



Insights of Agri-food in India: Present Trends, Challenges and Proposed Solutions

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Abstract: Agriculture is responsible for feeding the whole population and farmers are its main stakeholders. It accounts for 2.4% of the geographical area and provides nourishment to 17% of the human population. Even though there are 1.3 billion hungry to feed, nearly one-third of the food produced in the world each year is wasted. Food security refers to an individual, household, and community's ability to obtain enough, safe and nutritious food to live a long and healthy life. The agrarian sector has a strong pillar for strengthening the Indian economy as it contributes 20.19% of GDP. Good agricultural production has made India self-sufficient. Productivity is enhanced which has led to surplus agri-food output for India's current population. Despite increased agri-food production, one-fourth of the world's hunger is accounted in India. The government's food-security and anti-poverty schemes, which have critical gaps, inefficient food distribution, interrupted market supply chain, hygienic food packaging, efficient modern retail, and insufficient cold storage are the top issues that must be addressed and worked immediately. These challenges, there should be the implementation of easily assessable common E-commerce platform, management of storage, agri-food logistics, and fixing the loopholes of governmental schemes.

Keywords: Agri-food, Indian economy, Digital marketing, Hunger, Accessibility, Poverty

Agriculture is the mainstay of human's daily needs. It is the largest industry and accounts (2.4%) of geographical area and 4% of water resources in the world. As a return, it supports the world's human population by 17% and livestock by 15% (Khatkar et al 2016). Agriculture shows a pivotal role in the financial lift of India (Bose et al 2013). In the whole world, food derived from crops dominate the average per capita energy requirement by 78% while other food sources like milk, eggs, fish, and meat add up the rest 22% (Brevik et al 2013). Consequently, the dietetic requirement of the population is a basic necessity and can be managed by enhancing the production of agriculture (Singh et al 2019). The world's future dream is a "world free of hunger and malnutrition, where food and agriculture help to improve the living standards, particularly the poorest in an economically, socially, and environmentally sustainable manner". Much headway has been made for tackling the issue of hunger and poverty along with improving food security and nutrition but still, around 795 million people are starving, with over 2 billion suffering from micronutrient deficiencies as well over-nourishment (FAO 2017). However, global food security might be in peril, due to increasing pressure on natural resources and climatic change, as these both will result in danger the sustainability of food systems. The main challenges that must be addressed to eradicate hunger and

poverty comprise uneven demographic expansion, the threats posed by climate change, the nourishing of natural disasters and increases in trans boundary pests and diseases, and the need to adapt to major changes occurring in global food systems (FAO 2017).

India is capable of a handful of arable land with 15 agro-climatic zones, which is having almost all types of weather conditions, soil types and is thus capable of growing a variety of crops (Department of Water Resources, RD & GR 2021). The agrarian sector has a strong pillar for strengthening the country's economy as it contributes 20.19% of GDP (DAC & FW 2020-21). Good agricultural production has made us self-sufficient and uplifted our condition after independence from begging bowl for food to a net exporter of agriculture and other allied products. India is the second leading country in the terms of agricultural land i.e. 179.9 million hectares (Khatkar et al 2016) and in 2019 the gross cropped area was 195 million hectares. Currently, India ranks second in the world in terms of agricultural production. Nevertheless, of all these facts, the average productivity of many crops in India is quite low. Critical examination of the gaps behind this should be brought forward and actions should be taken to overcome it (Down to Earth 2021). According to UN projections, India's population would reach 1.5 billion by 2030 and 1.64 billion by 2050 (Down to Earth2020). The world's growing population

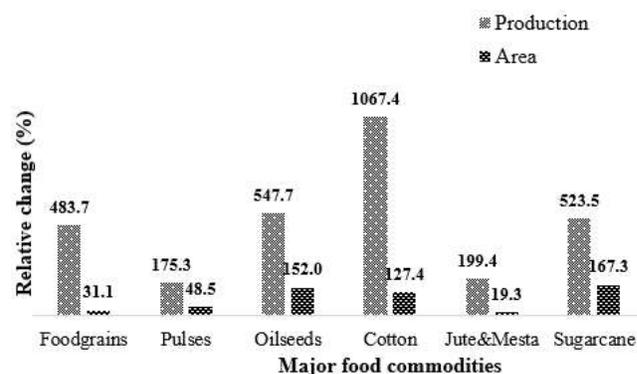
has increased demand for natural resources everywhere, but especially in India, which has only 2.44 percent of the world's geographical area but supports livestock and human population by 15 and 18%, respectively (Khatkar et al 2016). For the welfare of farmers, the Indian government has implemented several programs such as subsidies on various commodities, crop insurance, national and state level schemes (Balkrishna et al 2020). The present study reports about the current status of Indian agriculture with certain gaps which leads to the unavailability of agri-foods to the population despite surplus production.

Present status of the area, production, and yield of major food crops: After US and China, India has the world's third-largest economy with valued at \$ 2.1 trillion (FAO 2021). India ranked the world's second-largest producer of agricultural products, with \$375.61 billion in production. Although India produces 7.39% of the world's total agricultural output but still lags far behind China (19.49%) with a GDP of \$991 billion in the agricultural sector. The United States, the world's largest economy takes third place. Brazil and Indonesia are next in line (Statistics Times 2021). According to the FAO world agriculture statistics (2020-21), the World's biggest producer of milk, jute, and pulses in India and the second-largest producer of rice, wheat, groundnut, sugarcane, fruits, vegetables, and cotton. Along with these, it is also one of the major producers of fish, spices, livestock, poultry, and plantation crops (FAO 2021). The agriculture development has been presented in terms of relative increments in area and production under major crops from 1950 to 2020. The highest relative change has occurred in the production of oil seeds followed by sugarcane, food grains, and pulses with 547.7, 523.5, 483.7, and 175.3 %, respectively. The relative change in area is higher for the cultivation of sugarcane followed by oilseeds, pulses, and food grains with the percent change of 167.3, 152, 127.4, 48.5, and 31.1, respectively (Fig. 1) (Pocket Book of Agricultural Statistics 2020).

In Indian agriculture, grains manufacturing covers the principal part of cropped area (64.3%) followed by oilseeds and sugarcane (Pocket Book of Agricultural Statistics 2020, DAC & FW 2020-21). As per the National Statistical Office and Pocket Book of Agriculture Statistic (2020), the agricultural area of food grains in India was 124.78 million hectares (MH) in the year of 2018-19 which was increased to 127.59 MH in 2019-20 with an increase of 2.76%. There was an increase of 2.25% in oilseeds i.e. (24.79 MH in 2018-19 and 27.04 MH in 2019-20) but in sugarcane decreased by 0.49% (5.06 MH in 2018-19 and 4.57 MH in 2019-20). During the last 5 years (2015-16 to 2019-20), the areas under rice, wheat pulses, and oil have increased by 0.28, 1.03 & 0.95 MH, respectively, while the coarse cereals area has dropped

by 0.36 MH. In comparison to other cereals, the area under pulses has grown, while wheat cultivation has also accelerated. By 2023, Pulses production is expected to reach 23 million tonnes (Mt), with annual growth in area and yield of 1% and 2%, respectively (ICMR-NIN 2021). In the case of production and yield of food grains, the increment of 4.04 & 1.71 % has been observed from 2018-19 to 2019-20 FY. About 296.65 million tonnes (Mts) food grains production and 2325 kg ha⁻¹ yield was recorded in 2019-20. The food grain production is predicted to be 303.34 million tonnes in 2020-21 (Pocket Book of Agricultural Statistics 2020, Business Standard 2021). Out of the total food grains production in 2019-20, cereals, pulses, rice, and wheat accounted for 273.5, 23.15, 118.43, and 107.59 Mts, respectively. The seed oil production was 33.42 Mts and sugarcane 355.7 Mts in 2019-20 (Pocket Book of Agricultural Statistics 2020, DAC & FW 2020-21). The food grain yield in the year 2019-20 was 23.25 q ha⁻¹ which was higher than the previous year (2018-19) by 0.39 q ha⁻¹. The yield of oilseed was reported to be 12.36 q ha⁻¹ and for sugarcane, it was highest i.e. 778.93 q ha⁻¹. The absolute difference in the yield from 2015-16 to 2019-20 revealed that maximum yield was in sugarcane (71.73 q ha⁻¹) followed by cereals, oilseeds, pulses, cotton by 20.15, 12.34, 4.72 & 0.36 q ha⁻¹, respectively, while the yield decreased for tobacco by 13.81 Quintal/hectare (Pocket Book of Agricultural Statistics 2020).

State-wise it was reported that the maximum increase in cropped area in 2019-20 compared to the previous year (2018-19) was in Maharashtra followed by Rajasthan while the maximum decline was noticed in Madhya Pradesh followed by Bihar. Among the total cropped area 52.2% area is the irrigated area in India as reported in 2016-17 (Pocket Book of Agricultural Statistics 2020). States having maximum irrigated area is Punjab (99.1%) while the least irrigated state in Maharashtra (18.7%). Uttar Pradesh results for the largest part by area as well as production by a wide margin and also



Source: Directorate of Economics & Statistics

Fig. 1. Relative change (%) in production and area from 1950 to 2020

contribute nearly one-fifth of food grain production in India whereas Punjab and Haryana have been conventionally considered as the major contributors to the production of food grain. In recent years, Madhya Pradesh, Andhra Pradesh, Rajasthan, and West Bengal have appeared as significant producers of food grains (Pocket Book of Agricultural Statistics 2020). Yields and the share of irrigated land vary greatly between states. A strong correlation can be predicted amid these two variables. In terms of both yields and the share of irrigated land criteria, Punjab ranks first while Haryana ranks second. Madhya Pradesh, Rajasthan, and Maharashtra have the lowest yields among the biggest producers. In Bihar, the proportion of the area irrigated is above the national average but not the yield due to the high frequency of floods that occasionally ruin the standing crops. Horticulture crops currently cover a total area of 26.22 MH in 2019-20, representing a 25.59 percent increase over the previous year's total area of 20.88 MH (2009-10). Despite, production of approximately 319.57 Mts, horticulture production increased by approximately 43.25 percent from 2009-10 to 2019-20.

The productivity of horticultural crops has increased by approximately 14.06% (DAC & FW 2020-21). During 2019-20, the fruit crops area is 6.70 MH, with total production (100.45 Mts). The fruit production enhanced by 40.46 %, whereas the area by 6% during the period of 2009-10 to

2019-20 (3rd Adv. Est.). In the production of fruits like banana, mango, lemon, lime, and papaya, India is in first position (DAC & FW 2020-21). In the horticulture sector, vegetables are an essential crop, engross an area of 10.32 MH in 2019-20 (3rd Advance Estimates) with total production (189.46 Mts) with average productivity of 18.4 Tonnes/hectare. Vegetables compose about 59.3% of horticulture production. The area and production of vegetables elevated by 29.2% and 41.7% respectively during the period 2009-2010 to 2019-2020. After China, the second-largest producer of vegetables in India (DAC & FW 2020-21). During 2019-20 (3rd Advance Estimates), floriculture covered the area of 0.31 MH with flowers production (2.99 Mts). India is the world's biggest manufacturer, buyer, and exporter of spice and spice-related products. During 2019-20 (3rd Advance Estimates), the total production of spices was 9.75 Mts from an area of 4.14 MH (DAC & FW 2020-21).

Per-capita availability of agri-food: For the year 2019, the annual availability of food grains was 180.5 kg per capita as shown in Table 1. After 2015, there has been an annual increase in the availability of food grains. In 2018, the country's population of approximately 1.3 billion people had access to about 214 million metric tonnes of food grain. In India, 492 grams of food grain were available per person per day in 2019. This figure increased significantly since 2015. Rice, wheat, maize, various cereals, and a variety of pulses

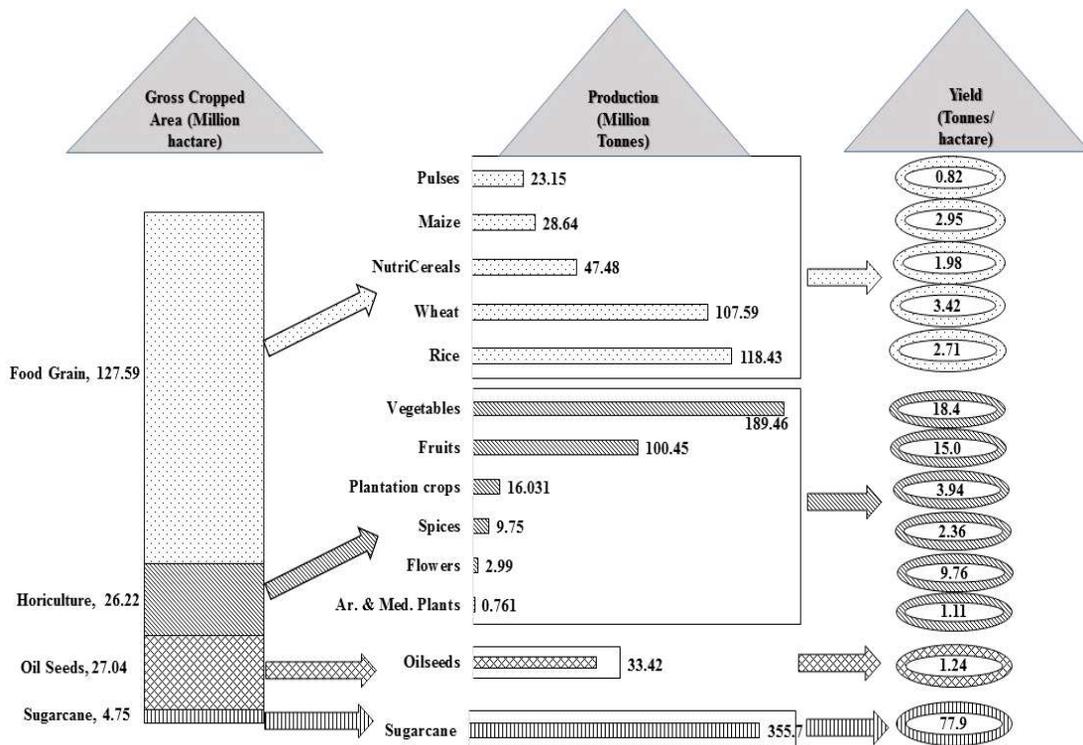


Fig. 2. Area, production, and yield of major food crops (2019-20). Ar: Aromatic; Med: Medicinal

were among the food grains. In that year, India's population of about 1.3 billion people had access to about 236 million metric tonnes of food grain. (Statista 2021, Economic Survey 2021). By 2023, per capita, cereal food consumption is expected to rise to 164 kg/person, up from 155 kg/person in the base period (2011-13), a 5.8% increase. Rice, wheat, and coarse grains per capita food consumption are expected to reach 78.8, 65.5, and 20.4 kg, respectively. Food consumption, which grew at a rate of 5% per year in per capita terms, is expected to reach a rate of 3% per year over the next decade. Imports are expected to increase to 5.1 Mt by 2023 as a result of excess demand (ICMR-NIN 2021).

Surplus to hunger: The unsolved conundrum:

Agriculture's current state specifies surplus agri-food output for India's current population. The agricultural investments and technical advancements had succeeded in increasing productivity. The quandary arises when one considers the statistic that nearly one-third of the food produced in the world each year is lost or wasted, even though there are 1.3 billion hungry people to feed. Despite increased agricultural-food production output, one-fourth of the world's hunger is accounted for in India. The majority of small-scale and marginal farmers are losing access to food. Farmers are unable to reach financial satisfaction and 14.8 percent of the population is malnourished and 38.4 percent of children lack food and nutrition security. If no further efforts are made to promote the 'business-as-usual situation, nearly 653 million people will remain malnourished in 2030 (FAO 2017). The estimated demand and supply estimates of food grains and other major crops in India 2020-21 shows that there is an excess of rice, wheat, and cereals while a shortage of pulses, oilseeds, and sugar (Table 2). The surplus amount should be managed to address the issue of food insecurity, while the loophole should be mended to balance the demand and supply chain.

In India, grain production is continuously facing a burden due to several factors such as steady growth in population (to reach 1366.8 Million by 2020-21), reduction in agricultural land, and several other deterrents. GHI report (2021), states that India holds the 101st position out of 116 countries in the Global hunger index. According to the Reserve Bank of India (RBI), the country has now touched a point where surplus food grain management has become a serious problem. Inefficient food supply chain management has also been attributed to the starving condition of the people whereas headlines proclaim a "resource constraint" that is weighing down the Indian government's frantic attempt to feed a starving population. Food Corporation of India reports that country had saturated its storage options, due to the excess stock of grains (Rawal et al 2020). This appears to be the situation for the previous three years that food stockpiles were hoarded as a result of the chaotic preferential structure of public distribution. A large volume of grain (71.8 lakh tonnes) is supposedly rendered useless throughout this procedure (Rawal et al 2020). This is a heartbreaking scenario where the people are starving rather than sufficient

Table 2. Demand and supply estimates of food grains and other major crops in India (Million tonnes)-2020-21

Commodity	Demand (Million tonnes)	Supply (Million tonnes)	Surplus/ shortage
Rice	108.16	119.76	11.6
Wheat	95.71	107.18	11.47
Coarse Cereals	45.44	46.96	1.52
Cereals	249.31	273.9	24.59
Pulses	26.05	23.73	-2.32
Food grains	275.36	297.63	22.27
Oilseeds	58.92	37.81	-21.11
Sugar	39.66	36.07	-3.59

Source: Directorate of Economics & Statistics

Table 1. Per capita net availability of food grains in India (Kg year⁻¹)

Year	Rice	Wheat	Other cereals	Cereals	Pulses	Food grains
2011	66.3	59.7	23.9	149.9	15.7	170.9
2012	69.4	57.8	21.9	149.1	15.2	169.3
2013	72.1	66.8	19.2	158.1	15.8	179.5
2014	72.3	66.8	22.6	161.6	16.9	178.6
2015	67.9	61.3	28.4	153.8	16	169.8
2016	67.2	72.9	26.1	162	15.7	177.7
2017	66.8	66.7	29.4	158.4	20	178.4
2018	69.2	61.5	30.6	161.3	18.7	180.1
2019	70.1	64.6	28.6	163.3	17.2	180.5
2020 (P)	73.4	64.8	31.3	169.6	17.5	187.1

Source: Directorate of Economics & Statistics; (P) Provisional

availability due to inefficient resource distribution channels. In India, People are dying and the situation appears to create a surplus of hungry despite a surplus of food. Importing food is akin to importing unemployment is primarily agrarian nations. The Subcontinent must strive for self-sufficiency by safeguarding its genetic heritage and distributing 'extra' grain that, surprisingly, fails to reach people in need. The crucial question of defining surplus who produces it and how it is produced has been unclear by several racketeers masquerading as philanthropists. The hunger issue is that the so-called international community, which has been at the forefront of a slew of dubious campaigns to benefit transnational corporate interests under the guise of bringing welfare to the masses, has been using its political clout to pursue nefarious agendas. At the first World Food Summit (WFS) in Rome in 1996, Heads of States of all countries of the world had "reaffirmed" the right of people to access "safe and nutritious food, consistent with the right to adequate food and the fundamental right of everyone to be free from hunger". Their unacceptable consideration shows that in the whole world, people more than 840 million did not have sufficient food to meet their basic nutritional needs. As the coexistence of massive extra stocks and a large hungry population in India demonstrates, hunger is more than a matter of productivity and surplus (Eide 1998).

Challenges regarding food accessibility: Environmental breakdowns are also one of the leading shortage of food despite excess production as a result of post-harvest losses, the food-security and anti-poverty schemes of the government seems to have critical gaps such as inefficient food distribution system, interrupted market supply chain, efficient modern retail, Cold storage and hygienic food

packaging. Activists and researchers have offered clashing purposes behind suicides, like monsoon failure, high obligation troubles, hereditarily adjusted yields, public psychological well-being, private matters, and family issues. To keep transparency between the farmer and civilian, the government should take some initiatives and try to start a digital marketing platform. Inter-state and-district restrictions on promoting and effort of agricultural goods are heavily regulated within India. By a slow and incapable chain of traders, food travels to the Indian consumer. Through poor roads, basic market organization, and unnecessary guidelines, Farmers' access to markets is vulnerable. In India, rural roads were poor which affected the timely transfer of outputs and supply of inputs from Indian farmers. By a slow and incapable chain of traders, food travels to the Indian consumer. The absence of coordinated retail and contending purchasers in this way restricts Indian farmers' capacity to sell the excess and commercial crops. The farmer of India gets only 10 to 23% of the value the Indian purchaser pays for the very same product, the distinction going to losses, inabilities, and mediators. Cold storage, food packaging other than safe and efficient rural transport system causes the world's highest food spoilage rates, especially during Indian monsoons and other adverse weather conditions. In India, excess production is done in states like Punjab, Haryana, Maharashtra, Karnataka, and Uttar Pradesh but their poor management leaves many people hungry due to the absence of infrastructure such as storage and transportation facilities (Sharma 2016).

Proposed solutions and way forward: The PDS plays an important role in addressing food security and can be made more efficient by reinforcing the role of states in PDS

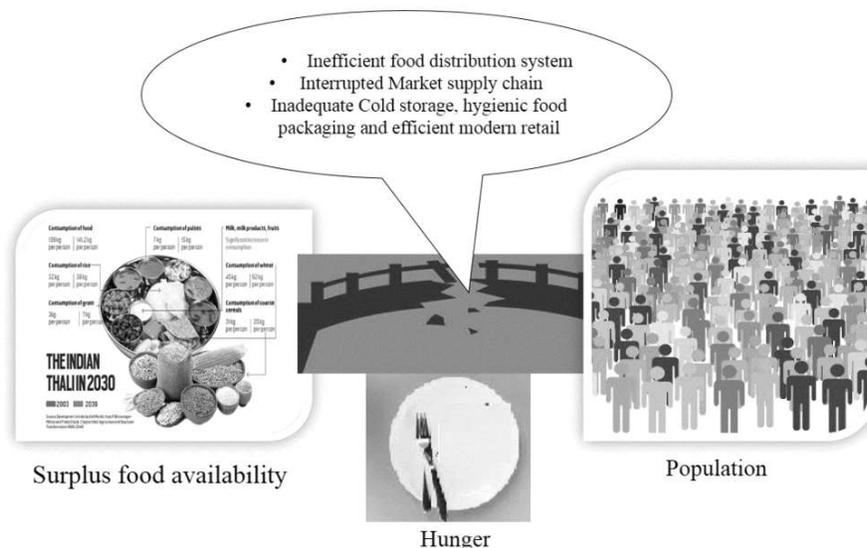


Fig. 3. Challenges regarding food accessibility

coordination, as well as improving transparency and accountability, monitoring measures to address issues of corruption, diversion, and leakages, and better partnerships between the federal and state governments. If supported and implemented, the role of information and communications technology has the potential to be a significant component of success. Computerization can improve the operation of PDS and reduce some leakage as digitalization spreads throughout the public sector. It can help identify beneficiaries and eliminate targeting-related inclusion and exclusion errors while also boosting openness and accountability. The use of a global positioning system to trace the food supply chain is another technology that is now being tested in some locations. This strategy ensures that commodities are scanned in and out at all points of the supply chain, and has proved to reduce corruption, leakages, and diversion, as well as increase the quality of goods given to consumers once the system was implemented (George et al 2019). Agribusiness should be made accessible for producers as well as consumers for providing a good market chain. There should be a common platform for the e-business of agri-food. Although several companies have provided their applications of agri-marketing that is in scattered forms, so an effort should be made to bring them under one platform and make it easy to use for producers as well as consumers. This application will make it easy to select the consumer and farmer's necessities, which will help to maintain transparency between the farmer and consumer. With the help of these applications, farmers may get complete information about eliminating black marketing and inflation. Some features such as feasibility in all languages as well as voice recognition for illiterate farmers should also be introduced in the digital application (Sivakumar et al 2021). There are some benefits of digital marketing which includes-

- Save effort and time.
- Good quality and variety at superior prices.
- Terminating dependency on vendors in prices of agri-food products.
- Reducing wastage and betterment of storage.
- Encouraging the formation of cooperatives.
- Earnings for both civilians and farmers with the least wastage by regular sale.

Digital marketing in the agriculture sectors showed most prominent and valuable importance. Farming and agribusiness should grow in India. The global level of farming and agribusiness should be grown in India to compete with the complexity of subsectors like agricultural machinery, precision agriculture, farm equipment, chemicals, crop production, supply-chain services, and many more (Radd Interactive 2021). In India, there are some barriers to using

and making the e-Application in the agri-food supply chain. These barriers are deliberately significant for e-Applications which are helpful knowledge to the policymakers and partners by zeroing in on those key boundaries which are significant for successful e-Application in the agri-food store network. Throughout some period, diverse empowering influences especially information technology (IT) helped in spreading the convenience of Proper supply chain management (SCM). Various utilization of SCM with its assistance can be brought about expanded responsiveness, diminished waste, cost-saving, and higher benefit (Kumar et al 2014). In India, up gradation in road and power generation infrastructure can help to increase agricultural productivity between 40-50% within 40 years. Adoption of smart agriculture in the industry farmers all around the world are being introduced to new situations as a result of Industry 4.0. Smart farming encourages not just a rise in agricultural production and revenue, but also the development of resistance to climate change (Kumar et al 2021). Aside from that, the number of cold storage facilities should be raised, and new technical interventions should be implemented to improve cold storage. This will assist to reduce food waste and make food available to those in need.

CONCLUSION

The main goal of this empirical study is to determine the production, availability, accessibility, demand, and supply of agri-foods, amid India's technological transition. Our suggestion for agri-foods insights is to adopt technological intervention at every step of the agriculture value chain that will assist producers and customers in getting the most out of their inputs. Efforts should be made to embrace digitalized agri-food marketing applications, improved agri-logistic facilities, better and technically improved cold storage, digital monitoring for PDS, and to check and rectify gaps in government efforts. All this together will assist in overcoming the obstacles for all, and the surplus will not be wasted, but will instead be put on the table, eliminating hunger.

AUTHOR CONTRIBUTIONS

All authors have made a substantial and direct contribution to the work.

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