**Geographical Perspectives on Agribusiness Networks: A Value Chain Analysis in the State of West Bengal**

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**Abstract:**

Agribusiness networks considering the chain from production to market. this paper uses a geographic approach to explore the agribusiness networks in West Bengal, India. West Bengal's varied geography, which includes the Himalayas to the delta region and is known as the Gangetic area, shapes its farming practices and diverse crops. The paper analyzes this complex link between this spatial variation and agribusiness networks involving small-scale farmers, middlemen, and market environments. Value chain analysis shows the way in which agricultural products are produced by a location's weather and landform, processed, and distributed until they finally integrate into the market. This journey has varied obstacles, including geographic restrictions such as floods and difficult terrain, economic hurdles like market accessibility and fluctuating prices, and social hindrances that involve land property rights and workforce aspects. Further, the article discusses how the changing technology and the policy have affected the network and what is needed from this point as we seek sustainability and environmentalism with respect to climate change. This analysis plays a key role in analyzing the agricultural dynamics of West Bengal, which are essential for policymakers, agricultural specialists, and strategists of agribusiness. Finally, the conclusion will include recommendations for future studies, including an examination of how world market trends, digital technology, and approaches to sustainable development interact with the new agricultural capes. However, this article is aimed at adding new dimensions to the broad discussion of agricultural development in heterogeneous settings with reference to West Bengal as a case.

**Keywords:**

Agribusiness Networks, Value Chain Analysis, Geographical Diversity, Sustainable Practices, Agricultural Technology, Economic Challenges, Climate Resilience.

**Introduction:**

The case study on West Bengal in the variegated agricultural terrain of India provides insight into the dynamics of agribusiness networks. Therefore, this paper intends to reveal the intricacies of these networks based on their geographic focus and, specifically, the value chain analysis. The geographic situation of West Bengal lies in the east of India, where there are many unique geographic features, including the highlands (the Himalayans), mountainous regions, down to the South with its coastal surroundings that provide a variegated surface that is aptly accommodating for It is these geographical disparities which make the greatest differences in agribusiness networks; dictating the type of crops, the method of cultivation, and related business models.These include a series of processes that are influenced by the local geography, topography, climate, and infrastructural advancement. In this case, the fertile Gangetic plains of the state, which is known across the country as a rice and jute producer, would have had an effect on its economic value change by way of specific challenges and prospects.

Furthermore, the economic setting of West Bengal, consisting of small holdings and a high dependency on arable farming, accentuates the issue further. Network analysis that captures how traditional production interfaces with the latest market demand, including the involvement of diverse players ranging from farmers to government bodies.

Therefore, this article discusses the complex interactions underlying the agribusiness networks of West Bengal in terms of location, economics, and society. In this way, one can be able to understand the trends in farming, which are critical for policymakers, agricultural experts, and agri-business strategists.

**The influence of the geographical setting on agriculture in West Bengal:**

The tapestry of agriculture of West Bengal is closely connected to the different characteristics of its landscape, which contribute individually to West Bengal's industrial networks. The state's geographical setting is quite dramatic, starting from the lofty mountains of the Himalayas in the north and leading all the way to the verdant Ganges delta in the South. The physical terrain shapes the agricultural choices available within the state as well as influences what crops can grow there.

In the north, the Sub Himalayan and Darjeeling Himalayas are cold and hence prefer the cultivation of tea as a major cash crop for the revenue of the state. The sloping terrain is perfect for tea gardens, and the uniqueness of the climate creates Darjeeling Tea with a unique style appreciated worldwide. The climate of this region is, however favorable for growing horticulture crops like oranges, apples, and cardamoms apart from tea(Debnath, 2021).

In the southern direction, large and fertile Gangetic plains are occupying the country. It is an expansive water zone with alluvial soil ideal for intensive farming. This is the rice belt, and this rice plateau makes West Bengal one of the biggest states in terms of rice production in India. There is also significant production of a type of fiber known as "the Golden Fiber." This is produced in the area due to conducive moisture climatic conditions and the availability of much water.A different case of farming is present within the Sundarbans area, which is a unique mangrove ecosystem in the coastal delta of the Bay of Bengal. The area is known for the growth of sturdy varieties of rice; hence, it is important in supporting the inhabitants' way of life despite being located in very tough, salty surroundings and under almost unending floods. Agricultural adaptation is one of the evidences of the perseverance of the local farmers in this area due to the toughness of physical limitations (Kumar, 2022).

The different geographic zones in West Bengal also determine the crops grown, methods of cultivation, and networks formed between agriculture businesses, which create challenges for the farmers. It is vital to note that the state has diverse geographical settings that impact the economic and social aspects of agribusiness networks within the state.

**Characterizing agribusiness networks in West Bengal:**

The state's economy involves very complex and intricate agribusiness networks within which it operates. The networks cover various processes, from farming to processing and finally to selling; they involve all kinds of players – farmers, traders, processors, bulk buyers, and retailers.

Small-scale farmers, who are the heartland of agricultural production in West Bengal, central the networks. They work on small pieces of land that are sometimes less than a hectare in size. In spite of this, they contribute towards the large-scale production of crops such as rice, jute, and other fruits and vegetables. Smallholdings demand a system of cooperatives and local markets, which enables farmers to get to major markets and share in the common buying strength.

Agents and brokers constitute the most important intermediaries that help link small-scale farmers with the wider markets. In most cases, they help aggregate products from various smallholder farmers, giving them access to large markets and improved prices. On the other hand, the role of intermediaries may cut into farmers' profits, which is an opportunity that is essential and needs them in terms of providing necessary services (Bagchi et al., 2021).

The other important aspect of the agribusiness network in West Bengal is Agro-processing. It is concerned with manufacturing, such as milled rice, jute products, and packed tea, which is extracted from raw agricultural products. This sector is adding value to the raw agriculture products, increasing employed personnel and the nation's income.There has been a shift towards increasing the use of modern agribusiness networks in West Bengal in recent years (Nayak 2t al., 2023). Attempts are being carried out to embrace new agricultural strategies, improvise storage facilities, and enhance marketing systems and channels. The government, in addition to other NGOs, is providing farmers with training and information on how they can gain more money from the sale of their products. Moreover, this should help strengthen the agribusiness networks.

**Fig 1.1***: Showing crops produced in various geographical distributions*

| **Region** | **Major Crops** | **Climatic Conditions** | **Notable Challenges** |
| --- | --- | --- | --- |
| Northern Hills | Tea, Cardamom | Cooler, temperate | Limited accessibility, terrain |
| Gangetic Plains | Rice, Jute | Humid subtropical | Flooding, soil erosion |
| Coastal Areas (Sundarbans) | Hardy rice varieties, Fish farming | Tropical, saline soil | Cyclones, rising sea levels |

***Source: Journal of Agribusiness Production***

The significance of understanding networks in West Bengal cannot be overemphasized, as it helps in understanding challenges and opportunities within the state's agricultural sector. This scenario provides an overall view of how various players interact, including the challenges and roles they play in this agribusiness environment.

**An overview of value chain analysis in Agriculture, West Bengal:**

Value chain analysis for the state of West Bengal's agriculture is an extensive study of the stages, starting with growing crops in the fields and ending with their consumers, involving production, processing, shipment, and sales. The efficiency and effectiveness of these processes, the distribution of value between various stakeholders, and the basis for future improvements are revealed by this analysis.

**Production Stage:**

 West Bengals' agriculture production is predominantly represented by small-scale farming. The second phase is all about rice, which serves as the staple crop for Bangladeshis, together with large production of jute, tea, fruits, and vegetables. Traditional as well as modern farming depends on geography and available resources. Some of the challenges in this phase may include a lack of the right inputs like quality seeds, fertilizers, and water or problems related to land ownership and labor.

**Processing Stage:**

Adds a lot of value to agricultural products. This ranges from rice milling in West Bengal to turning jute into fibers and end products, as well as producing tea. The next step is essential in boosting the retail value and expiry date. On the other hand, the processing sector suffers various challenges, such as old technological equipment, which leads to losses, inefficiency, and lack of infrastructure, therefore reducing the overall value shared with local communities.

**Distribution and Marketing Stage:**

 The third stage entails moving goods from the farm level to the market – locally or internationally. This stage influences how well products are distributed to the clients within a minimal time frame. Logistics problems such as insufficient storage facilities, inefficient transport systems, and a divided market are the main problems of the distribution network in West Bengal.

**Case Studies:**

These stages are clearly illustrated by a close examination of particular crops. For instance, the tea industry in Darjeeling is built on an established value chain that encompasses cultivating tea under specific climate conditions in the Himalayas, leading to high-quality tea leaves sold locally and internationally (Bajaj, 2021). However, while the rice value chain is broadly covered, it suffers from a number of inefficiencies along its stages, including the low margins by some commercial banks that affect farming's profits and longevity.

**Stakeholder Analysis:**

These include farmers, processors, wholesalers, retailers, and other government agencies. Each participant has its share of values that it is supposed to capture in the chain. As an example, although farmers play a crucial role in the initial phase, they usually have little negotiating ability in the exchange process. However, the portion may go above processors and wholesalers.

It is critical to comprehend and improve the agricultural value chain in West Bengal so as to raise the entire productivity and sustainability of agriculture. When accompanied by an upgrade in technology, infrastructure, open market access, and pro-sustainability policies, such changes will greatly enhance the efficiency of these value chains to the benefit of all, including the peasants.

**Problems encountered in Agribusiness networks in West Bengal:**

There exist a number of challenges facing the agribusiness networks in West Bengal on geographical, economic, and social dimensions. These problems have to be well understood to develop ways to make the sector stronger and uplift the population relying on this industry outlook.

**Geographical Challenges:**

 West Bengal has a varied topographical structure, which offers great possibilities as well as great obstacles. These northern hilly areas have issues of location and transportability, which make it difficult to reach and interact with markets. Meanwhile, in the Ganga plains, flooding is the main obstacle to planting (Patel et al., 2023). In addition, there are particular problems encountered in the Sundarbans area where saline soil and cyclones can be experienced. Such geographical barriers require specific agricultural practices that need particular infrastructure development in every region (Mishra et al., 2021).

**Economic Challenges:**

The small-scale farmers, the majority of them that exist in West Bengal, suffer economic problems like limited access to credit, unpredictable changes in the markets, and low bargaining power, among others. In most cases, middlemen tend to dominate the value chain, hence not providing enough returns to the farmers. Furthermore, farmers suffer more economic losses due to poor storage and processing facilities, which results in post-harvest wastage.

**Social Challenges:**

Land ownership problems and labor issues characterize the agriculture of West Bengal. Some of them work on leasehold land whose security is questionable; hence, it discourages their efforts in undertaking land cultivation projects. Moreover, labor migration into urban centers is causing difficulties in the supply of cheap migrant workers at important times of farming. Other social issues revolve around the call for proper schooling of farmers so that they can be informed about new farming techniques as well as comprehend how markets work.

**Policy and Infrastructure Issues:**

Although there have been several efforts by the government, there exist loopholes in the application of policies and infrastructure development. Irrigation systems are underdeveloped, which affects market access due to poor road networks. Moreover, there are insufficient agricultural extension services, which limit productivity on many farms.

**Climate Change and Environmental Impact:**

Changing rainfall patterns accompanied by increases in extreme weather events linked to climate change have also reduced crop yields. The environment is under threat. Degradation occurs in the form of soil erosion or reduction of water table level (Mandal et al., 2019).

Overcoming these issues calls for a multifaceted strategy comprising infrastructure growth, market enhancement, and farmer education empowerment/technical support. Furthermore, appropriate policies should be formulated for each region within the state. Environmental management also involves promoting appropriate agronomic practices such as sustainable farming and promoting climate resilience in agriculture. Addressing them can enable the agribusiness networks in West Bengal to enhance their productivity as well as the living standards of the farmers.

**Technological integration and innovation within agribusiness of West Bengal:**

Technology integration in the sector can potentially increase production or reduce any challenge that might come with it. There is a wide range of aspects, such as farming, resource control, processing, and finally, market outreach on integration that cuts across.

**Crop Cultivation and Management:**

Traditional farms in West Bengal are now being replaced by modern agriculture, including the application of precision farming and other technologies. Drip irrigation and sprinklers are some of the technologies that have been adopted to enhance the use of little water, especially in areas that are subjected to severe droughts. Another important step forward is the use of improved crop varieties that are resistant to diseases, as achieved through agricultural biotechnologies. These innovations promote higher output as well as resilience against attacks by insects and diseases (Vishnu et al., 2022).

**Resource Management:**

 Sustainability includes technological interventions that incorporate soil health monitoring and water resource management relevant to sustainable agricultural programs. Remote sensing and GIS contribute greatly towards efficient land and water administration so that farmers can choose the best crops and appropriate farmland.

**Processing and Value Addition:**

The use of modern machines in processing makes the quality of the products high and enhances efficiency. For example, superior-quality rice mills and jute production factories are equipped with machines that enhance production efficiency.

**Market Access and Supply Chain Management:**

More and more, digital platforms are being employed in market access and supply chain management. Direct contact between farmers and buyers is enabled via mobile applications and online sites, hence getting rid of intermediaries and thereby enhancing their incomes. The software is used for monitoring products right from the farm to the market and also for promoting transparency and productivity.

**Challenges and Future Prospects:**

The use of technology in agriculture in West Bengal is not without its problems. They include a lack of access to technical knowledge, low levels of farmer education and training, and capital. This entails the government and other stakeholders, such as the private sector and educational institutions, working together to ensure technology adoption by engaging in training, issuance of government subsidies, and creating publicity on the essence of technology adoption (Vardhan et al., 2022).

Technological advancements are inherently bound with the future of agribusiness in West Bengal. The state will be embracing the technology to make its agriculture competitive, sustainable and farmers' living standards high.

**The effect of government policies on agribusiness in West Bengal:**

Government policies have profound impacts on the agribusiness environment in West Bengal, including activities starting from production to marketing, exports, and other areas. The purpose of these policies is to tackle the existing problems in agriculture to achieve sustainability.

**Policy Framework:**

The West Bengal Government has adopted various measures to promote agriculture. They involve subsidizing seeds and fertilizers, supporting irrigation facilities, and crop insurance schemes to safeguard farmers against disasters. Furthermore, the state has other special policies encouraging the production of some crops, such as rice, tea, and jute, that play significant economic roles in the state (Mukherjee, 2022).

**Impact on Small-scale Farmers:**

 There are many small-scale farmers in the state who have been at the center of focus for government policy development. In this bid, policy measures such as the Kisan Credit Cards and other types of financial support are designed to ensure that farmers do not experience difficulties when accessing loans. The company has also established some training and development programs, which teach the farmers what is known as modern agriculture practice and resource management (Chatterjee, 2019).

**Infrastructure Development:**

 The government has invested greatly in improving agricultural infrastructure. These include the provision of rural road networks for better accessibility to markets, cold storage installation to combat post-harvest losses, and irrigation system enhancements. The development of the agribusiness infrastructure is essential for improving the effectiveness of the agribusiness network.

**Challenges in Policy Implementation:**

The stated objectives of both policies may be praiseworthy, but they remain to be a challenge to achieve in implementation. These are some of the common issues, such as bureaucratic delays, narrowness in reaching out to the most affected groups, and lack of information among farmers on the existence of the said programs. Second, the shifting political environment might affect the sustainability and concentration of such policies.

**Future Directions:**

Going forward, more integrated yet holistic policies that suit distinct agricultural zones in West Bengal are required to be devised. There is a growing need for policies concentrating on technological developments, environmental sustainability, and resilient agriculture. Moreover, more attention should be paid to public-private partnerships in order to improve the delivery and effect of government programs.

In general, government policies play an important role in the development of the agribusiness sector in West Bengal. Nevertheless, for these policies to succeed, a more specific strategy backed by effective implementation and performance evaluation process should be put in place. Such action would result in the filtering of such benefits to the lowest level, which will create a significant impact on Kenya's overall agriculture sector at large.

**Sustainability and Environmental Impacts on Agricultural Businesses in West Bengal:**

Although these agrarian practices play a vital role in the economic growth of West Bengal, they provide cause for worry about the issue of sustainability and environmental impacts. The agribusiness sector must develop sustainability into its business practices as it grows to secure sustainable futures and maintain a healthy environment.

**Environmental Challenges:**

 West Bengal suffers from various problems regarding its environment, which is an issue for its agriculture. Intensive cultivation of crops, particularly on the Gangetic plains, poses problems such as soil degradation, falling water tables, and extinction of biodiversity. There is an increase in the salination of soils and waters, which affects local agriculture and especially occurs in coastal areas, such as in the Sundarbans. Besides, though these chemicals increase crop yield, they have a negative impact on soil health and water quality.

**Sustainable Farming Practices:**

Due to this, people are paying increased attention to sustainable farming. The concept of organic farming that does without or keeps low using chemicals has been increasingly growing popular nowadays among people. To promote soil fertility and reduce the effects on the environment, techniques such as crop rotation, integrated pest management, and bio-fertilizers have been encouraged (Reddy et al., 2020).

**Water Management:**

Since this is a water-intensive crop, efficient water management is important. For example, rainwater harvesting and drip irrigation with suitable drought-resistant crop varieties could be considered in the direction of sustainable water usage.

**Climate-Resilient Agriculture:**

Given that climate change changes weather patterns, cultivating a climate-resistant type of farming becomes necessary. There are many such practices; for instance, they could grow more resilient crops, adopt agroforestry, or develop flood-safe crop production, particularly in the risk zones.

**Policy and Community Engagement:**

Sustainable practices are also promoted by governmental policies. Organic farming policies should be encouraged, and incentives should be given to those who adopt sustainable forms of agriculture. Additionally, investments in research and development for sustainable technologies will facilitate better outcomes of this policy (Ghosh et al., 2019). It is also necessary to engage the local communities and farmers in order to make such efforts practicable and acceptable.

**Balancing Productivity and Sustainability:**

Balancing sustainability and the increase in productivity is one of the difficult tasks faced during the transition to a sustainable agricultural system. This means that there must be farming models that are both affordable and friendly to the ecosystem.

Sustainable production can be introduced in West Bengal's agribusiness due to several measures such as technological innovation, political support, community development, education, etc. With this in view, West Bengal can meet the current challenges posed by environmental issues as well as assure agricultural longevity by embracing sustainable farming approaches.

**West Bengal agribusiness outlook:**

The success of agribusiness development in West Bengal depends on agribusiness's adaptation to both local and international changes. This future vision will entail the adoption of new technologies, diversification in crop production, and enhancement of market linkage as practices oriented towards sustainability.

**Embracing Technological Advancements:**

Technology will penetrate agriculture, including precision farming and digital marketplaces, to transform agribusiness in West Bengal. Artificial intelligence (AI), as well as IoT, has been incorporated into optimizing resource utilization and increasing crop yields while making real-time data available on various applications at the same time. Adoption of these technologies is critical for West Bengal to remain competitive in the fast-changing world markets.

**Crop Diversification and High-Value Agriculture:**

This can increase the profitability for the farmers through diversification into high-value crops and horticulture. The state has several types of climate zones; hence, suitable crops must be located from those different kinds if they can grow in other regions with the same conditions as the area. Furthermore, it involves the development of organic farming and GI-tagged products, which opens up a niche market for greater profits.

**Strengthening Market Linkages and Supply Chains:**

Building strong market chains and suitable supply channels for expanding agribusiness in West Bengal is crucial. Such measures would include improvement of storage and transport infrastructure, reduction of intermediaries to guarantee the payment for farmers at fair prices, and an establishment of farm-to-farm linkages as well as direct contacts between farmers and consumers.

**Sustainable Practices and Climate Resilience:**

At this point, there is a real sense of crisis in relation to changing climates and environmental sustainability. As such, implementing Agroecological farming is now more necessary than ever before. These include water-saving measures, environmentally friendly soil cultivation, and the use of drought-resistant crop varieties. The resilient agribusiness sector will determine future successes in agricultural development in West Bengal(Shar et al., 2023).

**Policy Support and Capacity Building:**

Governments are still necessary as they can lead and provide guidance for agribusiness for the attainment of sustainability with profits. The major drivers for such policies shall include those that enhance innovations, finance providers, and technologies, as well as sustainability among farmers. Moreover, providing education and training to farmers so that they can undertake new technologies in their farms will be useful.

**Enhancing Global Competitiveness:**

 In order to be competitive in the global marketplace, West Bengal must concentrate more attention on issues regarding quality, standardization, and branding. This includes observance of international quality norms and brand building for West Bengal's agricultural produce coupled with effective promotion strategies that would open up fresh markets.

The agribusiness in West Bengal stands at a crossroads between traditional practices and the latest technology, as well as the world market. This sector needs to be realized through collaboration and innovation, ensuring sustainability while providing suitable policy and structural frameworks. Equipped with these ingredients, West Bengal's agribusiness can be a major driving force behind the state’s economic growth.

**Conclusion:**

West Bengal's agribusiness networks are characterized by potential on the one hand but also present major obstacles on the other. The study demonstrated the complexity of the relationship between the variations in agroclimatic potential, farming strategies, product markets, technology assimilation, state regulation, and nature conservation efforts and how these affect agribusiness development in West Bengal.

**Key Findings:**

1. Geographical Influence: Differential agriculture in the various geographical subsystems of WB, from the Himalayas up to the Ganga plains, requires subsystem-specific approaches to agricultural developments.

2. Complex Agribusiness Networks: The farmers in West Bengal are small-scale and comprise a web of intermediaries, processors, and retailers for the value chain. These networks need streamlining if an organization intends to increase productivity and profitability.

3. Challenges and Opportunities: Geographical, economic, and societal constraints challenge the sector. Nonetheless, the same problems yield chances of creativity with regard to sustainable development and infrastructure enhancement.

4. Technological Integration: Technology is increasingly embraced by agricultural systems with the aim of enhancing yields, conserving resources, and protecting the environment. Successful integration of modern technologies is crucial for further development of this industry.

5. Policy Implications: The agricultural space is greatly shaped by government policies. The policies must be better directed and executed in West Bengal's agricultural zones depending on the individual stakeholders in this region.

6. Sustainability and Environmental Concerns: It is important to balance agricultural productivity with environmental sustainability. Farming should be sustainable as well as climate-resistant for the sustainability of the sector in the long run.

**Implications for Stakeholders:**

• Policymakers: The agricultural sector requires more sophisticated and appropriate policies that consider technology upgrading, market access, and environmental sustainability.

• Farmers: Sustainable agricultural practices and efficient production require education and access to resources by farmers, increasing productivity and environmental responsibility.

• Businesses and Investors: There are possibilities existing for investment in agribusiness of technology, infrastructure, and upgrading of added processing in West Bengal.

**Recommendations for Future Research:**

Therefore, more studies are necessary about the effect of world market tendencies on the agriculture of West Bengal, place digital technologies in the changing agrarian landscape, as well as long-standing ways for climate endurance and sustainable farming.

**References**

Bagchi, N. S., Mishra, P., & Behera, B. (2021). Value chain development for linking land-constrained farmers to markets: Experience from two selected villages of West Bengal, India. *Land Use Policy*, *104*, 105363.

Bajaj, R. (2021). Indian Tea Landscapes. *International Council on Monuments and Sites 11, rue du Séminaire de Conflans 94220 Charenton-le-Pont France*, p. 232.

Chatterjee, S. (2019). The curious case of farmer credit cards: Evidence from an Indian policy reform. *The BE Journal of Economic Analysis & Policy*, *19*(1), 20180048.

Debnath, M. (2021). Exploring the behavior of seasonal agricultural migrants in the Rarh region of West Bengal, India. *Spatial Information Research*, *29*(1), 83–96.

Ghosh, B., & Chakma, N. (2019). The composite indicator of land, water, and energy for measuring agricultural sustainability at the micro level, Barddhaman District, West Bengal, India. *Ecological Indicators*, *102*, 21-32.

Kumar, R., Sinha, R., Rakib, M. R. J., Padha, S., Ivy, N., Bhattacharya, S., ... & Sharma, P. (2022). Microplastics pollution load in Sundarban delta of Bay of Bengal. *Journal of Hazardous Materials Advances*, *7*, 100099.

Mandal, U. K., Maji, B., Mullick, S., Nayak, D. B., Mahanta, K. K., & Raut, S. (2019). Global climate change and human interferences as risk factors, and their impacts on geomorphological features as well as on farming practices in Sundarbans eco-region. *The Sundarbans: A Disaster-Prone Eco-Region: Increasing Livelihood Security*, 405-437.

Mishra, M., Acharyya, T., Santos, C. A. G., da Silva, R. M., Kar, D., Kamal, A. H. M., &Raulo, S. (2021). Geo-ecological impact assessment of severe cyclonic storm Amphan on Sundarban mangrove forest using geospatial technology. *Estuarine, Coastal and Shelf Science*, *p. 260*, 107486.

Mukherjee, S. (2022). Contract Farming in West Bengal: Patterns, Determinants and Policy Implications. *The Indian Economic Journal*, *70*(4), 670–684.

Nayak, A., Paul, K., &Bagchi, K. K. (2023). Value addition and issues of the supply chain in the marketing of agro-products in North Bengal with special reference to Pineapple, Potato, and Tomato (PPT). *Indian Journal of Agricultural Marketing*, *37*(1), 95-115.

Patel, S., Mall, R. K., Chaturvedi, A., Singh, R., & Chand, R. (2023). Passive adaptation to climate change among Indian farmers. *Ecological Indicators*, *154*, 110637.

Reddy, V. R., Chiranjeevi, T., & Syme, G. (2020). Inclusive sustainable intensification of agriculture in West Bengal, India: Policy and institutional approaches. *International Journal of Agricultural Sustainability*, *18*(1), 70–83.

Shah, M. H., Dey, J. K., SadikurRahaman, S., Kundu, S., Ajaharuddin, S. M., Pramanik, K., ... &Pande, C. B. (2023). Potential Impacts of Climate Change on the Sustainability of Crop Production in West Bengal, India. In *Climate Change Impacts in India* (pp. 237-264). Cham: Springer International Publishing.

Vardhan, P. N. H., Pal, P. K., & Roy, D. (2022). Study on the level of awareness of climatic resilient technologies among respondents in northern districts of West Bengal.

Vishnu Priya, P. S., Frey, L. M., Chinmayi, R., Mohan, R., Lalith Prakash, E., Anne Rose, S., ... & Vidhya, S. (2022). Exploration of technology-driven income sources for an agricultural community in West Bengal, India. In *IOT with Smart Systems: Proceedings of ICTIS 2021, Volume 2* (pp. 541-550). Springer Singapore.