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Agriculture and Public Policy in India – Recent Trends and Future Directions

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ABSTRACT

Agriculture plays a pivotal role in India's economy, providing employment to a significant portion of the population and contributing to the country's GDP. Public policy in India has historically focused on addressing challenges faced by the agricultural sector, such as land fragmentation, inadequate infrastructure, and low productivity. Over the years, agricultural policies have aimed at improving food security, ensuring fair prices for farmers, and boosting rural development. However, India's agricultural sector continues to grapple with issues like climate change, water scarcity, and the economic distress of farmers. This paper explores the evolution of agricultural policy in India, analyzing key reforms, their impact on rural livelihoods, and the ongoing policy debates surrounding subsidies, irrigation, and market access. It further examines the role of government initiatives such as the Pradhan Mantri Fasal Bima Yojana (PMFBY), National Agriculture Market (e-NAM), and minimum support price (MSP) systems in enhancing productivity and reducing farmers' vulnerability to market fluctuations. The paper also highlights the need for sustainable agricultural practices, the role of technology in improving agricultural outputs, and the importance of aligning public policy with environmental concerns to ensure long-term food security and economic stability.

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I. INTRODUCTION

Agriculture has long been the backbone of India's economy, engaging over 50% of the population and contributing significantly to the nation's GDP. As one of the largest producers of food grains and cash crops globally, India's agricultural sector is vital not only for food security but also for rural livelihoods and national economic growth. However, despite its importance, Indian agriculture faces numerous challenges, including fragmented landholdings, inadequate infrastructure, poor access to markets, and vulnerability to climate change. The policy landscape has thus played a critical role in shaping the development of this sector.

In India, public policies related to agriculture have evolved over time, transitioning from early post-independence focus on land reforms and food security to more modern concerns about sustainability, farmer welfare, and technological adoption. The Green Revolution, initiated in the 1960s, marked a significant policy shift towards increasing food production through high-yielding varieties and chemical inputs. Since then, numerous reforms have been implemented to support farmers, enhance agricultural productivity, and ensure food security.

However, despite various policy interventions, challenges remain. Small landholdings, lack of mechanization, dependency on monsoon rains, and fluctuating market prices continue to hinder agricultural growth. The distress of farmers, manifested through agrarian protests, indebtedness, and low income levels, has become a pressing issue in recent years. Furthermore, the debate over Minimum Support Price (MSP) policies, direct benefit transfers, and agricultural subsidies continues to shape policy discussions.

This paper aims to examine the evolution of agriculture and public policy in India, with a focus on major reforms, current challenges, and future policy directions. It will explore how government initiatives, such as the Pradhan Mantri Fasal Bima Yojana (PMFBY), e-NAM, and MSP, have impacted the sector, as well as the need for more sustainable and farmer-centric approaches in policy formulation. Understanding the intricate relationship between agriculture and public policy is essential for crafting strategies that ensure the long-term viability and growth of India's agricultural sector.

II. OBJECTIVES OF THE STUDY

The primary objectives of this study on Agriculture and Public Policy in India are:

1. To Analyze the Evolution of Agricultural Policies in India:
   - To examine the historical development of agricultural policies in India since independence, highlighting key reforms and their impact on agricultural growth and rural development.

2. To Evaluate the Effectiveness of Current Public Policies:
   - To assess the impact of current agricultural policies, such as the Minimum Support Price (MSP) system, Pradhan Mantri Fasal Bima Yojana (PMFBY), and e-NAM (National Agriculture Market), on farmers' income, productivity, and market access.

3. To Identify Challenges Facing Indian Agriculture:
   - To explore the main challenges faced by the agricultural sector, including issues like land fragmentation, water scarcity, inadequate infrastructure, climate change, and the economic distress of farmers.

4. To Investigate the Role of Technology and Innovation:
   - To evaluate how technological advancements, such as precision

farming, digital platforms, and biotechnology, are influencing agricultural productivity and policy effectiveness.

5. To Explore Sustainable Agricultural Practices:
    - To examine the role of sustainable agricultural practices in public policy and their potential to address environmental concerns, ensure food security, and promote long-term agricultural growth.
6. To Propose Policy Recommendations for Future Development:
    - To offer recommendations for improving agricultural policies, focusing on farmer welfare, market integration, infrastructure development, and environmental sustainability.
7. To Understand the Social and Economic Impact of Agricultural Reforms:
    - To investigate the socio-economic impact of agricultural reforms on rural communities, particularly in terms of poverty reduction, employment generation, and income distribution among farmers.

Through these objectives, the study aims to provide a comprehensive understanding of the intersection between agriculture and public policy in India, as well as offer actionable insights for improving the sector's efficiency, sustainability, and inclusivity.

III. THEORETICAL FRAMEWORK

The study of agriculture and public policy in India can be framed using various theoretical perspectives from agricultural economics, public policy theory, and rural development. The following key theories and concepts form the theoretical foundation of this research:

1. Modernization Theory:
    - Modernization theory posits that the development of agriculture is a necessary step in the overall economic development of a country. It emphasizes the need for technological adoption, infrastructure improvements, and policy reforms to transform traditional agricultural practices into more efficient and productive systems. In the context of India, this theory explains the shift from subsistence farming to market-oriented agriculture through policies such as the Green Revolution and the promotion of high-yielding varieties and modern agricultural techniques.
2. Dependency Theory:
    - Dependency theory, in the context of agriculture, focuses on how developing countries like India may be trapped in a cycle of dependency on external markets, technology, and resources. This is particularly relevant in understanding how India's agricultural policies, while aiming for self-sufficiency, may inadvertently perpetuate dependencies, such as reliance on subsidies, imported technologies, or global market conditions. This theory can be used to analyze the limitations of India's public policies in creating truly self-reliant and resilient agricultural systems.
3. Agrarian Crisis and Marxist Theory:
    - Marxist theory, particularly the focus on class struggle and unequal distribution of land and resources, offers insights into the structural challenges facing agriculture in India. The agrarian crisis, characterized by rural indebtedness, low farmer income, and unequal access to resources, can be analyzed through this lens. Policies such as land reforms,

subsidies, and credit schemes aim to address these issues, but often face obstacles like ineffective implementation or failure to address deeper systemic inequalities.

4. Rural Development Theory:
    - Rural development theory highlights the interconnectedness between agriculture and broader rural development goals, such as poverty reduction, employment generation, and improving living standards. The theory advocates for an integrated approach to development, emphasizing the need for infrastructural investment, education, healthcare, and access to markets to complement agricultural policies. In India, policies like rural employment schemes (MGNREGA) and rural electrification are key examples of how agricultural policies must be integrated into wider rural development strategies.
5. Public Choice Theory:
    - Public Choice Theory helps to explain the behavior of policymakers and the challenges in crafting effective public policies, especially when various interest groups (such as large farmers, agribusinesses, and political entities) lobby for their needs. In the case of India, the influence of various stakeholders, including farmers' unions, state governments, and private sector actors, often complicates policy formulation and implementation. This theory can provide insights into why agricultural policies like MSP or subsidy programs may have unintended consequences or become distorted by political considerations.
6. Sustainable Development Theory:
    - Sustainable Development Theory focuses on achieving long-term agricultural growth without compromising the ability of future generations to meet their needs. It emphasizes the balance between economic growth, environmental protection, and social equity. In the context of India, this theory aligns with the need for policies that promote sustainable agricultural practices, such as organic farming, water conservation, and soil health management, while addressing issues like climate change and resource depletion.
7. Institutional Economics:
    - Institutional economics examines how the formal and informal institutions (laws, policies, market structures) shape the behavior of individuals and organizations within an economy. In India, agricultural policies are often influenced by institutional factors like land tenure systems, market access, credit availability, and government institutions (e.g., Food Corporation of India, Agricultural Produce Market Committees). Understanding how these institutions function and interact helps to analyze the effectiveness of agricultural policies in addressing issues like market inefficiencies, farmer empowerment, and policy implementation gaps.
8. Behavioral Economics:
    - Behavioral economics looks at the psychological and social factors influencing farmers' decision-making. This perspective is useful for understanding the inefficiencies in agricultural decision-making, such as the tendency for farmers to continue using traditional practices even when

better options are available. Public policies targeting behavior change—such as insurance schemes, credit facilities, or awareness campaigns about new technologies—can be analyzed through this lens.

The theoretical framework for this study integrates multiple perspectives to examine the complex relationship between agriculture and public policy in India. It recognizes the historical, economic, social, and political dimensions of agricultural development while focusing on sustainable, inclusive, and efficient policy interventions. By utilizing these theories, the study aims to critically analyze the effectiveness of current agricultural policies and propose recommendations for future improvements.

IV. NEW POLICY INITIATIVES IN AGRICULTURE SECTOR

Agriculture being a State subject, Government of India supports the efforts of States through appropriate policy measures and budgetary allocation under various schemes/ programmes. The various schemes/ programmes of the Government of India are meant for the welfare of farmers by increasing production, remunerative returns and income support to farmers. For faster and wider development of agriculture in the country, in the new Government the Union Cabinet has approved following programmes:

1. Clean plant Programme: The Union Cabinet, approved the Clean Plant Programme (CPP) on 09.08.2024 with outlay of Rs. 1765.67 crore. The CPP aims to enhance the quality and productivity of horticulture crops by providing disease free planting material and will benefit dissemination and adoption of climate resilient varieties, with yield enhancement.
2. Digital Agriculture Mission: The Union Cabinet approved the Digital Agriculture Mission on 2.9.2024 with an outlay of Rs. 2817 Crore, including the central share of Rs. 1940 Crore. The Mission is conceived as an umbrella scheme to support digital agriculture initiatives, such as creating Digital Public Infrastructure, implementing the Digital General Crop Estimation Survey (DGCES), and taking up other IT initiatives by the Central Government, State Governments, and Academic and Research Institutions.
3. Progressive expansion of Agriculture Infrastructure Fund Scheme: The Union Cabinet approved the progressive expansion of Agriculture Infrastructure fund (AIF) on 28.8.2024 to enhance and strengthen the agricultural infrastructure in the country and support the farming community by expanding the scope of eligible projects and integrate additional supportive measures to foster a robust agricultural infrastructure ecosystem. Expanded scope includes allowing individual eligible beneficiaries for creation of infrastructure covered under 'viable projects for building community farming assets', integrated processing projects, convergence of PM Kusum 'A'.
4. National Mission on Edible Oils – Oilseeds (NMEO-Oilseeds): The Union Cabinet approved the National Mission on Edible Oils – Oilseeds (NMEO-Oilseeds) on 3.10.2024 with total outlay of Rs.10,103 Crore. It aims to boost domestic oilseed production and achieving self-reliance in edible oils. The Mission will be implemented over a seven-year period, from 2024-25 to 2030-31.
5. National Mission on Natural Farming: The Union Cabinet approved the National Mission on Natural Farming (NMNF) on

25.11.2024 as a standalone Centrally Sponsored Scheme. The scheme has a total outlay of Rs.2481 crore (Government of India share – Rs.1584 crore; State share – Rs.897 crore).

Moreover, following significant programmes have also been initiated during 2024-25.

i. National Pest Surveillance System (NPSS)

ii. AgriSURE – Agri Fund for Start Ups & Rural Enterprises

iii. Krishi Nivesh Portal (Phase –I)

iv. Krishi-DSS Portal – A Geospatial platform for Indian Agriculture

v. Introduction of Voluntary Carbon Market (VCM) for various sustainable agriculture practices (GoI, 2024)

V. ROLE OF PUBLIC POLICY IN AGRICULTURAL DEVELOPMENT

To ensure sustainable development under the Robust China Project, appropriate public policy strategies need to be designed from an analysis of demographic and social changes that will occur over the span of the project. Although Law and Local Government have become increasingly concerned about ensuring the sustainability of their development activities, the constraints to sustainability have not been adequately examined from a social perspective. Making use of the Resource Interaction Model applied at the project level, a biophysical assessment of the impact of population growth and social change on water resource development under the project suggests that a dependency on a single crop area may lock a large proportion of the population into poverty, degrading the very resource on which the population depends (Paul Sharma, 1970).

The implications for poverty and welfare raise the issue of appropriate interventions through public policy decisions. The development of a biodiversity matrix that examines the characteristics of 2803 biological species in terms of their unique potential to provide a range of resources or services of value to rural communities indicates constraints on the ability to respond effectively. Rural like villages pursuing livelihood in agriculture has a direct dependence on the land to meet their needs for food, fodder, fuel, and building materials and increase their income through sale of produce. Consequently, the ability of the system to harness the potential of the biota of biodiversity hinges on the landholding of resource that rural like community controls, which may well be inadequate (Motkuri, 2012). Broad policy implications of the demographic and social analysis highlight the role of micro-family planning and agricultural technology innovation at the household level as a mechanism for breaking the link between demographic and social change inducing the loss of natural resources and the associated decline in welfare.

VI. POLICIES FOR SUSTAINABLE AGRICULTURE

The need to transition to sustainable agricultural practices is increasingly being recognized in India, as in the rest of the world, under the rubric of environmentally friendly and resource-conserving practices. Nonetheless, the initiatives in that direction remain largely at the level of policy pronouncements and their implementation is yet to begin. Nevertheless, recent years have seen the declaration of a number of policies designed to promote organic agriculture, agro-ecology, and the conservation of agri-biodiversity. The fact that these new provisions have been enacted both at central, i.e. federal, level, as well as by some states, intensifies the need for thorough analysis of this new policy environment. The main objective of these policies is to provide support to farming communities, particularly smallholders and tribal populations relying on

local seeds and traditional practices, in their endeavor to maintain their agriculture and seed conservation practices. The primary aim is to stimulate demand from below, i.e. facilitate the efforts of farmer organizations, municipalities and other local bodies to engage in sustainable agriculture and for this purpose to build up their knowledge and capacity. The activities will broadly focus on farmer-to-farmer training, seed conservation, and landrace exchanges, as the first step to take up diversified agriculture, ensuring an increasing share of local crops on the local markets. As the new provisions are already in place, the rest of the text will focus on the assessment of the possibilities to implement the above envisaged activities, emphasizing what needs to be done at the level of government, farmer organizations and other stakeholders, and how can they intensify their efforts. It will also critically evaluate the constraints to policy implementation, and review what kind of support from the national authorities is essential to facilitate this process and make it sustainable. There are already clear difficulties on the way, primarily of financial nature, but also related to the regional and local unevenness in the overall awareness and the readiness, i.e. capacity, of the different sets of actors. When and how regional and local disparities, as well as the farmers' level of awareness and access to relevant education, get integrated in the process, the overall analysis should contribute to the better understanding of the ways in which locally adjusted policy can be developed in order to adequately address the urgent needs of the poorest regions and states in terms of sustainable agriculture and wider biodiversity. Farmers in those regions do not practice the desired cultivation technique, the relationship proved to be highly significant and negative. More educated farmers were also less likely to sell part of the crop, which strengthened the above-mentioned interpretation related to the importance of knowledge/education in the successful pursuit of sustainable agriculture. Thus, overall, there is urgent need for a policy approach that will address the need for combining, in a comprehensive manner, agricultural, environmental, and to a certain extent also broader economic and societal goals. Such an approach should closely link various activities at the levels of policy-making, knowledge and educational support, as well as advocacy. Further, since the above mentioned components belong to the arenas of both agriculture and science, they should rely on interdisciplinary collaboration. Governments should also ensure that measures which will make agricultural economics work in favor of sustainable agriculture are taken as a matter of priority.

VII. INVESTMENT IN AGRICULTURAL RESEARCH AND DEVELOPMENT

India's future agriculture will depend on innovation. Challenges range from the impacts of climate change on historical cropping patterns and seasons to issues related to declining soil health, pest and disease incidence, and water availability. There is also the "food-water nexus" social issue of agriculture competing with urban and industrial use for the same water resources. Resolving these multifaceted challenges will require investing in agricultural research and extension at higher levels than at present.

This chapter examines recent investments, current R&D activities, and institutional arrangements for funding agricultural research in India, and the strategies adopted by researchers and policymakers to use this funding effectively. Recent initiatives point the way to needed changes to a still-evolving system also grounded in the global experience. Sustainable crop productivity growth has largely been the result of public investments in agricultural research and development (R&D), beginning in the 1960s. Initial yield growth was achieved in cereals and focused on Triticum

aestivum, Oryza sativa, and Zea mays. The principal means for this increasing productivity were the development and dissemination of package technologies encompassing high-yielding varieties, irrigation and other inputs, and, more recently, mechanization and integrated pest management. However, in the absence of policy attention, this yield growth has plateaued (K Joshi et al., 2005). Given the considerable promise of alternative health benefits in a period of rapidly increasing concern over obesity and changing dietary habits, pulses seem a natural focus of further R&D attention. Through public, public-private, and PPPs, recent research appears to show potentially productive avenues for such investment that others might build upon. The paper also examined the ways in which extension methods need to adapt in order to scale up technological solutions and involve farmers more closely in the research process.

VIII. IMPACT OF PUBLIC POLICY ON FARMERS

India became independent more than 70 years ago. It inherited a large number of poor people, some of them involved in agriculture. Agricultural growth was expected to lift their income. The state had an important role in getting the growth right for them. Equally importantly, these farming people, who were then the majority, received serious public attention. In today's urbanized times, they are still a large number, perhaps around 50% or more of the households. Put differently, almost everyone in the country has either been a farmer, is the rural relative of one, or is supported by farming people. Good farmers have made a significant contribution to the development and urbanization of India. The latter are not always recognized, or rewarded, especially for the poor (Guthula et al., 2020). Urban, educated people outside this sector may therefore show attitudes towards agriculture that are dismissive, disconnected, or harsh. To counter this exclusion, the decisions that city-based lawmakers, policy formulators, and urbanites make are illustrated. This involves a general and comprehensive examination of agricultural strategies and practices. The main concern is, of course, the impact of these policies on farm income, lifestyle security, and social welfare, the last two being broader matters of cohesive and equitable societies.

A badly structured public policy can, in particular, impair the financial and input resources available to farmers. This will contribute to rural poverty if farmland is not sufficient or if there are public and private limitations on other livelihood options. For rural populations, these include smallholder and farming landless households (who depend on leasing access to land). Investment in education and health for poorer rural residents is critical to moving them out of the poverty trap. However, there is also a broad national context. Domestic tariffs and government spending can have a profound effect on Indian agriculture. For example, India allows the highest agricultural tariffs in the world, and some crops receive heavy price support. Many citizens oppose free trade in some areas, but it can also benefit domestic agriculture by enhancing efficiency. The flow of money is obviously important, for both inter-governmental trade and assistance. This includes exporting crops that have high aid, credit, or preferential demand (Bandhu, 2009). Farmers and rural populations that live close to markets also benefit significantly. Protectionist strategies, on the other hand, reduce these financial flows. In a world of open trade, economic feasibility is therefore in the right place, but it also depends on successful lobbying. Finally, in the larger analysis of the country policy, gender-specific challenges for women farmers are often ignored. A magisterial study of global gender disparities shows that women are disadvantaged compared to men in every nation (as farmers, agri-producers, wage earners, and entrepreneurs), except in a few Oceania exchanges. In many countries, most

notably in South Asia and parts of Africa, the gender-based disparity in agriculture is making strides. As a result, investment plans focused on women are likely to significantly increase agricultural prosperity. Unfortunately, current policies and study do not take proper account of gender challenges. This means that women farmers in developing countries are less able to withstand increasing climate crises (their efforts to engage in sustainable, protective agriculture are therefore particularly important). In addition, findings show that the rates of return to women farmers are 33% higher than those for men farming. Rough estimates suggest that filling the gender gap by this sum could result in a 2.5–4% growth in GDP by developing countries. To hold it on the radar, by increasing agricultural resources, income, and savings, a new concern should be to abet women farmers to meet the necessary protective steps better. Finally, field data on the implementation of public policies and its effects on farmers are lacking. Discussing a few cases can help provide a broader knowledge. However, winning some luck, pat legitimacy is barely expected to be tested.

IX. INCOME AND LIVELIHOOD SECURITY

Agriculture not only supplies the necessary food to the populace but also supports low technology-based labor extensive employment in rural areas. The slowdown in agriculture will result in the deceleration of the large workforce available in this sector. Traditional agriculture-based textiles and industries, rural development expenditures, well-being programs for socially disadvantaged groups in rural areas are adversely affected by a slowdown in agriculture. Rising demand for food grains and non-food grains due to demographic pressure is unlikely to be met from available resources. The limited availability of land and irrigation facilities is likely to reach a point where the dependency on agriculture only as a means of subsistence becomes enormity.

Though there is a composition change in labor from agriculture to other sectors, a large workforce will always remain in agriculture, if not raised. Larger export orientation to gather more resources from agriculture does not reduce the economic viability of agriculture, but on the other hand brings a 'Two Children Theory' of population management into agriculture (Guthula et al., 2020). Productive commercial orientation, rather than the sustenance one, must be the basis for the economic viability of agriculture. The necessary policy issues that have to be considered in raising this kind of productivity from agriculture to reduce poverty are also divided into developmental and protective policies. A two-stage modelling approach is adopted in considering these two sets of policies, to predict their effects on economic, financial aspects, dynamical balance between region, riceland, workforce, and to explore tradeoff between viability and sustainability, the conditions for better agricultural performance and a comparative perspective. Agro-based industries must be rationalized. With the liberalization of imports of essential commodities, the domestic industries and commercial agriculture must improve productivity and hence viability (Bandhu, 2009).

Agricultural policy is inherently complex, but useful insights can be gained through the identification of dominant effects. The inadequate understanding of varying attitudes about agricultural policy work among farmers; landowners, agribusiness people etc in a developing country such as India impedes the meaningful formulation and execution of appropriate policy changes that would stimulate investment, improve resource use etc. This study presents an agent-based simulation model for the agricultural sector and utilizes it to analyze 3 possible policies changes and related outcomes. Model development begins with an overview of the most salient features of the troubled sub-sector considered. This is

followed by a more detailed look at agent definitions and the algorithm that drives their normative behavior. Model calibration is tackled in data preparation and ends with a discussion of scenarios, experiments and results.

X. SOCIAL WELFARE AND INCLUSION

Social welfare and inclusive growth need to be an integral part of any society. The evolution of society years after years demands that the marginal group of the society needs to be accommodated in the growth story of the society. India, the world largest democracy has a unique feature of having a very resurgence farming community with 75% dwelling in the countryside and also the growth of Indian economy and GDP is very much dependant on the agriculture which is providing the occupation to about 58% of total population of the country reeling 22% of the total GDP till today (Kumar, 2017). Here dwells the importance of Agricultural policy and various welfare schemes that effect the dividends of agriculture. Any policy or scheme if it touches the root of agriculture, the farmers economic paradigm, improvement in productivity and the standard of living of farming should be the core and to add that the agricultural policies are not only the farmer centric but should have a larger dimension extending variable benefits to the other economic agents also. Agriculture policy is a unique policy with confluence of various cross-cutting schemes which effect the producer of the class as well as affected by the one of the beneficiaries of these policies. The policies have an implication of distribution of resources or input subsidies or prices support or the technological support.

A number of the Indian Farmers decades after decades and still hibernating under the social vice, economically feeble and low development domains. The comparisons of their socio-economic stakeholders with national average counterpart suffice a sorry state of affairs. There is a deep rooted existence of inequity and disparities in the social power structure of the Farmer's society based on gender, social origin and so called as Caste hierarchy, Hierarchical structure of this society are rigid and perpetuation on generation to other. During decades the people are considered as backward man make autonomous group. Only Bombay high court order on 1992 forced to non-state look seriously to include these communities. This is why the need of welfare-economic policies and scheme where these marginal groups can also empower them. Recently, many successes stories of the farmers have been observed throughout the nation where they empowered through inclusive policy or scheme. There is a stronger need for agriculture to show the success of these groups. On basis of a deeper and wider analysis, the broader dignity of equitable and inclusive development will be established for an equitable and development by the delivery of more power and self-respect to the presently marginalize peoples.

XI. FUTURE DIRECTIONS AND RECOMMENDATIONS

Sri Ravi Agrawal showed his kind support to agriculture by mentioning Indian farmers' achievements in respect of food grains. It is argued that the Indian farming community deserves not only appreciation but also effective and speedy support. The learning and technology of India indicate the potential power of the Indian farmer. The government, public society and farmers' organizations should come forward to furnish effective support. The agriculture of India at this time is in a dynamic phase. The green revolution strategy adopted in the mid-sixties has greatly improved agriculture and food grain production quickly through the use of high yielding varieties (Singh et al., 2013). The government of India improved the agri-infrastructure immensely both for production and for research and development

in agriculture. But now the green revolution technology is faced with the problem of rise in input cost and stagnation in productivity, particularly in the case of land. The farmer's use of input cost, such as chemical fertilizers and pesticides further troubles him with the problem of soil and environment. Thus, a new amicable 'Eco-technology' for farming and farmers should be developed and adopted by the farming community. Government controlled or restricted use of chemical fertilizers and pesticides by the farmers' community lead to poor development and is misleading. Hence the government should come forward and encourage farmers' participations in policy-making. It is also mentioned that the 'PMO', state agriculture ministries and education ministries have not forged education knowledge and technology to augment the farmers' practices. Alternately there should be a platform whereby the concerned and associated people, as well as departments, may assemble. Co-incidentally radio, TV, press and the farmers' mass media are also effectively endorsing the platform. This triangular inspection may broaden the base of the farming community, and technologies, knowledge, religious practices may be handed over to the very final user more quickly and effectively.

XII. TECHNOLOGICAL INNOVATIONS IN AGRICULTURE

Technological innovations are believed to play a pivotal role in transforming agriculture, both by augmenting productivity growth and by enabling the creation of a sustainable, resource-efficient agriculture for the future. Recent technological advancements in agriculture will provide the dynamic force behind dramatic changes over the next decade. Precision farming, biotechnology, and the use of renewable energy sources are examples of innovations which are expected to be disseminated more broadly in the near future. Precision farming encompasses technologies and systems, which optimize the management of inputs in agricultural production with respect to the actual variability of the resources in space and time. Technologies to achieve these objectives include satellite-based information systems, unmanned aerial vehicles, geo-referencing systems, and variable rate technologies for fertilization, seeding, and spraying . Biotechnologies refer to a wide variety of methods that are used to improve the genetic make-up of plants. Abiotic stresses in crop production, for example, will be reduced by the development of plants which have low irrigation requirements. Similarly, pest-resistant plants will reduce the use of harmful chemical substances; and waste products can be utilized as a renewable energy source. However, a successful broad dissemination of recent technologies must take account of the complexity of agricultural systems, a high diversity of public and private interests, an asymmetry of knowledge, and a public good character of new technologies.

Technologies have to be adapted successfully to the needs of existing agricultural practices, taking into account the specific economic and environmental conditions under which farmers work. This is of particular importance when technological change in agriculture involves potentially more complicated or risky procedures. Such activities imply high start-up costs which discourage farmers from adopting technology. Moreover, sometimes investment in new equipment involves the acquisition of knowledge and skills which are not available at present; Experiences in the context of Precision Farming show that these barriers can be very serious, and overcoming them requires both technical and organizational solutions. Technical problems might be linked to the unsuitability of technology given the local agro-climatic conditions or might arise due to significant differences in production know-how; organizational difficulties often concern the

involvement of a large number of actors with responsibility for specific tasks, which must be acted out in a temporal sequence. These barriers can be addressed by a sound management of the technology dissemination; but it is crucial that adoption initiatives have a multi-level and multi-actor perspective. On the one hand, the scientific and industrial sector must provide easy-to-use information and equipment which takes into consideration the particular local context. On the other hand, successful implementation of technology needs the mobilization of farmers, which usually involves cooperation and institutional support. Finally, decision-makers must recognize the priority role of initiatives in the dissemination of technology and act with determination in creating a favorable institutional framework by investing in physical infrastructure or by supporting public-private partnerships.

XIII. POLICY REFORMS FOR SMALLHOLDER FARMERS

At 95 million, smallholder farmers comprise the overwhelming majority of the Indian peasantry (Singh et al., 2013). It seems quite surprising, therefore, with the policy commitment of successive governments in India and elsewhere in favor of smallholder farms, how they still prevail given the range of fiscal resources, scientific knowledge, physical assets, and many other inputs they lack to be competitive in a rapidly changing technology and market context (Aliber & Hall, 2012). Smallholder farms, in most cases, are not financially viable as the costs of cultivation are higher than their net returns. They mostly rely on local labor and little or no mechanization, have large variations in crop types and production practices, and the level of cultivation has significant influence on their farming decisions. Also, these farms are traditionally conservative in adopting new technology, both in terms of investment capital and in adoption decisions. The financial viability of smallholder farms not only depends on the costs of cultivation on them but also on the stability in their income generation or prices of their produces. On the other hand, large size farms are operationally managed more professionally due to the infusion of graduates and post-graduate persons in the agriculture sector, especially since liberalization and open global markets. Therefore, it's crucial to investigate and choose evolving outcomes in crop types and farmers' practices of smallholder (95 million of the total Indian farmers) and large and medium size (five million) farms for the sustainability of Indian peasantry in the next few decades keeping in view the changes taken place after the globalization in 1991.

Besides, there is a distinct lack of consensus, often reflecting conflicting interests, as to what should be the content and nature of 'support' of smallholder agriculture. The same term often means different things to different people. Equally, commentators tend to draw attention to successes or to failures, case studies, and case studies in support of often strongly held ideological or disciplinary positions. At the same time, current policies and programs, both government and non-governmental toward smallholder agriculture are coming under increasing and widely varying scrutiny. It is in this context that a new research project has been initiated to focus on support for smallholder farmers.

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