



Future of food:
Innovation in managing demand
and supply disruptions

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Foreword - CII

The Indian food consumption landscape is changing significantly. Not only will the quantum of food that would be required to feed the growing population increase, but the changing dietary patterns would mandate the discovery of foods that are healthy, safe, and able to meet the nutritional requirements of consumers. While India has successfully managed to be self-sufficient when it comes to the production of several agriculture and horticulture crops, changing demand patterns will need us to explore intensification techniques to address limited agriculture resources sustainably.

To manage evolving food demands, significant disruptions would be required at the supply end, to which, technology will serve as a key enabler. Additionally, production systems need to be geared towards addressing food safety and ensuring traceability of the product to meet evolved consumer demands.

The levels of processing in India are significantly low when compared with global standards. Also, a plethora of challenges plague the sector—in terms of inadequate infrastructure, scale, quality materials, and linkage. A focussed approach in addressing these critical enablers can help the food processing industry and result in significant improvement in GVA. Improving quality of produce through better processing infrastructure, investment in infrastructure for the “farm-to-fork” value chain, and enabling links across the value chain are some key levers for enablement, which would unlock the potential of the food processing sector and link India to the global value chain.

The agri-business value chain in India is at the cusp of a transformation, which will see the emergence of new business models, enabled by digital technologies and resulting in enhanced efficiency of the agribusiness value chain. This calls for better collaboration across farmers, society, agriculture sector players, inputs providers, and user industries. It will be interesting to see how technology-enabled solutions will find increased adoption amongst farmers and the role that the government could play in supporting and promoting the budding agri-tech landscape in India.

In this context, CII in collaboration with Deloitte has prepared this report on “Future of food: Innovation in managing demand and supply disruptions”. The report focusses on analysing key consumption trends and how production strategies need to be geared up to meet the growing demand for food sustainably and the opportunities for food processing and agritech players. We hope that the insights shared in this report will help identify new opportunities and unlock the potential across the food and agribusiness value chain.



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Foreword - Deloitte

India's food demand is expected to increase with the growth of population and prosperity levels. Higher disposable incomes, growth of nuclear families, awareness on healthy lifestyles, need for nutrition and balanced diets etc., are some key factors that will influence the future of food consumption. There are changes in the dietary pyramid being observed, with an increasing shift towards protein- and fibre-rich diets. Additionally, what will also be important is the nutritional content of what is produced. COVID-19 has led to a recalibration of food choices. There is increased demand for healthy and nutritious food that can boost immunity and improve the quality of life index. Consumers are concerned more than ever about what they eat, how their food is produced (safety and traceability), and the impact that food production and consumption will have on the environment (organic) and society.

Whilst India has been able to attain self-sufficiency in the production of essential food items over the last few decades, increasing food demand from the growing population and consumption will necessitate new ways to enhance productivity from scarce resources, sustainably. Agriculture intensification strategies are expected to play a critical role in meeting food demand. The call for climate-smart and "regenerative agriculture" is an important requirement for a sustainable future. Indian food processing players are also in a transformational state on account of the need for increased efficiency, safe and traceable food, sustainable packaging, etc. Industry 4.0 and the adaptation of technology is key for the future of processing. Food distribution is expected to change significantly with increasing demand for the convenience and safety from consumers.

Given the interplay of multiple stakeholders in the food value chain, it is important to craft policies and strategies that would benefit various stakeholders—farmers/producers, processors, logistics operators, retailers (private sector), technology providers/agritech start-ups. Technology will be an important enabler in addressing these issues across the value chain and is expected to impact stakeholders in the value chain. Government support through policies and incentives will also play an important role in creating a sustainable food-supply chain.

The CII-Deloitte report "Future of food: Innovation in managing demand and supply disruptions" looks at how the agriculture and food value chain are transforming, where consumer demand is evolving, and the ecosystem of food production and processing needs to be realigned to meet evolving trends. The report analyses the demand trends and production/processing innovation that may play an instrumental role in the future food and agribusiness ecosystem, including opportunities for various stakeholders, policy makers, and agritech players. A concerted effort from stakeholders is expected to foster an efficient and sustainable food and agribusiness ecosystem that will address imminent concerns on food safety, availability, and sustainability, resulting in the creation of a vibrant and globally inter-linked food sector in India.



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Executive summary

Food demand: India's population is expected to grow by 273 million between 2019 and 2050, reaching 1.64 billion ^[1] Middle-income households in India are expected to increase from the current 50 percent to 80 percent by 2030, driving 75 percent of consumer spending.^[2] Share of wallet for food for an average Indian household is expected to increase to 35.4 percent by 2025 from 33.2 percent in 2005 .^[3] Rising population and increasing prosperity are expected

to increase food demand in India significantly. In terms of food spending by 2025, meat and poultry are estimated to account for ~30.7 percent, bread, rice, and cereals at 23.8 percent, and fruits at 16 percent of the total food spending .^[3]

We see six key consumer trends emerging, including the following:



- **Mindful diet:** Indian dietary trends have evolved with changes food consumption patterns over the years. There has been a decline in the share of grains in the daily calorie consumption (from 63 percent to 55 percent in the last six decades),^[4] while there has been an increase in the daily consumption of protein (~15 percent in the last two decades)^[5], fruits and vegetables, and superfoods including green tea and olive oil.
- **Mindful wellness:** Increased focus on leading a healthy lifestyle and preventive health care has led to increased adoption of healthy foods and

nutritional supplements such as nutraceuticals. Nutri-cereals such as millets are starting to substitute staples such as rice and wheat with a focus on food fortification to enhance nutritional value.

- **Mindful sourcing:** Today's informed consumers are concerned about the safety of the food that they consume and how it is produced, packed, processed, and delivered. This has led to increased consumption of organic foods, which is expected to grow at a CAGR of 21 percent to reach INR 182 billion by 2026 from INR 60 billion currently.^[24]

Customer preference for food traceability has led to the introduction of such solutions with clean labels also emerging as a trend.

- **Mindful preferences:** Customer preference for food items that appeal to their local tastes has led to the emergence of strong regional brands. Even within a state, customer preferences can vary across different regions, requiring brands to be cognisant as part of their product mix planning. National brands are also trying to focus on providing variants more suited to regional cuisines.
- **Mindful purchase:** There is a noticeable shift in customer purchases, increasing for packaged staples rather than relying on loose and unpacked supplies. This trend accelerated with the onset of COVID-19 and customers becoming mindful of the safety of food. Additionally, private labels of leading retailers are also witnessing a lot of traction with customers preferring to buy packaged food at affordable prices.
- **Mindful convenience:** A key customer trend is the need for convenience, manifesting as the high growth of ready-to-eat and frozen food categories. Food delivery, be it in the form of online groceries as well as prepared food, is growing significantly (at a CAGR of 28 percent for online food delivery during 2020-25 and CAGR 53 percent for online groceries during 2020-25)^[34] with multiple established companies and start-ups operating in this sector.

Food production and availability: Increasing demand, along with the focus on food security and self-sufficiency, will require increased food production in India. Cultivable land has decreased over the last few decades and the decline is expected to continue on the back of urbanisation and industrialisation. Hence, increasing food production would need improved agricultural yield, where India ranks lower than most developed nations. For instance, cereal yield is 3.2 MT/ha, which is 22 percent lower than the world average and 47 percent lower than China.^[41] We foresee a few key trends, which would enable meeting the increasing food demand, while also catering to changing customer preferences.

- **Intensification:** Increased usage of agri inputs is expected to support production growth. Current consumption of pesticides per hectare is significantly lower than the world average (0.3 kg/ha

for India vs. world average of 2.6 kg/ha).^[42] However, the overuse of agri inputs can lead to challenges in soil health, water scarcity, etc. The emergence of select intensification strategies such as vertical farming, hydroponics, aeroponics, aquaponics, and integrated farming systems, which are currently at a nascent stage, hold the potential to effect changes.

- **Farm mechanisation:** The workforce employed in agriculture in India has reduced from 636 million in FY11 to 582 million in FY20, ^[50] with increasing average wages. With companies launching subscription and pay-per-use models to make mechanisation affordable for small farmers as well, the focus is on improving access to machinery and equipment.
- **Regenerative agriculture:** India is the third-largest emitter of greenhouse gases and agriculture is responsible for 21 percent of India's greenhouse gas emissions.^[53] Increased customer preferences for sustainably produced food has led to companies also focussing on sustainable procurement. The government is also supporting sustainable agriculture practices through the National Mission for Sustainable Agriculture launched during 2014-15. Some key emerging sustainable practices include organic farming (1.8 Mha), vermicomposting (3.5 Mha), agroforestry (25 Mha), and micro irrigation (1.2 Mha).^[55] Agri input suppliers are also offering sustainable products such as organic fertilisers and bio pesticides, in-line with customer requirements.
- **Food processing opportunities:** India's food processing industry is the sixth-largest in the world and is expected to reach INR 40.1 trillion by FY26 ^[98] Companies are focussing on adopting Industry 4.0 practices to improve their productivity, while also opting for sustainable practices in their shopfloor through the use of renewable power sources, water conservation, etc. Key opportunities in the sector exist in infrastructure investment, such as cold-chains, supported by government initiatives and a focus on increased value addition through secondary processing.
- **Sustainable packaging:** Customer surveys show that ~59 percent of customers are preferring to use recyclable or reusable packaging, in-line with the preference for sustainability and environment consciousness.^[68] Companies are looking at using biodegradable packaging in their products.

Plastic is still the dominant packaging material and is difficult to replace; hence, companies are focussing on ensuring the use of 100 percent recyclable or reusable packing material and have set global targets.

- **Distribution transformation:** Traditional ways of distribution involved a linear supply chain with limited flexibility to change per customer preferences and supply patterns. However, changes that are now visible with omnichannel distribution are becoming a prevalent theme, similar to providing customers with access to products, based on their channel preferences. Hyperlocal and aggregator models are the other major themes transforming food distribution.

Role of technology: Technology is a key enabler disrupting the entire agri and food value chain. Technology adoption is being led by 1,000+ operating agri-tech start-ups in India. The entire agri-tech market size is estimated at ~INR 14 billion in 2020 vs. a potential ~INR 1687 billion, indicating a massive opportunity ahead.^[85] The Indian government is also supportive of technology adoption and has invested in 300+ start-ups.

There are five key emerging themes for technology adoption across agribusiness including the following:

- **Market linkages and improving the supply chain:** Focus on disintermediation to improve market linkages and supply-chain efficiency.
- **Productivity-enhancing tools and devices:** Technology enabling optimum use of agri inputs, water, and other resources to enhance farm productivity

- **Farming-as-a-service:** Providing farm-related mechanisation services on subscription or pay-per-use model.
- **Digitising agriculture – transparency and traceability:** Ensuring traceability of food across the entire value chain.
- **Farmer financing:** Providing access to credit to under-served farmers.

Way forward: Given the emerging trends around consumption (such as the shift in food pyramids – increasing uptake of proteins, growing salience of food safety, need for traceability, and localisation opportunities), there are opportunities for private-sector players across the value chain to focus on expanding their product portfolio with a nutritional focus, deepen links with producers, and improve efficiency.

Technology will be a key enabler for all value chain members with various emerging use cases.

The government can play a key supporting role across the agribusiness ecosystem by providing incentives and policy support.

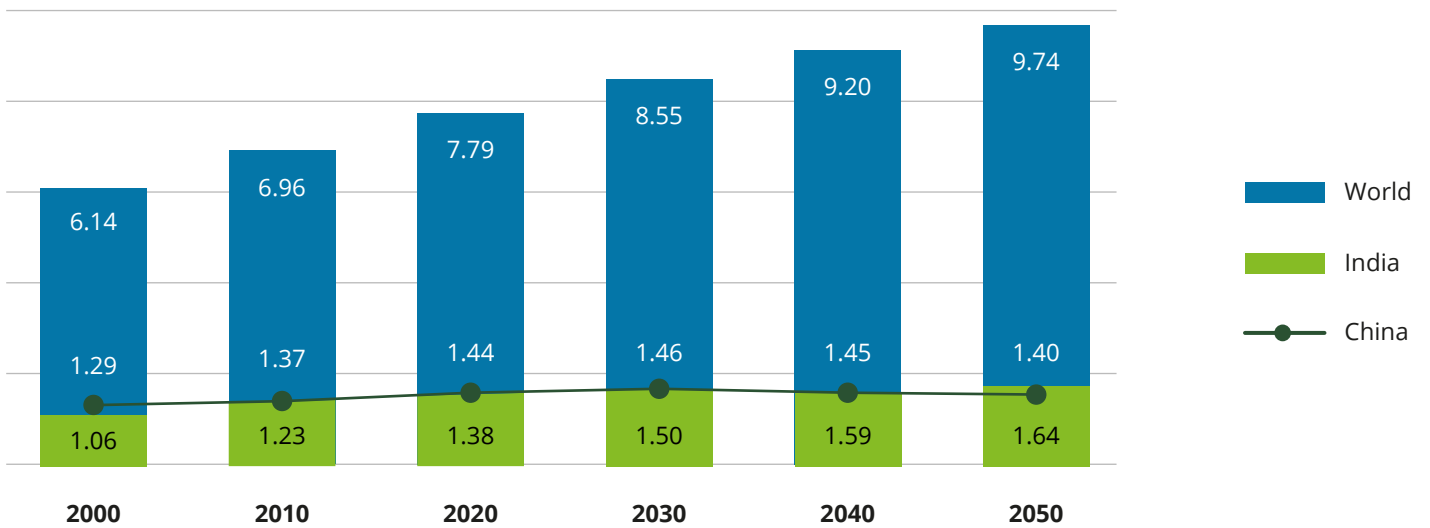
The entire Indian food and agriculture industry is at the brink of a transformation and would require all value-chain members to act in tandem and secure the future of food in India.

Food demand



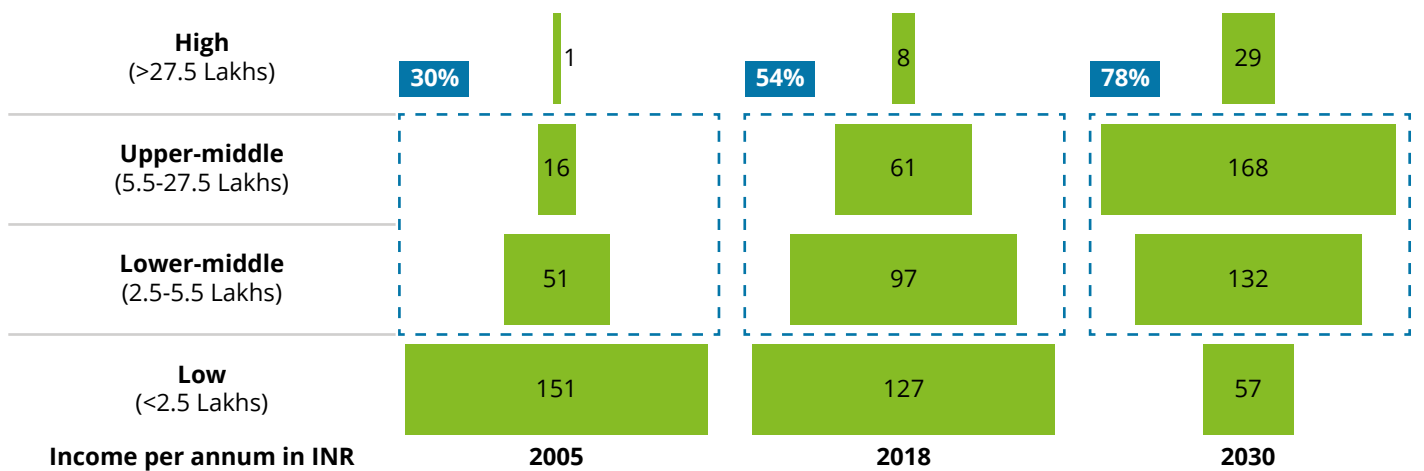
India is expected to add nearly 273 million people to its population between 2019 and 2050, surpassing China as the world's most populous country by 2027.^[1] It is estimated that by 2030, India will move from being an economy led by the

bottom of the pyramid, to one led by the middle class.^[2] Nearly 80 percent households in 2030 will be middle-income, up from about 50 percent currently. The middle class will drive 75 percent of consumer spending in 2030.^[2]



Population (in billion) over the years ^[1]

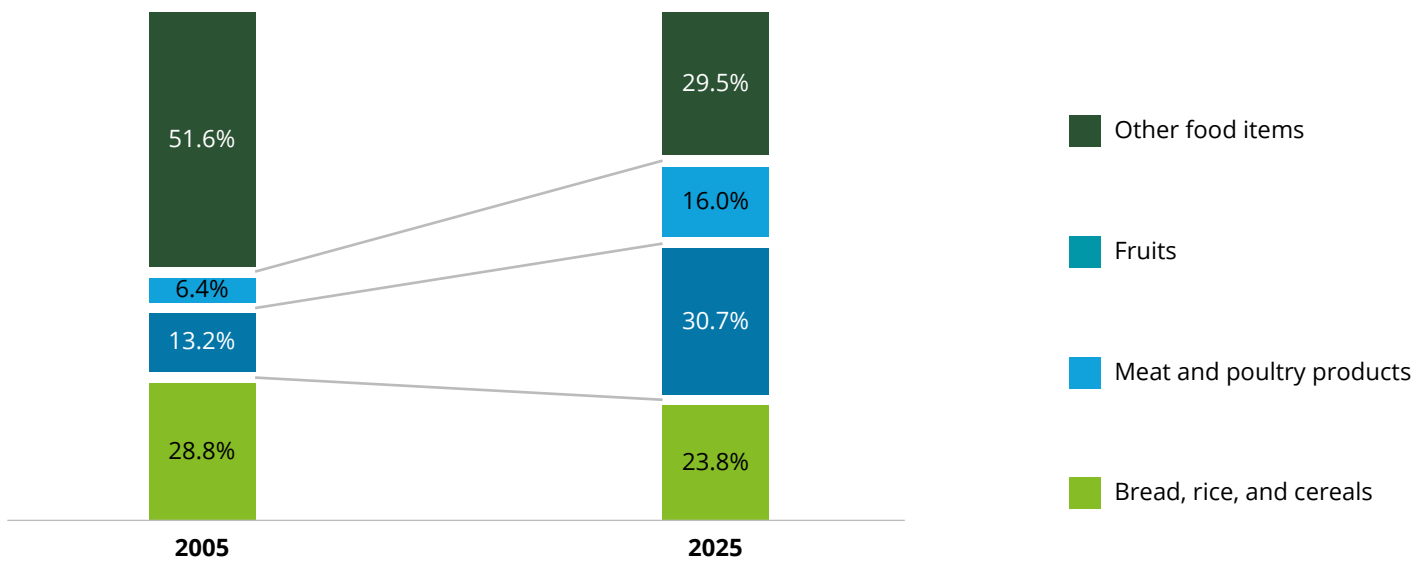
*Forecasted numbers for 2030, 2040 and 2050



Evolution of the middle class in India (Number of households in million) ^[2]

The average Indian household spent 33.2 percent of the total household budget on food in 2005. This is expected to reach 35.3 percent in 2025.^[3] Growing wages have enabled Indian households to afford more than basic staples. With more disposable income at hand, households are trading up to protein and

fibre-rich diets. Meat and poultry and fruits will account for nearly ~50 percent of the total spending on food in 2025, as compared with ~20 percent in 2005.^[3] Meat and poultry products will account for the largest share at 30.7 percent of total food spending; bread, rice and cereals at 23.8 percent; and fruits at 16 percent.^[3]



Changing dietary pattern in India ^[3]

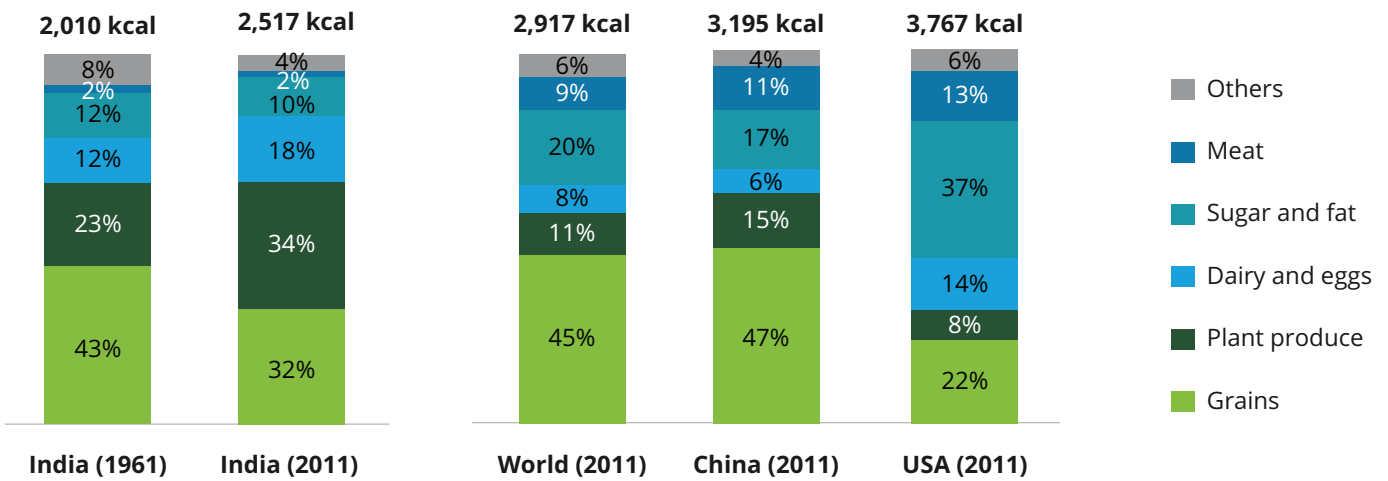
The concept of how food is purchased and consumed in India has tremendously evolved over the last decade. Most of these trends are here to stay, going even further to become food habits and dietary patterns. Demographic and socio-economic changes, such as increasing disposable incomes, rural to urban migrations, changing lifestyles, health consciousness, cross-

cultural influences, and increased presence on social media platforms are some prominent drivers for Indian consumers becoming mindful of what is on their plates, its health quotient, its sourcing and bearing on the environment, with the need for convenience and palette preferences to be met.

Mindful diet

Eating habits of Indians have undergone significant changes. In terms of calorie intake, the mix of the calorie intake has also changed. Indian diets are transitioning from staple foods, such as

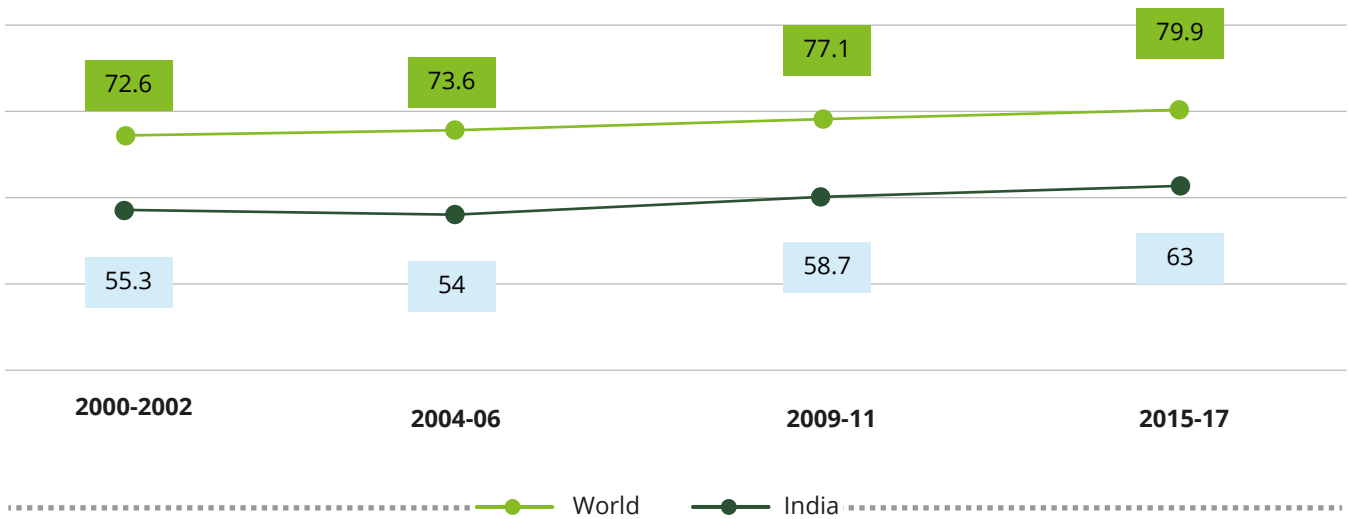
coarse cereals, to vegetable- and animal-based proteins and are projected to further diversify nutritionally and include healthy fats, fibre, and antioxidants.



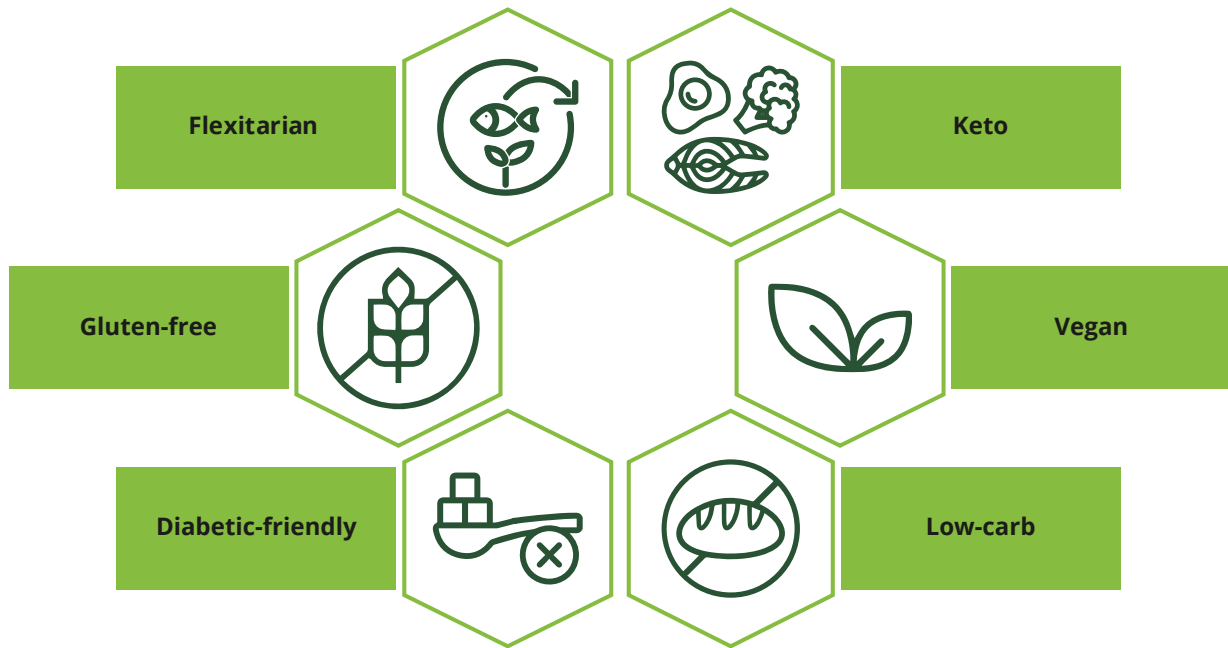
Average per capita daily kilocalories intake ^[4]

Still below the world average, India's average per capita daily protein consumption has risen

considerably, from 55.3 grams during 2000-02 to 63 grams during 2015-17. ^[5]



Average per capita daily protein intake in grams ^[5]



Emerging lifestyle and dietary requirements

Some key segments witnessing greater consumption include the following:

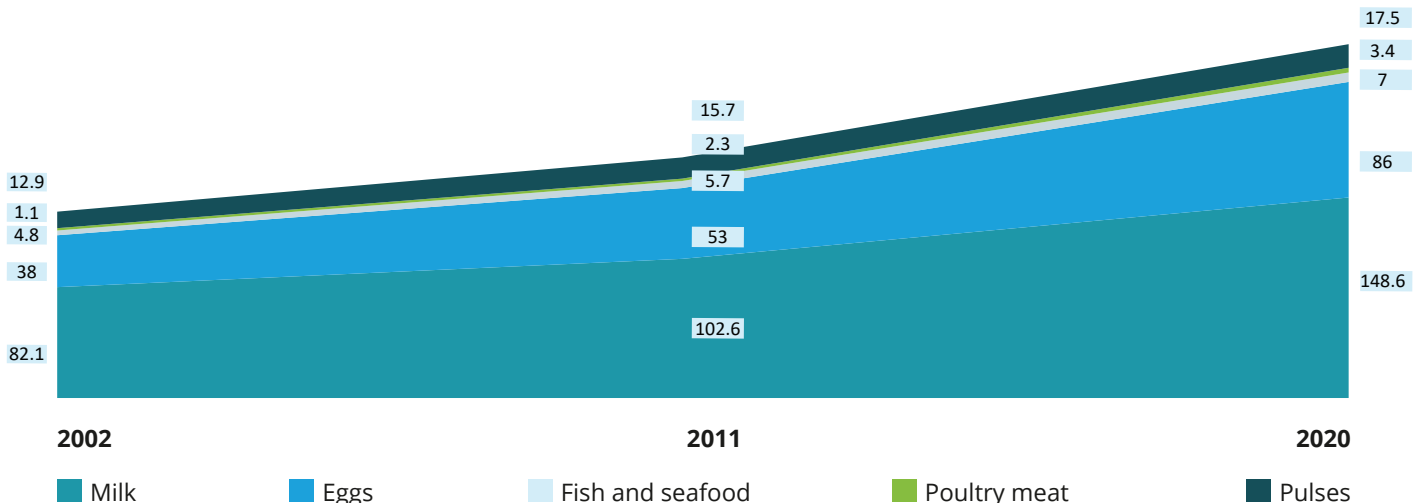
Protein

India has traditionally been a carb-loving country. The transition to protein has been gradual, but prominent. With the increase in disposable income and awareness around nutrition, the demand for animal proteins (meat, eggs, milk, and milk products) has also increased.

In the post pandemic context, protein is the most talked-about nutrient and of utmost importance

for its properties to build immunity, fight the disease, and support the post-recovery phase.

To ensure the nutrition of children, women, and expecting mothers in impoverished areas, the Government of India, via POSHAN Abhiyan, is developing an atlas to map crops and food grains indigenous to regions of the country, so that nutritious protein-rich food in local areas can be promoted.



Annual per capita availability of various protein sources [6] [7] [8] [9] [10]

*Milk, Fish and seafood, Poultry Meat and Pulses in kg/annum/capita, Eggs in number/annum/capita

Vegan diets and climate-friendly foods, a rage in international markets, is making inroads in India too. Animal-based foods, being more resource-intensive, as compared with plant-based foods, would see competition from plant-based alternatives. Plant meat or mock meat is a part of the smart protein sector, which includes plant-based, cultivated, and fermentation-derived meat, eggs, and dairy.

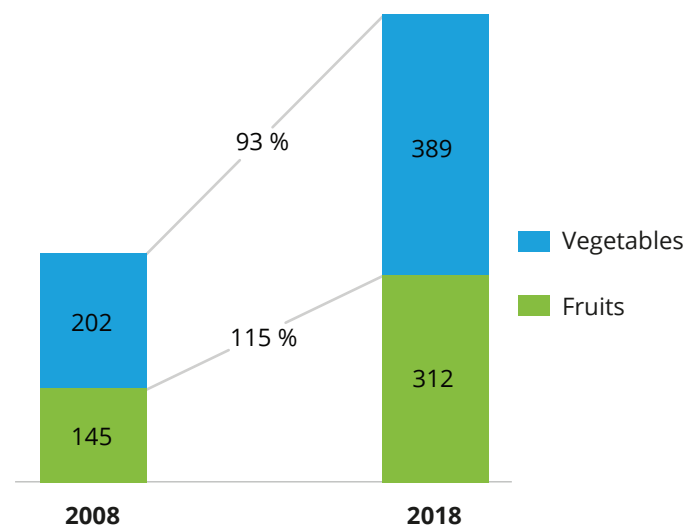
According to certain estimates, the smart protein industry in India at present is pegged to be between INR 1 and 1.5 billion, but expanding fast with the potential to touch INR 10 billion over the next few years.^[11]

Company	Location	Offering
Blue Tribe Foods	Mumbai	Plant-based chicken nuggets made of soya and peas
Wakao Foods	Goa	Burger patties and stir fries made of jackfruit
GoodDot	Udaipur	Vegan mock meat meals and fast foods
Imagine Meats	Mumbai	Plant-based meat products

Fruits and Vegetables (F&V)

Consuming F&V is important not only for vitamins, fibre, and minerals, but also for phytonutrients—useful chemicals, only found in F&V. There are important associations

between F&V intake and lowered risk of cancer, cardiovascular disease, and all-cause mortality. Average consumption of fruits and vegetables has only increased in the last 10 years.



Average per capita consumption of F&V (grams/day) ^[6]

Exotic fruits and vegetables have become a common feature on Indian plate leading to a thriving market for Avocado, Kiwi fruit, etc. Relying mostly on imports, some in-roads have

also been made in exploiting existing agriculture infrastructure to grow these crops/varieties in India.



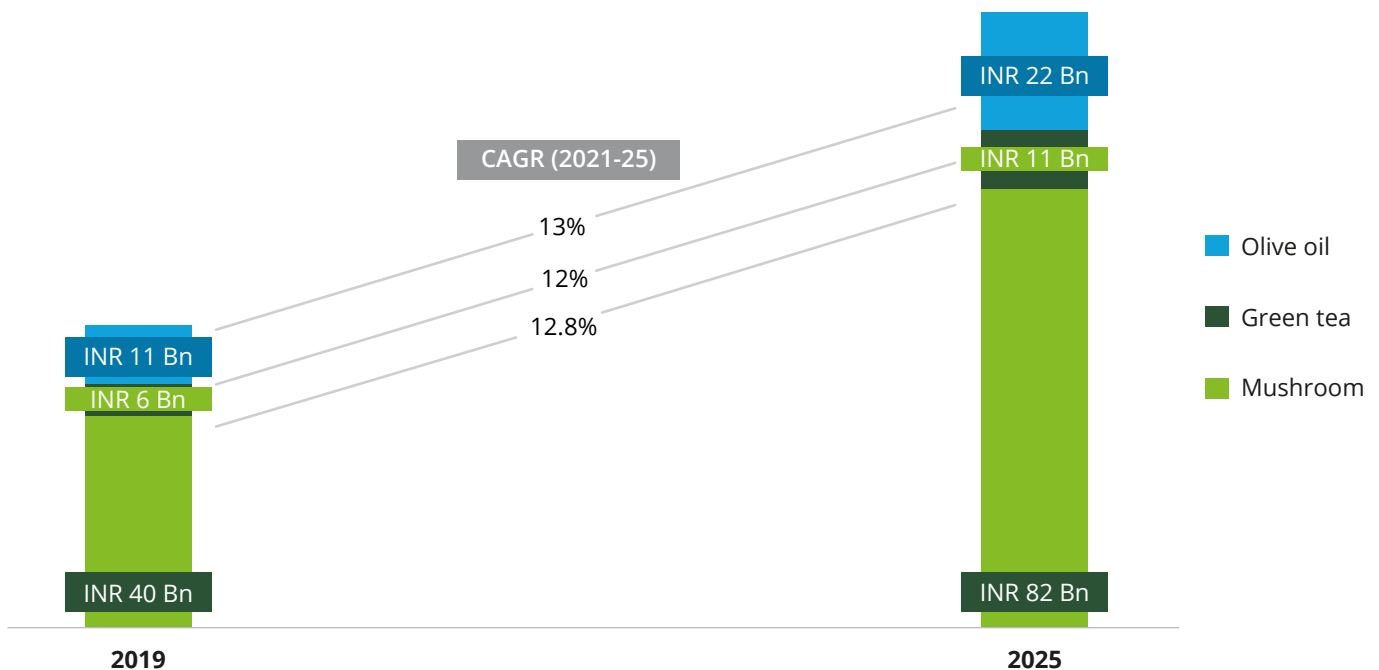
Imports of exotic F&V

Superfoods

Food consumption is no longer confined to meet basic energy/nutritional requirements of the body but also looked at as a source to enhance health attributes naturally. Thus, super foods that offer maximum nutritional benefits as they are high in vitamins, minerals, antioxidants, and have minimal calories have gained prominence. Wider acceptance for superfoods including

mushrooms, green tea, and olive oil across the Indian palette has also been observed.^{[12] [13] [14]}

Berries, seeds (basil, flax, chia, pumpkin seeds), oats, kale, quinoa are some superfoods that have gained popularity amongst Indian consumers.



Indian market for key superfoods ^{[12] [13] [14]}



Mindful wellness

With increased emphasis on a healthy lifestyle and consumption of effective health and wellness products, Indian consumers are waking up to preventive health care and holistic wellness

in a huge way. Natural and functional ingredients are growing in popularity due to rising health concerns.



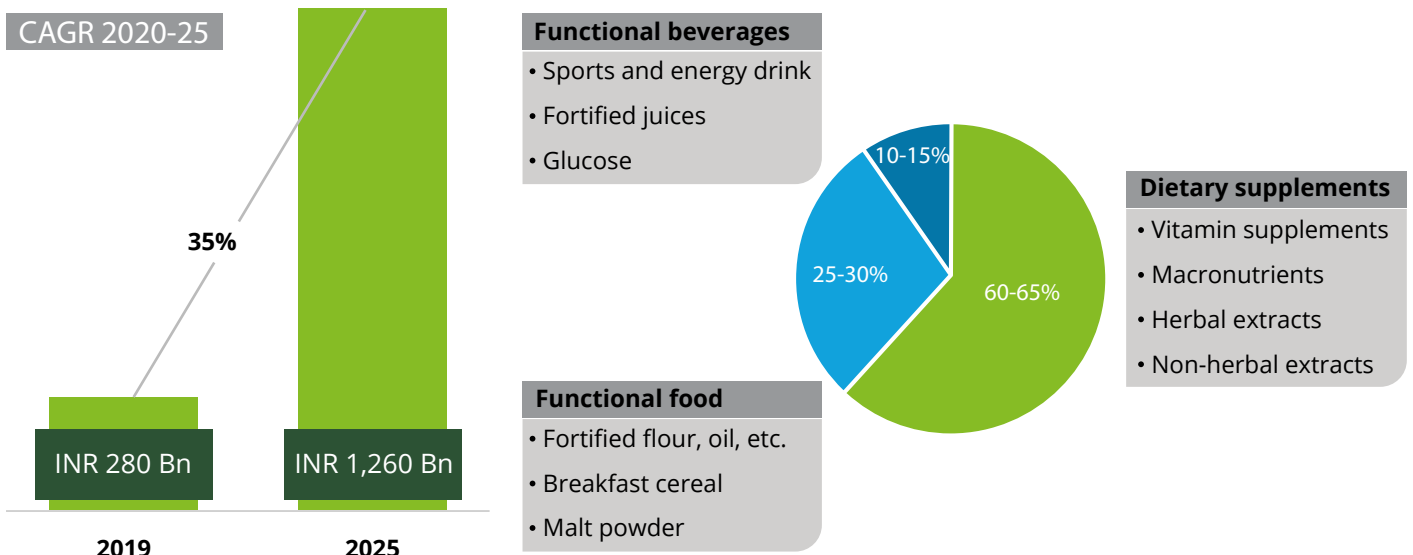
There is greater acceptance of immunity-boosting supplements and functional foods, especially amongst the upper and middle

classes. Increased focus on health and safety has led to high uptakes in key segments:

Nutraceuticals

A fast-paced lifestyle, poor work-life balance, and varying consumption patterns have led to rising incidences of chronic lifestyle diseases, stress, and other ailments. Increased awareness of self-care and higher spending power has enabled consumers to incorporate healthier dietary alternatives, vitamin, and immunity supplements.

Health care in India is gradually shifting its focus from cost-intensive curative procedures to preventive care. The nutraceutical industry has been on the rise over the past few years and more so since the pandemic. Doctors and nutritionists are actively prescribing nutraceutical products, especially after the onset of COVID-19.

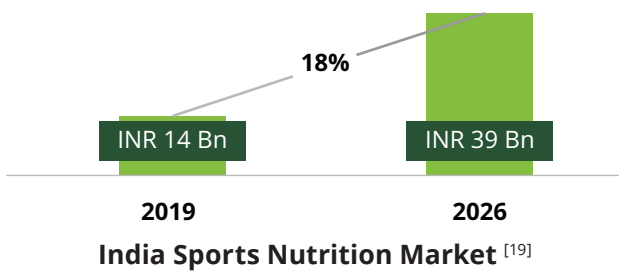


Indian nutraceuticals market ^{[17] [18]}

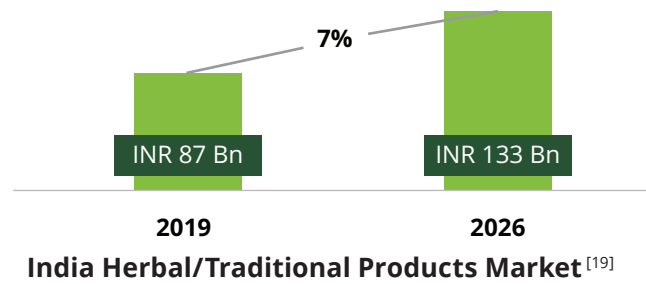
India is expected to hold at least 3-4 percent of the global market in the next 3-4 years, rising from 2 percent at present.^[20] Dietary supplements are currently growing at 17 percent and are expected to grow at 22 percent yearly.^[21] Increased interest in Ayurvedic immunity

boosting formulations and growing enthusiasm on fitness are expected to create strong growth for herbal/traditional products and sports nutrition, which includes energy bars, protein powder, protein RTD (Ready-To-Drink) and some other non-protein products.

CAGR 2019-26



CAGR 2019-26



This intersection of food, nutrition, health and technology, backed by availability of authentic and high-quality supplements, has spurred the growth of the health and wellness market, and brought trends like plant based and vegan nutrition to the fore. Advances in the medical

field such as predictive genetic testing will push people towards taking preventive health care even more seriously leading to an increased consumption of fortified foods that are rich in micronutrients.

Nutri-cereals

Nutri-cereals, commonly called millets are humble grains extensively grown as well as consumed in India. The category saw a gradual decline with the green revolution as the focus was on food security and on high-yielding varieties of wheat and rice. But millets are once again back in popular demand. In addition to being rich in dietary fibre, highly nutritious, gluten-free and non-allergenic, millets are a climate-smart crop as well.

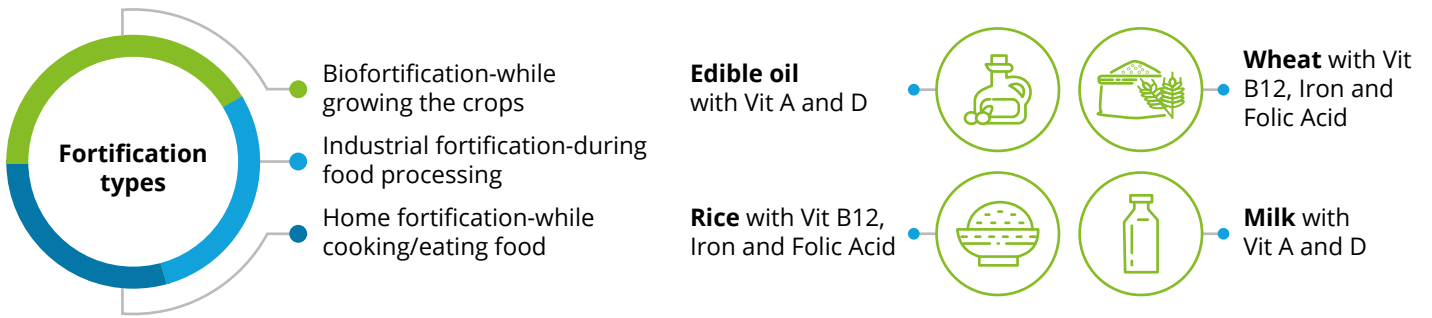
Rice and wheat are rapidly being substituted by millets as a regular cereal by diabetic and health-conscious consumers. There is also an increased demand for millet-based snacks and

breakfast options, such as millet flakes, biscuits, and porridge for diet-conscious consumers, who are looking for healthier product variants.

With the spiking demand for millets, the Government of India has launched various schemes to create an enabling environment to facilitate the production and marketing of millets. Some of these include: Integrated Cereals Development Programmes in Coarse Cereals (ICDP-CC), Macro Management of Agriculture (MMA), Initiative for Nutritional Security through Intensive Millet Promotion (INSIMP).

Fortified food

It is believed that food fortification is a scientific way of tackling nutrient deficiency.



In India, various food commodities, including edible oil, salt, wheat, and milk have been introduced in their fortified formats from time to time. Via rice fortification under Poshan Abhiyan, there is a renewed focus on fortification by the Government of India. It is estimated that rice fortification (rice fortified with vitamin B12, iron, and folic acid) is an INR 1,700 crore market in India.^[22]

To eliminate micro-nutrient deficiency, biofortified seed varieties are being promoted by the government. Seventeen bio-fortified varieties of four crops were released on World Food Day 2020.^[23]



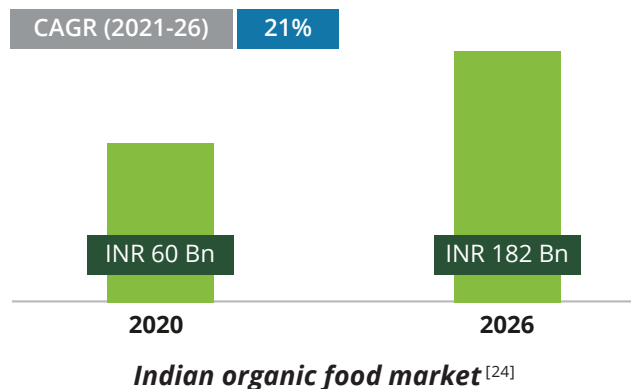
Mindful sourcing

Today's informed consumers are inquisitive about the safety of the food on their plates. Consumers are not just mindful about the hygiene of food but also about how it is produced, packed, processed, and delivered. In the quest for safer food, the demand for organically grown foods has increased during

the last decade due to their health benefits and better taste. Additionally, organisations are providing various user-friendly traceability techniques to deepen consumer's trust in their products. Influenced by these trends, there is a huge demand for clean labels in India.

Organic food

To reduce the damage that conventionally grown food can cause to the body, organic food consumption especially that of fruits and vegetables, is on the rise. Upper middle-class consumers are willing to pay a premium for organic products. Online availability of organic food products and shifting consumer preference towards organic food are the major factors expected to boost the demand for organic food products in India.



Food traceability

Role of traceability as a means to enabling food safety is becoming quintessential. Per the Consumer Food Value Equation survey^[25] conducted globally by Deloitte, 62 percent buyers focus on transparency, coupled with other wellness-oriented parameters, while making their purchase decisions.

Food traceability keep consumers informed about the agricultural practices adopted for food production, processing operations and storage facilities, use of raw materials, additives, etc., and

safeguards hygiene at all stages of the supply chain.

Realising the importance of traceability, APEDA (Agricultural and Processed Food Products Export Development Authority) and GS1 India have initiated a breakthrough food traceability systems, such as Anarnet, Tracenet, Peanutnet, Meatnet, and Grapenet for Indian farming products.^[26] Several dairy companies like AMUL, Govardhan and Chitale dairy have also initiated cattle tagging using RFID tags.

Clean labels

Clean-label products are amongst the top food trends in the organic food sector. It goes beyond the transparency of food ingredients and includes ethical and ecological factors that go into producing food. In India, though the clean label market is quite niche, it is growing with budding consumer demand for clean, simple, and safe products. "All-natural," "organic," "free-from additives/preservatives," are some clean

label claims gaining popularity in the Indian food market.

A health and wellness brand based out of Pune, Maharashtra, has launched products that are 100 percent natural and come with a clean label. With an average ingredient count of only seven ingredients per product, it ensures that consumers have upfront information on each one of them.^[27]

Mindful preference

Indian food is one of the most diverse cuisines, characterised by a wide variety of cooking styles and ingredients. Preference for local dishes has been catered to strongly by many regional brands who have been launching

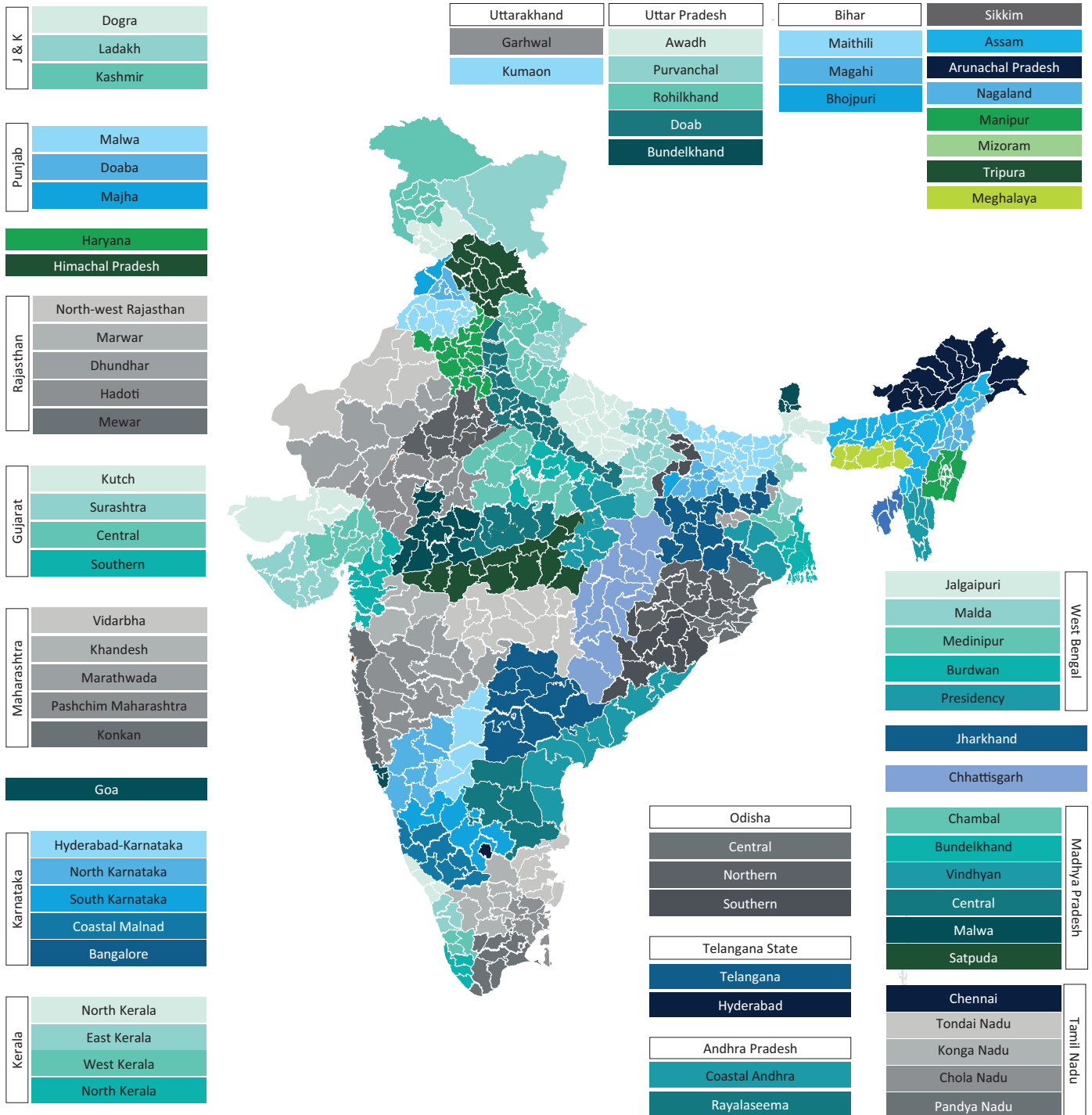
products for regional palates. Cognisant of the preference, big food and beverage companies are also increasingly adding ethnic flavours and indigenous ingredients to their packed snacks and beverages to suit local tastes.

Regional flavours

Cuisine preferences, in India, do not just vary across states, but also change within states and regions. This leads to a significant opportunities for regional brands to appeal to region-specific palates. Many brands have been agile and have innovated and launched product variants to suit local palates. Regional brands have been giving stiff competition to their national or global counterparts, across various food categories, including spices and masalas, snacks, oils, and sweets.

Recognising this customer preference, national brands too have started to innovate and launch products and variants that suit local taste preferences. The traditional way of developing and launching a product at the pan-India level, geographical-zone level, or even state level, will need to evolve to consider localised preferences to improve customer acceptance and increase chances of success.

Regional diversity across states in India*



*Deloitte internal analysis

Mindful purchase

There is an emerging trend of customers wanting to upgrade from buying food products from the unorganised sector and incrementally shifting towards the organised sector. This has led to

increased participation by packaged food players in selling commodities and staples, while also leading to growth in the private label business of large retailers.

Branding of commodities

For a long time, only a handful of food commodities such as ghee and tea were available in branded form. Concerns on food adulteration and demand for safely packaged food led to the branding of salt, spices, sugar, and cereals. The next in line were pulses and commodities such as besan, sooji, poha, and sabudana. To consume safe and unadulterated food items, branding of

commodities has gained and retain prominence, even after COVID-19.

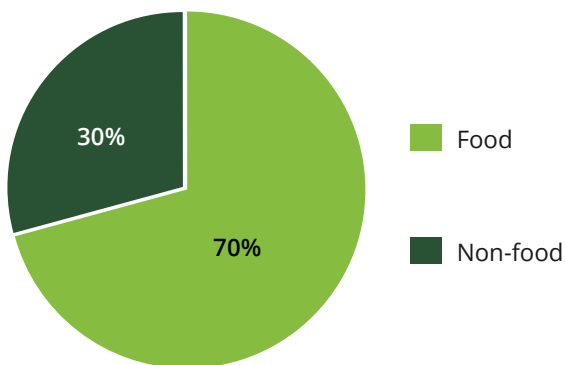
TATA Sampann and private labels of brands such as Amazon (Solimo), Flipkart (Supermart Select), and BigBasket (bb Royal and bb Popular) have played a significant role in driving this trend.

Private labels

Growth of modern retail and e-commerce, coupled with consumer demand for quality products at affordable prices, have made brands such as Reliance, Amazon, and Flipkart launch “own brands” or “private labels” in not just apparels and consumer durables, but also in food and grocery products.

COVID-19 has propelled the growth of private labels for food categories, owing to demands for safely packaged food options and controlled household spending on food items. Brands such as Metro^[30] and More have made significant sales in categories including biscuits and confectionery, breakfast cereals, and food commodities (flours and oils).

According to industry estimates, private labels in the food and beverage segment in India are expected to grow at a CAGR of 30 percent over the next five years.^[31]



Private labels in India (*as of May 2020) ^[29]

Mindful convenience

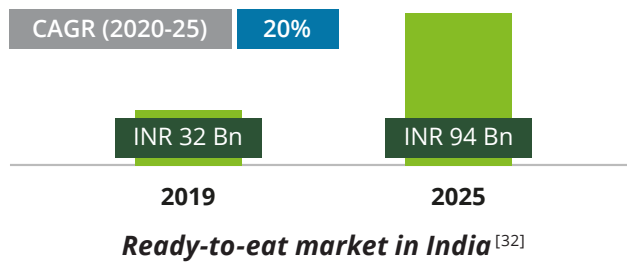
With limited time and energy to spend in the kitchen, affluent urban consumers are looking at easier, smarter, non-fussy meal solutions for daily meals. Convenience food is an umbrella term for Ready-to-Eat (RTE), Ready-to-Cook (RTC), Ready-to-Serve, and frozen foods.

Consumers are looking at multifold conveniences from packaged food offerings in carrying, cooking, and eating. Single-serve, microwave-friendly, on-the-go meal options are some micro-trends under the convenience food category.

RTE

With most restaurants being closed during the pandemic, and a sizeable number of people

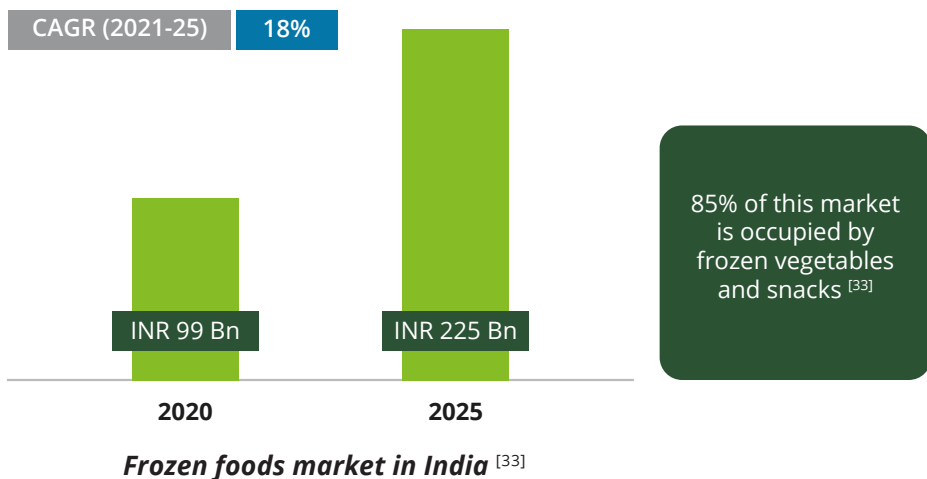
working from home, the ready-to-eat market in India has registered an accelerated growth.



Frozen food

Indian frozen food market comprises frozen meat products, snacks, fruits, vegetables, and fish and other seafood. Growth in the

e-commerce sector, improved cold chains, and enhanced lifestyles are major drivers for the stupendous growth of this market.



Intermediary products

Many Indian consumers currently do not have time to cook meals but do enjoy the overall process. Leveraging on this need are various value-added, semi-finished, or intermediary product offerings that intend to save time on cumbersome cooking steps such as cutting, grating, boiling, and grinding.

Fresh idli dosa batter by *iD fresh foods* is an example of a value-added product. *Y-Cook*,

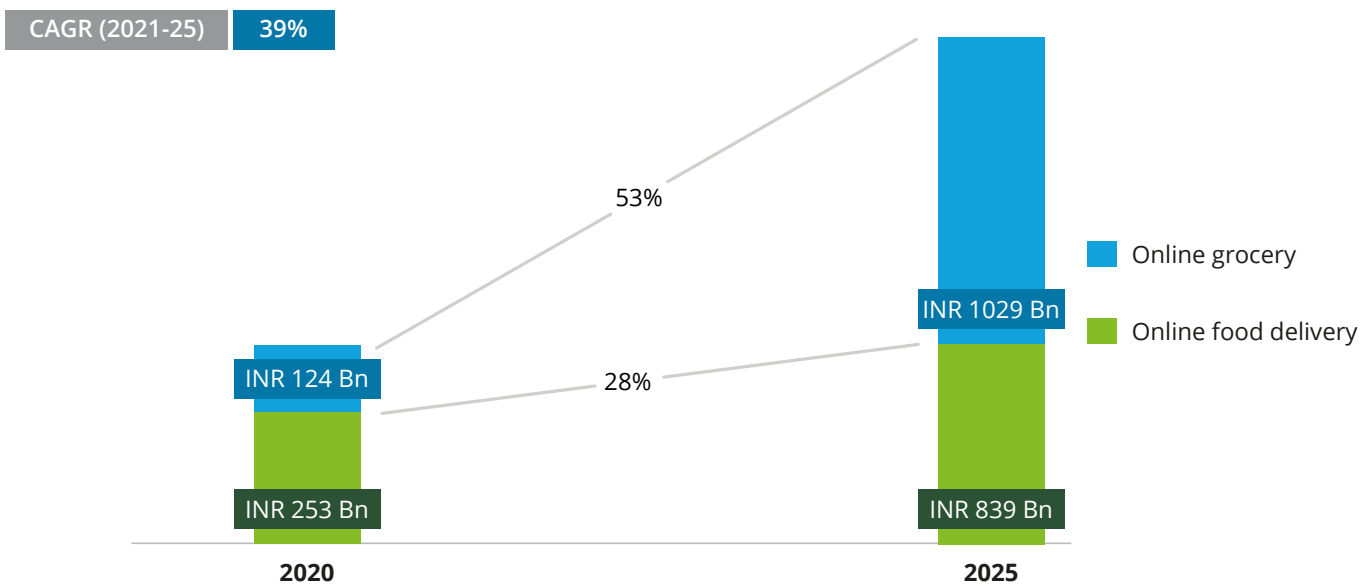
under the brand name *Ta-Daa*, provides a range of steamed lentils, fruits, and vegetables. Ginger-garlic paste, pizza/pasta sauces, puff sheets, cut fruits and vegetables, etc., are a handful of examples of intermediary products that are experiencing greater demand with the wave of in-home cooking.

Food delivery

Rise in urbanisation, a growing percentage of the working class, adoption of internet and smartphones, and lucrative offers and discounts by various food tech players such as Swiggy, Zomato, and Grofers have made the food-tech space grow by 35 times (in volume) during 2015-20.^[34]

In addition to fixed menu offerings by food delivery apps (aggregators and kitchen services), meal subscription services and DIY meals that offer customization, with respect to diet requirements, are also being offered directly to consumers.

The adoption of online grocery delivery has increased tremendously during the pandemic due to increased focus on health aspects and reliance on in-home cooking; with the growth skewed more towards fresh food items. The Gross Merchandise Value (GMV) of fresh food has grown by 144 percent during the first half of 2020, while staples and FMCG have grown by 85 percent and 62 percent, respectively.^[34] The online grocery delivery market is expected to grow more than eight times over the next five years.^[34]

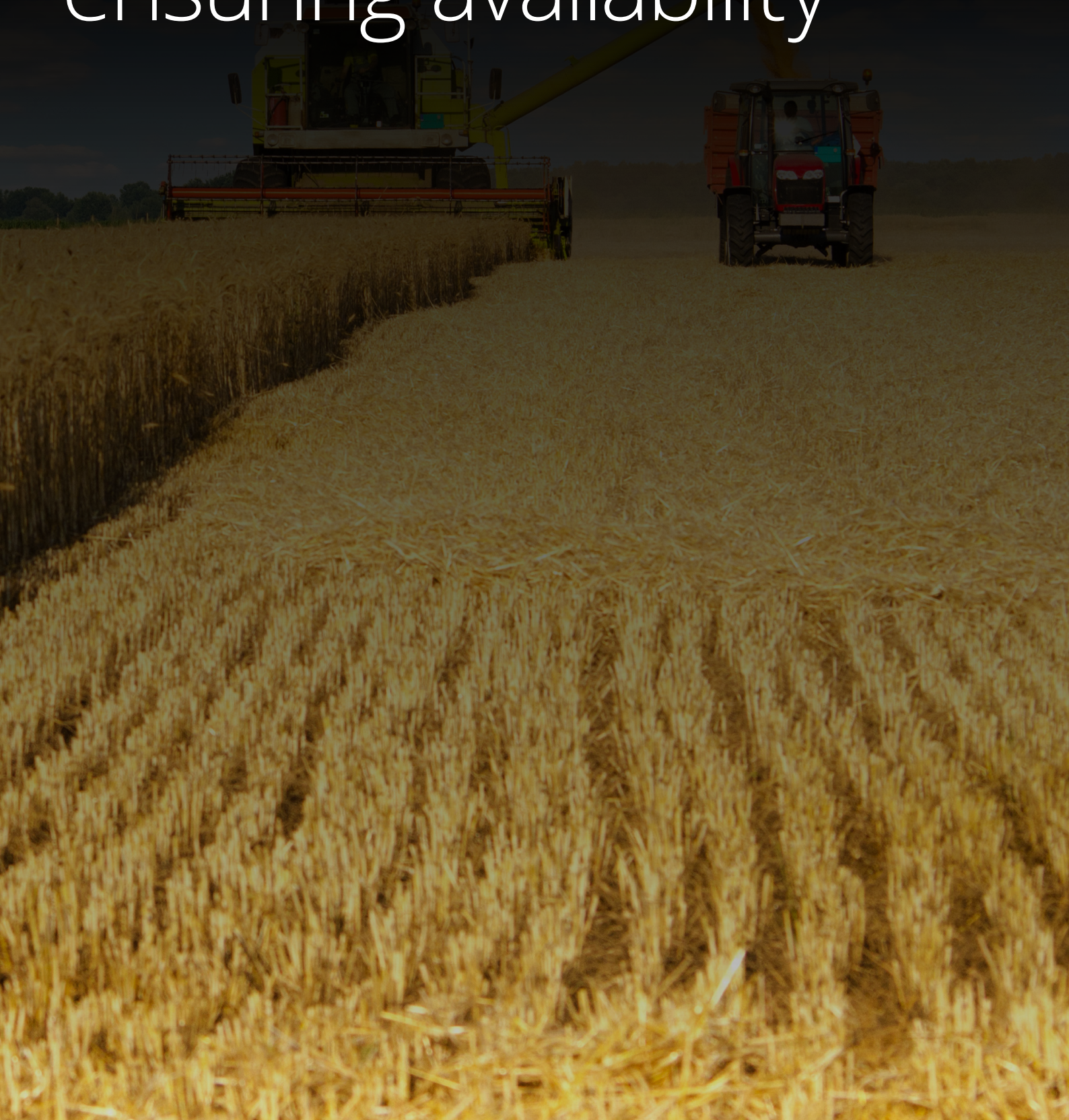


Food tech market in India (in revenue) ^[34]

To address the emerging food demands with a growing population and rising prosperity, and considering various socio-economic trends, several

modifications will be required at the food-supply side, such that food is accessible to all, without comprising on the standards of sustainability.

Food production and ensuring availability



India is one of the largest producers of milk, spices, livestock, rice, fruits and vegetables, and fish.^[35] However, there are some large categories, including edible oils, pulses, cocoa, where we still rely on imports and where the import value stood at INR 762 billion, 114 billion, and 18 billion,^[36] respectively in FY21 (till 28 Feb). To meet the increasing food demands, there needs to be a focus on ensuring food security and self-sufficiency for the products where there is significant dependency on imports. Availability of cultivable land and productivity would be the major drivers to meet this increased demand.

Cultivable land has decreased over the last few years ^[37]. As the economy grows, more

land is likely to get diverted to industrialisation and urbanisation, and hence, increased land availability is not expected to contribute significantly towards meeting the increased food demand.

India's agriculture productivity is lower than many developed nations such as the US, China, and European countries,^[38] which can be broadly attributed to the factors which include, but not limited to traditional farming methods, insufficient irrigation facilities, soil erosion, distributed landholding, lack of credit availability, etc. Hence, there is significant scope for productivity improvement via intensification practices to meet future demand.

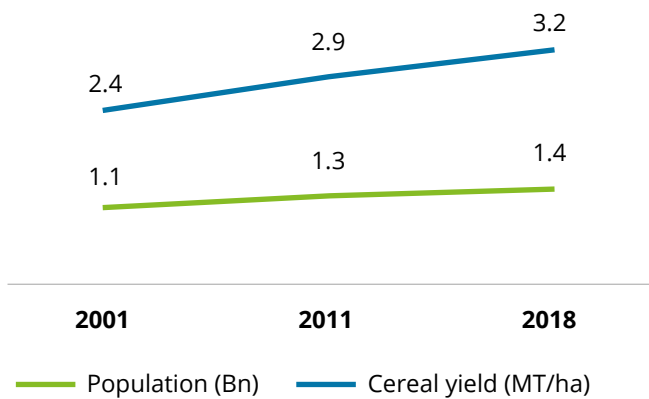


Figure 1: Population (Bn) and Cereal yield (MT/ha) comparison – trend^{[40][41]}

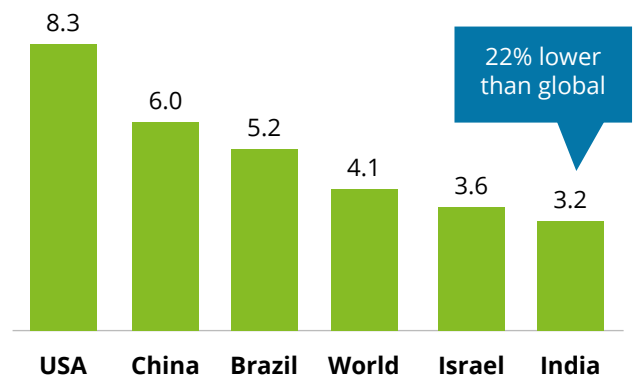


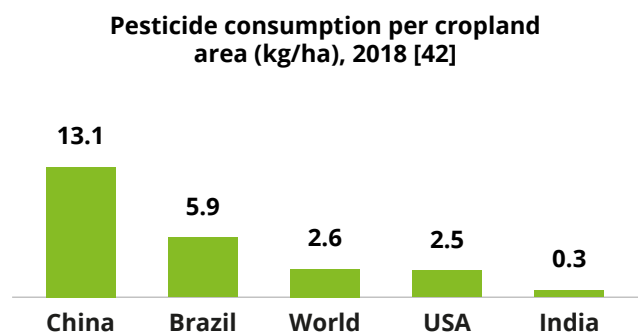
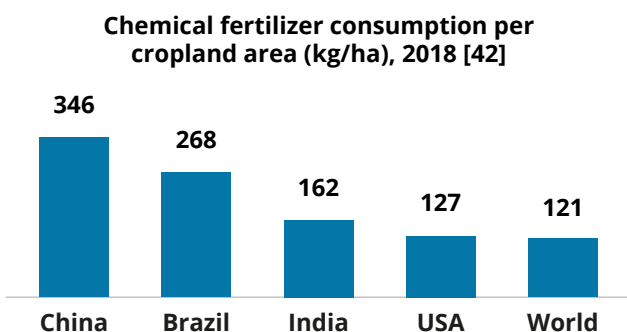
Figure 3: Cereal yield comparison (2018) (MT/ha)^[41]

Production

Intensification strategies – meeting the increased demand

A range of food intensification strategies have been implemented by farmers, such as increasing the use of agri inputs. India's consumption of chemical fertilisers is higher

than global standards but is much lower in case of pesticides. Increased use of such agri inputs can help improve overall farm productivity.






Micronutrient fertilisers have also gained acceptance due to increase in soil degradation and growing deficiencies of micronutrients and overall productivity of the soil. In India, more than 35 percent land has zinc deficiency due to excessive rice and wheat cultivation. Along with zinc, manganese micronutrients (due to excessive wheat cultivation) demand is also expected to grow rapidly in India. Overall, the

segment is projected to grow at 7.8 percent for the next five years to reach INR 27.6 billion. [43]

However, the overuse of such chemicals can lead to long-term challenges, such as reduced soil health, water scarcity, contamination of ground water, and reduced food safety. Thus, there is an emergence of select intensification practices that do not harm the environment yet, increase the yield with limited inputs.

Indicative intensification techniques

	 Vertical farming	 Vermicomposting	 Agroforestry
	<p><i>Vertical farming is a practice of growing crops in stacked vertical layers, often in a controlled environment</i></p>	<p><i>These techniques utilise nutrient solutions, moisture, and water (integrated with fish tanks), respectively to replace soil in farming</i></p>	<p><i>In IFS, an inter-related set of practices, such as farming and poultry are used simultaneously so that the waste from one component becomes an input for other enterprises of the system</i></p>
Advantages	<ul style="list-style-type: none"> • Up to 95% of water saving • Land utilisation (30 floor building eq 2400 acres) 	<ul style="list-style-type: none"> • Less requirement of land • Low dependence on irrigation • Water conservation 	<ul style="list-style-type: none"> • Improved efficiency • Lowered cost of agriculture • Increased income for farmers
Current status	<ul style="list-style-type: none"> • Global market for vertical farming stood at INR 210 Bn in 2021, expected to increase to INR 1232 Bn by 2028 (CAGR of 25%) [45] • Adoption is low but growing in India 	<ul style="list-style-type: none"> • Global hydroponics market stood at INR 665 Bn in 2020, expected to increase to INR 1.2 Tn by 2026 [45] • Aeroponic stood at INR 42 Bn in 2018[46], globally 	<ul style="list-style-type: none"> • The system is nascent, but experiments include integrated rice-fish-poultry farming system in 12 villages of Cuddalore, Villupuram, Nagapattinam and Thiruvannamalai districts of Tamil Nadu [47][48]
Growth drivers	<ul style="list-style-type: none"> • Extreme weather conditions • Lack of cultivable land • Increased VC interest (BASF investment in Urbankisaan) 	<ul style="list-style-type: none"> • Increased yield with low inputs • Increasing VC and PE interest 	<ul style="list-style-type: none"> • Farmers looking to diversify income • Focus on prevention of deforestation
Challenges and risk drives	<ul style="list-style-type: none"> • Regular power availability • High-end technology availability • High capital requirement 	<ul style="list-style-type: none"> • High power requirements • High capital requirement • Accessibility of technology 	<ul style="list-style-type: none"> • High capital requirements • Supply-chain inadequacies • Accessibility to technology

Mechanisation of agriculture – increasing the pace

Indian agriculture has been facing challenges due to lower labour availability and corresponding increase in labour costs over the past decade.

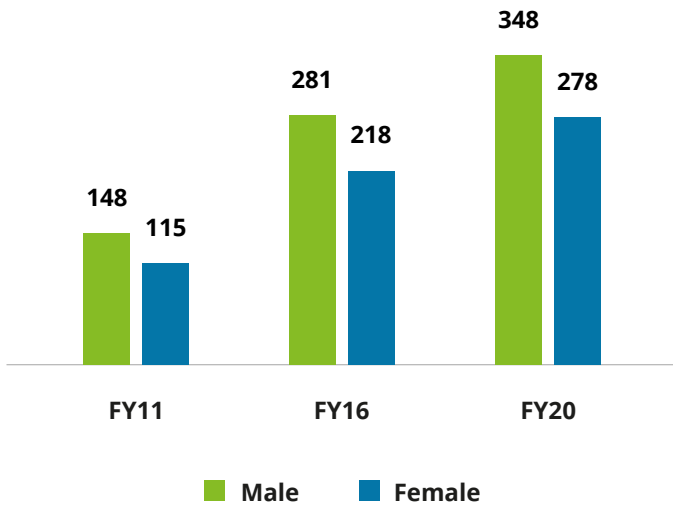


Figure 3: Average wages in agriculture - trend (INR/day) ^[49]

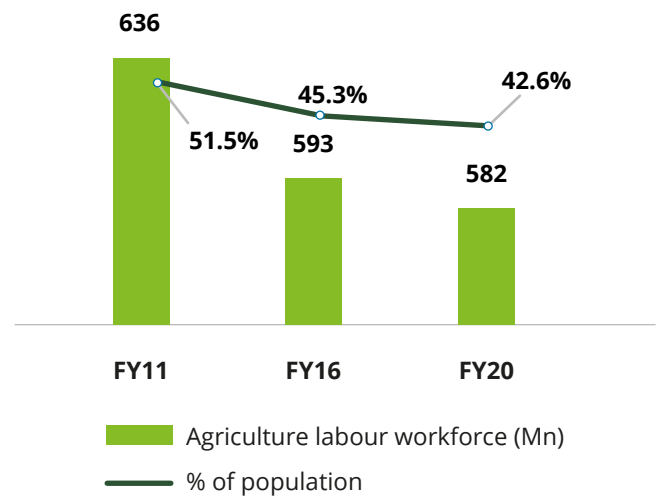


Figure 2: Workforce employed in agriculture in India (Mn) ^{[41][50]}

Automation and mechanisation of tasks at the farm level can reduce the dependency on manual labour and increase efficiency. For instance, farm power availability from tractors has grown from 0.007 kW/ha during 1960-61 to 1.03 kW/ha during 2013-14. It is further estimated to reach 3.74 kW/ha by 2032-33.^[51] Fragmented landholding patterns reduce farmers' ability to invest in transition, creating a need for innovative models for medium to small-scale farmers to implement automation in their farms.

The government of India launched Sub-Mission on Agricultural Mechanisation (SMAM) scheme during 2014-15 for various activities focussing on farm mechanisation, including subsidies on equipment purchases.^[52] The government (custom hiring centres) as well as a range of

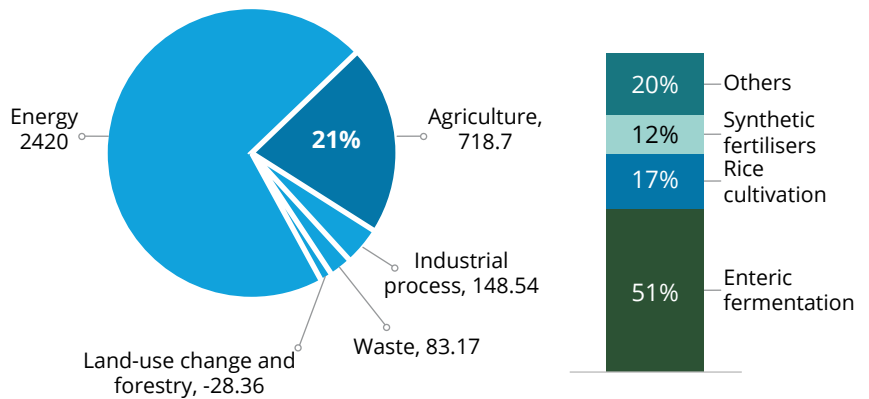
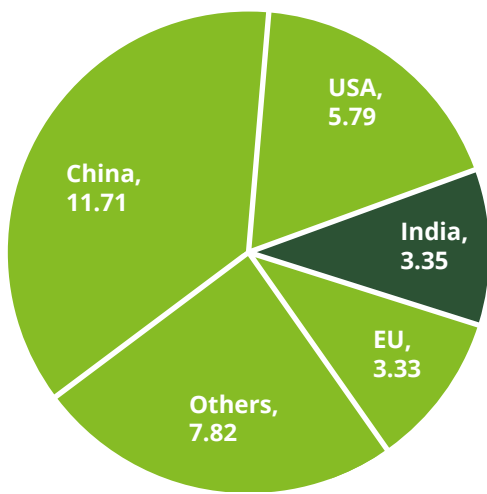
private players, such as Mahindra and Mahindra and Sonalika, have implemented rental models of farm equipment, enabling small farmers to automate parts of the production without significant capital investment. Due to the continuing trend of labour shortage and benefits from mechanisation on overall productivity, the use of such models is expected to grow further.

However, there are several challenges in widespread adoption of mechanisation, such as lack of awareness, lack of access to resources including credit, status of rural infrastructure, and lack of equipment versatility. Despite these, mechanisation is the need of the hour and it provides significant opportunities to players focussed on addressing these challenges and improving mechanisation access.

Regenerative agriculture – sustainable and ecological food production

The importance of sustainable procurement is growing globally. Consumers are growing increasingly aware of the environmental impact of the food they consume and are demanding higher transparency in traceability.

India is the third-largest emitter of GHGs after the US and China.^[53] Agriculture is responsible for 21 percent of India’s total GHG emissions.^[53]



Global GHG emissions in GT CO2e





India GHG emissions in MT CO2e

India Agriculture GHG emissions

In line with customer expectations and mindfulness about sustainability, Indian companies have started adopting sustainable practices in food procurement. Companies are acquiring sustainable procurer certifications such as Earthseer to address the demand from consumers. This is also a visible global trend, for e.g., globally, 93 percent potatoes procured by the world’s largest manufacturer of frozen potato products were GAP certified.^[54] In India, companies such as DCM Shriram and Vijayanagar Sugar have been certified with Bonsucro certification for sustainable sugar procurement.

The Indian government initiated the National Mission for Sustainable Agriculture (NMSA) during 2014-15, under which, schemes such as rainfed area development, sub mission on agroforestry (SMAH) and soil health management are developed and centrally sponsored. A few sustainable farming practices are emerging across India.

Indicative regenerative agriculture techniques

	 Organic farming	 Vermicomposting	 Agroforestry	 Micro irrigation
	<p><i>Organic farming limits/prohibits the use of synthetic agriculture inputs and promotes the use of organic material to promote overall sustainability</i></p>	<p><i>Vermicomposting uses the biotech process of using earthworms to boost biowaste conversion to compost, known as vermicompost</i></p>	<p><i>Agroforestry is a practice of integrating farming, forests, tree and livestock in varied scales</i></p>	<p><i>Modern irrigation method using dippers, sprinklers, or foggers to irrigate only a surface or subsurface of land</i></p>
Advantages	<ul style="list-style-type: none"> Improved soil health Lowered risk of contaminated groundwater 	<ul style="list-style-type: none"> Lowered pest and disease Increased productivity Improved water holding capacity and soil health [57] 	<ul style="list-style-type: none"> Reduced pressure on forests Protection of ecological systems Improved soil nutrients Reduced soil run-off and erosion 	<ul style="list-style-type: none"> Water conservation Cost reduction in field preparation Increased yield and quality of produce Prevention of fungus and weeds
Current status	<ul style="list-style-type: none"> 1.8 Mha of area is certified under organic farming across India with 1.9 Mn registered farmers. [55] Export of organic products from India reached 0.88 MMT (INR 70 Bn in FY21), up 51% in dollar terms from FY20. [56] 	<ul style="list-style-type: none"> Nineteen states have a combined land of 3.5 Mha with over 1.5 Mn farmers associated with it [55] 	<ul style="list-style-type: none"> Practiced on 25 Mha of land across India with five Mn farmers associated [55] Predominantly adopted by large farmers 	<ul style="list-style-type: none"> Over 1.2 Bha of cultivable land was estimated to be using micro-irrigation systems by FY19 [58]
Growth drivers	<ul style="list-style-type: none"> Increased awareness on food safety Government support 	<ul style="list-style-type: none"> Increased awareness on food safety and sustainability 	<ul style="list-style-type: none"> Farmers looking to increase income Government support Increased awareness on sustainability of food production 	<ul style="list-style-type: none"> Government support through PMKSY-PDMC and Micro Irrigation Fund Reduced availability irrigation water Learning from countries such as Israel
Challenges and risk drives	<ul style="list-style-type: none"> Availability of organic supplies High gestation period and loss of revenue Lack of incentivisation Costly certification process 	<ul style="list-style-type: none"> Availability of vermicompost supplies Lack of incentivisation Gestation period for composting Odour and resultant attraction of rodents and flies 	<ul style="list-style-type: none"> Availability of improved seed variety Availability of widespread research Lack of awareness among buyers and thus, lower price for the produce Accessibility of technology for tribes 	<ul style="list-style-type: none"> Availability of funds for installation Requirement of technical know-how for installation and maintenance Availability of energy

Note: Mha – million hectares; Bha – billion hectares



Case:

Sikkim, with a cultivable land of more than 76,000 ha, is the first in India to be certified as fully organic in 2010.^[59] The state officially adopted a resolution to switch to organic farming back in 2003. Special emphasis was put on techniques such as crop rotation, companion planting, and protection of environment and ecology.

Agriculture inputs transformation – fertilisers and crop protection

Focus on sustainable farming practices has inspired agri input market players to adapt to the demand and launch bio variants of inputs such as fertiliser and crop protection. Bio fertilisers

supplement chemical fertilisers with improved yield and soil properties. In India, the organic fertiliser market is expected to grow to INR 154 billion by 2027 with an expected CAGR of 11.3 percent.^[60]

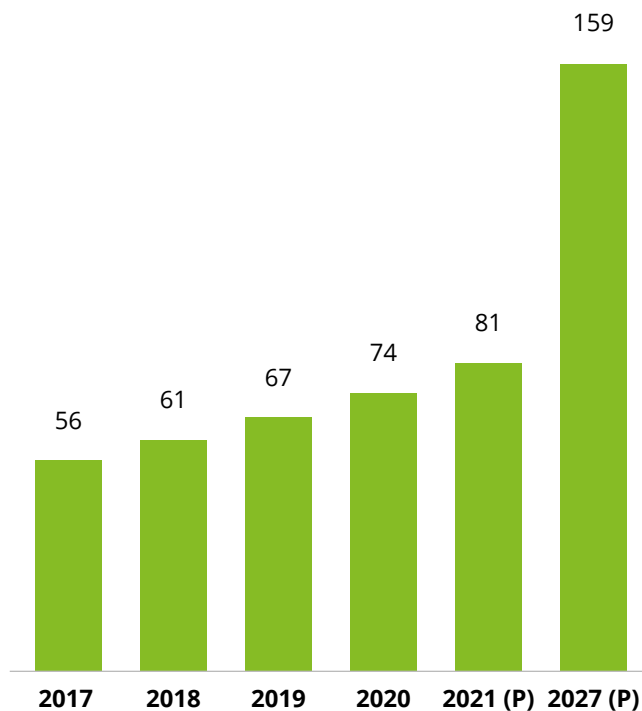


Figure 4: Indian organic fertilizer market size - trend (INR Bn) ^[60]

Leading players such as UPL (6), Coromandel (4), IFFCO (7) and Krishak Bharati Cooperative Limited (10) offer a range of bio fertilisers. Rallis India has entered the organic fertiliser space by acquiring a majority stake in Zero Waste Agro Organics Ltd.^[61]

Similarly, synthetic pesticides have also been found to contaminate the soil and affect the overall food chain. The global bio pesticides

market is expected to grow at CAGR of 14.7 percent from INR 301 billion in 2020 to reach INR 595 billion in 2025.^[62] A similar trend is expected in India as witnessed in the bio fertiliser space. Companies such as UPL, Biotech International, BASF SE, and PI Industries are working towards providing bio pesticides with products such as Biovita, neem/tobacco-based pesticides.

Processing

India's food processing industry is the sixth-largest in the world and is expected to reach INR 40.1 trillion by FY26^[98]. It accounted for 8.98 percent of manufacturing GVA in FY2018,

contributing to 11.11 percent in agricultural value added.^[63] Gross value added from food processing sector has increased at a CAGR of 8 percent during FY14-FY19.^[64]

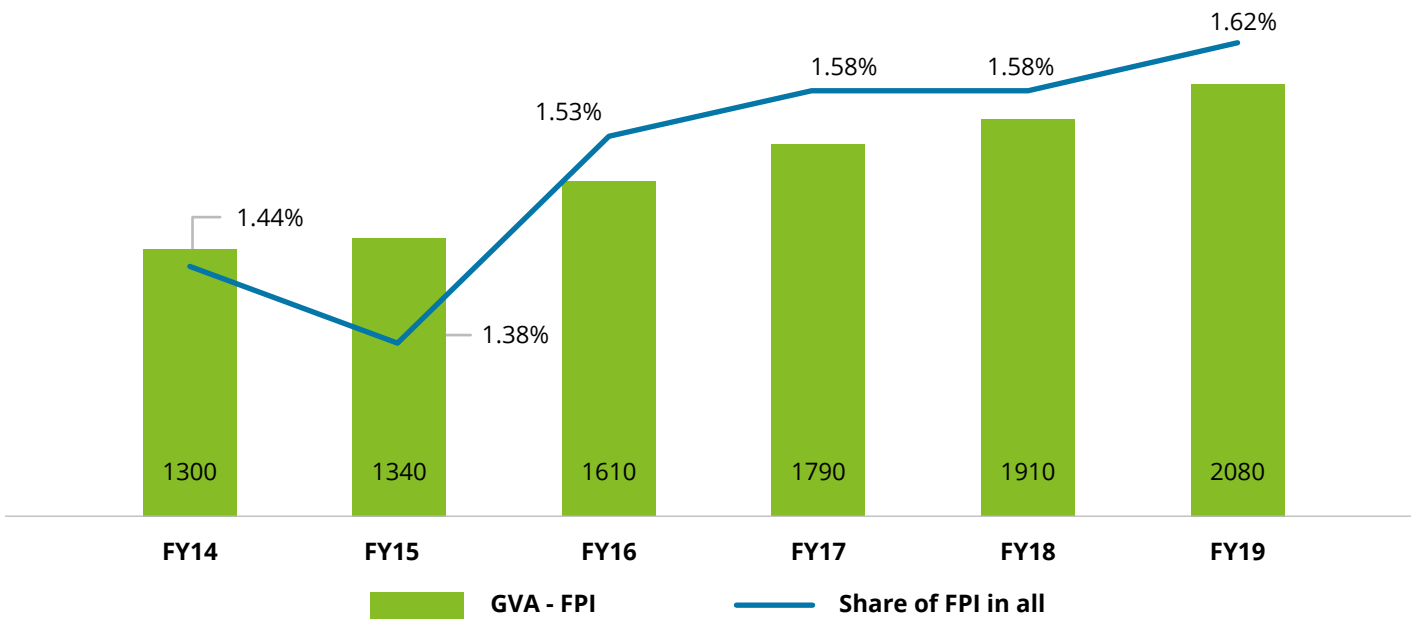


Figure 5: GVA (INR Bn) and share of FPI in all GVA(%) in India for the food processing sector ^[64]

India currently processes less than 10 percent of its agricultural output. That is significantly lower than other Southeast Asian countries such as Thailand, Vietnam, and the Philippines.^[63] Key challenges faced by the segment include the following:

- Availability of suitable infrastructure
- Limited opportunity for direct market linkages
- FPI industry is dominated by MSME players (98.4 percent in number of units)
- Availability of NABL accredited food-testing laboratories
- Seasonality of the segment leads to lower capacity utilisation

The segment presents players with three key opportunities:

- **Operational excellence and sustainability practices**

Companies have invested in technology innovations that can help manage and

improve their operations and overall productivity. They are also being mindful about their impact on the environment and are taking steps to reduce resource wastage and adopt sustainable practices.

Smart factories

Increased connectivity between machines and technology
 Use of IoT and blockchain to transform factories into smart factories
 Robotic automation, predictive maintenance using AI/ML, Data-aided decision mapping and quality management

Transportation

In-factory transportation can be automated to improve efficiency
 Increased focus on use of electric modes of transportation

Optimising power cost

Implementation of smart power conservation solutions, i.e., using LEDs for lighting, improved technology for refrigeration and dehydration
 Increased focus on sources of power being renewable



Water consumption

Mindful use and reduction in wastage of water
 Increased focus on reduction of water pollution through eliminating harmful chemicals in processing

Food safety and traceability

Reduced usage of harmful chemicals in the food processing and preservation for increased food safety
 Standardisation and certifications of food traceability

- **Infrastructure:** Investments by the government and private players are required to develop the necessary infrastructure. For instance, a majority of the cold storage capacity (37-39 million tons) ^[63] in the country is currently utilised for potatoes (68 percent of storage capacity),^[63] resulting in poor utilisation of the existing capacity due to produce seasonality.

Currently, there are two schemes focussing on increasing the cold storage capacity in the country, namely, a) Mission for Integrated Development of Horticulture (MIDH) of the Agriculture Ministry and b) Pradhan Mantri Kisan Sampada Yojana (PMKSY). While these schemes have resulted in the addition of 1,104 cold chains under MIDH and 208 cold chains

under PMKSY, there exists a considerable need for additional capacity to reduce wastage and increase shelf life of perishable produce.^[63] On 15 May 2020, under the Atmanirbhar India initiative, the government allocated INR 1 trillion for cold-chain and post-harvest infrastructure development.

The government also initiated value-add infrastructure by providing Production Linked Incentives (PLIs), under which RTE/RTC, fruits and vegetable products, marine products and mozzarella cheese are covered.^[65] However, there are large gaps in the value chain, which present private players with significant investment opportunities in the segment that is expected to reach INR 37.4 trillion by 2025-26. ^[66]

- Increase in secondary processing:**
 Only 10 percent of the agro-produce is processed in India currently. Gross Value Added (GVA) by Food Processing Industry (FPI) in manufacturing GVA was 9.7 percent in 2017 for India compared with 26.0, 34.3, 16.2,

11.4 for Australia, New Zealand, France, and the US, respectively in 2017.^[67] The agriculture to consumer spend multiplier for India is 1.9x, compared with 2.6x and 6.6x for China and the US, respectively.

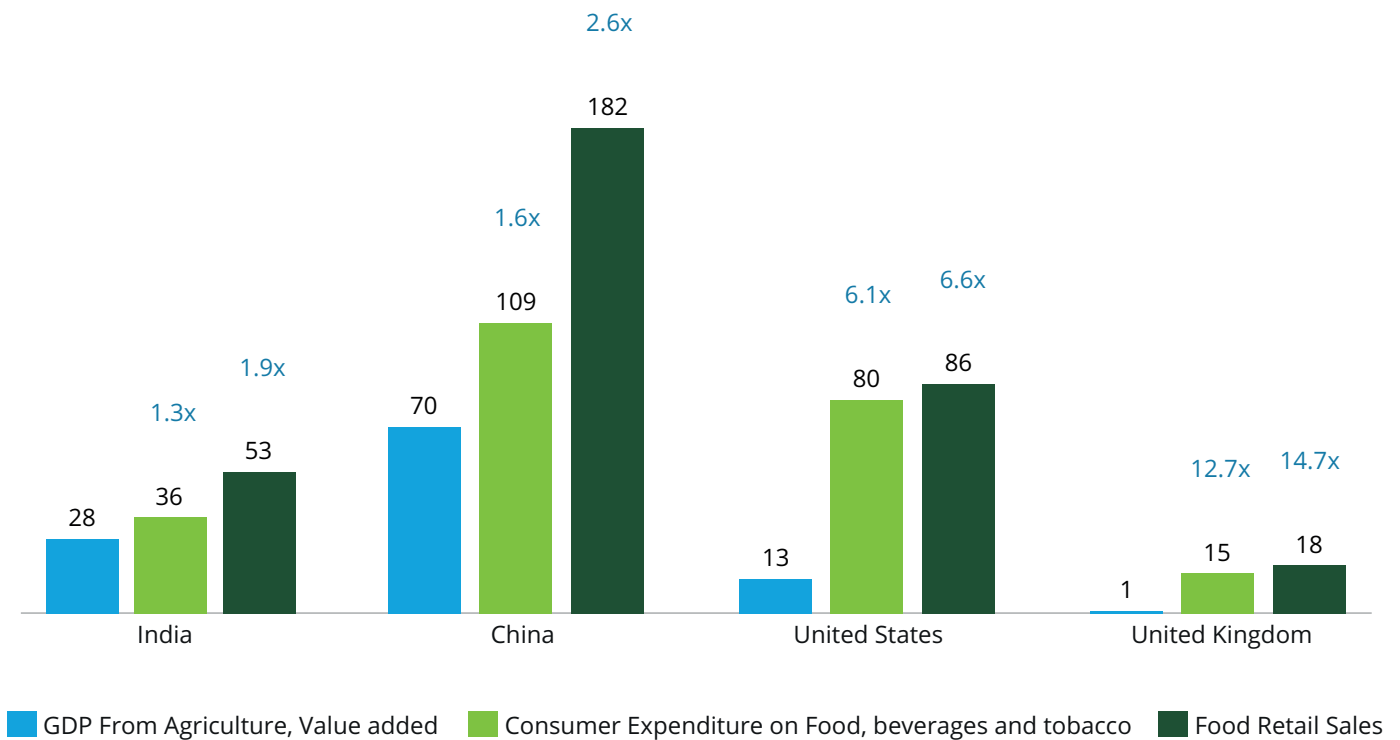


Figure 6: Comparison of India vis-à-vis other countries in 2018 (in INR trillion) ^[63]

Most of the processing can be classified as primary processing, offering lower value-addition and not creating a chain for higher level of processing—secondary and tertiary. For instance, only about 2 percent fruits and vegetables are processed in India, as compared with 65 percent in the US, 78 percent in the Philippines, and 23 percent in China. The government has introduced the Pradhan Mantri Matsya Sampada Yojana, focusing on boosting produce and export in fisheries. It has allocated

INR 200.5 billion under PMMSY—INR 123.4 billion for fishery activities (marine, inland fisheries and aquaculture) and INR 77.1 billion for infrastructure, comprising fishing harbours, cold chains, tracing and testing facilities.^[63] Such schemes in other segments could lead food processing to upgrade from primary to increased secondary processing. This presents an attractive opportunity for food processors to increase GVA by moving up the ladder to increased secondary processing.

Packaging

Consumers are increasingly demanding sustainable packaging of the products they purchase. GlobalData conducted a post-COVID-19 survey and revealed similar consumer preferences on packaging.^[68]

This has led to companies setting aggressive targets.

- Air India and the Indian Railways replaced plastic food packaging with eco-friendly paper and are planning to use wooden cutlery as well.^[69]
- Nestle, HUL, Kraft Heinz, and Mars are committing to reach 100 percent of recyclable/reusable packaging globally by 2025.^{[70] [71] [72]} Nestle's 88 percent of the total packaging and 62 percent of plastic packaging is recyclable or reusable.

These goals have boosted innovation towards developing more sustainable, recyclable, and reusable packaging materials. Biodegradable packaging includes materials sourced from corn, bamboo, plant fibers, wood fibers, mushrooms, etc. India's leading manufacturer of primary consumer packaging and labelling materials has developed primary and secondary packaging for a range of applications, including dry food and coffee, which are recyclable and meet sustainability targets.

... the Global Data survey revealed consumer preference for packaged food and sustainability of the packaging



Consumers regard **plastic-free packaging** as their top priority (double the world average)



Consumers regard **recyclable/reusable packaging** as top priority)



Consumers agree to purchasing more **"On The Go" food** than before



**Case:**

DRDO, in collaboration with Ecolastic, has developed ecofriendly packaging products that are produced by using natural and plant-based materials. This is amid India's decision to ban the usage of single-use plastic by 2022. Ecolastic offers pellets, films, and bags that are plastic free, food-grade, and 100 percent compostable.

Mintel's global new products database highlights that 82 percent food brands launched in the last five years in India use plastic as primary packaging.^[73] Complete elimination of plastic from packaging is not expected in the short term, leading to requirements for a circular economy. The union environment ministry has also proposed a draft notification for regulation, under which, 35 percent plastic waste will have to be managed by the producers.^[74]

There have also been innovations in packaging technologies such as Vibrathon and Robo Home, where start-ups in India are automating

packaging to offer end-to-end traceability and increased efficiency by using technologies such as AI, IoT, blockchain, and robotics.^[75]

These innovations clearly point to a large overhaul in the way we think of packaging in the food and beverages sector. The Indian government has allowed 100 percent FDI for the processed food segment. Loans are also provided to processing units under priority sector lending. Although the innovation is nascent at this stage, companies will need to focus on making their packaging more sustainable.

**Case:**

India's largest hyperlocal and omni-channel meat brand launched an innovative eco-friendly packaging for all its home delivery orders. The primary packaging is made of non-plastic virgin food-grade material that is fully recyclable. The goal is to make 100 percent of their packaging plastic-free by 2023.^[76]

Distribution

The traditional way of distribution involved a linear supply chain, where each member was only connected to immediate members. Additionally, the linear nature of the distribution model allowed limited flexibility to change

per consumer demands and supply patterns. However, there are changes that are now becoming visible in how companies are operating their distribution models.

Omni-channel distribution

Consumers are increasingly looking for multiple channels to get food items. Omnichannel distribution provides customers with an enriched purchase experience at a variety

of touchpoints. Integration between these touchpoints have provided companies with a holistic understanding of customer preferences and increased efficiency of sales efforts.

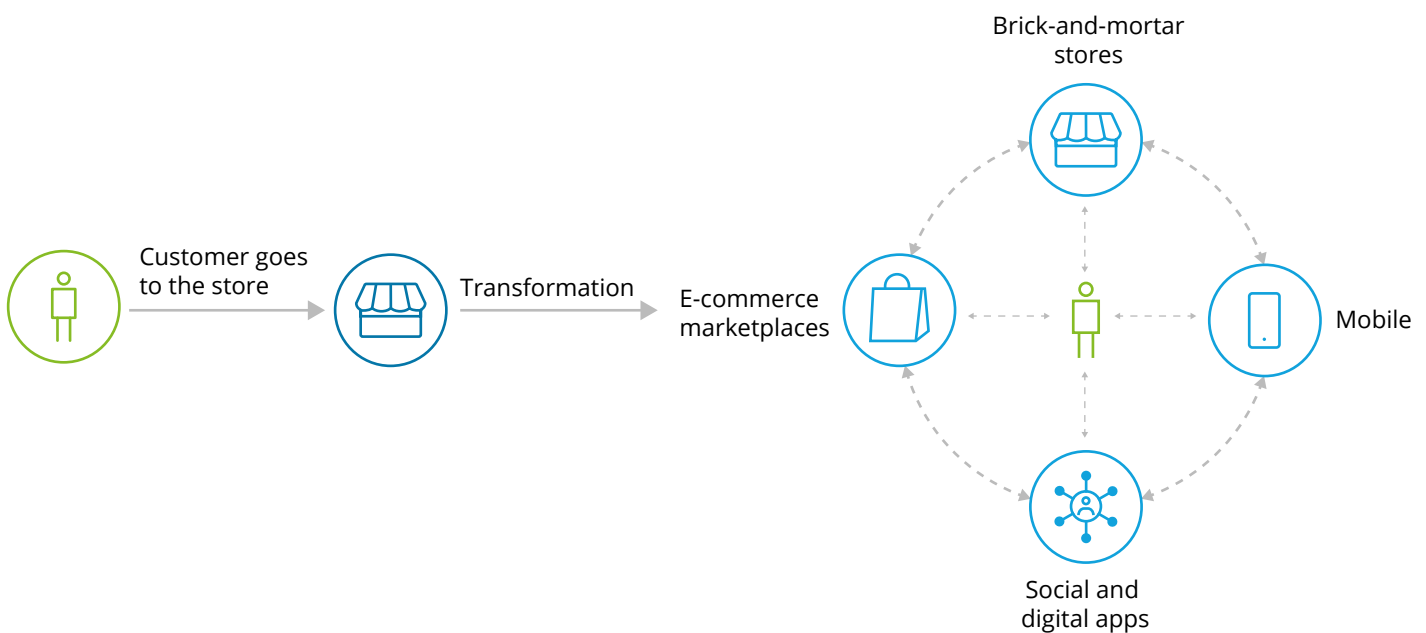


Figure 8: Transformation from traditional to Omnichannel distribution

Although there are many challenges, such as product mix selection, price harmony, and inter-channel conflicts, the model is expected to grow and evolve due to innovative strategies including

hyper-personalisation, responsive customer support, a variety of payment options, and innovative business models.^[77]



Case:

One of the largest FMCG players in India, in its efforts to become omni-channel, launched its own online shopping platform named "UShop". In addition to being available at local Kiranas, hypermarkets, modern trade and online marketplaces, having an inhouse online platform helps build a more personalised experience through the platform and understand consumer behaviour through the data collected.^[78]

Hyperlocal model

Due to the mega trend of convenience and on-demand service, customers are expecting much shorter delivery times for the food they consume. This leads to an obvious extension of online platforms to integrate supplies from local stores to reduce delivery time and adopt a hyperlocal model. Platforms such as JioMart offer local merchants and kiranas an O2O (Online-to-Offline) marketplace to meet consumers' demand of local food, with the convenience of online purchases. Many other players such as Amazon and Flipkart are entering the hyperlocal model of distribution as well.

However, the hyperlocal model faces certain challenges such as labour availability and cost of operations. There is research interest in this space to address many of these challenges through technology, such as commercial drones for last-mile delivery. For e.g., A large pizza chain started experimenting with drone delivery in Houston in early 2021. In India, liberalised Drone Rules, 2021, was passed in August, which could further incentivise research in the field.^[79] However, widespread adoption is still expected to take time.

Aggregator model

Aggregator models of distribution have been able to increase efficiency through consolidation. They offer a wide range of services, including product visibility, platform for conducting commerce activities, finance facilities, logistic solutions, analytics, etc.

B2C aggregators for food delivery include

Zomato and Swiggy, while grocery aggregators include companies such as bigbasket, Grofers, and Amazon pantry. Large farm-to-factory players include one of the largest FMCG players in India, which started the F2F platform in 2000 and has over 4 million farmers in over 35,000 associated villages.^[80]



Case:

A B2B trade platform, specifically designed for small and medium businesses in India was started in 2016. It enables small farmers and brands to sell their products to other businesses across the country. The food business crossed the daily volume of 8000 MT across 50 cities, with 1.5 lakh orders in 2020.^[81]

However, there are challenges with the aggregator model due to conflicts with the established distributor-led channels. For instance, players such as Amul and Parle have stopped direct supply to Udaan because of concerns regarding cannibalisation of sales through their exclusive distributors. In another

instance, the National Restaurant Association of India has approached the Competition Commission of India over commissions and control of aggregators such as Swiggy and Zomato.^[82] Although there are operational and social challenges, the aggregator model is likely to find solutions to these and continue to grow.

Role of technology



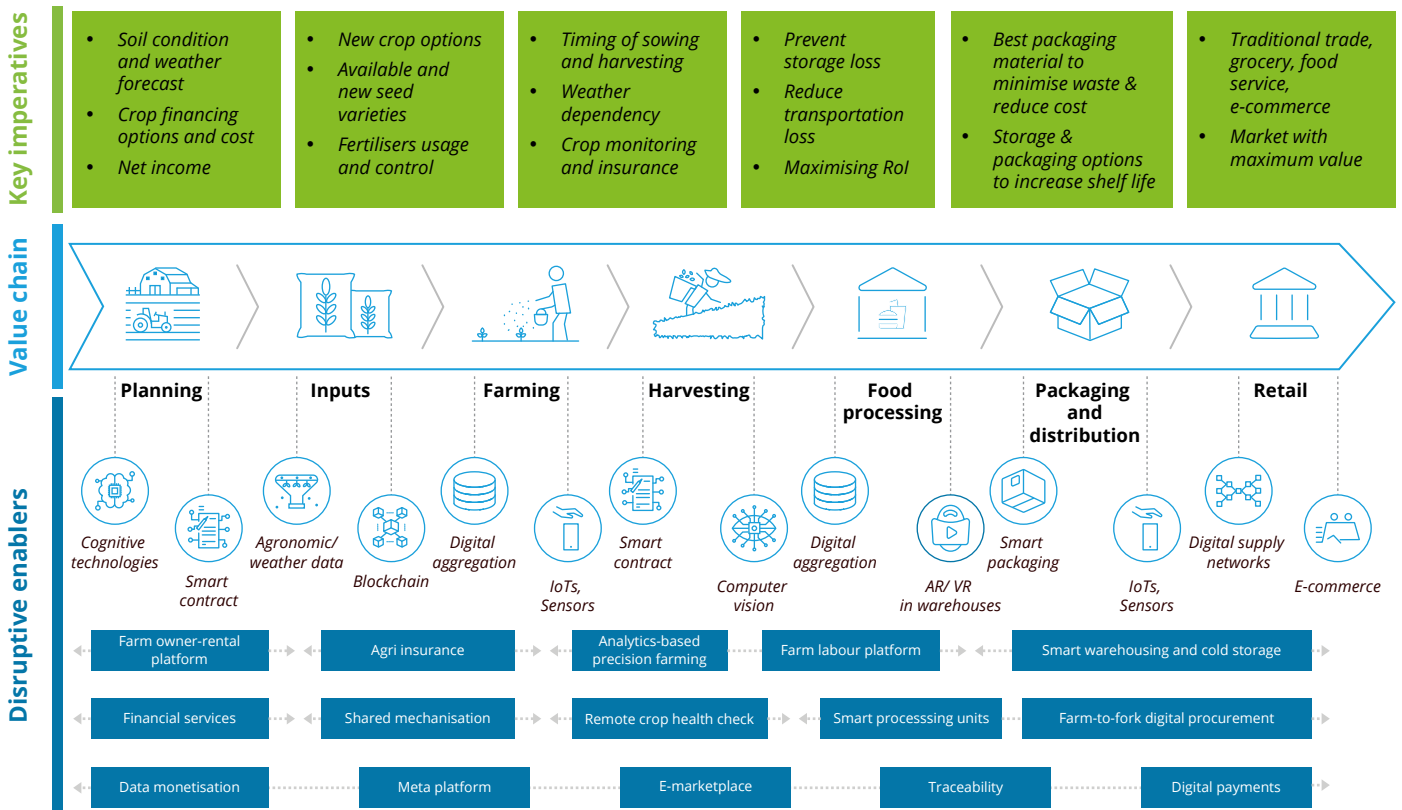
The Indian agri and food value chain is highly fragmented with multiple small to medium-size players operating at each stage. Approximately 85 percent Indian farmers are small and marginal farmers with landholding size <5 acres.^[83] The high level of fragmentation across the value chain leads to multiple issues that reduces overall productivity.

These issues can be addressed by using technology as a key enabler to simplify and improve different processes. Technology adoption is being led by several agri-tech start-ups with more than 1,000+ such start-ups operational in India. These start-ups have seen funding of ~INR 31.5 billion in FY20^[84] and the entire agritech market size is estimated at ~INR 14 billion in 2020 vs. a potential ~INR 1,687 billion, indicating the huge opportunity ahead.^[85]

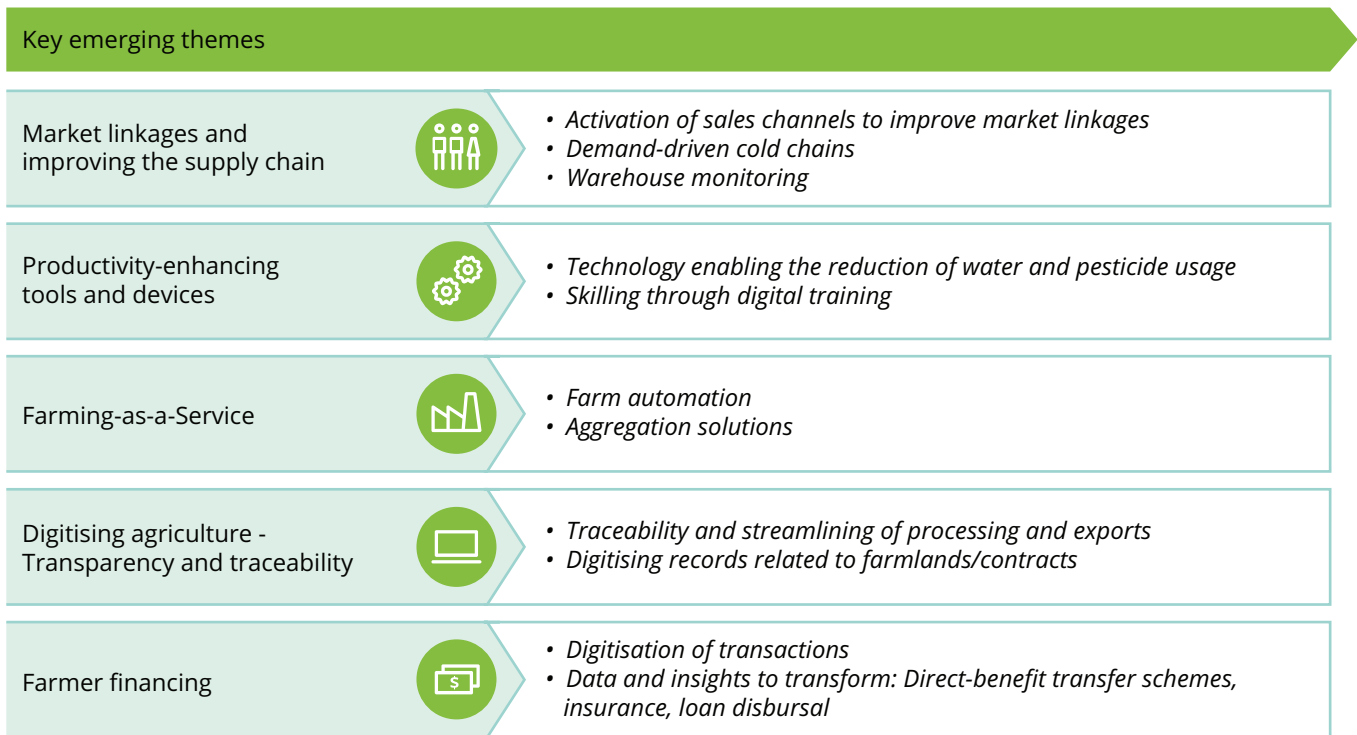
The Indian government is also supportive of higher technology adoption to improve farmer livelihood. Enam was launched in 2016 with the objective to create a unified market for agri produce and help farmers with price discovery and facilitate trade. Many state governments are also tying-up with agritech companies to introduce technology solutions. The Government of India is also supporting agritech start-ups with funding of INR 367.1 million to 346 start-ups by August 2020.^[86]

All these factors together have led to emergence of multiple use cases across the agribusiness value chain, which are being addressed by agritech start-ups.

Technology use cases across the value chain^[87]



There are five key themes that are being addressed by different technology solutions:



Market linkages and improving the supply chain

For agri inputs, farmers rely on nearby retailers and sub-retailers to provide them with the required agri inputs, who in turn get supplied by distributors. On the crop output side, farmers sell their produce to small traders, who sell to large traders that control the flow of crop output to processed food companies, food service outlets, and end customers. The large number of intermediaries across the supply chain leads to higher costs for farmers on the input side and lower price realisation on the output side.

Companies have started focussing on disintermediation of the agri input and

crop output supply chain through launch of e-commerce platforms that help farmers procure agri inputs directly and sell their crop output to buyers in a transparent way, which enables true price discovery. The use of such platforms is expected to transform the unorganised nature of agri input and crop output trade in India. Government steps such as the “The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020”, which enables the sale of crops outside of APMCs, without any charges, is expected to further boost use of such platforms.

Farmers	Agri input suppliers	Institutional buyers
1. Reduced cost of agri inputs	1. Direct access to farmers	1. Direct access to farmers
2. Right selection of agri inputs	2. Lower marketing and distribution costs	2. Supply visibility
3. Improved farm productivity		3. Quality assurance
4. Better price discovery for output		

Additionally, companies are also focussing on providing robust supply chain solutions across technology-enabled warehouses, cold chains,

and logistics to improve the overall efficiency of the supply chain.



Case Study:

One of the fastest-growing agritech start-ups in India, with a focus on providing market linkages and advisory services to farmers, currently operates in Bihar, UP, Orissa, and West Bengal, and has a farmer network of ~650,000 farmers.^[88] They provide farmers with advisory services covering crop best practices, discussion forums, and market linkages through an agri input and crop output marketplace model. They use an innovative model of micro-entrepreneurs who ensure last mile delivery of agri inputs and the collection of crop output from farmers. These micro-entrepreneurs serve a catchment of 600-800 farmers within a catchment of 3-5 km. It currently has 1,300+ micro-entrepreneurs across 680,000 villages and handles 500-600MT of crop output and delivers 6,500-7,000 input orders daily.^[89]

Productivity enhancing tools and devices

Productivity improvement at the farm level is being targeted through the adoption of the right set of farming practices and optimum use of inputs and resources such as water. Technologies such as AI/ML, IoT, and predictive analytics are

used as key enablers. The focus is on ensuring that precision farming principles are followed. Some examples of practices being followed include the following:

- Tractors fitted with sensors are available to help farmers till the land to the exact depth that the crop needs
- Fields can be divided into sections to test for nutrients and inputs can be used accordingly
- Crops can be given precise amount of water based on moisture content
- Satellite imaging is being used extensively to map cultivation area under different crops, estimate yields, irrigation planning etc.
- Globally, drones are being used for soil and field planning, farm monitoring, and crop protection by spraying relevant agrochemicals. In Rajasthan, drones were used to spray insecticides at a height that

also reached trees to protect fields from locust attacks.

Benefits of precision farming are significant. It can reduce input costs by 18-20 percent and enhance yield by anywhere between 30 percent (rice and wheat) and 100 percent (sugarcane, fruits and vegetables).^[90]

However, there are some challenges that need to be overcome. The estimated cost of precision farming was INR 2 lakh/ha in 2018,^[91] which is a hindrance. Awareness is also low amongst farmers, leading to hesitancy in investing heavily in initial set-up. Companies are looking to address these challenges by providing subscription-based and pay-as-you-use models.



Case study:

A precision farming agritech startup launched in 2018 offers an IoT SaaS product for horticulture crops, offering AI-driven advice to farmers. Its services are focussed on microclimatic forecast, disease and pest warning, precise irrigation requirements, and farm finance management. It currently covers 700 farms across 20,000 acres in Chhattisgarh, Madhya Pradesh, and Maharashtra, and works on a subscription model from farmers.^[92] They claim to have saved three billion litres of water through precision irrigation and have helped farmers increase yield up to 40 percent.^[93] It has launched an innovative water credit scheme, whereby farmers who use the prescribed amount of water on their fields (thereby reducing water wastage) get their entire monthly subscription fee for advisory services refunded.

Farming-as-a-Service

Farming as a service is being offered by start-ups to enable farmers to use machinery and equipment across different stages of the farming cycle. Indian agriculture, typically consists of low equipment usage due to high costs, especially for small and medium-size farm owners, who rely on manual labour, reducing overall productivity. Additionally, farmers face issues with low equipment utilisation, which makes it hard for them to recover costs

Companies offer subscription models or pay-per-use models that reduce the overall costs for farmers. It shifts the use of equipment from a fixed-cost model to a variable-cost model. Farmers can decide what services they want to opt for and get suitable operators and experts to help them with operations. Companies benefit by getting higher equipment utilisation by having them utilised by multiple farmers.

Digitising agriculture – transparency and traceability

By using a combination of primarily mobile and web apps, blockchain, IoT and analytics, movement of food across the value chain can be tracked and its safety can be established.

IoT devices and mobile and web apps are used to capture data, which is then stored in a blockchain in real time and ensures complete transparency. Real-time data usage ensures complete visibility of food, as it moves across the value chain and allows back tracing as well. Additional benefits include improvement in overall productivity of the value chain through the use of analytics to aid decision making.

Food safety and traceability is a key emerging consumer trend driving growth in this segment. There are challenges, especially with respect to getting participation of all value chain members to ensure complete traceability, which is tough, especially in a fragmented market. Different stakeholders follow different processes and have varied interests, making it tough to align. However, with focussed work being done in this area to create awareness and showcase benefits, especially by agri tech start-ups, this theme is expected to grow stronger in the coming years.



Case study:

A leading blockchain-powered traceability platform has worked with companies such as Olam, Rallis, and MTR. It is working with Slay Coffee to ensure end-to-end traceability of coffee and covers stakeholders such as coffee growers, plantations, curing works, roasters, central warehousing operations, cafés, and finally the consumers, in getting information of the movement of coffee across stages, which is then stored in a blockchain ledger. Through the use of mobile and web applications, participating stakeholders can track and trace the movement of coffee beans through the entire value chain.^[94]

Farmer financing

Getting access to credit from formal channels such as banks and NBFCs is a difficult task for farmers. Only around 20 percent small farmers get access to credit from formal banking institutions, while the remaining need to rely on the unorganised market in the form of money lenders and middlemen, who charge exorbitant interest rates.^[95]

Agri-focused FinTechs are attempting to solve this problem by capturing data around farmers

and using analytics to evaluate their risk profile and digitising transactions to ensure transparency. Companies are also providing loans to farmers with their produce acting as collateral. Companies are also looking to offer customised solutions for farmers with small ticket sizes and without collateral to ease the process and provide higher access. Other financial services such as insurance are also offered by assessing the risk profile of the farmers through data collection.

For the Indian agri-tech market to reach its potential, all stakeholders across the agri-tech ecosystem have a major role to play.

Stakeholders and their roles



Enabling farmers

All stakeholders in the agri-value chain need to work in tandem to enable farmers in mitigating the issues and move up the value chain for an equitable and sustainable growth



Private players

- Strong R&D base and cross-country collaborations to drive innovation for new products/variants
- Food safety being of paramount importance; end-to-end traceability to be a key focus area for food processing
- Supply-chain efficiency across the value chain; managing vendor networks, manufacturing excellence, outbound logistics, and D2C models



Agri-tech start-ups

- Opportunity for players to expand horizontally across agri-tech segments to own the end-to-end relationship with the farmer
- Emphasise more on small and marginal farmers, who form the majority in Indian agriculture
- Opportunity to tie up with some large retailers and e-commerce players, who are looking to expand their presence through backward integration



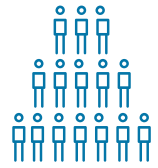
Financing bodies

- Financial services players could serve farmer households through access to credit and through access to crop insurance
- Increase digital and financial literacy within small and marginal farmers



Regulatory bodies

- Central and state governments can help set up agri-tech-focussed incubators and grants
- Enabling localised data collection on soil health, and providing access to government research facilities
- Focus on digital market places (meta platform) to drive better collaboration amongst stakeholders



Benefiting customers

The entire process of enabling farmers through combined efforts of all the stakeholders in the agri value chain will also benefit consumers by providing them with safe and healthy food

Way forward

Given the emerging trends around consumption (such as shift in food pyramids – increasing uptake of proteins, growing salience of food safety, need for traceability and localisation opportunities), there are a few opportunities for private-sector players across the value chain to focus on the following:

- Expand the product portfolio with a focus on improving consumers’ nutritional requirements:** Depending on the target consumers, the processors may look for backward integration with producers (or farmers) to procure bio-fortified foods (such as iron millets, and zinc wheat/rice). Or, they may look to create infrastructure within the existing facilities for food fortification with essential nutrients, which may address the growing requirement of nutrition. Investment in in-house R&D or potential partnerships with players with expertise in food formulations can be explored.
- Deepen the linkage with producers to reduce import dependence on essential food crops:** Large part of the import bills of the country comprise trade in pulses, oilseeds, etc., which form an integral part of the food consumption basket. Working closely with farmer producers/Self-Help Groups (SHGs)/FPOs may lead to self-sufficiency in these essential items and at the same time, help farmers better utilise their lands and enhance their income through multi-cropping. Corporates may relook at the allocation of CSR funds with a special focus on development of these backward links in essential crops, where there is significant import dependence.
- Mindful procurement with focus on food safety:** Food safety is a growing concern globally and India is no exception. Given the fragmentation of the farming system in India (with almost over 85 percent farmers being small and marginal)[83] and also due to the relative lack of knowledge in good agricultural practices, it is pertinent to ensure that the chemicals in the products procured are within safe levels, which otherwise might be detrimental to consumer health. While traceability systems have been implemented in selected crops/commodities, it has met with limited success, owing to the fragmented nature of the farming system. It is thus, important

for the processors and/or aggregators to ensure traceability of the produce from the farm gate to the primary processing centre and subsequent value-addition phases.

- Innovate keeping consumer preferences in mind:** Consumer preference for food in India is highly localised and players need to have offerings, targeting local palettes. Changing consumer preferences have led to changes in consumption style with the emergence of single-serve SKUs and smaller pack sizes. Convenience of food is a key trend with consumers gravitating towards hyper-local deliveries and preferring to shop across channels of choice. Players can look to develop an omni-channel presence and need to be mindful of developing capabilities around the visibility of customers, products, inventory, with the focus on enriching customer experience.
- Drive efficiency in operations:** India’s overall food productivity is much lower than global peers and there needs to be a focus on improving yield. Research has been growing to implement indoor farming (vertical farming, hydroponics, etc.) at a commercial scale. Although these are fairly nascent, they can be explored to meet growing demands and in light of resource scarcity such as land and water. Food processing players can look to improve efficiency by transforming their facilities to smart factories. Key focus areas can be robotic automation, smart energy conservation, total predictive maintenance, quality and performance management, and automated decision making. Distribution players can explore solutions such as drone delivery to increase efficiency and reduce reliance on labour.

These shifts would entail changes in the way the traditional agribusiness ecosystem operates and would open up a plethora of opportunities for agri input players and logistics providers.

For agri input players

Agri input transformation towards biological substitutes: Agri input players will have to adapt in accordance with the changing consumption patterns. Growing concerns about chemical content in food is

gradually increasing demand of substitutes for chemical-based fertilisers and crop-protection chemicals. Agri input players will need to introduce and expand their portfolio with bio fertilisers, (mycorrhiza, nitrogen-fixing bacteria), microbial -based bioinsecticides (bacillus thuringiensis), plant-based bio fungicides, etc.

Increasing reach of agri machinery: Automation and mechanisation will play an important role in India's goal for food security due to issues such as labour availability and increasing urbanisation. Distributed landholding has resulted in marginal and moderate farmers not being able to afford many high-end machines that automate and increase efficiency in farming. OEMs and/or aggregators can expand their market size by innovating business models to "pay-as-you-go" or on subscriptions.

For logistics providers

- **Warehousing/cold chains:** Cold chain and overall warehousing infrastructure for food is currently suboptimal. Players can look to address gaps by increasing capacity, geographical diversification, and developing multi-crop capabilities. Renewable power sources can be explored by players to reduce operational expense (30 percent of operational expense for cold chains)^[96] and meet sustainable standards.
- **Transportation:** Players could look to upgrade their offerings to ensure food safety and reduce wastage through the use of reefer vans, temperature-controlled vans, etc., to transport perishable goods such as fresh fruits and vegetables, marine products, and so on. There can be an emergence of logistics aggregator models, focussed on matching demand and supply to improve utilisation.

Role of technology

Technology over the last few years has played a significant role in binging various disruptions across the food and agri-value chain. This is evident from the growth of agri-tech start-ups with innovative business models that have helped unlock inefficiencies and bring about a transformation in the agriculture sector. Currently, adoption levels are quite low compared to the overall potential (~1 percent).^[85] Going forward, key trends where technology is expected to play a major

role in redefining the agriculture landscape include the following:

- **Precision agriculture and farm management:** Adoption of data analytics and machine learning algorithms are potential enablers to predict weather and resource usage, which can help improve farm productivity and take preventive action against potential natural calamities.
- **Mechanisation and automation:** Usage of robotics and drones may help overcome the crisis due to labour shortage, especially during peak harvesting seasons, leading to significant amount of post-harvest losses and improvements in time to market; trends in automation, expected on a large scale in smart factories and warehouses are expected to boost efficiency in the value chain.
- **Market linkage (Farm inputs as well as supply-chain output market linkage):** Harnessing data and platforms can help farmers find the right price, ensure transparency and realisations, give the right indicators to supply chain aggregators, who can then better plan their procurement, depending on the demand, and thereby, optimising post-harvest losses.
- **Traceability and quality management:** Artificial Intelligence or imaging and IoT are expected to play a major role in monitoring crop quality. The success of blockchain has been fairly limited in ensuring traceability in the agri value chain but going forward and with the ecosystem getting more organised, blockchain is expected to play a more significant role.

Role of government

While there are significant opportunities for private-sector players in the food and agribusiness value chain, there has to be proactive support from the government in enabling this transformation.

- **Encourage/incentivise sustainable cultivation:** The government can look to promote sustainable cultivation to ensure that increasing food demand does not harm the environment. This could require incentivising the adoption of bio fertilisers and bio pesticides by farmers over chemical variants. There

is also a case for promoting the shift towards organic farming, where incentives through FPOs and SHGs can help address challenges with revenue losses during the gestation period. The government can also look at streamlining the organic certification process and encourage more states to have APEDA-accredited certification agencies. The government could also look to provide incentives to food processing players to engage with farmers/FPOs for sustainable farming methods that can help address issues related to resource degradation and decent living and wages for growers.

- **Relook at the cluster development policies and initiatives for value addition:** The focus can be given to certain food segments to ensure greater output and value addition. Clusters can be developed with both forward and backward links, and players can be incentivised with objectives to promote cultivation of crops with high import dependency. The government can look to increase the allocation for the PLI scheme (RTE/RTC, fruits and vegetables, marine products, and mozzarella cheese are included) to increase the ambit of products covered. It could also include a component on evaluation to drive better labour skilling and expanding its present coverage to include smaller unorganised players, who constitute ~98 percent of the industry.^[64]
- **Expedite creation and upgradation of storage/post-harvest infrastructure:** Food wastage is a major problem with estimates suggesting that ~40 percent food output is being wasted in India.^[97] A primary reason for this is the lack of adequate storage facilities. The government is already incentivising the cold-chain industry, but can look to further encourage the sector to address the demand-supply gap by focussing on increasing geographic distribution beyond Uttar Pradesh and West Bengal (60 percent share of cold chain),^[63] support upgradation and capacity expansion, and also support multi-storage solutions (across a variety of food items).

- **Augment food testing facilities and infrastructure:** Building on the alignment of Indian regulatory standards on food safety and packaging with global norms along with the increased participation of Indian regulatory agencies in global codex processes, it is advisable to fast track the process of modernising existing government-owned testing laboratories through NABL-accredited private laboratories.
- **Increase allocation in R&D:** A relatively low focus on R&D and new technology and leading players spending only 5 percent of their expenses on R&D initiatives have resulted in limited products or packaging development in India. While institutes (for instance Central Food Technological Research Institute) and some state universities are working on developing new products and technologies, their programmes are usually limited and face bottlenecks in large-scale commercialisation. The government could incentivise R&D and technology development, with specific focus on import substitution through specific seed funding corpus, encouraging collaboration between research institutions, start-ups, and established companies. Providing additional support through suitable tax-related policies such as patent box provisions can also be explored.

The Indian food and agriculture sector is at the cusp of a transformation and would require all value-chain members to act in tandem, along with government support to secure the future of food in India.

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All the facts and figures that talk to our size and diversity and years of experiences, as notable and important as they may be, are secondary to the truest measure of Deloitte: the impact we make in the world. So, when people ask, “what’s different about Deloitte?” the answer resides in many specific examples of where we have helped Deloitte member firm clients, our people, and sections of society to achieve remarkable

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About CII



Confederation of Indian Industry

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government and civil society, through advisory and consultative processes.

For 125 years, CII has been working on shaping India’s development journey and, this year, more than ever before, it will continue to proactively transform Indian industry’s engagement in national development.

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