Revitalising Agriculture in South 24 Parganas: Strategies for Sustainable Farming and Direct Sales

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Abstract*— The paper explores the various challenges faced by farmers in the South 24 Parganas region of West Bengal. These challenges include inadequate financial support, limited technical knowledge, unsustainable farming practices, overproduction, market price fluctuations, and a lack of basic facilities and amenities. These issues have led to a decline in interest in farming and an increase in land sales among the farming community. Our study aims to propose effective strategies to empower farmers, improve financial stability, and foster community development. We conducted thorough surveys and interviews to gather data. A key contribution of our research is the proposal of a mobile application. This app facilitates direct interactions between sellers and buyers, spreads awareness, educates people about effective farming techniques, and motivates young people to pursue farming. The innovative app includes user profiles, a recommendation system for personalized product discovery, and a chat feature with real-time translation, ensuring smooth communication and efficient deal-making

***Keywords*—Sustainable Farming, Direct Sales, Mobile Application, Farmer Empowerment, Awareness, Market Price Fluctuations, Real-Time Translations, Supervised Learning, NLP**

1 INTRODUCTION

The government has taken steps such as microfinance and self-help groups, especially for women [4], to enhance their impact by providing modern farming skills. These initiatives highlight the beneficial role of self-help groups in improving rural women's socio-economic status and decision-making abilities. However, farmers are losing interest due to increasing cultivation costs and lower demand and sales for their produce. These economic pressures make it difficult for farmers to repay their loans on time, leading to financial stress and diminishing enthusiasm for continuing in agriculture. In a recent study conducted in Murshidabad, West Bengal, [2]the impact of microfinance on rural farmers was examined. The study revealed significant improvements in living standards, income, savings, and employment opportunities. With farming as their primary source of income, averaging Rs.325,435/- annually, most loans are short-term and are preferred over money lenders due to the absence of collateral requirements. The findings show that microfinance minimizes financial crises and enhances access to credit and investments. Pensions also making a significant contribution to income. The study emphasizes the crucial role of microfinance in socio-economic upliftment and recommends further research on its long-term impacts better to understand its role in poverty alleviation and economic development. However the surplus production as well as farming capacity has an impact on the economy [9]The study looked at how much extra rice farmers in West Bengal had to sell. It found that big farms had more rice to sell than small farms. They found that about half of all the rice grown was sold, and big farms sold more rice than small farms. Things like having a big farm, getting a good price for rice, and having a place to keep rice all helped farmers sell more. But if a family had lots of people living with them or owed money, they couldn't sell as much rice. Compared to other places where lots of farming happens, West Bengal didn't have as much extra rice to sell because of how families lived and how much they owed. In India, farmers need good ways to sell their rice to make sure there's enough food and to have enough money. [10]This study looked at how farmers in a place called Keshpur sell their rice. They talked to farmers and other people who help sell rice. They found that there are different ways farmers can sell their rice, like to village merchants, Dalals, Arhatia, or the government. Farmers can maximize their profits by selling their produce to the government,but they incur significant expenses in transporting the rice. To support farmers, the government should facilitate the sale of their rice by providing resources such as bags for storage, covering the transportation costs, and streamlining the process.Additionally, farmers encounter difficulties in selling fruits and vegetables due to the need for cold storage [5], in West Bengal, there is a shortage of cold storage facilities, resulting in produce not staying fresh for long. Although the government is working to establish more cold storage facilities, challenges such as insufficient funds and limited storage space persist. Despite West Bengal's significant production of fruits and

vegetables, it lags behind other Indian states in preserving their freshness. Another issue is the challenge of adopting new technologies for farmers, who are encountering difficulties in this regard. [1] A survey conducted in a lateritic zone in West Bengal revealed three major reasons why farmers might not adopt new technology: lack of understanding, inability to customize it to their needs, and inability to use it in various situations. The study aims to enhance the productivity of small farmers in India by providing them with better training. It also suggests that companies may consider investing in assisting farmers as part of their social responsibility. This study is particularly significant for regions like Jangalmahal, where resources for farmers are limited. It is important to cultivate crops in an environmentally friendly manner to promote sustainable farming. However, in West Bengal, a lack of awareness and pressing income needs are leading farmers towards unsustainable practices [8] The main issue is the absence of a comprehensive policy framework to promote sustainable agriculture intensification (SAI), despite the existence of individual programs and policies. Many farmers continue to use practices that harm the environment due to a lack of awareness about better methods or urgent financial needs. Improved collaboration among village-level organizations is essential to achieve sustainable farming. The agricultural sector in our region faces a multitude of challenges, ranging from inadequate financial support and limited technical knowledge to unsustainable farming practices and market price fluctuations. Despite government initiatives, these issues have led to a decline in farming interest among local communities. In our research, we engaged with individuals directly involved in farming, including farmers and landowners, to explore these challenges further. Through surveys and conversations, we sought to comprehend the underlying problems and identify potential solutions. As part of our investigation, we have developed a questionnaire to gather insights and are currently analyzing data collected from various authenticated sources. Our aim is to propose strategies that empower farmers to sell their produce directly, improve their financial standing, and contribute to community development. A key contribution of our study is the development of a mobile application designed to facilitate seamless interactions between sellers and buyers. This innovative app features user profiles, a recommendation system for product discovery, and a language-agnostic chat function for effective communication and deal closure. Additionally, the app spreads awareness and educates people about effective farming techniques, aiming to motivate young people to pursue farming.

2 LITERATURE REVIEW

Recently, the integration of AI assistants in e-commerce has significantly impacted business operations by enabling machines to learn from data and interactions without direct programming [12]In e-commerce, product type is critical for success. While many scholars have empirically studied this issue, there's a lack of theoretical research explaining why and how product types affect e-commerce. This article introduces the Product E-commerce Value Theory, which includes five elements: supply and demand difference, perception of quality, willingness to pay for e-commerce, logistics satisfaction, and post-purchase evaluation. An analysis framework for product selection in e-commerce is also proposed based on this theory [7]Furthermore, research has developed methods for creating chatbots to assist users across various industries. Chatbots answer questions, provide customer information, offer train schedules, aid in reservations, act as virtual assistants, and serve as automated call centers for millions of customers. This study employs a deep learning-based conversational AI technique, combined with convolutional neural networks and TensorFlow, to enhance chatbot accuracy. Experimental results show that deep learning significantly improves chatbot accuracy compared to traditional models [11]E-commerce websites are popular because they make shopping easier. Chatbots, which are AI programs, enhance customer service by simulating conversations with users through text or voice. They help e-commerce businesses reach more customers, increase sales, and provide better service by guiding users and making personalized recommendations. Chatbots are becoming essential for marketing and customer support [3]E-commerce websites are popular because they make shopping easier. Chatbots, which are AI programs, enhance customer service by simulating conversations with users through text or voice. They help e-commerce businesses reach more customers, increase sales, and provide better service by guiding users and making personalized recommendations. Chat bots are becoming essential for marketing and customer support.

3 METHODOLOGY

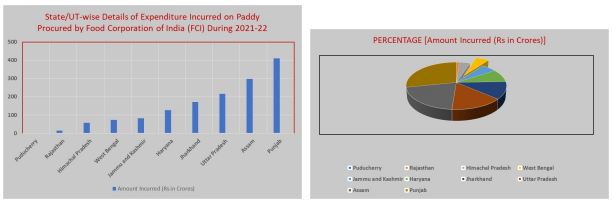
This paper collected data mainly from websites such as data.gov.in and wbpspm.gov.in. We gathered statistical data from these sites and also communicated with people from South 24 Parganas through telephone conversations and direct interviews. This was necessary because many individuals involved in farming or related activities are not very tech-savvy and are unable to fill out online forms.

We conducted the entire study by collecting data from various websites, analyzing the recent scenario, and plotting graphs to identify changes in crop yield. We also prepared questionnaire lists in tables for conducting conversations to understand why people are losing interest in farming. Then, we tried to suggest AI-based solutions.

3.1 Observations From Collected Data

Despite West Bengal being agriculturally prosperous and well-known for its paddy production, the data on the Details of Expenditure Incurred on Paddy Procured by the Food Corporation of India (FCI) during 2021-22 reveals that the state lags behind other states.[The data used in this study was obtained from [6], the most recent

data, available at the time of analysis.] Below is a graph illustrating this comparison



(a) Bar Graph (b) Pie Chart

Fig. 1: Expenditure Incurred on Paddy Procured by Food Corporation of India (FCI) During 2021-22

We collected data from the West Bengal Planning and Statistics Department [13], providing District-wise Estimates of Yield Rate and Production of Nineteen Major Crops of West Bengal spanning from 2010 to 2015, which represents the most updated data available. Our primary focus was on South 24 Parganas district. Hence, we extracted data specifically for this district to analyze its agricultural scenario.

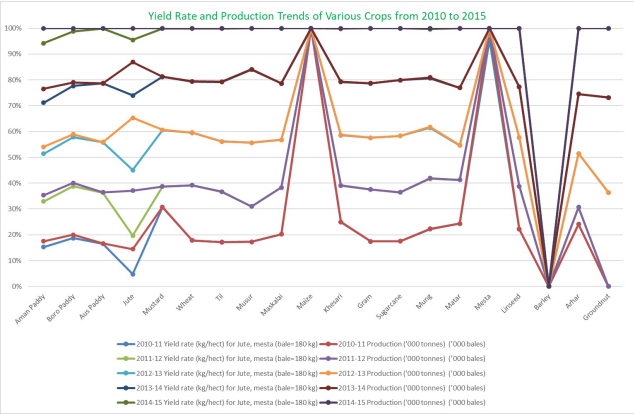


Fig. 2: Yield and Production of Various Crops in South 24 Parganas from 2010-11 to 2014-15

Here are various types of rice, each with varying yield rates and production quantities over the years. Other crops, such as Wheat, Gram, and Arhar, show consistent or increasing trends, while Maize and Barley have minimal or zero production in some years. The production of pulses also varies, with Mung showing a decreasing trend and Matar's production fluctuating.

3.2 Questionnaire and Conversation

Initially, we used questionnaires to collect data, but we found this method insufficient for capturing the nuanced insights we needed. Questionnaires often limit responses to simple yes/no answers or numerical values, which fail to reflect the complexities of individuals' experiences and emotions. Recognizing this limitation, we shifted to conducting in-depth interviews. This approach allowed us to engage more deeply with farmers, gaining richer, more comprehensive insights into their challenges, perspectives, and needs. For our research and survey purposes, we conducted direct interviews with participants, followed by telephone interviews, All interviews were recorded with their consent. The conversations were centred around the following questions:

1) General Information

1. Are you a professional farmer?
2. How many years have you been farming?
3. Do you own the land you farm on?
4. What crops do you cultivate?
5. Are the crops you produce for personal use or sale?
6. How much do the earnings from farming contribute to your household expenditure?
7. Are you engaged in any other professions besides farming?

2) Challenges and Issues

1. Are you facing problems selling your produce?
2. Are you getting a fair price for your produce?
3. Have you been losing interest in farming? If so, why?

3) Future Outlook and Concerns

1. Are people in your area selling their land to acquire money?
2. Is the next generation in your family interested in farming?
3. If land continues to be sold for non-farming projects, do you think this will be a problem?
4. If you are offered a fair price and can sell products directly through the app, would you be interested?

4) Environmental and Agricultural Practices

1. Does climate change affect your crop yield?
2. Do you use pesticides (kitnashak) on your crops?

3.3 Agricultural Site Visits in 24 Parganas South

3.4 Insights from Conversations

From the various conversations, we can understand the following points:

1. **Middlemen in Sales:**
   - Farmers typically rely on intermediaries to facilitate the sale of their produce to end consumers, resulting in reduced profits and market access challenges.
2. **Usage and Sale of Produce:**
   - Farmers often allocate only a small portion of their harvest for sale, preferring to retain the majority for personal consumption to meet household needs.
3. **Dependency on Weather and Pesticides:**
   - Agricultural productivity is subject to weather fluctuations, prompting farmers to use pesticides as a precautionary measure to safeguard crops from pests and diseases.
4. **Financial Dependency and Diversification:**
   - Insufficient income from farming compels many farmers to seek alternative sources of livelihood, leading to a decline in interest and investment in agriculture.
5. **Next Generation's Career Aspirations:**
   - Younger generations are increasingly drawn to non-agricultural professions due to limited financial

Fig. 3: Agricultural site visit in 24 Parganas South

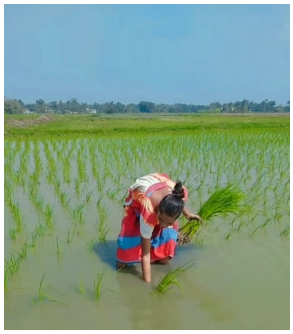


Fig. 4: Agricultural site visit in 24 Parganas South (A Picture of a Paddy Transplantation)

Fig. 5: Farming is not feasible due to rainfall causing water accumulation in the fields

Fig. 6: Gathering data on various farming challenges

prospects and the perceived challenges associated with farming, resulting in a diminishing agricultural workforce.

6. **Impact of Development on Land Sales:**
   - While some farmers support development initiatives, such as road expansions, to enhance infrastructure and urban amenities, such projects often result in the sale of agricultural land for non-farming purposes.
   - This trend, while driven by desires for improved living standards, can negatively impact soil quality and contribute to environmental degradation.
   - Additionally, farmers not directly affected by road expansions may still feel compelled to sell their land due to the adverse effects of nearby development projects on their properties.
7. **Concerns for the Future:**
   - The conversion of agricultural land for non-farming purposes poses long-term risks to food security and environmental sustainability, potentially exacerbating future food shortages and environmental crises.

The use of pesticides presents a challenge, as many farmers lack the technical know-how and are apprehensive about using them. However, younger generations are more familiar with these techniques. To address this, we could develop a system where the tech-savvy younger generation can assist with farming, marketing, and grain knowledge, while also promoting eco-friendly practices in harvesting and preservation.

Awareness seminars in villages and periodic training are essential to engage farmers and their families. Additionally, creating employment opportunities within the sector could attract people from non-farming backgrounds, increasing overall interest and involvement in agriculture. By incorporating urban facilities in an eco-friendly manner, we can help maintain interest in farming and ensure its future sustainability.

3.5 Our Proposed Model

To ensure widespread adoption of technology in farming, we're implementing a dual approach: a transformative strategy to modernize outdated practices and an AI-based mobile app designed to assist farmers. Through conversations, we discovered that while some farmers still use harmful, outdated pesticide methods and are reluctant to use mobile apps, they trust that younger, tech-savvy individuals can navigate the app effectively. This solution aims to address health and environmental risks, support fair pricing, and facilitate direct consumer transactions, meeting the strong desire among farmers for improved and more equitable practices.

1) Transformative System Approach

This highlights the potential of integrating tech-savvy youth into farming practices. They could assist with farming, marketing, and dealing while adopting eco-friendly harvesting methods and crop preservation methods.

Regular awareness seminars and training sessions in villages are essential to support this integration. These initiatives should educate current farmers and attract individuals from non-farming backgrounds to engage in agriculture. Enhancing farming's appeal through better employment opportunities and eco-friendly urban amenities can help sustain interest and ensure long-term viability.

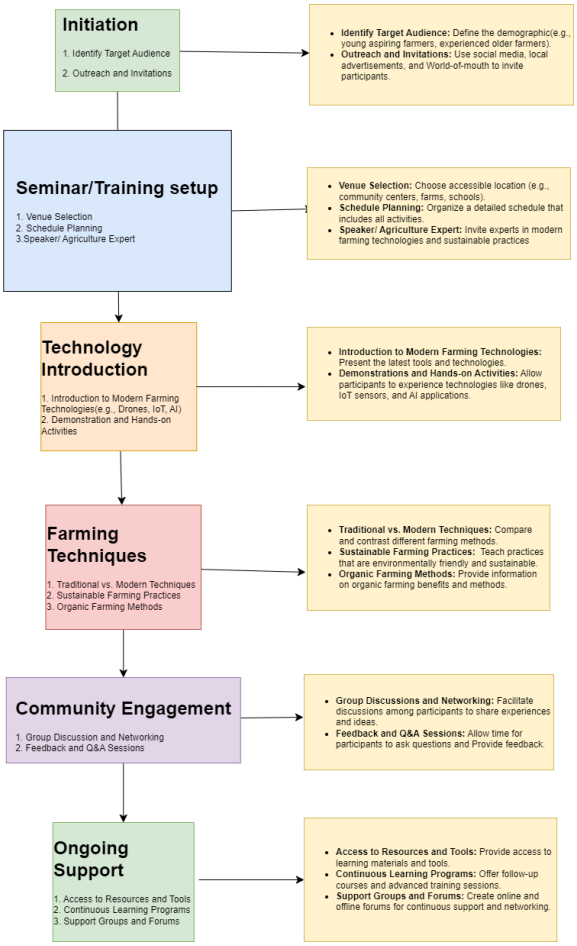


Fig. 7: Sustainable Agriculture Engagement Model: Bridging Farmers' Needs and Youth Interest in Farming

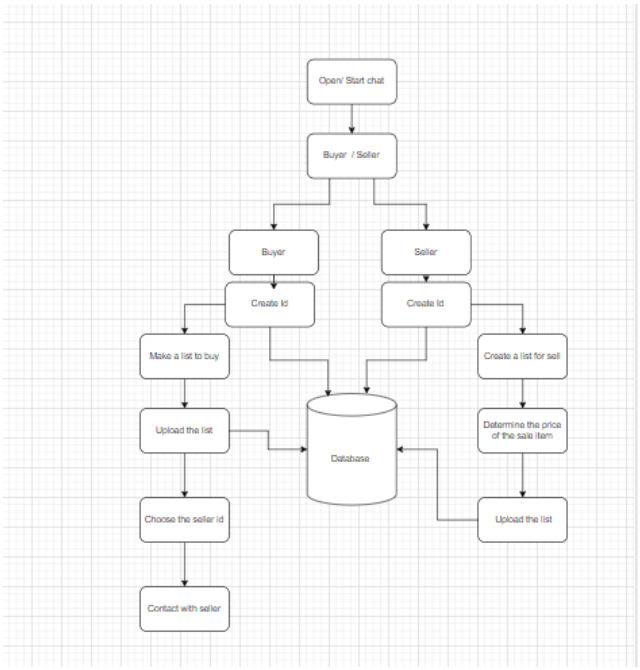


Fig. 8: Block diagram of Our AI-based Application

By creating a supportive system that encourages the younger generation's active participation, we can foster a more resilient farming community. This approach, combined with ongoing training, can facilitate the adoption of new technologies and benefit the agricultural sector and the community overall. shows in 7

2) AI-based mobile application

The integration of artificial intelligence (AI) in agriculture has the potential to revolutionize the traditional methods of buying and selling produce, particularly through a direct seller-to-buyer model. An AI-based application designed for this purpose can streamline the process by allowing farmers to sell their products directly to consumers without intermediaries. This approach not only maximizes the profits for the farmers by eliminating middlemen but also provides consumers with fresh, high-quality produce at competitive prices. The AI system can analyze various factors, such as market demand, seasonal trends, and individual buyer preferences, to recommend the best products to users, ensuring a personalized and efficient shopping experience.

One of the key features of this AI-based agricultural marketplace is the recommendation system, which leverages machine learning algorithms to understand and predict buyer preferences. By analyzing historical purchasing data, browsing behavior, and feedback, the system can offer personalized suggestions to each buyer, enhancing user satisfaction and increasing sales for sellers. For instance, if a buyer frequently purchases organic vegetables, the AI can prioritize and highlight similar products from various sellers. This not only helps in meeting the specific needs of the buyers but also assists sellers in targeting the right audience for their produce, thereby optimizing the overall supply chain efficiency.

Effective communication between buyers and sellers is crucial in this direct marketplace model, and language barriers can pose significant challenges. To address this, the app incorporates a real-time translation feature powered by AI, allowing seamless communication between parties speaking different languages. For example, if a buyer communicates in Bengali and the seller responds in Hindi, the app will automatically translate the messages into the respective native languages of both parties. This ensures that both buyers and sellers can understand each other clearly, facilitating smoother transactions and fostering trust within the marketplace. By breaking down language barriers, the AI-based app not only enhances user experience but also broadens the market reach for sellers, promoting inclusively and accessibility in the agricultural sector 8

Fig. 9: App Design Prototype

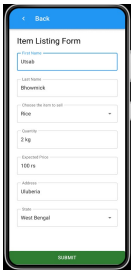


Fig. 10: App Design Prototype

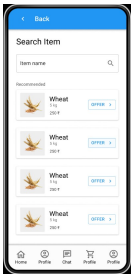


Fig. 11: App Design Prototype

3) Proposed Government Support for Fair Transportation Costs to Boost Farmers' Profits

In our discussions with farmers, we discovered that they typically sell their crops at fixed rates within a predetermined range, considering only the basic transportation costs. This practice significantly reduces their profit margins. Moreover, when the farming fields are located in remote areas, the labor costs to transport the crops from the field to the main road where transport vehicles are available are considerably higher. This further cuts into their already slim profits.

To address these challenges, we propose that the government should step in to provide a dedicated transport facility for farmers. The transportation cost should be calculated based on the distance in kilometers, the current fuel price, and a reasonable profit margin for the driver. A mathematical formula to determine this could be:

Transportation Cost = (Distance (km) × Fuel Price per Kilometer) + Drive Profit Margin

This would ensure a fair and transparent method for calculating transportation expenses, taking into account the variable costs of fuel, distance, and providing a fair profit for the driver.

Additionally, to further support the farmers, we suggest that the government offer a subsidy or financial aid to cover a portion of the transportation costs. This would alleviate some of the financial burdens associated with transporting crops from remote areas, motivate farmers, and ultimately allow them to retain more of their earnings as profit. By implementing these measures, we can help ensure that farmers are better compensated for their hard work and contribute to the overall sustainability of the agricultural sector.

4 DISCUSSION AND FUTURE WORK

4.1 Discussion

The research on revitalizing agriculture in South 24 Parganas highlights several critical challenges faced by farmers in this region, including inadequate financial support, limited technical knowledge, unsustainable practices, overproduction, market price fluctuations, and a lack of basic facilities and amenities. These issues have collectively resulted in a decline in farming interest and an increase in land sales among the farming community. This discussion will delve into the key findings of the study, analyzing their implications and proposing actionable strategies to address these challenges.

4.2 Future Work

Building on the findings and proposed strategies outlined in this research, future work will focus on several key areas to further enhance the sustainability and effectiveness of agriculture in South 24 Parganas.

1) Enhanced Mobile Application Features

Data Analytics Integration: Incorporate advanced data analytics to provide farmers with insights into market trends, crop health, and weather patterns, enabling more informed decision-making.

Blockchain for Transparency: Implement blockchain technology to ensure transparency and traceability in transactions, fostering trust among buyers and sellers.

2) IoT Devices

We are working on developing two innovative devices designed to support farmers by monitoring both soil and air quality. Feedback from farmers and agricultural professionals has highlighted a significant gap: many aspiring farmers struggle to understand which soil and weather conditions are optimal for different crops, which can lead to sub optimal yields and decreased enthusiasm for the profession.

Our first device will focus on soil quality, providing real-time data on factors such as moisture levels, pH, and nutrient content. This information will help farmers determine which crops are best suited for their soil conditions and optimize their use of fertilizers and other amendments.

The second device will monitor air quality, including temperature, humidity, and atmospheric conditions. This will allow farmers to assess how weather conditions impact crop growth and make better decisions regarding planting times and crop management.

By equipping farmers with these tools, we aim to enhance their understanding of environmental conditions, improve crop yields, and increase their engagement and satisfaction in the farming profession.

3) Community Training Programs

Technical Training: Expand training programs to include advanced farming techniques, digital literacy, and the use of AI tools. This will empower farmers with the knowledge to leverage technology effectively.

Sustainability Practices: Promote training on sustainable farming practices, including organic farming, water conservation, and soil health management, to ensure long-term agricultural productivity.

4) Infrastructure Development

Cold Storage Facilities: Develop additional cold storage facilities to reduce post-harvest losses and maintain the quality of produce. This is particularly crucial for perishable goods. Transport Logistics: Improve transportation infrastructure to facilitate easier access to markets, thereby reducing transportation costs and increasing market reach.

5) Research and Development

Crop Diversification: Conduct research on crop diversification to identify high-value crops that can be introduced to the region, reducing dependency on a few traditional crops and spreading risk. Climate Resilient Crops: Invest in the development and promotion of climate-resilient crop varieties that can withstand extreme weather conditions.

6) Enhanced Market Access

Direct-to-Consumer Models: Further refine the direct-to-consumer sales model by integrating additional features like subscription services and home delivery options, making it easier for consumers to purchase directly from farmers.

Export Opportunities: Explore opportunities for exporting local produce to international markets, providing farmers with higher profit margins and a larger customer base.

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TABLE I: Yield Rate and Production of Various Crops in South 24 Parganas from 2010-11 to 2014-15

Dry Crops	**2010-11**		**2011-12**		**2012-13**		**2013-14**		**2014-15**	
	Yield (kg/hect)	Production ('000 tonnes)	Yield (kg/hect)	Production ('000 tonnes)	Yield (kg/hect)	Production ('000 tonnes)	Yield (kg/hect)	Production ('000 tonnes)	Yield (kg/hect)	Production ('000 tonnes)
Aman Paddy	2110.23	302.957	2136.03	329.019	2216.68	364.032	2360.94	747.982	2440.98	794.541
Boro Paddy	3167.61	216.36	3184.01	215.172	3007.83	181.321	3172.77	231.508	3335.3	211.431
Aus Paddy	1968.77	11.33	2342.27	17.323	2304.7	8.958	2707.83	10.921	2526.81	12.76
Jute	11.55	23.608	12.81	42.401	19.34	49.329	21.15	31.6	20.87	10.997
Mustard	2082.36	5.901	538.1	2.709	1479.12	8.191	1394.15	4.477	1263.2	7.851
Wheat	2557.4	6.519	3060.84	7.56	2920.19	9.894	2840.08	9.881	2940.8	11.375
Til	936.92	2.432	1068.95	2.987	1063.38	2.604	1260.7	3.384	1134.36	3.374
Musur	684.59	0.599	543.94	0.707	978.68	1.181	1126.51	1.152	632	0.818
Maskalai	744.48	0.087	661.75	0.191	677.97	0.047	803.85	0.43	783.28	0.47
Maize	2525.94	0.134	0	0	0	0	0	0	0	0
Khesari	1403.56	4.736	792	3.206	1099.74	6.653	1156.29	7.008	1158.1	7.762
Gram	917.77	0.424	1063.36	0.632	1055.57	0.63	1113.38	0.719	1125.41	0.761
Sugarcane	81190.44	2.273	87671.24	7.368	101323.22	7.498	100231.77	2.706	93032.61	0.186
Mung	693.4	6.468	606.05	7.001	612.97	8.432	594.04	8.535	585.83	11.399
Matar	1263.43	1.498	879.79	0.825	693.4	1.138	1156.26	0.045	1197.25	1.827
Mesta	9.7	0.446	0	0	0	0	0	0	0	0
Linseed	466.47	0.075	351.45	0.056	396.98	0.064	411.83	0.059	479.8	0.1
Barley	0	0	0	0	0	0	0	0	0	0
Arhar	1625.98	0.74	447.51	0.195	1403.56	0.721	1555.92	0.68	1718.98	0.884
Groundnut	0	0	0	0	2921.56	0.079	2951.22	0.056	2156.79	0.05