



Future of Food system:

Preparing for the next frontier



October 2026

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01

The Evolution of India's Food Security Journey: Meeting the core challenges



At the stroke of midnight on 15 August 1947, India embarked on its journey as an independent nation, carrying with it the hopes and aspirations of millions. The challenges before the country were immense, ranging from low agricultural production and productivity, limited per capita food availability, widespread malnutrition, and high mortality rates, to the broader task of socio-economic development. In 1950-51, India had a production of approximately 50.8¹ million tonnes of foodgrains for a population of around 361 million people, translating into an annual per capita availability of about 141 kilograms, or roughly 0.39 kg per day². At the same time, the country's average life expectancy was estimated to be only 32 years, underscoring food security as one of the critical challenges confronting the nation at the time.

Every nation follows its own path and pace of policy evolution, particularly in areas of critical socio-economic significance. India's journey has likewise been characterized by a gradual and calibrated approach, shaped by the rapidly growing population, the availability of resources, evolving developmental priorities, and changing global dynamics. Over time, this policy evolution expanded the national focus from a predominantly production-centric approach towards Food Systems Approach taking action from farm to fork across food supply chains.

The first two decades after Independence were characterized by a Production Centric Approach, where agricultural policy was primarily shaped by the need to overcome food scarcity and enhance domestic production capacity. During the 1950s, food shortages and low agricultural production prompted the First five-year Plan to be focused on agricultural development, irrigation, and land reforms. These measures laid the groundwork for improving farm output and reducing the immediate risk of food insecurity.

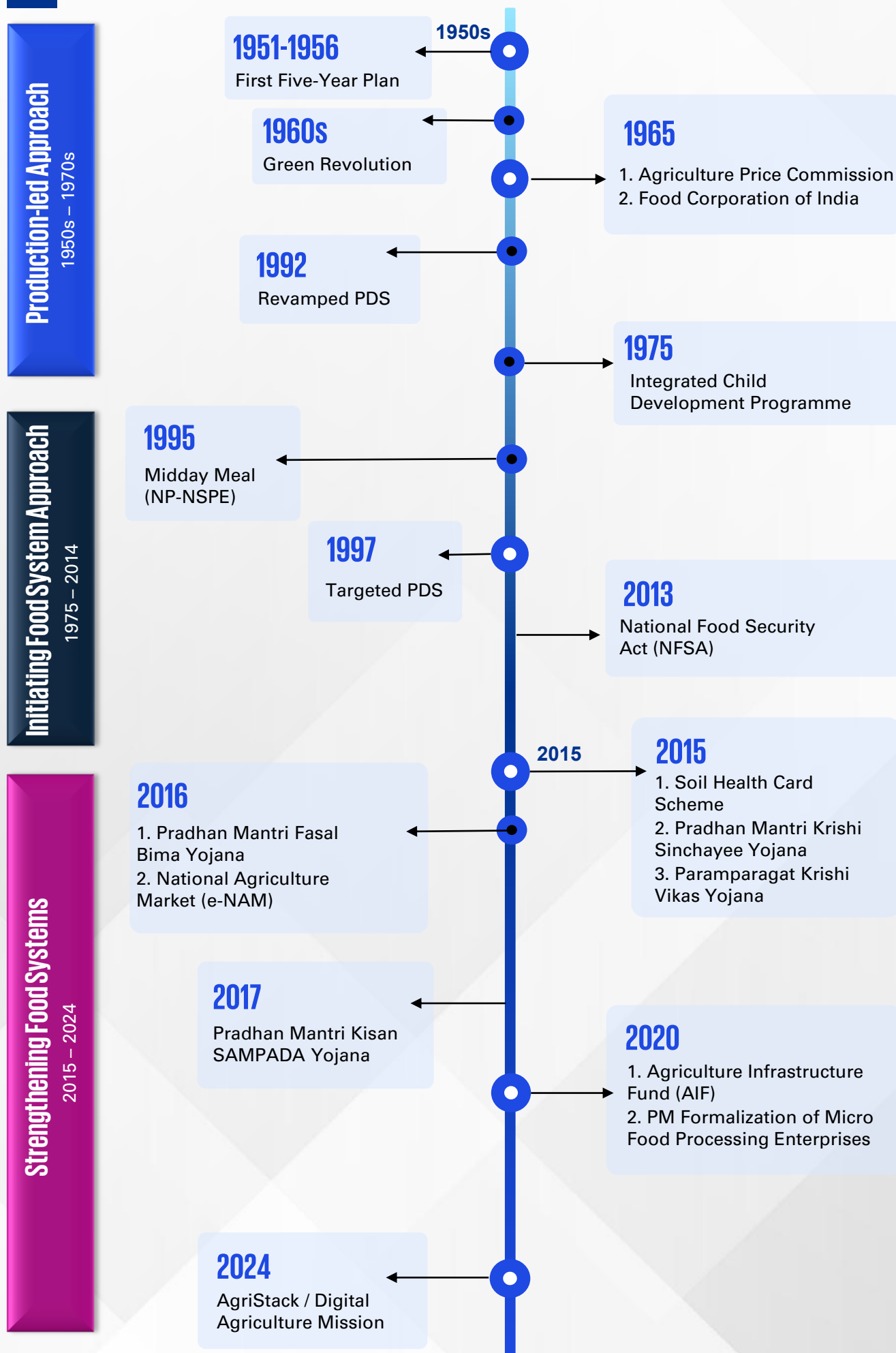
Similarly, in the 1960s, rapid population growth, recurrent droughts, and food deficits triggered transformative policy measures such as the Green Revolution, establishment of Agricultural Price Commission and creation of Food Corporation of India. The introduction of minimum support prices to incentivize production and creation of buffer stock established the foundation of India's long-term food security framework making India achieve food sufficiency.

From the 1970s onwards, India's policy focus began transitioning towards a more Food Systems Approach. While increasing food production remained important, policymakers increasingly recognized that food security extends beyond availability to encompass access, affordability, nutrition, and equitable distribution. Interventions such as the Integrated Child Development Services (ICDS) and reforms to the Public Distribution System (PDS) reflected a growing emphasis on ensuring that food reached vulnerable populations. This perspective continued to evolve through the 1990s, with the introduction of the National Programme of Nutritional Support to Primary Education (NP-NSPE), commonly known as the Mid-Day Meal Scheme, which strengthened the integration of nutrition and educational objectives. These developments ultimately gave way to a rights-based framework through the National Food Security Act (NFSA), 2013, transforming access to food from a welfare measure into a legal entitlement and marking a significant milestone in India's food security journey.

Further strengthening the food systems, the government's interventions have sought to address constraints across the entire agri-food system, ranging from soil health, irrigation, and crop insurance to market access, storage infrastructure, food processing, and digital public infrastructure. Initiatives such as Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Pradhan Mantri Fasal Bima Yojana (PMFBY), and Soil Health Card Scheme aimed to improve farm productivity and climate resilience, while reforms such as National Agriculture Market (e-NAM) and promotion of Farmer Producer Organisations (FPOs) sought to strengthen farmers' access to markets and improve price realization. Simultaneously, large-scale investments through the Agriculture Infrastructure Fund (AIF), PM Kisan SAMPADA Yojana, and PM Formalization of Micro Food Processing Enterprises (PMFME) focused on reducing post-harvest losses, expanding processing capacity, and strengthening agricultural logistics. More recently, initiatives such as Agri-Stack, One Nation One Ration Card (ONORC), Smart PDS, and the World's Largest Grain Storage Plan in the Cooperative Sector have highlighted the government's emphasis on leveraging technology, improving supply-chain efficiency, and building a more resilient, inclusive, and future-ready food system.

1. RU-56-02-0119-280722/FACTSHEET/PIB/July 2022

2. Food supply and security





02

Approach to Future Food Systems: An Integrated Lens



Today, however, India's challenge is no longer simply to produce more, but to ensure that affordable nutritious food reaches the right person, at the right place, and at the right time without placing an unsustainable burden on natural resources or farmers. The future of India's food system must therefore be examined through three interconnected pillars: **availability**, **accessibility** and **affordability**. Together, they provide a practical framework for India's future food system.

Availability has three dimensions: availability of **sufficient food**, availability of **nutritious food** and availability of **diverse food choices** that reflect the evolving tastes and preferences of a growing consumer base, particularly in urban India. Availability of calories is not necessarily availability of nutrition. Ensuring availability would require not only higher and more stable output, but also a shift towards crops and production systems that support healthier diets.

Accessibility includes both physical and information access. Physical access depends on efficient production, transportation, storage and distribution systems that can move food reliably from farms to consumers. Information access enables better decisions across the value chain. Farmers need timely market intelligence, weather advisories and extension support, while consumers need clear information on nutrition, food quality, traceability and safety.

Affordability has both economic and environmental dimensions. Economic affordability means enabling consumers to obtain diverse, nutritious food at reasonable prices while ensuring remunerative returns for producers. Environmental affordability recognises the hidden costs of production including pressure on soil, water, biodiversity and the climate and asks whether today's food choices could be sustained without compromising tomorrow's productive capacity.



03

Food Systems at a Crossroad



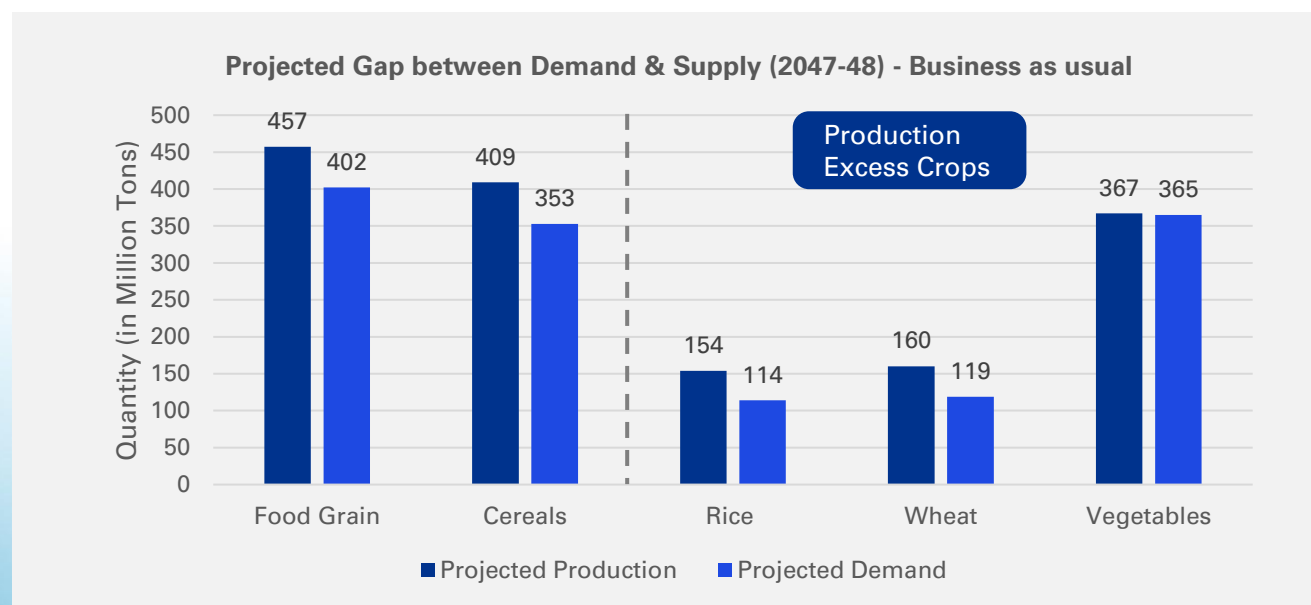
Food Production and the Future Estimates

Today, ensuring sufficient food availability to sustain the population is no longer India's primary challenge. The more pressing question is whether the current food system is prepared to meet future demand amid continued population growth, evolving consumption patterns, resource constraints, and emerging sustainability concerns.

According to the United Nations' World Population Prospects, India's population is projected to rise from about 1.43 billion in 2023 to approximately 1.68 billion by 2050³. Meeting the needs of this larger population would require productivity gains that are resilient to climate variability and do not accelerate the depletion of land and water resources.

The current production landscape presents an optimistic picture for India's food system to meet the food requirements of current population. Production levels of major food grains and animal-source foods such as rice, wheat, milk and eggs are in pace with national requirements, although critical deficits persist in commodities such as pulses, oilseeds etc. However, the more pertinent question is whether it would remain adequate for a nation whose population is projected to reach nearly 1.68 billion by 2050.

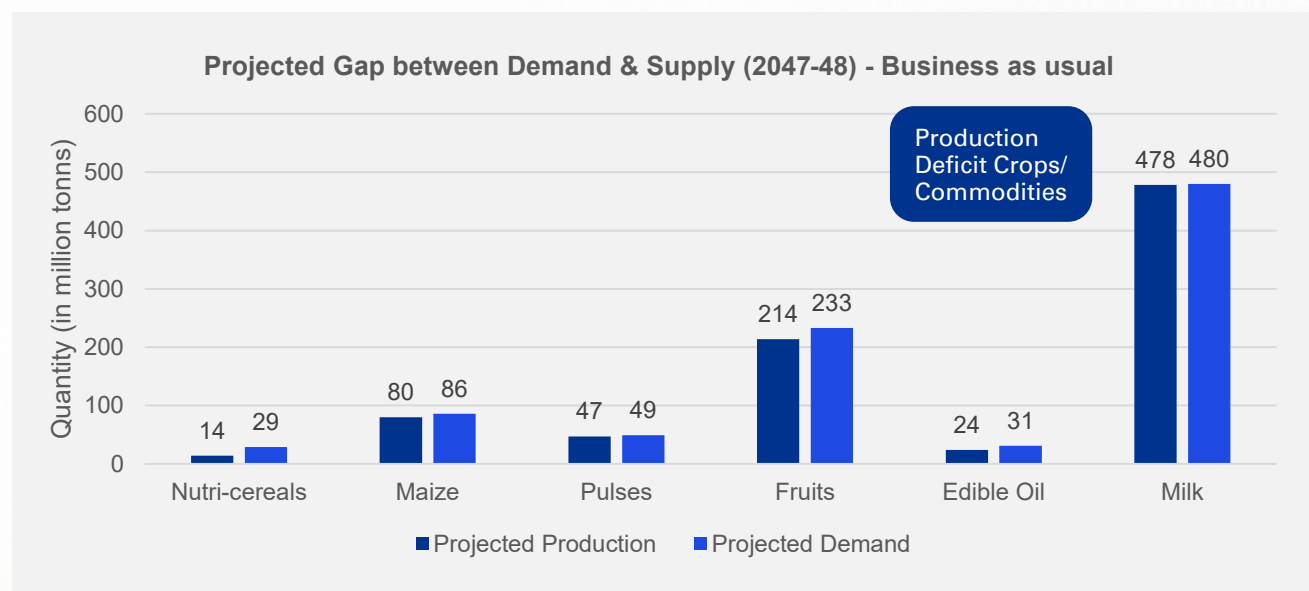
In a NITI Aayog, Working Group Report on Crop Husbandry, Agriculture Inputs, Demand and Supply Projections of future demand and supply indicate that business-as-usual growth trajectories may not be sufficient to bridge the emerging gaps in several key commodities. The graph below presents crops for which projected production levels are expected to match projected demand⁴.



3. Data Portal Population Division - United Nations

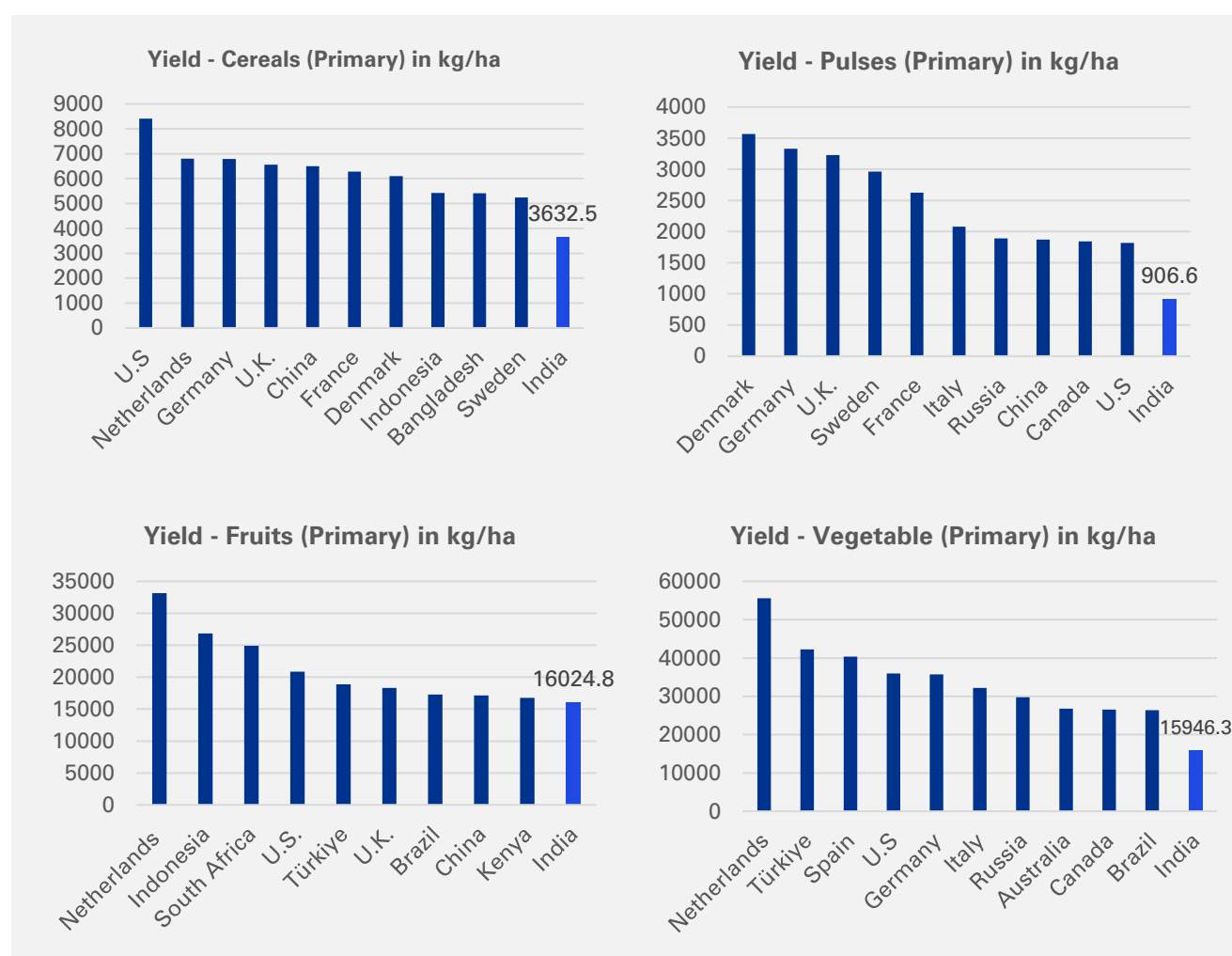
4. Working Group Report on Crop Husbandry, Agriculture Inputs, Demand and Supply/NITI Aayog/2024

The graph below presents crops for which projected demand levels are expected to exceed projected demand⁵.



5. Working Group Report on Crop Husbandry, Agriculture Inputs, Demand and Supply/NITI Aayog/2024

One of the key factors underlying the widening gap between projected demand and future production is that much of India's agricultural growth over the past decades has been driven by expansion in cultivated area rather than sustained improvements in productivity. The country is the world's second-largest producer of both rice and wheat, with production reaching 150.18 million tonnes and 117.94 million tonnes, respectively, in 2024-25. India also leads the world in pulse production, recording an output of 25.68 million tonnes, underscoring its critical contribution to global nutrition security. Further, it is the world's second-largest producer of fruits and vegetables, with production of 114.51 million tonnes of fruits and 219.67 million tonnes of vegetables⁶. Yet in various crops like pulses and oilseed we are not able to meet the growing domestic demand. As opportunities for acreage expansion become increasingly limited, future production growth would depend far more on achieving significant gains in yields. From the graph we could say there is a considerable realizable potential in India in terms of yield⁷. (The chart presents the top yielding countries and India's position for comparison for the year 2024. India's placement in the chart does not imply it ranks immediately after the top 10 countries).



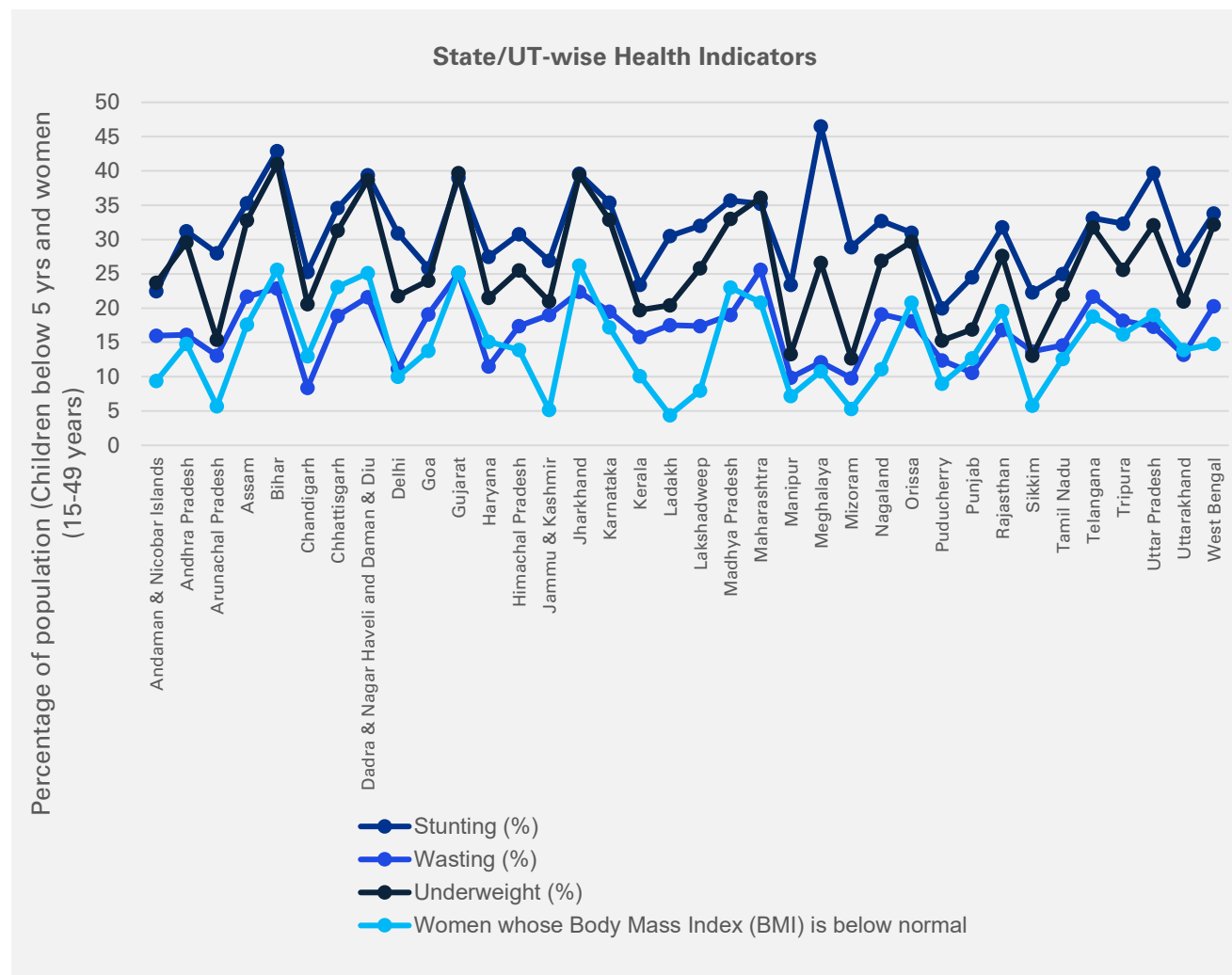
Food production systems are increasingly exposed to climate-related risks, including rising temperatures, changing precipitation patterns, extreme weather events, and degradation of natural resources. If left unaddressed, these pressures could undermine agricultural production potentially bringing India back to a situation where ensuring adequate food for its population becomes a significant challenge once again. Additionally, the availability of critical agricultural inputs such as fertilizers, as well as imports of essential commodities, is significantly influenced by global market conditions. Any disruption in international supply chains, trade dynamics, or geopolitical developments could adversely affect their availability, leading to production-related challenges.

6. India's Resilient Production Systems in Agriculture/PIB/4 April 2026

7. FAO

Beyond Hunger: Nutritional Security

Despite progressing in recent decades from a low-income to a middle-income country, India faces severe challenge related to stunting, wasting and under-weight among children under five. Nutritional security is influenced by a range of interconnected socio-economic and production factors, including household income, food availability and diversity, maternal education, access to healthcare, and nutritional awareness. Below graph represents State/UT wise prevalence of stunting, wasting and underweight among children under 5 years and malnutrition among Women (15-49 years of age)⁸.



However, for the purpose of this paper, the analysis is limited to the crop system dimension of nutritional security. Food security and nutritional security are not synonymous. A nation may produce sufficient food, but unless households can access and consume a balanced diet, nutritional deficits would persist. In India, the Indian Council of Medical Research (ICMR) has prescribed Recommended Dietary Allowances (RDAs) that define the nutrient requirements necessary for healthy growth and development. Building on these benchmarks, NITI Aayog, in its Working Group Report on Crop Husbandry, Agriculture Inputs, Demand and Supply, has provided population weighted RDA norms for a balanced diet as normative demand. A deeper examination reveals a paradox that lies at the heart of the nutritional security challenge. While national food production exceeds normative dietary requirements, this availability has not translated into adequate nutritional outcomes. The analysis indicates that per capita food production stands at approximately 1,721 grams per day, nearly 36 per cent higher than the normatively required level. Yet, actual food consumption remains around 20 per cent below the prescribed requirement. This divergence highlights that the challenge as of now is of effective access and affordability.

8. Source: NFHS 5 (2019-21)

S. No.	Commodity	Production (gms/capita/day) (A)*	Normative Demand (gms/capita/day) (B)*	Actual Consumption (gms/capita/day) (C)*	Nutritional Gap (D) = (C)-(B)
1	Cereals	550	285	357	72
2	Fat and Edible Oil	24	27	30	3
3	Sugar and Products	63	26	28	2
4	Pulses and equivalent non-veg	103	98	46	-52
5	Milk	398	359	209	-150
6	Vegetables	377	366	276	-90
7	Fruits	205	104	53	-51 ⁹

*Data for the year 2019

If we analyse the nos. above, it reveals that actual intake of cereals, fats and edible oils and sugar and sugar products exceeds normative dietary requirements while actual consumption in case of high-value food commodities such as pulses (and their non-vegetarian equivalents), milk, fruits, and vegetables is significantly less than the normative dietary requirements. This disparity suggests that affordability could be a major constraint, limiting the ability of households to meet recommended nutritional intake levels despite the recognized importance of these food groups. Also, behavioural changes and informed choices form an important aspect of nutritional security.

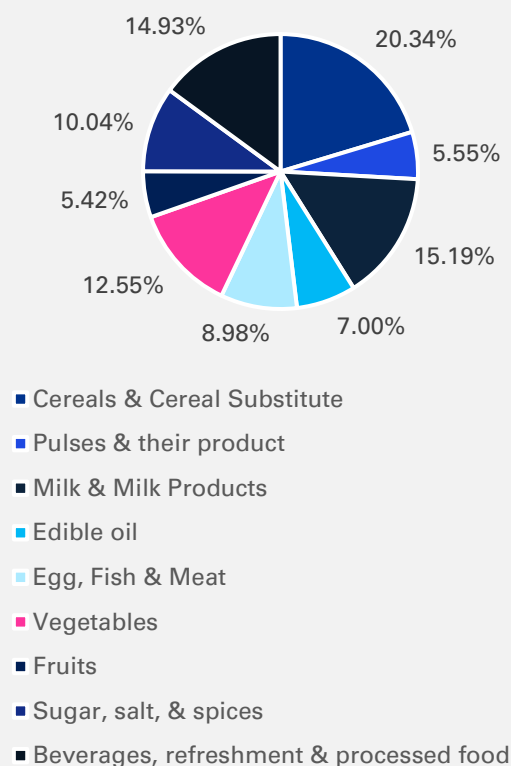
9. Source: Working Group Report on Crop Husbandry, Agriculture Inputs, Demand and Supply, NITI Aayog/2024

Diversity on a Plate: A case for Evolving Food Choices

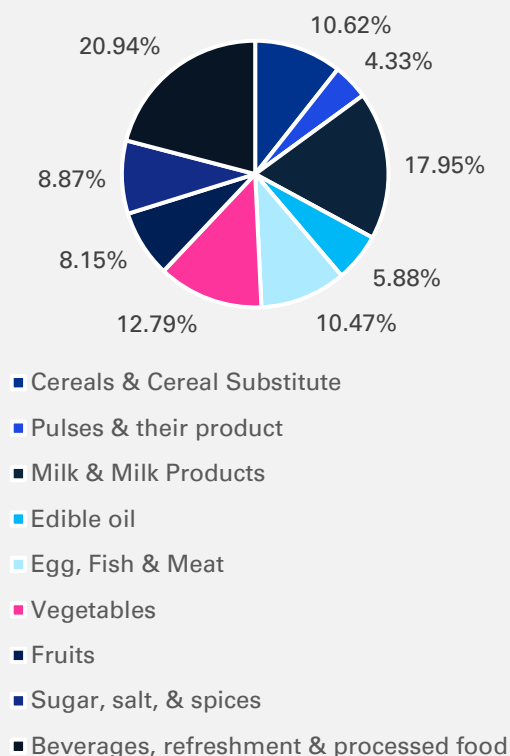
Engel's Law suggests that while households spend a smaller proportion of their income on food as incomes rise, however their absolute expenditure on food continues to increase. India's consumption patterns reflect this transition, with the share of food in household expenditure steadily declining over the past two decades, even as overall food spending has grown. Household consumption surveys show India's food share of MPCE (Monthly per capita Consumption Expenditure) easing from about 59.40 per cent in 1999-00 to 47.04 per cent in 2023-24 in rural areas and 48.06 per cent in 1999-00 to around 39.68 per cent in urban areas¹⁰.

A comparison between 2011-12 & 2023-24 of consumption expenditure pattern within food category shows that the share of expenditure on Beverages, Refreshments & Processed Food, Fruits, Milk & Milk Products, and Eggs, Fish & Meat has increased in both rural and urban areas. This suggests that consumers are progressively moving beyond a food basket centered primarily on cereals and staples towards a more diverse mix of foods. Higher spending on fruits, dairy and animal-source foods indicate growing demand for nutrient-rich foods, while the increase in processed foods and beverages points to evolving lifestyles, convenience preferences and changing food consumption habits.

Rural 2011-12 (% Monthly per capita expenditure on items under Food Category)

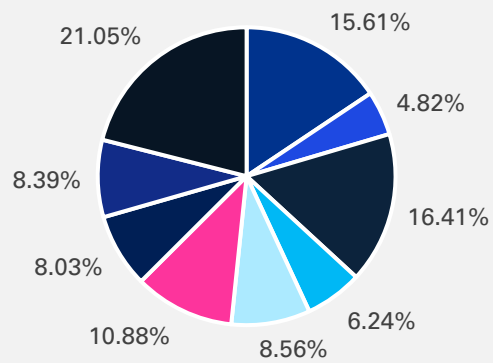


Rural 2023-24 (% Monthly per capita expenditure on items under Food Category)



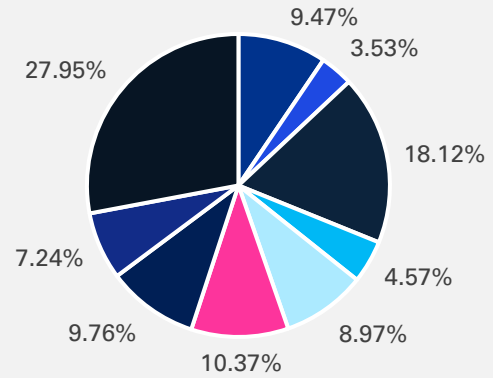
10. Survey on Household Consumption Expenditure 2023-24/National Statistics Office

Urban 2011-12 (% Monthly per capita expenditure on items under Food Category)



- Cereals & Cereal Substitute
- Pulses & their product
- Milk & Milk Products
- Edible oil
- Egg, Fish & Meat
- Vegetables
- Fruits
- Sugar, salt, & spices
- Beverages, refreshment & processed food

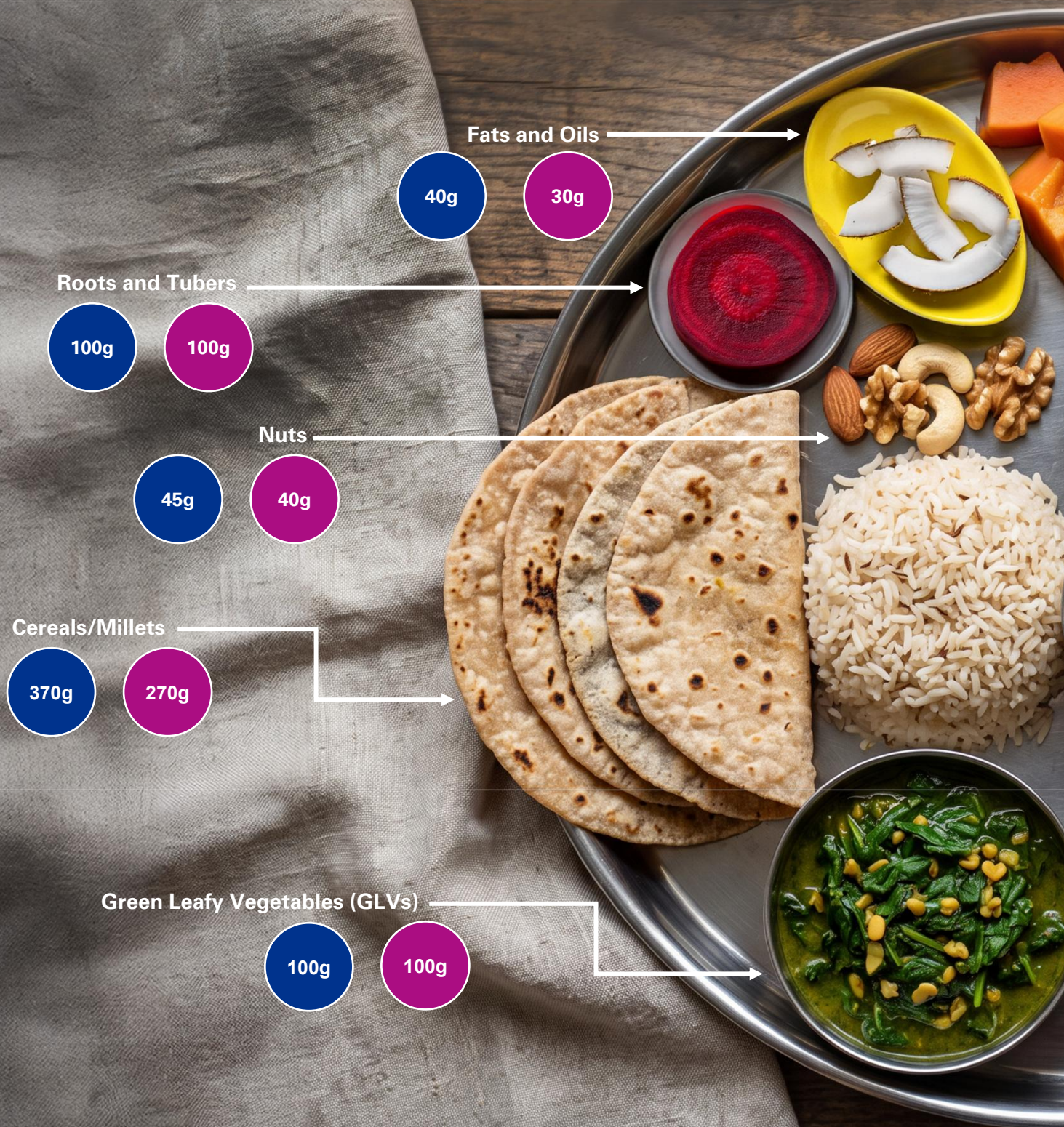
Urban 2023-24 (% Monthly per capita expenditure on items under Food Category)



- Cereals & Cereal Substitute
- Pulses & their product
- Milk & Milk Products
- Edible oil
- Egg, Fish & Meat
- Vegetables
- Fruits
- Sugar, salt, & spices
- Beverages, refreshment & processed food



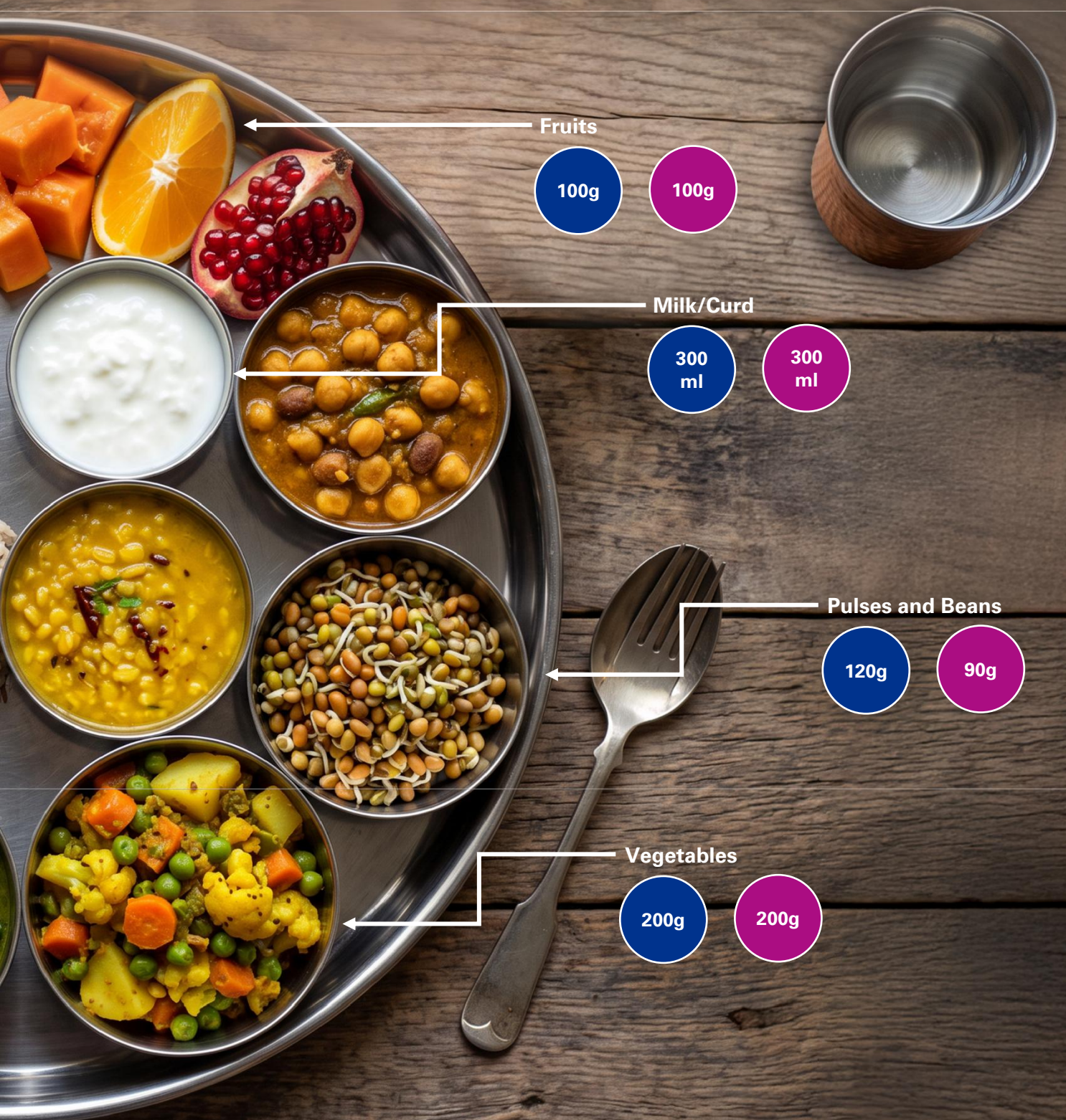
Food plate to meet daily nutrient requirements



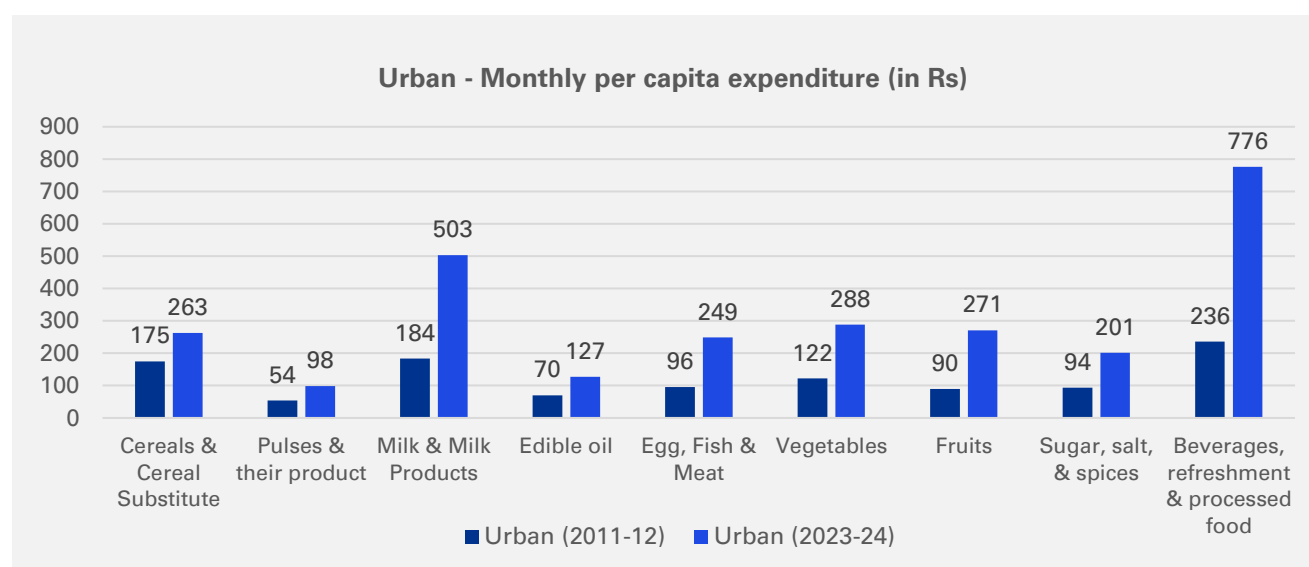
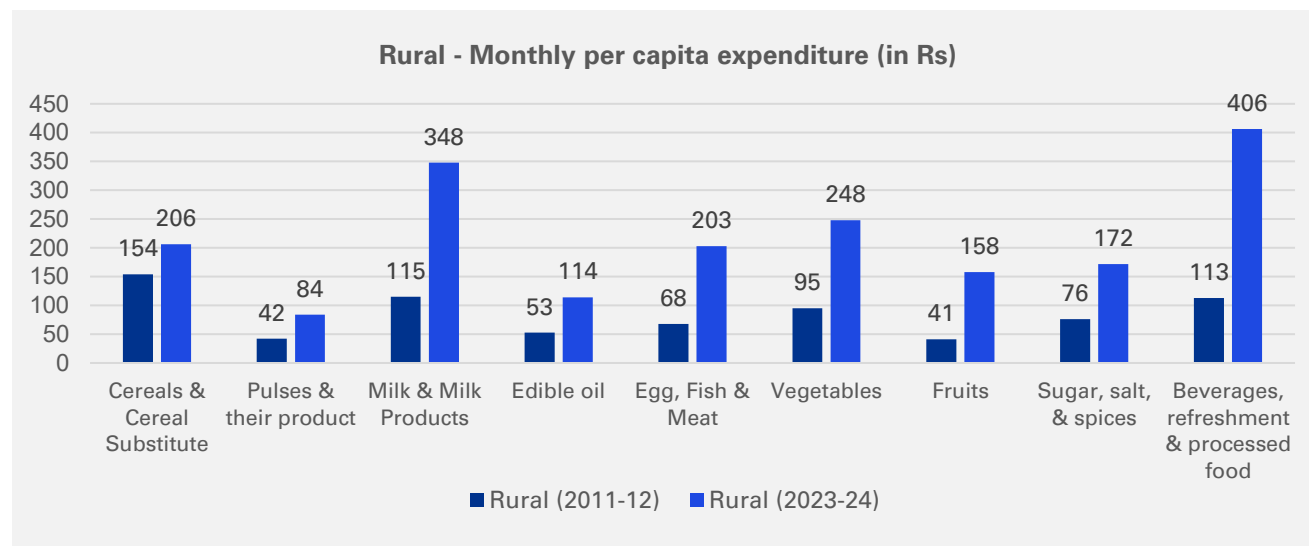
Men (Moderate category of work)
Body weight: 65 kgs



Women (Moderate category of work)
Body weight: 55 kgs



A comparison of household expenditure in food items in absolute terms is provided below for Rural and Urban Household. The major difference in the expenditure between rural and urban consumption patterns is observed in Beverages, refreshment and processed food, fruits, and milk and milk products.



This shift is not limited to better nutrition but also a growing emphasis is on food quality, safety, convenience and choice. In urban areas particularly, consumers are becoming more discerning, placing greater importance on health outcomes, product authenticity, and traceability.

However, the evolving demand pattern presents a significant challenge for the food system. Any mismatch between production and demand of several nutrient-dense commodities like pulses, nutri-cereals, milk, eggs etc may cause affordability concerns. The challenge ahead would be ensuring that consumers have reliable access to a diverse range of nutritious foods aligned with their evolving tastes and preferences at affordable prices.

Food Accessibility: Bridging the Last Mile

Understanding food accessibility goes beyond production and availability; it requires an analysis of the regulatory, institutional, and infrastructure systems that govern the movement, storage, and distribution of food across the country.

Over years, India has developed a robust food distribution network, with the National Food Security Act (NFSA), 2013, which legally entitles nearly two-thirds of the population to subsidized foodgrains serving as a cornerstone. The Act currently covers around 80 crores¹¹ beneficiaries across the country.

On the institutional front, India has established a multi-agency set-up comprising the Food Corporation of India (FCI), Warehousing Development and Regulatory Authority (WDRA), Central and State Warehousing Corporations at National level that enables procurement, storage, stock management, transportation, and distribution and a network of Fair Price Shops that ensure last-mile delivery of foodgrains. As of 2025, FCI and State agencies together possess foodgrain storage capacity of over 917.83 lakh metric tonnes, storage capacity for central pool grains. In addition, India has developed a nationwide network of approximately 8,815 cold storages with a capacity exceeding 40 million metric tonnes, supporting the preservation and movement of perishable commodities¹².

Food movement is further facilitated through an expanding logistics and key infrastructure ecosystem which include **mode of transport, storage and technology and digital initiatives**. India has a widely developed mode of transport. India's road network spanned ~6.3 million kms, including national and state highways and other roads, as of fiscal 2025. The country had 13 major ports and more than 200 non-major ports as of fiscal 2025. India had 138 operational airports, with improved cargo handling at all major airports. India has the fourth-largest rail network in the world, with 68,584 route km as of fiscal 2024¹³.

With respect to India's storage capacity, warehouse and cold chain network plays an important role. The organised warehousing capacity of India is estimated at approximately 246.33 million metric tonnes. Organisational share of storage capacity in India is provided below¹⁴:

Organisation / Sector	Storage Capacity (MMT)	Share (per cent)
Food Corporation of India (FCI)	45.87	18.6
Central Warehousing Corporation (CWC)	14.82	6.0
State Warehousing Corporations (SWCs)	50.40	20.5
Other State Agencies	9.92	4.0
Cooperative Sector	16.58	6.7
Private Sector	108.74	44.1
Total	246.33	100.0

11. Scan Portal/Ministry of Food and Public Distribution, Government of India

12. From Harvest to Home/PIB/September 2025

13. Assessment of the infrastructure and logistics requirements of India's food processing sector/MoFPI/July 2025

14. WDRA Annual Report 2024-25 (Annual Reports - WDRA)

The distribution of cold storage infrastructure across India reveals significant regional concentration. Uttar Pradesh alone has over 2400 cold storages accounting for 151 lakh MT of cold storage capacity, representing more than 38 per cent of the total storage capacity in the country followed by West Bengal, Gujarat and Punjab¹⁵.

Recent initiatives such as PM Gati Shakti, Agriculture Infrastructure Fund (AIF), Pradhan Mantri Kisan SAMPADA Yojana (PMKSY), and the World's Largest Grain Storage Plan in the Cooperative Sector are strengthening connectivity between farms, warehouses, processing centers, and consumer markets.

On digital front in logistics, Unified Logistics Interface Platform (ULIP) integrates digital systems across ministries and departments, facilitating real-time information exchange, reducing delays and costs, and enhancing transparency and visibility within the logistics ecosystem. The introduction of E-logs, FASTag and GST e-way bill has enhanced transparency and efficiency within the logistics ecosystem.

Despite significant progress, post-harvest losses in India remain substantial when compared with global benchmarks. According to a **2022 study commissioned by the Ministry of Food Processing Industries (MoFPI)**, post-harvest losses range from **6-15 per cent for fruits** and **4.8-11.6 per cent for vegetables**¹⁷. These losses represent a considerable challenge to food accessibility, resulting in reduced market availability, lower farmer incomes, and inefficiencies across the food supply chain. Commodity-specific estimates of losses at the farm and market stages are presented in the table. One of the key reasons for persistent post-harvest losses is the uneven distribution of storage including cold storage capacity across geographies. Uttar Pradesh alone has over 2400 cold storages and in contrast, several states in the North-East and hill regions have fewer than 5 cold storages, highlighting considerable gaps in regional infrastructure availability.

Another challenge is uneven infrastructure composition. Approximately three-fourths of India's cold storage facilities are dedicated primarily to potato storage. Consequently, commodities such as fruits, vegetables, dairy products, seafood and meat remain inadequately served despite overall growth in capacity. Multi-commodity cold stores, pre-cooling facilities and refrigerated transportation networks remain particularly deficient across several regions.

The warehousing ecosystem also faces challenges related to modernization, mechanization and digital integration. Many facilities continue to rely on traditional storage systems that are vulnerable to quality deterioration, pest infestation and operational inefficiencies.

Although India's aggregate cold storage capacity appears substantial, the mismatch between available capacity and commodity-specific requirements presents a major challenge. Existing estimates indicate that the country requires approximately 47-55 million metric tonnes of cold storage capacity against the currently available 39.7 million metric tonnes¹⁸. This translates into a deficit of nearly 10-15 million metric tonnes. The impact is particularly severe for perishable commodities. Fruits and vegetables are highly sensitive to temperature fluctuations and physical handling, making them dependent on efficient cold-chain systems. In many cases, produce reaches local markets without pre-cooling, sorting, grading or refrigerated transportation. The result is deterioration in quality, reduced shelf life and lower market realization.

Commodity	Farm-level losses ¹⁶	Market level losses
Paddy	4.16 ±0.0187	0.61 ±0.0546
Wheat	3.61 ±0.083	0.56 ± 0.1282
Pigeon Pea	4.67 ±0.107	0.99 ±0.1058
Chickpea	5.89 ±0.0627	0.85 ±0.0647
Apple	7.87 ±0.0933	1.64 ±0.624
Guava	11.59 ±0.2112	3.46 ±1.3711
Mango	6.03 ±0.0474	2.5 ±0.1908

15. Cold Storage Facilities in the Country/PIB/September 2020

16. PhI_study_final_report_07.12.2022_2

17. NABCONS Study Assesses Post-Harvest Losses Across 54 Crops During 2020–22/PIB/August 2025

18. Assessment of the infrastructure and logistics requirements of India's food processing sector July 2025

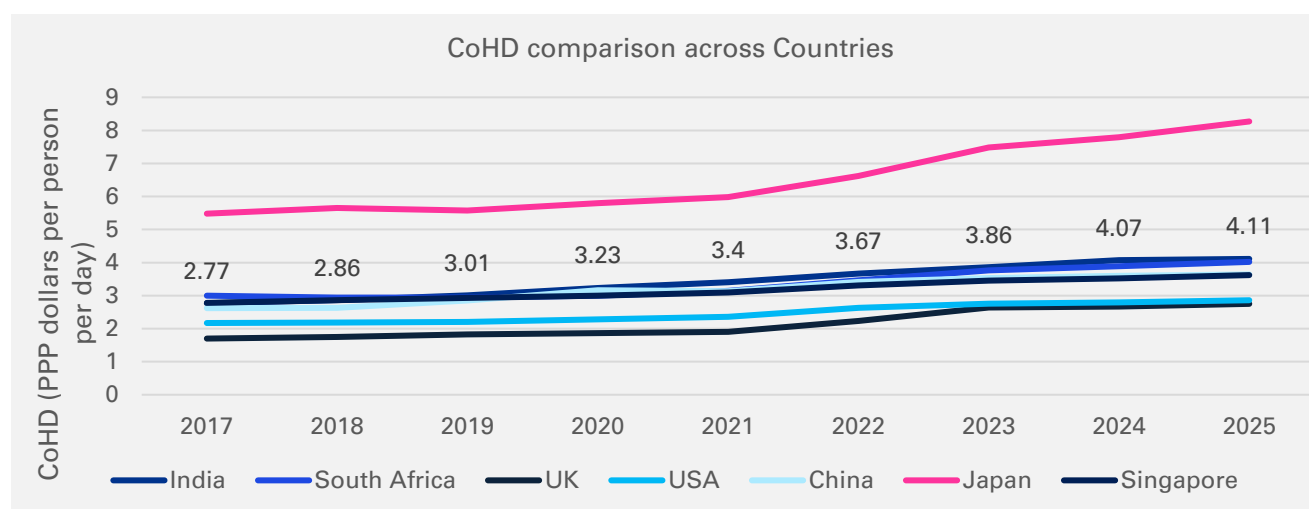
For farmers, access to information is as important as access to markets. Decisions on crop selection, input use, harvesting, and sales are increasingly influenced by the quality and timeliness of information available to them. Reliable insights on market prices, consumer demand, weather variability, emerging pest risks, and procurement opportunities enable producers to respond more effectively to changing conditions, reduce uncertainty, and improve returns from their produce. Recognizing this, the Government has introduced several initiatives such as the Electronic National Agriculture Market (e-NAM), Agri-Stack etc. Growing ecosystem on Agromet Advisory Services, and digital platforms providing real-time market and weather information presents the demand for digital information.

For consumers, information accessibility is fundamental to building trust in food systems and enabling informed dietary choices. Rising awareness regarding nutrition, food safety, quality, sustainability, and ethical sourcing has increased consumer demand for transparency across the food value chain. Information on product origin, production practices, nutritional composition, shelf life, and safety standards helps consumers make choices aligned with their health and preferences while reducing information asymmetry between producers and consumers.

The Economics of a Healthy Diet

Food affordability should not be viewed through the prism of food prices alone. Rather, it is shaped by the interplay of several factors, including food prices, household incomes, and other essential out-of-pocket expenditures. In this section the discussion is not if food exists but if healthy diets can be purchased without displacing other important expenses of social life and existence.

To measure the affordability of healthy diets, the Food and Agriculture Organisation (FAO) has developed the Cost of a Healthy Diet (CoHD) indicator. The CoHD reflects the structural characteristics of agrifood systems, which vary significantly across regions and countries. Several factors influence the cost of a healthy diet which include level of economic development, agricultural productivity, value chain efficiency, input costs. Below is the CoHD of India across years in comparison with other countries¹⁹ :



At CoHD of 4.11 in 2025, the proportion of population who are unable to afford a healthy diet is 35.5 per cent in India which is approximately 520.1 million population²⁰. From a sectoral perspective, India continues to face several structural challenges that have important implications for the affordability of healthy diets. A significant gap persists between current and realizable yields across many crops, limiting the full productive potential of the agricultural sector. At the same time, public investment in agricultural research and development remains an area requiring further strengthening to drive innovation, enhance productivity, and build resilience against emerging risks.

19. Source: The State of Food Security and Nutrition in the World 2026/FAO/2026

20. The State of Food Security and Nutrition in the World 2026/FAO/2026

In addition, despite notable progress, gaps remain in storage, transportation, processing, and distribution infrastructure, resulting in post-harvest losses, supply-chain inefficiencies, and higher transaction costs. Collectively, these challenges increase the cost of producing, moving, and delivering food, thereby posing a significant constraint to the availability and affordability of healthy diets for a growing population.

Producing more with Less: Ensuring Environmental Affordability

Food in India like Rice and Wheat look bountiful but the real cost to an extent has been shifted onto the soil, the aquifers and the air, without having recorded in any price. Environmental affordability asks a simple question; can a country keep paying a bill it has not yet been shown. According to the latest groundwater assessment by the Central Ground Water Board (CGWB), Punjab's annual extractable groundwater resource was estimated at 17.63 billion cubic metres (BCM), while actual annual extraction reached 27.66 BCM, resulting in a groundwater extraction rate of 156.36 per cent²¹. Hence, going forward, agricultural investments may need to be evaluated not only on their economic returns and production potential, but also on their environmental footprint. Integrating natural resource costs, carbon emissions, water-use efficiency, and ecosystem impacts into project appraisal frameworks could help align agricultural growth with long-term sustainability objectives.

21. Ground Water Resources of Punjab State/Ground Water Management Circle Water Resources Department, PUNJAB/March/December 2024



04

Shaping the Next Frontier

WEATHER FORECAST:
SUNNY | 29°C



SOIL HEALTH:
MOISTURE 74% | PH 6.8

CROP HEALTH:
OPTIMAL (VEGETATION INDEX)

YIELD ESTIMATE:
+18% (PROJECTED)



Looking at the ecosystem, the need is to move beyond incremental improvements and pursue transformational interventions across production systems, technology adoption, and resource management. The challenge before India is not merely to sustain food security, but to build a food system capable of meeting the aspirations and nutritional needs of a significantly larger and more prosperous population over the coming decades. As food systems face increasing pressures from population growth, climate change, and evolving dietary preferences, identifying and acting upon some of the most powerful levers of change become imperative.

Lever 1: Productivity Gains

The next wave of agricultural transformation may be driven by sustained productivity gains, enabling the country to produce more nutritious food while using fewer natural resources. This calls for a decisive shift towards innovation-led agriculture, supported by advanced genetics, precision farming, climate-smart practices, digital technologies, and stronger extension systems that could bridge the gap between research breakthroughs and farm-level adoption.

Equally important is a transition towards a production model that leverages the comparative advantages of different agro-climatic regions. Aligning crop choices with local soil, water, climate, and market conditions may significantly enhance resource-use efficiency, improve farmer incomes, and strengthen the resilience of food systems. A more regionally specialized and productivity-driven agricultural landscape may be critical for meeting the dietary needs of a growing and increasingly diverse population while safeguarding environmental sustainability.

Lever 2: Strengthening Food System Efficiency

The gap between food availability and consumption points towards structural issues within the food system, including inequitable distribution, affordability constraints, resulting in barriers to accessing diverse food commodities. Therefore, improving nutritional security may require a three-pronged strategy: strengthening food system efficiency to enhance access to nutritious foods, making food commodities affordable while simultaneously fostering behavioural change towards healthier dietary practices. From a policy perspective, the challenge of the future may not be merely to produce more food, but to ensure that the right food reaches the right people in the right proportions.

In this emerging paradigm, food security may be judged not merely by the adequacy of calories available, but by the ability of the system to support healthier diets, greater consumer choice and improved nutritional well-being for all. One aspect of achieving this transition is by diversifying agricultural production towards high-value and nutrition-rich commodities, accelerating productivity growth in pulses, horticulture, livestock and fisheries. Equally important is the development of responsive value chains and market ecosystems that would efficiently connect producers with changing consumer demand while ensuring food safety and quality assurance, where consumer companies may play a significant role. As India's food system evolves, consumer companies may not be viewed only as market participants but as ecosystem actors capable of shaping nutrition, accessibility and sustainability outcomes.

FMCG companies, retailers and e-commerce platforms sit at the critical intersection between producers and consumers and therefore have a unique opportunity to influence both food-system efficiency and nutrition outcomes at scale. Future growth may increasingly come from categories that address nutrition needs rather than simply expanding food consumption volumes. In this context, consumer companies could leverage their scale, innovation capabilities, distribution networks, and consumer insights to expand the availability of nutrient-dense products, particularly in underserved and low-income markets. Affordability could be improved through product reformulation, smaller pack sizes, supply-chain efficiency, and the use of locally sourced ingredients. According to WHO, dietary habits are shaped not just by individual preferences but by broader food environments, including product availability, marketing, pricing and information. This creates a direct role for consumer companies in influencing healthier consumption patterns. Beyond product availability, companies also have a critical role in shaping dietary behaviour.

Lever 3: Supply Chain Excellence

Supply-chain excellence should increasingly be viewed not only as an efficiency lever, but as a nutrition and food-access lever. A key constraint facing India's Supply Chain ecosystem is the inadequate reach and efficiency of cold-chain infrastructure, which contributes significantly to post-harvest losses, particularly for perishable commodities. Addressing this challenge may require the creation of an integrated, technology-enabled cold-chain network encompassing farm-gate pre-cooling facilities, modern temperature-controlled warehouses, and reliable refrigerated transport systems. Particular emphasis should be placed on expanding solar-powered cold storage solutions in rural areas to overcome power supply constraints, while emerging technologies such as cryogenic cooling and phase-change material-based storage could help improve energy efficiency and reduce operational costs.

Warehouse modernization by replacing traditional grain silos with aeration systems and adopting digital management systems to streamline operations and improve traceability. Emphasis on climate control bulk storage for reducing spoilage and enhancing value retention. Furthermore, commodity-based warehousing with collateral management services may empower farmers and processors with access to working capital through warehouse-receipt financing.

The effectiveness of storage and cold-chain investments depends heavily on connectivity between farms, warehouses, markets and consumers. Investment in small-reefer trucks to cater to hyperlocal demands and improve last-mile connectivity is essential.

For consumer companies, investments in supply-chain capabilities generate value far beyond operational efficiency. It strengthens business performance and improves food-system outcomes by reducing losses, improving product availability, and lowering the delivery cost of nutritious foods.

From a business perspective, advanced forecasting, integrated logistics, and cold-chain infrastructure improve inventory productivity, reduce working capital requirements, minimize spoilage, and enhance service levels. For categories such as fresh produce, dairy, meat, and ready-to-eat foods, stronger supply chains translate directly into lower wastage and higher margins. **From a food-system perspective**, the impact may be even more significant in terms of reduced food loss, improved availability of perishable nutritious food, better accessibility across geographies and greater affordability for consumers.

Targeted incentives for innovation-driven enterprises and startups may accelerate the adoption of sustainable cold logistics solutions. Furthermore, the use of blockchain-enabled traceability systems may enhance transparency and temperature compliance throughout the value chain, thereby safeguarding product quality, strengthening consumer confidence, and improving access to both domestic and international markets.



Lever 4: Trust and Transparency through Information Accessibility

Traditionally, food accessibility was primarily a function of physical reach, distribution infrastructure, and proximity to markets only. In future food systems, trust and transparency may become as important as shelf availability which comes from right information. In the future, access may not merely mean that food is available; it would mean that consumers would identify, trust, afford, and choose nutritious food with confidence. This expands the definition of accessibility to include nutritional awareness, product transparency, food traceability, and consumer trust.

The importance of these dimensions is growing as food systems become increasingly complex. Consumers today are demanding greater visibility of where their food comes from, how it was produced, and its nutritional value. At the same time, poor dietary choices continue to contribute to rising malnutrition and lifestyle diseases, underscoring the need for informed consumption.

Consumer-facing organisations are uniquely positioned to reduce information asymmetry and empower healthier dietary choices. Beyond making products available, they could play a critical role in helping consumers understand and trust what they consume. Eg. Clear nutritional communication, Digital product traceability, enabling consumers to access information on origin, ingredients, quality certifications, and supply-chain journey through QR codes and digital platforms.

Advanced analytics and artificial intelligence could play a significant role in improving demand estimation, inventory management, and logistics planning across the food value chain. Their integration into warehousing and transportation systems may streamline operational efficiency, minimize wastage, and reduce logistics-related costs, thereby contributing to greater food accessibility and more resilient supply chains.

Strengthening the network of certified warehousing infrastructure and linking warehouse receipt mechanisms with digital trading platforms, agricultural markets, and formal financial institutions may facilitate better price discovery, expand market access, and promote financial inclusion in rural areas.

At the same time, increasingly sophisticated supply chains may necessitate stronger mechanisms for transparency and food safety assurance. Greater adoption of end-to-end traceability frameworks, QR-code-enabled product identification, blockchain-based supply chain records, and real-time monitoring systems may be one of the essential aspects to enhance consumer trust, ensure product authenticity, and strengthen food safety oversight.

The choices made today would determine whether India's food system can successfully navigate the demands of a more populous, prosperous, and climate-constrained future. The imperative is clear: move from ensuring food security alone to building a food system that is productive, nutritious, inclusive, resilient, and future-ready.

The future role of Consumer Markets companies extends beyond selling food products.

As India transitions from food security to nutrition security, consumer companies which include FMCG companies, retailers and e-commerce platforms have an opportunity to become active contributors to food-system outcomes by making nutritious food more accessible, affordable, trusted and sustainable.

The next generation of leaders may be defined not only by market share, but by their ability to reduce the distance between nutritious food and the consumer

Lever 5: Technology as an Ecosystem Enabler

Affordability remains one of the most persistent barriers to healthy diets. While efforts often focus on increasing production or developing new products, a significant opportunity lies in reducing the cost of overall operating models which could unlock nutrition gains at scale by lowering waste, improving availability, and reducing the cost-to-serve across the value chain.

Technology is emerging as a critical enabler of this transformation. Advanced analytics and AI-powered forecasting may help companies better align supply with demand, reducing overproduction, stock-outs, and inventory write-offs. Digital supply-chain visibility enables real-time tracking of products, helping identify bottlenecks and improve logistics performance. Inventory optimization ensures that perishable products are available when and where needed, while minimizing spoilage.

Lever 6: Sustainability and Growth hand-in-hand

Mounting environmental and resource pressures, including water stress, resource scarcity, climate variability, and food waste are no longer confined to the farm gate; they directly affect sourcing costs, supply reliability, operational continuity, and long-term business performance. Climate-induced production shocks, depleting natural resources, and increasing scrutiny of environmental footprints are reshaping how companies think about growth and resilience.

Against this backdrop, sustainability may no longer be viewed solely as a compliance, disclosure, or ESG reporting requirement. Instead, it is emerging as a strategic business imperative that strengthens competitiveness while creating long-term value across the food system. Investments in sustainable sourcing, environment stewardship, renewable energy, circularity, and waste reduction may help companies build more resilient supply chains, mitigate input-cost volatility, and secure access to critical raw materials. At the same time, consumers are increasingly rewarding brands that demonstrate transparency, environmental responsibility, and social impact, making sustainability an important driver of trust and brand differentiation.

India's first food revolution was centered on ensuring food security through higher agricultural production. The next food revolution would need to focus on ensuring **nutrition security** by reducing the distance between nutritious food and the consumer. This distance is no longer merely physical; it is equally economic, informational, and systemic.

Achieving this transformation may require a collective effort across the food ecosystem. Government needs to continue to enable the development of infrastructure and a supportive ecosystem through conducive policies and strategic interventions that support nutrition-sensitive food systems. Producers and processors must focus on improving productivity, reducing losses, and enhancing the nutritional value of food. Companies can serve as the critical bridge between production and consumption by leveraging technology, distribution networks, product innovation, transparency, and consumer engagement to make healthy choices more accessible and affordable. Financial institutions and technology providers would also have an important role in scaling solutions. Ultimately, the success of future food systems may not be measured solely by how much food is produced, but by how effectively nutritious food reaches every consumer.

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