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Research Article

Facelifting Indian Agriculture Need and Methods

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Abstract

Agriculture is vital to India's economy. India produces enough food, feed, and fiber to feed 18% (1.38 billion) of the world's population (2020), covering 11.24% of arable land and 4% of renewable water. The sector has grown 3.2% year from 1980/81 to 2019/20, almost doubling the population growth of 1.7%. It transformed India from a food deficit to a net trade surplus of 3.7% of agri-GDP in 2018-19. Agriculture accounts for 16.5% of GDP and 42.3% of employment (2019/-20), with an average holding size of 1.08 hectares (2015/16).

Indian agriculture, the backbone of the economy, struggles with low productivity, fragmented landholdings, monsoon dependence, and restricted access to modern technologies. Food security, farmer welfare, and economic stability require urgent transformation since over 60% of the population depends on agriculture.

Modernization is needed due to stagnated agricultural growth, land shortages, climate change, and changing demand patterns. Traditional methods are inefficient, yet a growing population requires more agriculture. Farmers' income and agriculture's sustainability and profitability must also be improved. New technologies, market reforms, and sustainable practices are needed to align Indian agriculture with global norms.

Technological integration, sustainable practices, modern marketing reforms, and other ways can convert Indian agriculture from subsistence farming to a market-driven, technology-enabled, and sustainable model. This facelift will boost food security, rural development, and India's economy by helping millions of farmers.

Keywords: Indian Agriculture; Modernization; Sustainability; Technology; Policy Reforms; Market Access

Introduction

Agriculture has long supported India's economy, employing over half the people and providing food and raw materials. However, structural and operational issues plague the sector. Agriculture in India remains vulnerable to climate change, low productivity, poor infrastructure, and limited market access despite gains in other industries. Small, fragmented landholdings, monsoon reliance, and outmoded farming practices exacerbate these challenges.

Transforming Indian agriculture is more important than ever. The agricultural sector must adapt to a growing population, rising food consumption, and changing diets. Global competitiveness and sustainable development require India to adopt modern techniques, technology, and innovations to improve efficiency, minimize waste, and promote environmental sustainability.

According to an RBI paper on farm sector problems, India requires a second green revolution and subsequent reforms to make agriculture more climate-resistant and sustainable. While Indian agriculture showed resilience during COVID-19, the author suggests a second green revolution and next-generation reforms (ET 2022) [1].

The modernization, or "facelifting," of Indian agriculture is necessary to protect millions of farmers, assure food security, and keep up with global agricultural trends. To establish a more resilient and productive agricultural environment, technical advances, market reforms, infrastructure upgrades, and sustainable practices are needed.

Green Revolution saw dramatic increases in high-yielding variety (HYV) area, fertilizer use, and irrigation. From 1966-67 to 1988-89, HYV rose from less than two million ha. to over 62 million ha., fertilizer use from 1 million tonnes to 11 million tonnes, and irrigation from 27 million ha. to 60 million ha., tractors went from 54 thousand to 1,205 thousand, and double cropping increased from 15% to 25% of net area sown. By 1988-89, irrigation and HYV covered more than one-third of the gross cultivated area, and the average fertilizer dose had increased from sub-7 kg. per hectare. in 1966-67 to over 62 kg. per hectare. Large-scale agricultural modernization increased land and labor productivity. Pre-Green Revolution land productivity increased at 0.8% per year; post-Green Revolution it increased at 2.5%. While labor productivity was stagnant until 1966-67, it rose 1.12% year from 1966-67 to 1988-89. Capital investment per hectare in agriculture increased during the Green Revolution. growing at 2.9% every year from 1966-67 to 1988-89, up from 1.7% before.

An examination of the metrics above reveals three phases of Indian agriculture development. Phase I, from 1950-51 to 1966-67, saw a large increase in net arable land through land reclamation and improvements. This period saw marginal labor and land productivity gains and capital productivity declines. By the late 1960s, most of the net area accessible for cultivation had been tapped, and agriculture would have to rely more on non-land resources. Phase II of agricultural growth, from 1966-67 to 1980-81, saw substantial modernization and increased capital investment. In reality, agricultural gross capital formation as a percentage of GDP rose to more than 9% from 6% pre-Green Revolution. Phase III, following 1980-81, saw major increases in land, labor, and other production. Land productivity grew 3.1% annually in the 1980s, labor productivity 1.9%, and capital productivity 1%. The underlying infrastructure and growth potential built during earlier modernization have been better utilized during this age. The latest issue of Economic Survey (Government of India, March 1990) noted that irrigation capacity was utilized greater than the targetted level in 1986-87 and 1987-88. After studying agriculture modernization's effect on partial factor productivity, we may assess its effect on total factor productivity. Partial factor productivity (such as labor or land productivity) shows the combined effect of production factor changes and technical progress. To quantify the pure effect of technical progress, total factor input (TFI) must be a weighted average of land, labor, and capital. Differentiating the NDP in agriculture from the TFI yields the total factor productivity (TFP), a broad metric of technical advancement (Dholakia & Dholakia, 1992) [2].

This study addresses Indian agriculture's need for reform and modernization strategies. It shows how technology, legislative reforms, infrastructure development, and farmer empowerment can improve agricultural efficiency and sustainability. This study proposes to rebuild Indian agriculture for the 21st century by addressing gaps and possibilities in the current framework.

Most Indians depend on agriculture, which has driven the economy's centripetal growth. Approximately 70% of people live in villages where it is their main occupation. For married folk, agriculture carefully places first. Things changed around the turn of the century. The agriculturally reliant population has expanded by 189 million in the 53 years since independence, yet the number of people growing their own wheat has decreased by 200 million. Over 70% of peasants have less than 5 hectares, and 52% have less than 2.5.

Many wheat-opposing nations, notably India, have solved the supply problem. Not just political power restricts awareness of these truths. The problem is India's 1987 rice self-sufficiency inflexibility. More inputs, more outputs was the high-cost Green Revolution science, and farmers are eroding water tables. Today, the loss in milk production, increased fertilizer prices, and energy shortages exacerbate India and its neighbors' conflict. Agriculture must be included in economic reforms. Only a broad, encompassing approach that addresses the political-ideological origins of current policies may improve agro-industrial policy over time, making it more consistent, sustainable, wide-ranging, and cheaper.

Status of Indian agriculture

The contribution of Indian agriculture to GDP at factor cost has been declining from 43.49% in 1960-61 to 58.20% in 1949-50, 56.52% in 1950-51, 58.13% in 1995-96, and 14.07%, 17.82%, and 14.59% in 2019-20, 2020-21, and 2021-22. The fall in commodity output, including agriculture, and rising prices suggest that agriculture has been losing ground for 60 years. India's major crops are more productive than usual. The crop production per hectare, especially in food grains, is far lower than in many Asian countries. Traditional agriculture covers 44% of India's cropland. Farmers aren't using seeds, fertilizers, irrigation, plant protection, and financing efficiently. Regional differences in rice and wheat yields are similarly large. Despite crop productivity, regional food prices affect farmers' income. India's rural population is 40% impoverished. India's crop outputs, especially paddy and oilseeds, are very variable due to the monsoon. Over 70% of Indian farmers are economically disadvantaged.

Avinas., *et al.* (2019) [3] note that the review background covered current and past agricultural stances. It discusses area, production, productivity, soils, agricultural machines & tools, GDP, climate, rainfall, and water in past and present agriculture. 2013-14 had more area and production than 2015-16. The 2013-14 food grain production was 12.96 mt more than the 2015-16 production. Out of 328.9 mha of Indian soil, 173.65 mha is deteriorated. India degrades 53 billion tonnes of soil annually. In the 19th century, America established the first agricultural machinery and tool factory, providing farmers with gas-powered tractors and harvesters. Farm machine and tool subsidies in 2013-14 were 30% lower than in 2015-16. The current carbon dioxide level is 371 ppm, down from 397-416. In the current period, temperatures rose 0.12°C and 1.02°C or 1-1.4°C and 2.23-2.87°C. Agriculture GDP was 13.9% in 2013-14 and 15.9% in 2015-16. Rainfall efficiency depends on precipitation. Between 1950 and 2000, there were 100mm+ rainfall occurrences. The environment has rainfall scarcity when long-term rainfall is below 10%. Long-term 2013-14-2015-16 rainfall is below 10%. Ground water use increased after 195051. India uses 50% groundwater. Groundwater is used 245 billion cubic meters annually.

Small farming, with an average landholding size of 1.47 hectares and diminishing marginal productivity, cannot reduce poverty. A marginal farmer (holding land up to 1 hectare) has a negative monthly income of Rs. 292.19. The Indian government has many plans, development initiatives, and rural development strategies. However, secondary and tertiary activities that produce more jobs than agriculture are growing faster than primary agriculture, suggesting that these policies have not fully increased productivity and development of agriculture. Average Indian landholdings shrink each year. Over 60% of India's arable land is owned by smallholders. Economic, social, and environmental costs result from land, water, and resource deterioration. The market is inundated with inexpensive food imports, and food production and distribution need agricultural expenditures. If Punjab, Haryana, Western Uttar Pradesh, and Eastern Madhya Pradesh have irrigation facilities, they can conduct modern agriculture. Otherwise, 'nature-friendly' or 'climate-proof' agriculture is advised. Climate change hurts water, agriculture, and food, slowing rainfed agriculture's expansion. Water shortages may reduce cultivation intensity, hurting smallholders' socioeconomic conditions. Over 12 million tons and 12 million people work in Indian inland aquaculture. Due to 2% output growth, it has not reached maximum production. Averaging 1 hectare, about 80% of farms are small. Fisheries inflow depends on environmental variables and quality seeds, feeds, chemicals, medications, and labor.

Mixed crop and livestock production is common in Odisha and Kerala, India. A mixed crop farming system reduces production

costs per unit area, increases pay and productivity, and reduces farmer risk (tractorjunction, 2024) [4].

Challenges in Indian agriculture

Indian agriculture has many issues. Reduced soil fertility, water degradation, chemicalization, and air pollution threaten sustainability first and foremost. Soil degradation and resource depletion cause annual food grain losses. Input supply has a large technology gap and low standard input utilization. Outputs also fall short of potential. In summary, intrinsic bottlenecks between soil capabilities and agro-technologies, inadequate access to inputs and credit, inadequate access to output markets, continuous price disadvantages to small and scattered producers, and high and rising production costs are hurting Indian agriculture. Monoculture production increases rural semi-proletarian and proletarian populations, reduces income, food supply, and resources, and causes population unrest and urban and intercontinental emigration. Thus, rural, agriculture-based socio-economic development requires crop diversification, preservation of traditional agriculture, and conversion to organic farming. The imperfect market mechanism, realization and processing of agricultural products, lack of adequately skilled personnel, lack of population information and awareness, and suppression of individual initiatives to solve ecological, socio-economic, and cultural problems are the main constraints to organic farming development. Organic farming makes significant contributions.

Indian economy is village economy of cultivators, handicraftsmen, and agricultural laborers. Since independence, India has moved from net importing to net exporting foodgrains and relies largely on agriculture. Indian agriculture changed due to the mid-1960s green revolution. Indian agriculture is under turmoil. This is because Indian agriculture could not solve its challenges. This report addresses these issues and identifies the most urgent areas to address the agricultural crisis (Singh, 2017) [5].

Sustainability issues

Indian agriculture still follows green revolution J-curves such monoculture crops, which are unsustainable and harm farmers. Overuse of chemical fertilizers, which are essential to soil health, is causing water scarcity and sickness. Undermining farmers' water tables, crop rotation, and animal preservation has worsened the country's situation. Chemical fertilizers and cultivation degrade soil qualities, worsened by climate change. Fossil fuel-based fertilizers continue to drive plant nutrients. Population dynamics may worsen sustainability difficulties owing to soil nutrient depletion.

The agriculture productivity sustainability challenge is growing. The post-Green Revolution phase has high input-use and slowing total factor productivity increase. The 1980s agricultural productivity has not been sustained in the 1990s, making it difficult for researchers to shift the production function upward by strengthening the technology index. It requires an assessment of agricultural productivity patterns, particularly for individual commodities farmed in India's key states (Kumar and Mittal, 2006) [6].

Extensive irrigation causes water scarcity in several places of India. Sustainability requires more efficient irrigation to preserve water and reduce dependence on cheaper cereals, other crops, and date palms, which use less water. Game changers are needed. We also need more research and extension education in all kinds to improve agriculture. To protect India's future, scientists will require breakthrough technology to enable farmers practice permanent conservation and revive biodiversity on farms. A sustainable approach that goes beyond population expansion to handle land and water limitations, protect biodiversity, and prevent invasive species spread is needed.

Technological gaps

Indian agriculture has several technology shortcomings. Virus-resistant Vasant Dhan, drought-tolerant maize in Kharif, water-saving wheat, and scourge-resistant brinjal in Rabi helped states reduce yield loss. Despite their high initial production costs for fruits, spices, seeds, and cotton, sophisticated technologies are lucrative when they lower cultivation expenses. Many storage and value addition interruptions, such as power outages and transportation services, limit agricultural companies' potential to boost rural output. Official laptop and desktop penetration data in India shows 17% of rural people used laptops in 2020. Farmers generally utilize smartphones for knowledge technology. Many Indian farmers use knowledge groups for information.

Research and development, product testing, government permissions, and other formalities enable agricultural technology change. They receive no Indian remuneration for this gradual period. For their prosperity, resource centers, farmers' subsidies, and monitors to introduce innovative irrigation methods and technology are needed to support research and development. Indian agricultural research and development will fill gaps in soil, seeds, sowing, crop protection, seedling, irrigation, and farm work technology. In recent years, Haryana and other Indian states have seen great

technological progress in meeting the growing demand for gadgets to estimate planting time and location. Every year, crops need essential high-yield technologies like paddy NGSKs Tindi and 976, computed from January 2016 data at 196 kg per hectare. The release of "developer agriculture" involves technical development to embed and adapt mechanisms, and farmers are predicted to need more category uses during technology development.

The majority of India's income comes from agriculture, according to Bhatnagar et al. (2019) [7]. India Brand Equity Foundation found that 58% of the population relies on agriculture and that INR 17.67 Trillion contributes to India's GDP. Integrating computer science and IT can greatly improve agriculture. This integration is Precision Agriculture. Precision Agriculture uses many technologies as Image Processing, AI, GIS, Sensor Network, and GPS.

Challenges in market access

Poor transportation and communication infrastructure limits market access and increases farmers' storage costs until a marketable excess is reached. Even if farmers reach a terminal market, rates often drop, and the opportunity expenses for another day's fruit gathering will exceed their disillusionment sale profit. Without market intelligence, farmers miss opportunities to sell their produce. Marketing agricultural products widens the rural-urban divide. Multilevel markets are poorly integrated because intermediaries have dispersed their activity. Increasing intermediation rates lower farmers' profitability and price band. Agri-produce from rural areas needs direct access to urban consumers.

Complex middlemen and high intermediation lower farmers' realization. However, other traders have much bigger average absolute margins than poor farmers. The fact that nice buyers have a bigger per kilogram profit than farmers at all levels supports this. They support eliminating intermediaries.

Reddy (2007) [8] examines Indian agriculture production, productivity, difficulties, and strategy. The author recommends increasing agriculture output, notably in the country's large rain-fed lands. Crop, livestock, horticulture, fodder, and grassland cultivation should be prioritized. Better seeds, fertilizers, and irrigation can boost productivity. Infrastructure like irrigation, rural roads, markets, power, cold storage, etc. drives agricultural growth. Subsidies for food, fertilizers, power, irrigation, finance, etc. have diverted resources, reducing public investment in agriculture, according to the report. The study found that Indian agricultural exports are limited by cost, quality, and competition from other agrarian economies. The author advocates contract farming for high-value commodities on small farms and public-private agricultural research partnerships.

Indian agriculture needs a makeover

India's agriculture sector faces several issues. The share of the population remaining depending on agriculture as a primary source of livelihood boosts agriculture's GDP contribution. Revitalising agriculture is the least we can do to help over 600 million farmers. In addition, the quantity of Sustainable Development Goals, especially No Poverty and Zero Hunger, makes implementation difficult. Modern agriculture will stabilize food security and boost farmers' incomes. India will be one of the world's largest economies if its rural areas maintain up with the rest of the country and turn its demographic dividend into trained manpower. Modernizing Indian agriculture can enable 70% of rural India prosper and accelerate growth. Modernizing agriculture is key to alleviating poverty and hunger in India. A freer, more appealing agriculture will match the ambitions of an increasingly isolated and diversified India in ways politicians don't realize. India's foundation is agriculture. Making contemporary approaches affordable for farm laborers will preserve Green Revolution self-reliance. Each of the proposed complexes could employ 40,000 people. This gives Indian authorities the backing to produce finances for a modern agriculture, if not an effective perspective to make ends meet and implement existing plans and programs to revive Indian agriculture.

Making Indian agriculture look better

India is complex due of its composite agriculture. Facelifting agriculture should address significant agro-climatic farm issues. A "one size fits all" approach doesn't fit Indian complexity. Precision farming: Customizing technology and procedures boosts yield and lowers input costs. This strategy will benefit bigger acreage by using scientific production. Small and marginal Indian farmers can use Western precision farming. Agro-ecology: Agro-ecology includes many operations, including carbon fixing and biodiversity preservation, in addition to farming for exports and refinement. Due to its richness and abundant flora and fauna, the ecology supports organic production. It could also be a "way out" for contractual farming for export with easy certification. The majority of Indian organic farming comes from experimental off-season surpluses and offshoots. Financial inclusion: Kisan Credit Card coverage and crop insurance schemes for various hazards must be prioritized. Easy credit and insurance will enable resource substitution for modern activities. If rains are sporadic and late, the loan must include the insurance cost. Paradoxically, a minimal interest rate is

offered for a savings bank balance while double-digit interest is charged on loans to the people, including the elite. To fight meaningless muscle flexes, "education, education, and education" must be the foundation of all strategies. Implementing new thinking requires education and capacity training. Farming culture requires modern tools. True transmission of current technology from lab to researcher, extension staff, and practicing research scientists to farmers requires a broader attitude change. Focus on how illiterate farmers use new chemicals and tools without art. Externally-aided or not, investments only pay off then.

Communication and extension activities are crucial to agricultural development. Farm extension relies heavily on electronic media. Kerala, the consumer state, was a complete agricultural state before independence. Print media is booming in agricultural extension and publication. AIR (All India Radio) farm programs and Doordarshan farm programming expanded the role of electronic media in agricultural extension. The media-heavy southern Indian state embraced this electronic media agricultural communication revolution. After 1990, Kerala saw a rush of private TV networks, and there are 24 Malayalam channels. All major news and entertainment channels air agricultural programs. Malayalam-language AIR and Doordarshan farm programs are popular with Kerala farmers.

T.V. idea introduction. is acceptable, farmers need direct instruction from field experts to start implementing new farming practices. Farmers still prefer print media reports and agricultural pages and complain about news papers removing them. They like print reports because they can gather and refer to articles. Private TV agriculture shows are questioned by farmers. channels. Even though they favor private TV channels for learning new agricultural practices and other farm information, they check for pesticide or agro-fertilizer sponsorship (Thomas and Anil Kumar, 2010) [9].

Adoption of precision agriculture

Indian agriculture needs a boost to boost productivity and farmer incomes. Precision agriculture boosts production. Precision agriculture maximizes resource use for sustainable, environmentally friendly farming. It employs information technology, innovative gear and equipment, and high-quality managers and staff to optimize production inputs to maximize outputs and minimize production resources. Remote sensing, geographic information systems, and the global positioning system provide precision agriculture data. Precision agriculture relies on monitoring plant health, soil conditions, and weather. Geospatial technologies and approaches enable spatial and temporal crop and management unit management.

New high-resolution remote sensing methods for yield estimation are being investigated, as is integrating data sources. Remote sensing and geospatial technology in Indian agriculture improve crop health, drought monitoring, productivity, water-use efficiency, yield estimation, and resource sustainability. Avoiding extra nutrients helps river contamination's environmental effects. Precision agriculture lowers manure and chemical waste in low-productivity areas and addresses shortcomings. Economic and environmental factors can control this technology-based agriculture decision. Knowing soil nutrient content distribution and important product factors that affect production can guide a management plan. By enhancing fertilizer use efficiency, soil tests and fertilizing only when needed may boost yields and profit. It will also support environmentally friendly sustainable agriculture. By adapting inputs and husbandry to field variability, results can be improved and expenses reduced. Precision farming reduces pollution and chemical waste, making it sustainable. Some farmers use precision farming to promote and practice it.

Some barriers hinder precision agriculture adoption. Individual farmers cannot create agricultural maps due to a lack of infrastructure and resources. Gathering such data is difficult. Such technology requires sector-related corporations to succeed. Small farms sometimes struggle to adopt this technology. The farmer may be uneducated, illiterate, unaware of new approaches, and underestimating investment potential. This suggests social groups don't inform farmers. Government and the commercial sector can reduce these hurdles and speed adoption. Thus, farmers' move from traditional scanning technology identification and understanding is promoted.

Encourage agroecology

Agroecology studies how farming practices affect ecosystem health. Most global agroecological programs use mixed cropping or intercropping. There is growing evidence that diversified agroecological systems are more climate-resilient than monocultures. Agroecological strategies can limit the use of toxic chemicals and help replace them with biopesticides. Soil organic carbon is mostly restored by crop leftovers and animal manures. Diversifying cropping systems using agroecological principles is a global transformative agriculture technique that attempts to close the yield gap and boost crop productivity and production.

According to Somashekar., *et al*. (2024) [10], agroecology integrates ecological and socioeconomic principles to promote food system resilience and productivity. This overview covers agroecology's key principles—biodiversity, ecological services, social equity-and techniques like crop diversification, soil health management, and integrated pest management. To promote sustainable food systems, these practices are assessed for their environmental, economic, and social consequences. Case studies from diverse regions show how agroecological practices assist local communities. The evaluation also emphasizes the need for enabling policies, educational programs, and research to promote agroecology. Agroecology confronts awareness, resource, and policy challenges despite its many benefits. The paper suggests ways to overcome these obstacles and calls for more agroecology research. This review synthesizes current information and identifies essential topics for further research to help policymakers, practitioners, and scholars comprehend agroecology's potential to sustain agriculture.

Indigenous tribes around the world have practiced many of the above agroecological concepts for hundreds of years, with respect for environmental and ecological sustainability. Most community-based groups worldwide focus on in situ crop and animal conservation. Rural unemployment, distress migration, and stress among poor rural people are reduced by small farm holdings' individual or collective agricultural activities and family involvement, including women and children. Food production relies on local labor and resources. In some multipurpose cooperative organizations, small and marginal farmers practice food and nutrition-based agriculture. Locally available eco-friendly, sustainable, and cost-effective natural resources protect food biodiversity and the environment.

Improved credit and insurance access

Farmers' financial constraints limit their capacity to embrace contemporary farming methods, buy new equipment, etc. Credit helps farmers invest in high-yield techniques and minimize risk because adopted crops usually have better returns. Credit risk management can be improved by linking it to agricultural input providers, who know what works and what doesn't. Credit alone cannot mitigate the risk, hence an insurance program is needed to protect investments from natural disasters.

After the Kisan Credit Card was introduced, more people borrowed private funds, and its outstanding amount exceeded agricultural loans. It has been effective, especially during droughts and crop capital shortages. Innovative methods with cooperative credit societies and farming communities are needed. This approach of linking water harvesting structure clubs to cooperative credit societies may work. Municipal corporations may help create a new lending model to connect credit agencies with farmers and rural residents. Rationalize interest rates. The interest subvention system has reduced lending costs for farmers, although it is hard to distinguish it from other factors. The flanking program must train aware farmers in program lending. Cooperative credit societies can help rural lives, thus policy should focus on this sector in a mission mode with complete coordination with these agencies. A nationwide financial inclusion initiative to market farmer insurance products is also suggested. For this, awareness and readiness are crucial. Thus, insurance awareness campaigns are needed. Weather-based crop insurance, multi-peril crop insurance, animal insurance, credit and crop insurance, and trellis insurance after harvesting are all available. This must be planned. Additionally, the government has begun providing both, but coverage has been limited due to a publicity campaign. Thus, farmers are under protected. These policies are offered by insurance firms, but they affect pre- and post-harvest claim settlements, another qualified failure. The coverage is under RP-300, which can only partially replace working capital loss. Capacity building has addressed inception management and competency. The Department would release weather-based agricultural varieties, traditional insurances, operating guidelines, and changes. Chain partnerships and contractual farming are also options.

Conclusion

Indian agriculture needs and has great potential to change. With over half the country's population dependent on agriculture, solving its inefficiencies will strengthen the economy, maintain food security, and improve millions of farmers' livelihoods. Indian agriculture needs technological integration and policy reforms to become more sustainable, productive, and resilient. The agricultural industry is crucial to farmer welfare and food security in India. Farmers struggle owing to high input and machinery costs despite agricultural modernization. Sustainable and accessible mechanization is needed now to boost agricultural productivity. India heavily subsidizes agriculture, so investing in efficient, environmentally friendly technology is crucial. Water and electricity conservation should be a state priority and encouraged. Indian agricultural transformation enterprises should be supported, encouraged, and invested in by the government. (Bardia, 2020) [11].

Farmers, known as 'Annadatas', are crucial to a nation's empowerment and success. The Indian government's honest attempts to

help this vital group deserve praise. In a fast-growing economy like India, agriculture is as important as industry and digital infrastructure (Ministry of Information and Broadcasting, 2024) [12].

Key Takeaways

- Indian agriculture needs a facelift
- India's population is growing rapidly, thus agricultural output must rise to fulfill food demand.
- **Climate Change:** Unpredictable weather, droughts, and floods require climate-resilient approaches in the sector.
- Many farmers are distressed due to low production, poor market access, fragmented landholdings, and diminishing profitability. Increased income and reduced vulnerability necessitate immediate action.

Transformation methods

- **Technological Integration:** Precision agriculture, drone-based surveillance, AI-based data analytics, and IoT improve yield predictions and resource management.
- Micro-irrigation, rainwater collecting, and drip irrigation are essential due to monsoon dependence.
- **Sustainable Farming:** Organic farming, crop diversification, and minimal chemical fertilizers and pesticides will maintain soil health and production.
- **Policy Reforms:** Streamlining subsidy distribution, encouraging farmer-producer organizations (FPOs), and improving market linkages will empower farmers and boost profitability.
- **Capacity Building and Education:** Teaching farmers new technology, financial literacy, and expanding agricultural extension services will boost self-reliance.

Government, commercial sector, and civil society must work together to transform Indian agriculture. Investment in rural infrastructure, education, and research must accompany policy reforms. Agri-tech innovation by corporations and public-private partnerships can boost efficiency and market access.

Finally, improving Indian agriculture requires grassroots and top-level policy changes. The sector may modernize by adopting modern technologies, encouraging sustainability, and enabling farmer-centric policy. These reforms will produce a resilient, prosperous agricultural sector that boosts national economy and global food security if implemented holistically.

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