

Research Article

Retrospect and Prospect of Indian Agriculture Economic Policy Reforms, Trends and Challenges-An Overview

Dr. Ashutosh

Assistant Professor, Department of Economics, National PG College, Bhongaon, Manipuri, Uttar Pradesh, India

Corresponding Author: Dr. Ashutosh

Abstract

India is a global agricultural powerhouse. It is the world's largest producer of milk, pulses, and spices, and has the world's largest cattle herd as well as the largest area under wheat, rice and cotton. It is the second largest producer of rice, wheat, cotton, sugarcane, farmed fish, sheep & goat meat, fruit, vegetables and tea. The country has some 195 m ha under cultivation of which some 63 percent are rain fed while 37 percent are irrigated in addition, forests cover some 65m ha of India's land. The majority of India's poor (770 million people or about 70 percent) are found in rural areas. India's food security depends on producing cereal crops, as well as increasing its production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes. Indian agriculture, the primary livelihood source for nearly half of the nation's population, has undergone a dramatic transformation since the introduction of economic reforms in 1991. While the early stages of liberalization determined on industrial and financial sectors, agriculture was indirectly impacted through trade liberalization, decrease of subsidies, and changes in institutional support structures. The reforms brought new opportunities for export led growth and market-driven diversification, but also introduced challenges related to input costs, rural indebtedness, and regional disparity. The present study is descriptive methodology. This present paper significantly analyzes retrospect and prospect policies the impact of economic policy reforms on Indian agriculture and issues, challenges over the past three decades.

Keywords: Agricultural, Economy, Global, Forest, Financial, Liberalisation and Market.

1. Introduction:

While agriculture's share in India's economy has progressively declined to less than 15% due to the high growth rates of the industrial and services sectors, the sector's importance in India's economic and social fabric goes well beyond this indicator. First, nearly three-quarters of India's families depend on rural incomes. Second, the majority of India's poor (some 770 million people or about 70 percent) are found in rural areas. And third, India's food security depends on producing cereal crops, as well as increasing its production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes. To do so, a productive, competitive, diversified and sustainable agricultural sector will need to emerge at an accelerated pace.

India is a global agricultural source of power. It is the world's largest producer of milk, pulses, and spices, and has the world's largest cattle herd (buffaloes), as well as the largest area under wheat, rice and cotton. It is the second largest producer of rice, wheat, cotton, sugarcane, farmed fish, sheep & goat meat, fruit, vegetables and tea. The country has some 195 m ha under

cultivation of which some 63 percent are rain fed while 37 percent are irrigated in addition, forests cover some 65m ha of India's land.

2. Statement of the Problem

Agriculture sector mostly three challenges will be important to India's overall development and the improved welfare of its rural poor: 1) Raising agricultural productivity per unit of land: Raising productivity per unit of land will need to be the main engine of agricultural growth as virtually all cultivable land is farmed. Water resources are also limited and water for irrigation must contend with increasing industrial and urban needs. All measures to increase productivity will need exploiting, amongst them: increasing yields, diversification to higher value crops, and developing value chains to reduce marketing costs. 2) Plummeting rural poverty through a socially inclusive strategy that comprises both agriculture as well as non-farm employment: Rural development must also benefit the poor, landless, women, scheduled castes and tribes. Moreover, there are strong regional disparities: the majority of India's poor are in rain-fed areas or in the Eastern Indo-Gangetic plains. Reaching such groups has not been easy. While progress has been made the rural population classified as poor fell from nearly 40 percent in the early 1990s to below 30 percent by the mid-2000s there is a clear need for a faster reduction. Hence, poverty alleviation is a central pillar of the rural development efforts of the Government and the World Bank. 3) Ensuring that agricultural growth responds to food security needs: The sharp rise in food-grain production during India's Green Revolution of the 1970s enabled the country to achieve self-sufficiency in food-grains and stave off the threat of famine. Agricultural intensification in the 1970s to 1980s saw an increased demand for rural labor that raised rural wages and, together with declining food prices, reduced rural poverty. However agricultural growth in the 1990s and 2000s slowed down, averaging about 3.5 percent per annum, and cereal yields have increased by only 1.4 percent per annum in the 2000s. The slow-down in agricultural growth has become a major cause for concern. India's rice yields are one-third of China's and about half of those in 'Vietnam and Indonesia'. The same is true for most other agricultural commodities (Ministry of Agriculture & Farmers Welfare. Annual Report 2023-24)

3. Glances and Impact of New Economic Reforms (1991):

The year 1991 marked a watershed moment in India's economic history. Facing a severe balance of payments crisis, the Indian government under former Prime Minister 'P.V. Narasimha Rao' and Finance Minister Dr. Manmohan Singh launched a broad set of economic reforms aimed at liberalizing the economy, reducing fiscal deficits, and integrating with global markets. These reforms, encapsulated under the 'New Economic Policy' (NEP), were primarily directed at industrial deregulation, trade liberalization, financial sector restructuring, and reduction in the role of the public sector. While agriculture was not explicitly the focus of the initial reform agenda, it experienced significant second-order effects as the reforms began to reshape the macroeconomic environment.

The reforms brought about fundamental shifts in the way agriculture interacted with the national economy and the global market. One of the earliest and most pronounced changes was the gradual dismantling of trade barriers, including the reduction of import tariffs and removal of quantitative restrictions on agricultural commodities. In the context of commitments made under the World Trade Organization (WTO) Agreement on Agriculture, India converted non-tariff barriers into tariffs and established bound rates for agricultural products. This shift from a protectionist to a more liberal trade regime exposed Indian agriculture to international price volatility and competition, especially in crops such as oilseeds, pulses, and cotton.

According to the 'Ministry of Commerce and Industry', the bound tariff for most agricultural commodities was set between 100 percent and 150 percent, although applied tariffs were generally much lower to encourage competitiveness and meet domestic demand.

Another major impact of the reforms was the rationalization of subsidies and curtailment of public expenditure, especially in input support systems. The Economic Survey (1996-97) noted that real public investment in agriculture, particularly in irrigation and rural infrastructure, declined consistently from the mid-1980s onward, a trend that continued through the reform period. While subsidies on fertilizers, power, and irrigation were retained to some extent due to political

compulsions, their distribution became more regressive. Large and medium farmers, especially in irrigated regions, benefited disproportionately, while marginal and rainfed farmers remained underserved. The skewed structure of subsidies led to inefficiencies such as overuse of nitrogen-based fertilizers, depletion of groundwater, and regional disparities in agricultural growth. The post-1991 period also witnessed changes in the institutional architecture of agricultural credit. Directed lending targets for priority sectors were redefined, and the banking system underwent reforms that prioritized financial viability over social objectives. As a result, small and marginal farmers began to find it increasingly difficult to access institutional credit. According to NABARD's 2019 report on rural credit, the share of institutional loans to agriculture stagnated, and non-institutional sources such as moneylenders remained prevalent in several states, particularly in eastern and central India.

New dynamic reforms introduced in the marketing of agricultural produce. Although the 'Agricultural Produce Market Committee' (APMC) Act continued to regulate market yards in most states, the push for creating a unified national market gained momentum. The introduction of contract farming, direct marketing, and private 'mandis' (storages) in selected states represented early efforts to move toward a market-oriented regime. However, these initiatives remained fragmented and uneven in their implementation due to the lack of enabling legislation and infrastructure.

Another indirect but important consequence of economic reforms was the emergence of agro-exports as a strategic priority. With India becoming self-sufficient in food grain production by the late 1980s, the focus began to shift toward high-value agricultural exports such as basmati rice, marine products, cotton, and horticultural commodities.

According to the 'Agricultural and Processed Food Products Export Development Authority' (APEDA), India's agricultural exports grew from Rs. 6,548 crore in 1991-92 to over Rs. 2.7 lakh crore by 2021-22. However, this export push was accompanied by rising concerns over food security, environmental sustainability, and the marginalization of subsistence farmers who lacked access to export-oriented technologies and markets.

In essence, the economic reforms of 1991 catalyzed a new policy environment in which agriculture was expected to operate more competitively, with reduced dependence on state support and greater exposure to global markets.

While the reforms succeeded in initiating diversification, improving export performance, and stimulating private sector participation in agro input and processing industries, they also created new vulnerabilities. The reduction in public investment, inadequate access to credit, weak marketing infrastructure, and volatility in global commodity prices posted significant challenges to inclusive agricultural growth.

This reform induced changes laid the groundwork for a gradual, albeit uneven, transformation of Indian agriculture in the decades that followed. They also set the stage for policy debates that continue to shape agricultural discourse in India, debates on price support, input subsidies, trade protection, and institutional reform. The next section of this paper will delve into the measurable impacts of these reforms on key agricultural indicators, using data from the Ministry of Agriculture, RBI, and other official sources to evaluate performance trends in the post-reform era.

3.1. Transformation of Agricultural Investment Trends Post-Reforms:

One of the most noticeable outcomes has been the consistent decline in agriculture's share of GDP from nearly 29 percent in 1990-91 to around 18.3 percent in 2022-23, even as it continued to employ over 45 percentage of the national workforce (MoAFW, 2023). This indicates a widening gap between agriculture and the rest of the economy, characteristic of a dual-sector model where the benefits of growth accrue disproportionately to non-farm sectors.

The economic liberalization of 1991 marked a gradual but visible shift in Indian agriculture's structural trajectory. Although agriculture was not directly targeted in the initial reform agenda, its exposure to macroeconomic changes, market integration, and institutional restructuring was significant. Despite this structural shift, the 'Gross Value Added' (GVA) of agriculture has grown in absolute terms, albeit at a moderate and uneven pace. During the Eighth Five Year Plan (1992-97), the sector recorded an average annual growth of 3.7 percent, which declined to 2.5 percent in the

Tenth Plan and later improved marginally to around 3.6 percent in the Twelfth Plan (Planning Commission & NITI Aayog). Factors contributing to this sluggishness include stagnant productivity in rain fed areas, inadequate irrigation coverage, and weak rural infrastructure.

Productivity improvements in major cereals like rice and wheat have occurred steadily supported by continued adoption of 'High Yielding Varieties' (HYVs) and improved irrigation. ICAR data shows that wheat yields rose from 2.2 tonnes/ha in 1990 to 3.5 tonnes/ha in 2021, while rice yields increased from 1.9 to 2.8 tonnes/ha during the same period. However, this progress was not uniform across all crops. Pulses and oilseeds, for instance, lagged significantly until the introduction of focused missions such as NMOOP. Even today, India relies on imports for more than 60% of its edible oil requirements, underscoring the productivity challenges in these segments.

4. Methodology:

The present study is descriptive methodology. This present paper significantly analyzes retrospect and prospect policies the impact of economic policy reforms on Indian agriculture and issues, challenges over the past three decades. using data from the 'Economic Survey,' 'Ministry of Agriculture' and 'Farmers' Welfare', The National Bank for Agriculture and Rural Development (NABARD), Reserve Bank of India (RBI) and other official sources. The study concludes with policy Suggestions and recommendations to line up agricultural growth with sustainability, equity, and global pliability.

5. Results and Discussion:

5.1. Current Status:

The existing yield levels of a majority of crops remains much lower than the world average. The predominant causes are low irrigation, use of low quality seeds, low adoption of improved technology, and knowledge deficit about improved agricultural practices. Close to 53 per cent of cropped area is water stressed. Rainwater management practices and services are resource starved. This limits a farmer's capacity to undertake multiple cropping and leads to inefficient utilization of land resources.

Inefficient extension delivery systems have led to the presence of large yield gaps as well. Yield gaps exist at two levels in India. First, there is a gap between best scientific practices and best field practices. The second gap exists between best field practices and the average farmer. There exist significant yield gaps both amongst and within states. Yield gaps have been found to exist in even highly productive states such as Punjab. Closing these gaps provides an opportunity to enhance productivity and incomes significantly. This further implies that states with low productivity (or large yield gaps) have significant potential for catch-up growth in their productivity levels.

Demand side factors favour the expansion of area under fruits and vegetables, and livestock products. These enterprises also offer better income. Staple crops (cereals, pulses and oilseeds) occupy 77 per cent of the total gross cropped area (GCA) but contribute only 41 per cent to the output of the crop sector. High value crops (HVCs) contribute an almost similar amount to total output as staples do, but they occupy only 19 per cent of the GCA. Research has also shown that diversification to the fruits and vegetables segment is likely to benefit small and medium farmer's more than large ones.

Over the past few years, new development initiatives aimed at modernising agriculture have been introduced. Pradhan Mantri Krishi Sinchai Yojana (PMKSY) aims to expand irrigation coverage whilst promoting water use efficiency. Area under micro irrigation has grown 2.5 times in the last four years. The second cycle of the Soil Health Card (SHC) scheme is underway, which will focus on job creation and entrepreneurship development through local entrepreneurship models. So far, 3.76 crore SHCs have been distributed under the second cycle.

5.2. Constraints:

1. Use of outdated and inappropriate technology is the main reason for low productivity of crops and livestock.
2. Given the pre-dominance of small and margin- al farmers in Indian agriculture, affordability becomes a significant constraint on technology adoption by farmers.

3. There exist several bottlenecks hampering on-farm adoption of technology developed in public sector.
4. Agricultural research in the country is constrained by resource inadequacy, regulations and intellectual property rights (IPR).
5. Multiple private and public sources supplying different information to farmers create confusion.
6. A huge gap exists between the demand for and supply of skills in agriculture, hindering diversification, adoption of precision agriculture and on farm post-harvest value addition.

India has not caught up to the rest of the world in terms of technology, which has led to the dominance of inefficient production practices, such as flood irrigation, at the farm level. Renewed focus on ground absorption of technology, market intelligence, skills and extension and modernising trade and commerce in agriculture are needed to modernise agriculture in India.

Both production and marketing suffer due to the absence of adequate capital.

Low scale is a serious constraint on the adoption of improved practices and in the input and output market.

Way Forward:

5.3. Productivity and efficiency:

1. Increase area under irrigation: Irrigation coverage needs to be increased to 53 per cent of gross cropped area (GCA) by 2022-23. The focus should be on increasing coverage through micro-irrigation.
2. Increase adoption of hybrid and improved seeds: States should take the lead through the following measures:
3. Dynamic seed development plans are required. These may be based on crop wise area (each season separately), seed rate per hectare used, desired/targeted seed replacement rate and crop wise seed requirement. Crop wise requirement should be worked out based on historical trends, introduction of new varieties and replacement of poor yielding varieties.
4. States should aim to increase the seed replacement rate (SRR) to 33 per cent for self-pollinated crops and 50 per cent for cross-pollinated crops in alternative years.
5. Increase Variety Replacement Ratio (VRR): Phase out old varieties of seeds and replace them with hybrid and improved seeds to enhance productivity.
6. The Indian Council of Agricultural Research (ICAR) along with State Agricultural Universities (SAUs) should develop climate resilient varieties of crops suitable for the 128 agro-climatic zones of the country, through farmer participatory plant breeding and adopting farm varietal trials from the third year of the development of the seed.
7. Strengthen seed testing facilities: Seed testing facilities need up gradation in terms of both personnel and technical expertise regular performance monitoring is required to maintain the quality of test results.
8. Uniform national procedure for seed licensing: To tackle the problem of heterogeneity in seed licensing procedures across states, the central government should develop model guidelines for seed licensing and support states in implementing these.
9. Efficient fertilizer usage: Strengthen the SHC scheme and include not merely nine but all sixteen parameters in the tests. This will ensure SHC based fertilizer distribution at the ground level. Seed SHCs with the integrated fertilizer management system Link SHCs with Kisan credit cards and make SHCs mandatory for subsidies. Ensure proper functioning of the SHC labs.
10. Reorient fertilizer subsidy policy: The current lopsided fertilizer subsidy policy needs to bring secondary and micronutrients on the same nutrient-based subsidy (NBS) platform as phosphorus (P) and potash (K).
11. Regulate pesticide use: Align the pesticide regulatory framework with food safety laws to make adoption broad based. Strengthen extension activities to ensure that best practices reach the average farmer.

12. Custom hiring centres: Madhya Pradesh has had demonstrable success with their custom hiring centre model to hasten the pace of farm mechanization. This model should be replicated nationwide by employing rural youth and promoting entrepreneurship.
13. Subsidies on liquid fertilizers: Targeted subsidy should be provided on liquid fertilizers to encourage substitution with micro-irrigation.
14. Investment subsidies for micro-irrigation: Rather than power and water subsidies, investment subsidies for micro-irrigation can be provided through the DBT mode (Suresh Vadranam, 2024)

5.4. Strengthening Extension Systems:

Synergy between Agriculture Technology Management Agency (ATMA) and Krishi Vigyan Kendras (KVKs): The ATMA programme needs to be reoriented to include bottom up planning at the district and block levels to develop Strategic Research Extension Plans (SREP).⁴ Further decentralization and autonomy are essential to the success of this programme. Subject matter specialists at KVKs should orient their research to the block action plans developed by ATMA.

Public Private Partnership in KVKs: The guiding principles of ATMA provide for the promotion of PPP in extension delivery. With each KVK in possession of approximately 50 acres of land, KVKs should incubate private sector initiatives in extension delivery.

Market led extension: Give priority to extension services that disseminate information to farmers regarding

- (i) crop selection
- (ii) demand for and supply of crop produce,
- (iii) expected price of commodity and
- (iv) availability of infrastructure facilities for storage, transport and marketing of produce.

Value added extension: Prioritise value added extension services to enable a reduction in post-harvest losses by converting raw agricultural produce to processed products. This allows for increased price realization and contributes towards increasing farmers' income (FHP is available only for 2015-16)

District level skill mapping: ICAR and SAUs should map the demand for and supply of skills in agriculture at the district level and coordinate with skill development missions to impart the required skills to farmers and agricultural labour (Ministry of Finance. Economic Survey, 2022-23)

Replicate dealer training programme in state agricultural universities: The National Institute of Agricultural Extension Management's (MANAGE) dealer training programme should be replicated in SAUs, with diploma holders granted licences to conduct extension activities.

Sustainable water use in agriculture: About 83 per cent of water is used in agriculture. The solution to resolving India's imminent water crisis lies in conserving water in agriculture. Therefore, more efficient irrigation technologies, water harvesting and better crop selection must be encouraged.

Diversification: promotion of high value crops (HVCs) and livestock High value crops Encourage diversification to HVCs: Design an incentive mechanism to wean farmers away from cereal crops to HVCs. The area under fruits and vegetables needs to increase by 5 per cent every year.

Establish regional production belts: As in the cluster-based approach, regional production belts for HVCs need to be identified and supported through the Mission on Integrated Development of Horticulture (MIDH). Make SHCs mandatory in these belts.

Use of hybrid technology in vegetables: Shift to using hybrid varieties for vegetables. At present, 10 per cent of the cropped area under vegetables is under hybrids. Shifting to hybrids has the potential to increase yields by 1.5 to 3 times and provide a significant increase in income.

Rootstocks for production of fruits: Rootstock technology has shown the capacity to double production and be resilient to climate stress. Measures should be taken to standardize and promote usage of rootstocks to produce fruits. Smart horticulture: There have been pockets of success spread throughout the country, using techniques such as high-density plantation, protected cultivation and organic production. These methods need to be documented and replicated at the national level. It is recommended that a mission on smart horticulture may be setup to identify and promote new

technologies. This mission must work in synergy with various agricultural research institutions in the country.

Strengthen market for organic products: Targeted efforts to create a market for niche products are recommended. Spices unique to a state can be branded by the Spice Board to encourage the production of organic spices.

Convert agricultural waste: Recycling and utilizing agricultural waste would give a further fillip to farmers' income.

Livestock and fisheries: Breed indigenous cattle with exotic breeds: Breeding of indigenous cattle with exotic breeds needs to be encouraged to arrest the issue of inbreeding. This will enable greater gene coverage, reduced diseases and greater resilience to climate change.

Promote and develop bull mother farms: Employing multiple ovulation and embryo transfer technologies, these farms can significantly enhance milk productivity through the supply of cattle with enhanced milk potential to farmers.

Village level procurement systems: Installing of bulk milk chillers and facilities for high value conversion of milk are needed to promote dairy in states. The private sector should be incentivized to create a value chain for HVCs and dairy products at the village level.

Convergence of schemes in fisheries sector: Integrate the Blue Revolution scheme with MGNREGA. Ponds created through MGNREGA should be used to promote aquaculture and can be used to create potential clusters as well. Capacity building for fish breeders and farmers: Establish fish co-operative organisations and run village level schemes in coordination with panchayats to disseminate best practices and research.

5.5. Constraints:

Fragmented land holdings

Agriculture is characterised by an extremely fragmented landholding structure with an average farm size of 1.15 hectares and the predominance of small and marginal farmers, with those holding less than 2 hectares

Low price realization

There exists a large gap between farm harvest prices (FHP) and retail prices. Prices also tend to fall below the minimum support prices in a good production year, leading to agrarian distress. Mechanisms need to be developed to ensure remunerative prices to farmers, in both 'good' and 'bad' monsoon years.

Non-farm employment

Lack of non-farm employment opportunities has resulted in excessive dependence on agriculture for livelihood among both small and marginal farmers as well as among the landless.

Agricultural credit

Despite an allocation of more than INR 11 lakh crore of commercial credit, access to institutional credit remains a constraint, especially in the case of tenant farmers.

Agricultural trade

Exporters of agro-commodities are not successful in raising their share in global markets because of uncertainty in the foreign trading regime.

5.6. Way Forward

Marketing reforms: Many of the constraints in marketing can be addressed by adopting the Model Agricultural Produce and Livestock Marketing Act (APLM), 2017,³ which provides for progressive agricultural marketing reforms, including the setting up of markets in the private sector, allowing direct sales to exporters/processors and customers, farmer-consumer markets, e-trading, single point levy of market fee, a unified single trading licence in a state, declaring warehouses/ silos/cold storage as market sub-yards and the launch of the National Market for **Agriculture**.

1. APLM should be adopted by all states as expeditiously as possible.
2. Amend Essential Commodities Act
3. The Essential Commodities Act, which has proven a disincentive to large investment in agricultural technology and infrastructure, should be replaced with a modern statute that balances the interests of farmers and consumers.

Stable export policy:

In consultation with all stakeholders, the Government of India should come up with a coherent and stable agricultural export policy, ideally with a five to ten-year time horizon and a built-in provision for a mid-term review. Efforts should be made to achieve this urgently.

Price realization

The government should consider replacing the Commission on Agricultural Costs & Prices (CACP) by an agriculture tribunal in line with the provisions of Article 323 B of the Constitution. NITI Aayog should set up a group to examine the following:

Replacing the minimum support price (MSP) by a minimum reserve price (MRP), which could be the starting point for auctions at minds separating the criteria for MSPs for

- (i) surplus produce;
- (ii) for deficit but globally available products; and
- (iii) for products that are in deficit both domestically and globally.

Examine options for including private traders operating in markets to complement the minimum support price regime through a system of incentives and commission payments. Raising MSP or prices can only be a partial solution to the problem of assuring remunerative returns to farmers. A long-term solution lies in the creation of a competitive, stable and unified national market to enable better price discovery, and a long-term trade regime favourable to exports.

- (i) **Agriculture advisory service:** An effective and technology driven Agriculture Advisory Service may be considered on the lines of those of the United States Department of Agriculture (USDA) and the European Union (EU). The mandate would be to ensure that farmers adopt an optimal cropping pattern that maximizes their income.
- (ii) **Futures trade:** Futures trade should be encouraged. Removal of entry barriers to increase market depth should be considered.
- (iii) **Crop insurance:** PMFBY needs to be modified to Promote weather-based insurance. Increase non-loaned farmers' insurance coverage. Allow for mixed cropping and increase the number of crops notified. Contract farming Encourage states to adopt the Model Contract Farming Act, 2018: Contract farming can be thought of as a form of price futures. The contract will specify the price and quality at which the farmers' produce will be purchased. This protects the farmer in cases where prices fall below the MSP (NITI Aayog, 2018).

6. Land Aggregation

Encourage states to adopt the Model Agriculture Land Leasing Act, 2016: The Model Act aims to improve land access to small and marginal farmers through land leasing, whilst also providing for a mechanism for tenants to avail of institutional credit. A major constraint to land leasing under the present regulatory environment is the un-willingness of landowners to lease out land due to fears of land capture by tenants. The Model Act spells out the rights and responsibilities of both landowners and tenants. Like the Model Contract Farming Act, 2018, this Act too contains provisions for dispute resolution within a specified timeframe.

Digitize land records: Complete digitization of land records is a must for effective implementation of land leasing. Geo-tagging, along with location agnostic online registration of land records to generate updated land records, must be carried out.

Promote farmer producer organizations (FPOs): There are now 741 FPOs in the country, managed under the aegis of Small Farmers Agribusiness Consortium (SFAC). They have demonstrated that aggregating farmers can help achieve economies of scale. The benefits accorded to start-ups under the Start-up India Mission need to be extended to FPOs as well. National Bank for Agriculture and Rural Development (NABARD's) model of joint liability groups can be promoted to channelize small growers into the value chain.

7. Research & development

Focus on precision agriculture: Support research on energy friendly irrigation pumps, micro irrigation, climate smart technologies, internet of things (IoT), and use of technology in animal husbandry to monitor animal behaviour, health and production to prepare for future challenge

Rise research spending: Research spending, currently at 0.3 per cent, needs to be increased to at least 1 per cent of agricultural GDP (Suresh Vadranam, 2024)

Create a knowledge hub to disseminate best practices: It is essential that new technology be adopted at the farm level. The performance of 'Krishi Vigyan Kendras' (KVKs) should be regularly reviewed by external agencies and well performing KVKs must be strengthened to disseminate best practices at the field level.

Develop models of integrated farming: Research so far has focused on practices for individual crops or enterprises. The Indian Council of Agricultural Research (ICAR) and State Agriculture Universities (SAUs) should focus on providing recommendations across the farming value chain, covering production, post- production, processing and other value- addition activities.

Innovation several breakthroughs have the clear potential for quickly doubling farmers' income. One is the recorded success of zero budget natural farming by Subhash Palekar. It is now being adopted across the country and providing notable increases in farmers' net income by sharply reducing costs of production and improving incomes by raising yields and improving the quality of agricultural produce. Two, there are patented herbal inputs that improve soil quality and make plants more pest resistant. These herbal inputs, for which actual performance data is now available for a few thousand farmers, need to be applied across the country.

Three, rapid progress has also been made in organic farming techniques, which have also helped improve incomes of cultivators and dairy farmers. These should be carefully examined for possible application across the country.

Non-farm income Moving labour out of agriculture into manufacturing will go a long way towards the goal of doubling farmers' income.

Nearly two- thirds of rural income is generated in non- agricultural activities. In non-agricultural activities in rural areas, another avenue is shifting farmers to agro-business and farm-related skills which are currently in short supply. Create and nurture agripreneurs for achieving greater value addition through agro-processing and propagation of modern extension services.

India will also have to accelerate growth in the manufacturing, services and exports sectors to wean labour away from agriculture. This will result in higher productivity and income for farmers.

7. Conclusion and Policy Recommendations:

"Policy makers will thus need to initiate and/or conclude policy actions and public programs to shift the sector away from the existing policy and institutional regime that appears to be no longer viable and build a solid foundation for a much more productive, internationally competitive, and diversified agricultural sector.

1. ornamental agricultural productivity, competitiveness, and rural growth
2. Promote new technologies and reforming agricultural research and extension: Major reform and strengthening of India's agricultural research and extension systems is one of the most important needs for agricultural growth. These services have declined over time due to chronic underfunding of infrastructure and operations, no replacement of aging researchers or broad access to state-of-the-art technologies. Research now has little to provide beyond the time-worn packages of the past. Public extension services are struggling and offer little new knowledge to farmers. There is too little connection between research and extension, or between these services and the private sector.
3. Recuperating Water Resources and Irrigation/Drainage Management: Agriculture is India's largest user of water. However, increasing competition for water between industry, domestic use and agriculture has highlighted the need to plan and manage water on a river basin and multi-sectoral basis. As urban and other demands multiply, less water is likely to be available for irrigation. Ways to radically enhance the productivity of irrigation ("more crop per drop") need to be found. Piped conveyance, better on-farm management of water, and use of more efficient delivery mechanisms such as drip irrigation are among the actions that could be taken. There is also a need to manage as opposed to exploit the use of groundwater. Incentives to pump less water such as levying electricity charges or community monitoring of use have not yet succeeded beyond sporadic initiatives. Other key

priorities include: (i) modernizing Irrigation and Drainage Departments to integrate the participation of farmers and other agencies in managing irrigation water; (ii) improving cost recovery; (iii) rationalizing public expenditures, with priority to completing schemes with the highest returns; and (iv) allocating sufficient resources for operations and maintenance for the sustainability of investments.

4. Facilitating agricultural diversification to higher-value commodities: Encouraging farmers to diversify to higher value commodities will be a significant factor for higher agricultural growth, particularly in rain-fed areas where poverty is high. Moreover, considerable potential exists for expanding agro-processing and building competitive value chains from producers to urban canters and export markets. While diversification initiatives should be left to farmers and entrepreneurs, the Government can, first and foremost, liberalize constraints to marketing, transport, export and processing. It can also play a small regulatory role, taking due care that this does not become an impediment.
5. Promoting high growth commodities: Some agricultural sub-sectors have particularly high potential for expansion, notably dairy. The livestock sector, primarily due to dairy, contributes over a quarter of agricultural GDP and is a source of income for 70 percent of India's rural families, mostly those who are poor and headed by women. Growth in milk production, at about 4 percent per annum, has been brisk, but future domestic demand is expected to grow by at least 5 percent per annum. Milk production is constrained, however, by the poor genetic quality of cows, inadequate nutrients, inaccessible veterinary care, and other factors. A targeted program to tackle these constraints could boost production and have good impact on poverty.
6. Developing markets, agricultural credit and public expenditures: India's legacy of extensive government involvement in agricultural marketing has created restrictions in internal and external trade, resulting in cumbersome and high-cost marketing and transport

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Citation: Dr. Ashutosh 2026. "Retrospect and Prospect of Indian Agriculture Economic Policy Reforms, Trends and Challenges-An Overview". International Journal of Academic Research, 13(2): 66-76.

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