

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### 2.14 Aspects of Food and Nutrition Security

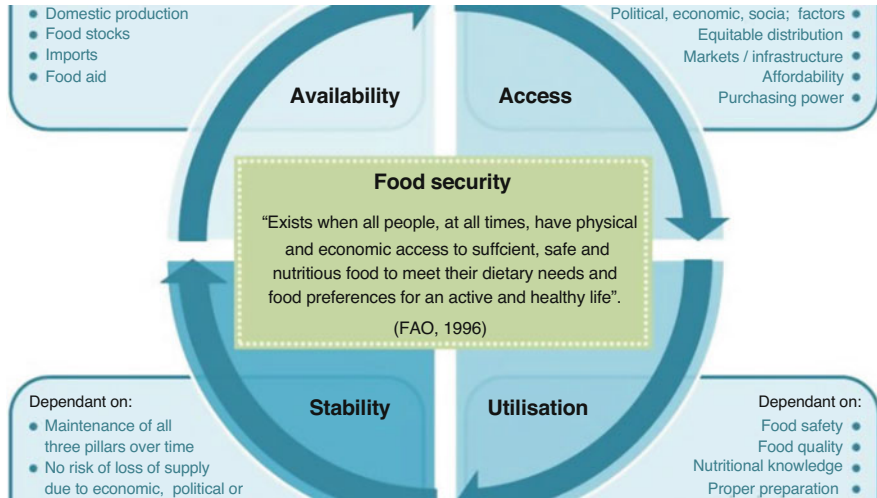
The conceptual framework of food security Fig. 2.7 illustrates the relationship among the various elements of food security. Two factors influence the framework: a physical and a temporal factor. The physical determinant is the food flow:

**Table 2.5** Procurement of rice, wheat, and pulses

Year	Rice		Wheat		Pulses	
	Production (LT)	Procurement (% of production)	Production (LT)	Procurement (% of production)	Production (LT)	Procurement (% of production)
2015–2016	1044.1	32.8	922.9	24.9	16.3	0.0
2016–2017	1097.0	34.7	985.1	31.3	23.1	0.0
2017–2018	1127.6	33.9	998.7	35.8	25.4	6.4
2018–2019	1164.8	38.1	1036.0	32.9	22.1	18.9
2019–2020	1179.4	43.3	1071.9	36.4	23.2	6.5

Source: <http://164.100.24.220/loksabhaquestions/annex/178/AU3447.pdf>

Source: Lok Sabha Unstarred Question No.3447 Answered On 23rd March,2022



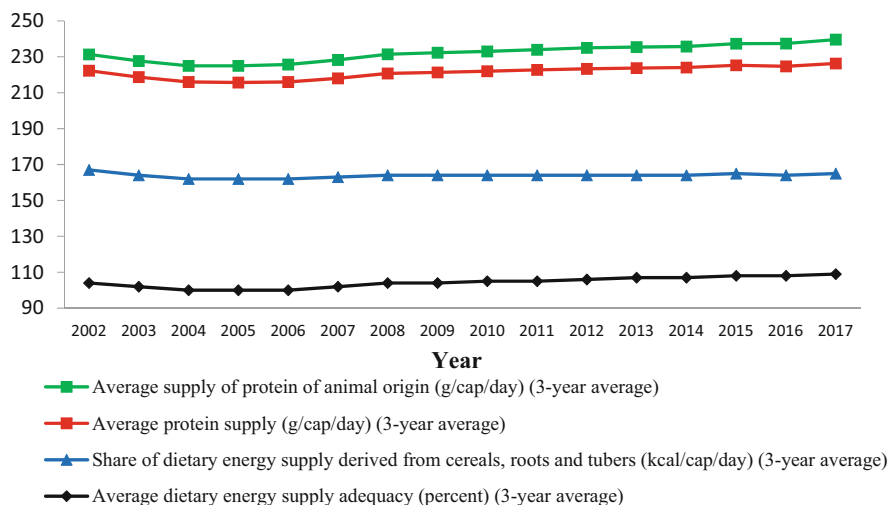
**Fig. 2.7** Conceptual framework for food security. Source: FAO (1996)

Availability, Accessibility, Use, and Utilization. The temporal determinant of FNS refers to stability, which affects all three physical elements. In this section, different pillars of food security for India were analyzed from the year 2000–2019.

### 2.14.1 Food Availability

**Availability** refers to the physical existence of food, be it from its own production or from the market. On a national level, food availability is a combination of domestic food production, commercial food imports, food aid, and domestic food stocks, as well as the underlying determinants of each of these factors. The use of the term availability is often confusing since it can refer to food supplies available at both the household level and at a more aggregate (regional or national) level. However, the term is applied most commonly in reference to food supplies at the regional or national level. Indicators of availability are explained in Fig. 2.8.

Average dietary supply adequacy, the share of dietary energy supply derived from cereals, roots, tubers, and average protein supply are the indicators of availability. Based on FAO data, the national average per capita food energy supply is calculated. Rice and wheat are the major sources of dietary energy in India. In the early 2000s, the supply of dietary energy was less stagnant (Fig. 2.8) and gradually increased after 2007. Major sources of protein for human consumption are pulses, meat, fish, and milk products. The average protein supply is measured in g/cap/day. Protein supply was somewhat stagnant or even declining in the early 2000s, but from 2005, it shows an increasing trend year-on-year in the same way the share of dietary energy supply derived from cereals, roots, and tubers shows an increasing trend.



**Fig. 2.8** Indicators of food availability. (Source: FAOSTAT 2022)

### 2.14.2 Food Access

Access is ensured when all households and all individuals within those households have sufficient resources to obtain appropriate foods for a nutritious diet. It is dependent on the level of household resources—capital, labor, and knowledge—and prices.

Figure 2.9 depicts the rail line density and prevalence of undernourishment. The rail line density was lower in 2002, but it slowly improved after 2011. The prevalence of undernourishment is an outcome indicator of food access. It shows the probability that a randomly selected individual from the population consumes a number of sufficient calories to cover her/his energy requirement for an active and healthy life. Undernourishment was high in 2005 (22.1%) but decreased steeply.

GDP per capita was based on PPP\$. PPP-GDP is GDP that is converted into international dollars using PPP rates. It was measured in constant 2011 international dollars. Fig. 2.10 depicts the Gross domestic product per capita, PPP, dissemination from 2002 to 2018; the GDP per capita was lowest in 2002 at about 2711.5 dollars and gradually showed an increasing trend, indicating increased purchasing power and food access.

### 2.14.3 Food Utilization

The use of food refers to the socioeconomic aspect of household food security. If sufficient and nutritious food is both available and accessible, the household has to make decisions concerning what food is to be purchased, prepared, and consumed (demanded) and how the food is allocated within the household. In households

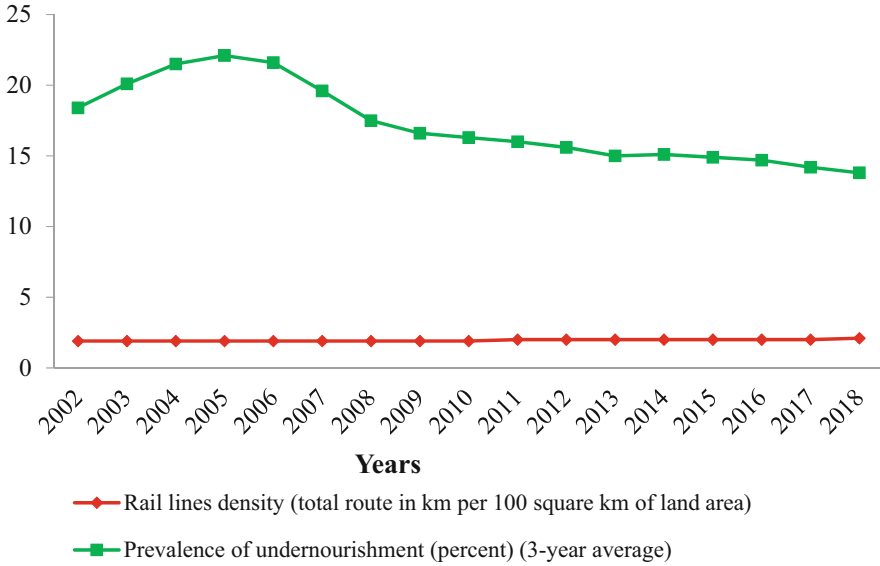


Fig. 2.9 Indicators of food access (Source: FAOSTAT 2022)

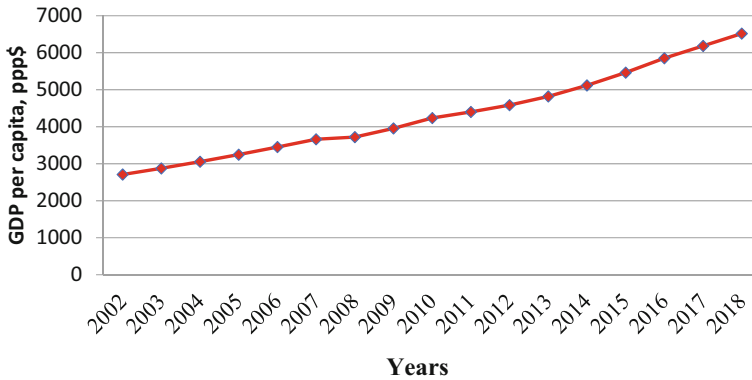
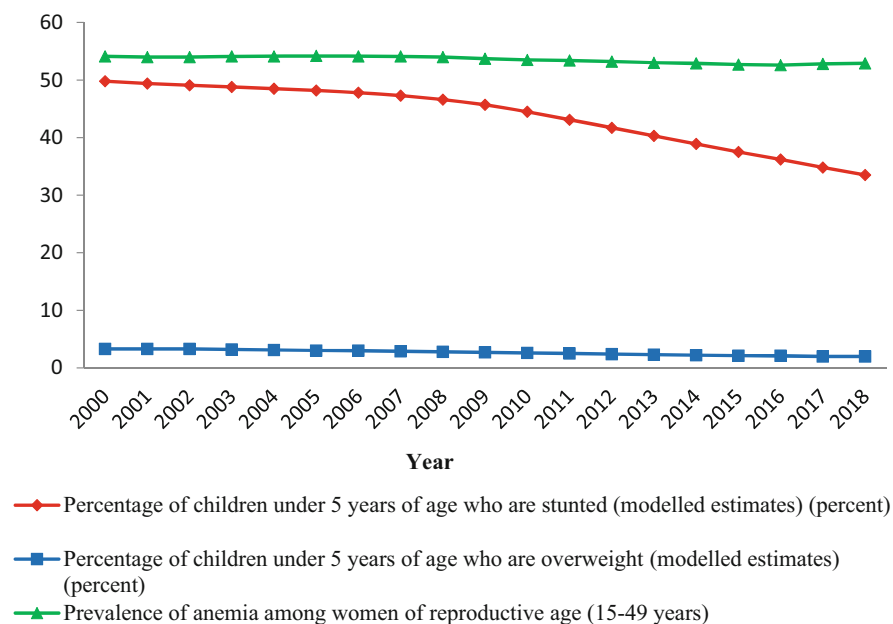


Fig. 2.10 Gross domestic product per capita, PPP\$ (FAOSTAT 2022)

where distribution is unequal, even if the measured aggregate access is sufficient, some individuals may suffer from food deficiency. The same is true if the composition of the consumed food is unbalanced.

Focusing on the individual level of food security also requires taking the biological **utilization** of food into consideration. This refers to the ability of the human body to take food and convert it into energy which is either used to undertake daily activities or is stored. Utilization requires not only an adequate diet but also a healthy physical environment, including safe drinking water and adequate sanitary



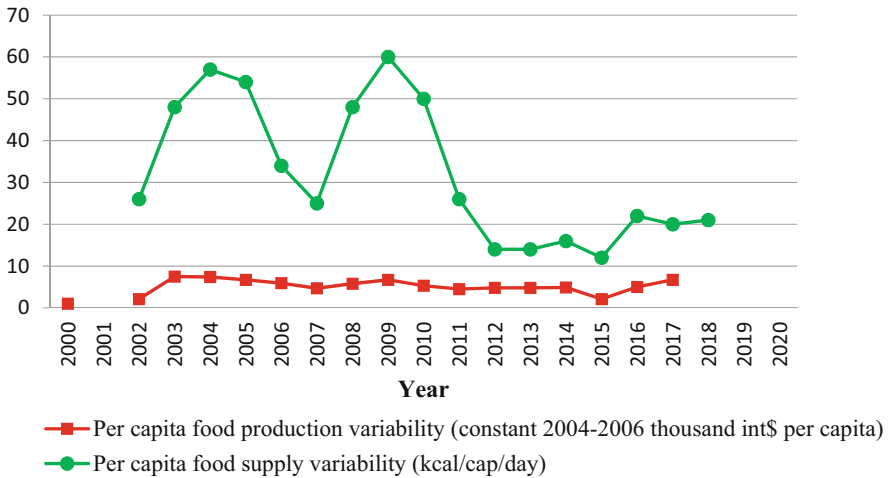
**Fig. 2.11** Indicators of utilization (Source: FAOSTAT 2022)

facilities (so as to avoid disease) and an understanding of proper health care, food preparation, and storage processes.

The percentage of children under 5 years of age who are stunted and overweight are outcome indicators in utilization. Children under 5 years of age who are stunted and overweight were higher in 2000 at about 49.8 and 3.3%, respectively; year-on-year, there is a steep decrease in the percentage of children under 5 years of age who are stunted and overweight (Fig. 2.11).

#### 2.14.4 Food Stability

**Food stability** or sustainability refers to the temporal dimension of nutrition security, i.e., the time frame over which food security is being considered. In much of the food security literature, a distinction is made between chronic food insecurity—the inability to meet food needs on an ongoing basis—and transitory food insecurity, when the inability to meet food needs is of a temporary nature (Maxwell and Frankenberger 1992). Transitory food insecurity is sometimes divided into two subcategories: (i) cyclical, where there is a regular pattern to food insecurity, e.g., the “lean season” or “hungry season” that occurs in the period just before harvest, and (ii) temporary, which is the result of a short-term, exogenous shock such as droughts or floods.

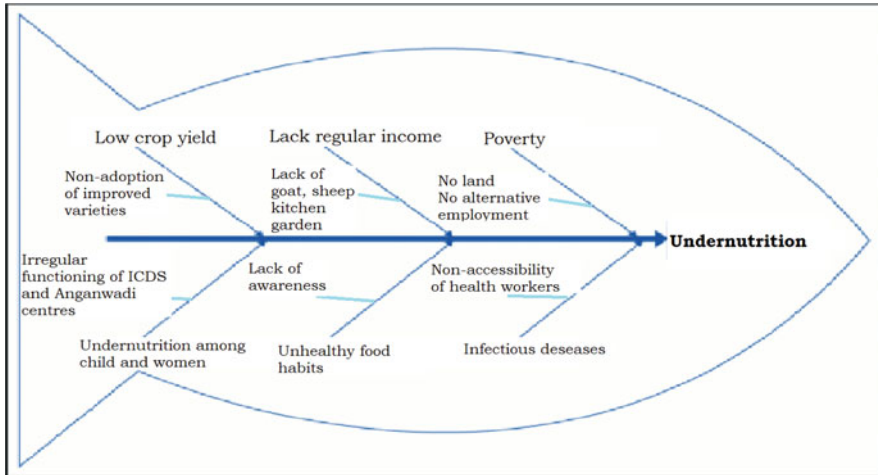


**Fig. 2.12** Indicators of stability

Per capita food production variability and Per capita food supply variability (kcal/cap/day) are depicted in Fig. 2.12 that, per capita food production variability corresponds to the variability of the net food production value in constant 2004–2006 international dollars divided by the population number as from UN 2010 estimates. Variability is based on the trend of the net food production index number per capita over the period of 2002–2018 and corresponds to the standard deviation of the deviation from the trend over a period of 5 years. Per capita food production variability was much lower in 2002, which gradually increased in 2003. After 2003 there was a steep decrease in Per capita food production variability, whereas it was much higher in 2017, and it is the same in the case of per capita food supply variability.

## 2.15 The Problem Analysis

The above analysis showed some undernourishment, especially among women and children, from both secondary sources, which was supported by primary data collection from a few village studies. A detailed analysis of the problem was done by drawing a fishbone diagram of problem analysis, diagnosis, and dissection (Fig. 2.13). The major causes of undernourishment are poverty, irregular incomes, low crop yields, unhealthy food habits like an excessive proportion of rice compared to fruits and vegetables and infectious diseases.



**Fig. 2.13** Root cause analysis of undernourishment through fishbone diagram (Source: Focus group discussion in a village in Telangana by the authors)

## 2.16 Conclusions

This chapter has attempted to analyze data from three dimensions of food availability, access to nutritious food and utilization of food supplies in India. The results and analysis indicate that there is very good progress in food availability with increased production of all food items, and there is also a visible improvement in food access with the implementation of the Food Security Act. There is a need to focus on agriculture diversification, enhanced productivity, incentives for promotion of cultivation, marketing, and demand generation of nutri-rich foods like coarse cereals and pulses. There is a need to focus on strengthening safety net programs like PDS, improving Child and women nutrition programs like ICDS and mid-day meal programs to reduce undernourishment and anemia, and reducing wasting prevalence among children and women. There is a need for improvement in water, sanitation, and hygiene practices and changing consumer behavior toward healthy food.

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