Agricultural Transformation in India:

Issues, Challenges and Possibilities

Edited by:
Dr. Siddaraju V.G.

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FOREWORD

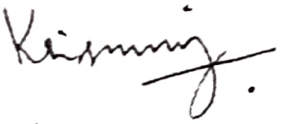
India's agriculture sector is at crossroads which is mainly due to structural transformation in the agriculture sector which is intertwined with change in agriculture policy and dynamics of nature of natural resource use and institutional reforms. India's agricultural policies aimed at realising food sufficiency have achieved tremendous success with record food grain 330 million tonnes (MT) in 2022-23. This has been attributed to change in technology and resource use efficiency to realise more agricultural productivity. The institutional reforms undertaken by the government is unparallel to support agriculture and the farming community in India which include land reforms, augmentation of water, providing agriculture credit and extending crop insurance, assisting farmers to market their produce apart from providing minimum support price. All these factors, agricultural policies, change in resource use pattern, and institutional reforms have significantly contributed for the diversification and transformation of agriculture sector in India. However, the Indian agriculture sector faces new issues and challenges which need to be addressed given the challenges of sustainable development. Major three issues and challenges of agriculture sector in India are production and productivity related risks and uncertainty, unpredictable market risks and uncertainty, and climate change vulnerability risks and uncertainty. The first and foremost challenges is the natural resources such soil, water, biodiversity, and agro-climate are under tremendous pressure which would limit agriculture production and productivity as they are highly influenced by the quality of soil, availability of water and influence of climate change. In this context, the risks and uncertainty in agriculture is not only influenced by the gambling with monsoon, but now with climate variations such as frequent droughts, torrential rains, floods, pest attacks and market uncertainty. High degree of risks and uncertainty are growing manifold despite institutional support which cannot match or equate them. As a result, many small and marginal farmers (22.50 per cent) live below official poverty line. Large areas of agricultural land are facing depletion and degradation due to excess application of chemical fertilizers and pesticides. India's agriculture is also facing water scarcity and stress with growing use of water for competing uses

such as domestic water, industrial needs, and environmental needs. Climate change has become a major challenge for the small and marginal farmers as their ability and willingness to adapt to the climate change is highly limited. Further, the costs of cultivation are rising with application of more inputs and plummeting profits with unpredictable market forces. As a result, achieving sustainable development in agriculture sector in India is a major challenge midst of agriculture success in production. High dependence on agriculture sector India for meeting livelihood needs need to be addressed with diversification of agriculture and compelling surplus labour to move to the Industrial and tertiary sector. Doubling of farmers income needs to be given a new shape by extending minimum support price, handholding farmers in marketing of agricultural produce, provide crop insurance at the time of crop loss, besides helping farmers to adapt to the climate resilient agriculture. Enhancing the quality of natural resources with change in agricultural practices towards soil, water, biodiversity through adoption of natural and organic farming may have more chances of reducing risks and uncertainty. Government has responsibility to facilitate agricultural diversification and transformation towards sustainable agriculture in the 21st century to face all these challenges.

In this backdrop, I am happy to pen a foreword to the edited book titled "Agricultural Transformation in India: Issues, Challenges and Possibilities" which is timely and appropriately deals with above issues and challenges faced in the agriculture sector in India. The edited book is collection of 25 research papers. Several scholars have contributed a field-oriented research articles to the edited volume on various aspects of India's agriculture transformation. The researchers focused on the contemporary but diverse issues faced by the agriculture sector in India, they can be grouped into agriculture production, productivity and cropping pattern, agricultural transformation and sustainable development goals, crop insurance, skill development, doubling of farmers income, agricultural practices and indigenous knowledge, natural and organic farming, climate change and adaptation in agriculture sector, FPO and marketing of agricultural produce.

The editor, Dr Siddaraju, V G, Associate Professor, Centre for Study of Social Exclusion and Inclusive Policy, University of Mysore, Mysuru have taken lot of efforts to put these useful articles on important themes and issues surrounding India's agricultural transformation in India. The authors of the research papers presented their papers during the two-day national conference on the above theme and got several useful suggestions and comments from the subject expert to improve the quality and content of the papers. With this rich material I am quite sure that the edited book will be of great use to the policymakers, researchers, and students.

Wishing the editor and the edited book all the Success.



(Dr. Krishna Raj)

PREFACE

Agricultural transformation is more than changes in farming practices. It is about accelerating the transformation of the country's rural economy. Agricultural transformations often focus too much on volume rather than value and on productivity of row crops rather than opportunities for high-value crops, downstream processing, and livestock. Farmers are businessmen everywhere. Farming households in developing countries balance a portfolio of crops, livestock, and nonfarm work. Because they feed their families with some farm produce and sell it to markets, they make decisions based on their potential profit, risk, and cash flow across family food consumption and sales. Too often, agricultural plans recommend particular commodities without paying attention to this basic calculus of farmer household economics. Successful agricultural transformation plans give farmers the opportunity to increase their household incomes.

I would like to express my heartfelt thanks to all the authors who have enriched the book by contributing their learned papers. I also thank Prof. Muzaffar H Assadi, Vice-Chancellor and Smt.V.R. Shylaja, Registrar, University of Mysore, Mysuru for their never ending encouragement and logistic support. I thanks to faculty members and Non-Teaching Staff of CSSEIP and Department of Anthropology, University of Mysore for their support. We acknowledge all others who have supported and assisted directly and indirectly for the completion of this work. I also grateful to the Grabs Educational Charitable Trust®, Chennai for publishing this edited book.

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Positive Implications of Agroecotechnology and Indigenous Practices on Indian Agriculture under Climate Change Regime: A Systematic Review

Rakshith H and Nidhi V

Introduction

India is one of the largest and most important agricultural countries in the world, with a long history of farming and agricultural practices. The sector plays a crucial role in the country's economy, with over 50% of the population relying on agriculture for their livelihoods. Research has shown that India is the largest producer of milk, jute, and lentils, and the second largest producer of wheat, rice, fruits, and vegetables (Food and Agriculture Organization of the United Nations, n.d.). The impact of government interventions on agriculture in India is huge and the investment in agriculture & rural infrastructure has been effective in increasing crop yields and improving the livelihoods of farmers (Kumar, D., & Shah, A. 2018). There is also a recommendation for a multi-disciplinary approach to addressing the country's agricultural issues (Jain, S. K., & Kundu, R. 2015). India's importance in the global agricultural landscape cannot be overstated, and continues to play a vital role in ensuring food security and driving economic growth in the region with its wealth of efficient indigenous practices followed from centuries long.

However, the effects of climate change on Indian agriculture and economy are significant and far-reaching especially in the recent years. Changes in temperature, rainfall patterns, and weather extremes have a

significant impact on crop production and agricultural practices in India (Kurien, J., & Singh, A. 2016) leading to declining yields and reduced income for farmers hindering their growth. The climate change influence on Indian agriculture was studied under the National Innovations in Climate Resilient Agriculture (NICRA). The crop yields in India are projected to reduce significantly (Khatri-Chhetri, B., & Adhikari, B. 2016) posing a threat to self sufficiency coupled with reduction in GDP (Ministry of Agriculture and Farmers' Welfare, n.d.).

Objectives

The major focus of our review is about how incorporating the various facets of agroecotechnology such as precision farming, weather forecasting, technologies for efficient water utilization, focus on soil health, developing climate resilient crops etc., coupled with indigenous practices and efficient policy making by government which in this juncture, will be proven inevitable and also as a potential solution to mitigate the climate change effect and maintain the yield rate which implies a huge scope in rural development.

Methods

We intent to focus on pragmatic consequences of agroecotechnology along with indigenous farming methods under climate change conditions. Land use in India for sustainable agricultureis highly diversified, it is about 60.22% as agriculture land share of land area in India (Ministry of Agriculture and Farmers' Welfare, n.d.).

Figure 1: Land use/ Land cover map for India

Source: The Annual Cycling of Nighttime Lights in India (CC BY 4.0)

Climate change is having a significant impact on agriculture, soil health, crop production and the lives of farmers around the world. These effects are detrimental as global temperatures continue to rise and weather patterns become more extreme and unpredictable. In order to mitigate this issue, several prime factors are brought up.

Precision farming

Precision farming is a broad management approach that uses technology to optimize crop yields, reduce costs, and minimize environmental impact. (Blackmore, Simon. 2016). This agriculture farming methodology is based on the idea of using data and technology to precisely measure and manage the various inputs and processes involved in agriculture (Abdul Hakkim,. et al. 2016). The intent is achieved by using a variety of technologies, including GPS, sensors, drones, and precision equipment, to collect data on things like soil fertility, weather patterns, crop growth, and pest populations. Cornerstone of precision agriculture is the use of variable rate technology (VRT) and sensors which allows farmers to apply inputs such as fertilizer and pesticides at specific rates based on the specific needs of different areas of the field (Akshay Mehta., & Monish Masdekar. 2018). This can help to reduce costs and improve efficiency, while also reducing the environmental impact on agriculture.

Soil moisture sensing technology

Soil moisture sensing technique is a key tool for improving agricultural productivity and water management in the face of changing climatic conditions. This technology uses sensors to measure the water content of soil and provides real-time information on soil moisture levels. The pivotal principle of soil moisture sensors are; tensioner method, neutron probe method, gamma- ray method, infrared remote sensing and dielectric method (Yu L M., et al. 2021).This information can be used to optimize irrigation scheduling, improve crop yields, and to reduce water waste. There are a variety of different soil moisture sensing technologies available, including capacitance sensors, time domain reflectometry (TDR) sensors, and neutron moisture meters.

One of the main advantages of soil moisture sensing technology is its ability to improve irrigation scheduling. By providing instantaneous information on soil moisture levels, farmers can optimize irrigation scheduling to apply water only when it is needed. Reducing water

waste and increasing crop yields (Bogena, H.R, Weuthen, A., & Huisman, J.A. 2022). Soil moisture sensing technology can also be used to monitor soil moisture levels in remote areas, such as in arid regions. It is one of the promising technologies till date in agriculture which should be further developed to achieve high-precision, low cost, non-destructive automated and highly integrated system (Yu L M., et al. 2021).

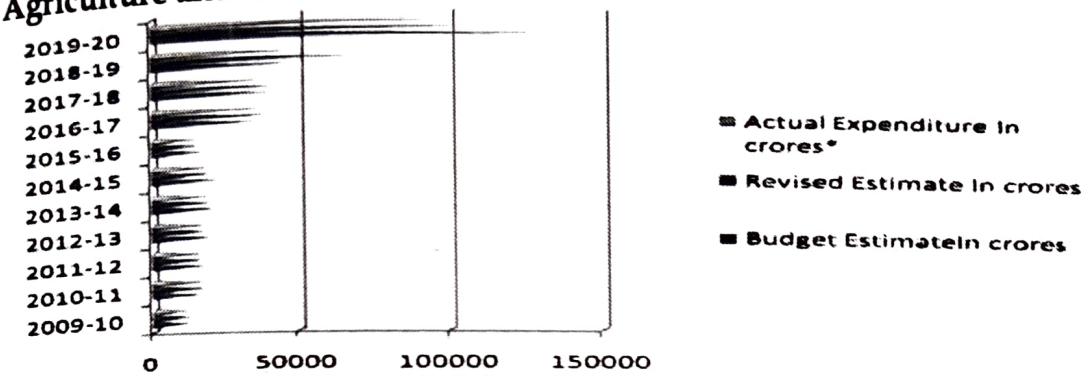
Indigenous Knowledge Systems

Indigenous knowledge systems (IKS) refer to the knowledge and practices that have been developed and passed down within a specific community that has immense potential for innovation in agriculture (Anwesha, Borthakur., &Pradeep, Singh. 2012). These systems are often based on the community's relationship with their environment, and they have been shaped over generations through observation, experimentation, and adaptation to local conditions. In India IKS have been an integral part of the agricultural practices in rural communities for centuries (Sow, Sumit., & Ranjan, Shivani. 2021). These systems have developed over time through the observations and experiences of local farmers, and they are based on the unique environmental and social conditions of the region. IKS along with leading to higher yields, also plays crucial role in the management of natural resources in rural areas and ensure communities have access to diverse range of nutritious foods. Soil health and soil carbon pool being dyad noteworthy components in agriculture can be signified by the grazing of native herbivores (Naidu, D. G. T., Roy, S., & Bagchi, S. 2022). Traditional farming practices, such as crop rotation and intercropping can help to conserve soil fertility and maintain the health of the ecosystem. It significantly proves to have momentous contribution in preserving cultural heritage and maintaining the social fabric of rural communities (Tharakan, J. 2017). The conventional practices and knowledge that make up IKS are often deeply ingrained in the culture and history of a community, and they can serve as a source of pride and identity.

Policy making

Agriculture is the backbone of India's economy with over 70% of the population dependent on it for their livelihood. (Syed Abrar Ahmed., et al. 2022). Thus, Government has announced the amount of ₹50,000 crores to alleviate the difficulties in agricultural sector.

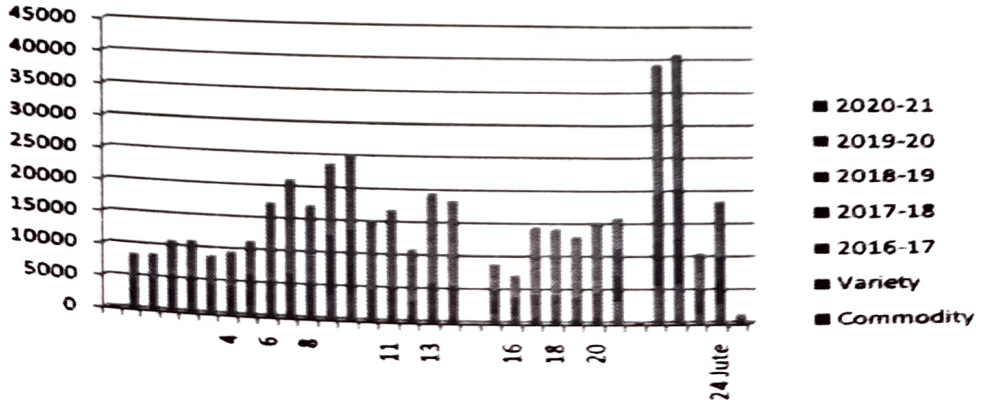
Fig 2. Estimates and Expenditure by Departments under Ministry of Agriculture and Farmers' Welfare



Results and Discussion

This systematic analysis of scientific and socio-economic oriented literature review on the characteristics of agroecotechnology and indigenous practices is defined by various conceptions of agriculture to aid in rural development. Agroecotechnology being an interdisciplinary field of study that combines the principles of ecology and sustainable agriculture to develop environmental friendly farming practices in order to create agricultural systems which are both productive and conserve natural resources. They mainly aid to protect biodiversity and reduce the negative impact of farming on the environment which is an impacting parameter to be considered. This is one of the prime technologies that help farmers adapt to copious changes by promoting crop diversification, developing drought-resistant varieties, and using irrigation systems that are more efficient (Report for the soil association. 2021).The combination of indigenous farming methods and modern agroecotechnology holds the influential tool for sustainable farming, hereby promoting rural development. It is mainly characterized by subsidies to farmers on agricultural commodities.

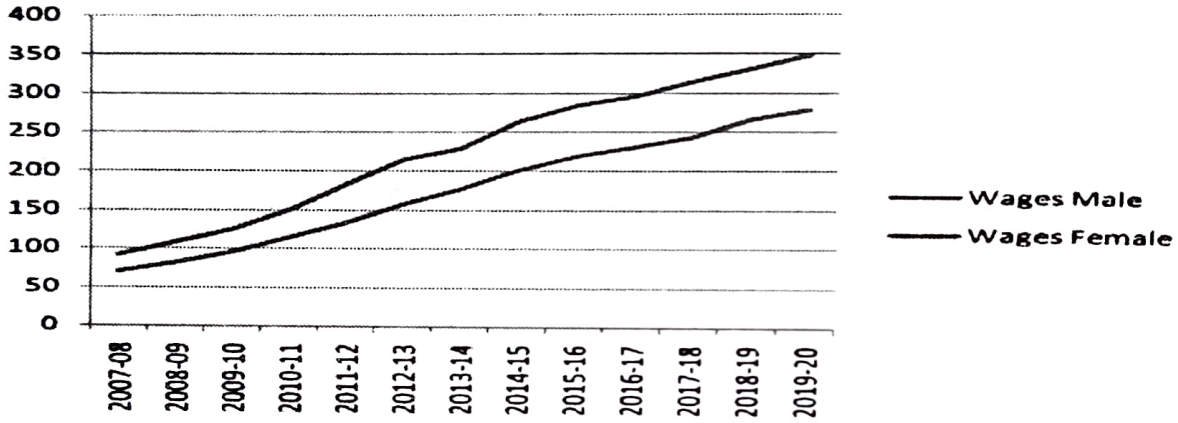
Fig 3. Minimum support prices of various agricultural commodities, according to crop year.



Government policies play a vital role in framing sustainable

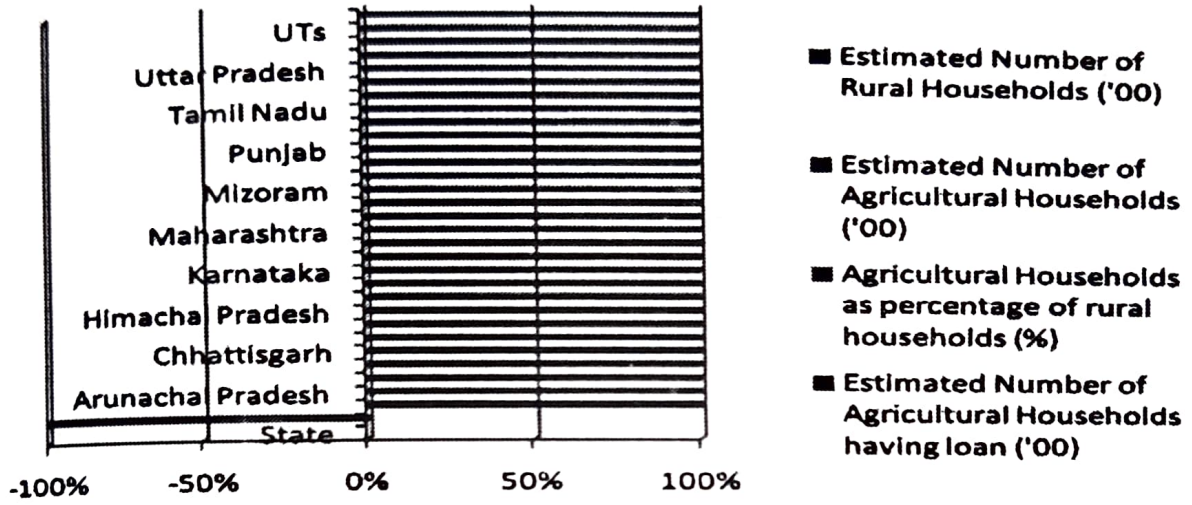
agriculture especially in a country where gender bias in agricultural sector undermines progress towards feasible development across multiple dimensions. Women provide crucial support in this domain along with household livelihood, yet they are not paid accordingly. Gender budgeting would assess the quantity and adequacy of allocation of resources for women (Krishi Jagran, n.d.).

Fig 4. Average annual daily wages of Indian field labourers



The Indian government has implemented several policies and schemes to support the agriculture sector, such as the Pradhan Mantri Fasal Bima Yojana, which aims to provide insurance coverage to farmers against crop failure due to natural calamities, Pradhan Mantri Krishi Sinchai Yojana to improve irrigation facilities in rural areas, Paramparagat Krishi Vikas Yojana which aims to promote organic farming in clusters. The government has also implemented policies to promote the use of technology in agriculture, such as the National e-Governance Plan and the National Agriculture Market (e-NAM) scheme. These policies aim to provide farmers with access to information and technology. National Rural Employment Guarantee Act (NREGA) to provide employment opportunities in rural areas, which objectifies to provide a minimum of 100 days of guaranteed employment to every household in rural areas. (Ministry of Agriculture and Farmers' Welfare, n.d.). These policies deliberately work on to ensure the convenience of rural people, especially farmers. Thereby, one can observe that agricultural loans have dropped down expeditiously after the implementation of these policies.

Fig 5. Estimated numbers of rural households, agricultural households and indebted to agricultural households



However, the on ground success of these potential policies totally depends on the smooth and forthright functioning of governmental machinery.

Conclusion

In this review article, we aimed to advance the understanding of the concept of constructive connotation of agroecotechnology and indigenous practices in agriculture under climate change regimes. We pursued this purpose by identifying the ideas and aspects that are associated with rural development. Through a structured analysis, we identified how different schemes and facets of rural development can be combined with scientific concepts to bring out multivariate disciplines. Identifying suitable interventions in small holder agriculture through system analysis by utilizing computer based simulation tool, helps coping with climate change risk by also retaining the characteristics of indigenous farming (ICRISAT, n.d.).The various categories of expertise and insights can be combined through transdisciplinary cooperation, practical relevancies and technical implementation to form vivid implications to subdue climate change in agricultural sector and thus promote rural development. These policies implemented by the government aids in promoting sustainable agricultural practices, increase productivity, and lead to the overall development of rural areas.

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