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Cost - Return Analysis of Banana Cultivators in Burhanpur District, Madhya Pradesh

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Abstract: *This study examines the economic dynamics of banana cultivation, highlighting the challenges and opportunities faced by farmers. The research reveals that banana farming is a capital-intensive practice, with significant investments in inputs, labor, and infrastructure. Despite the availability of government-sponsored crop loan schemes, many farmers rely on informal credit sources, leading to increased production costs and decreased profitability. The study also identifies the role of market intermediaries in agricultural marketing, which can reduce farmer's profit margins. However, the adoption of modern technologies, such as tissue culture propagation, is found to enhance farm profitability and productivity. The findings underscore the need for innovative financing solutions, improved market efficiency, and sustainable agricultural practices to promote the livelihoods of banana farmers. This research provides valuable insights for policymakers, stakeholders, and farmers seeking to improve the sustainability and profitability of banana cultivation.*

Keywords: banana cultivation, tissue culture, profitability

I. INTRODUCTION

The surge in fruit and vegetable production has become increasingly crucial in recent times, driven by the burgeoning demand stemming from rapid population growth and rising income levels, which have led to shifts in consumption patterns. Ensuring adequate nutritional intake for the general population has gained paramount importance. Fruits and vegetables, as protective foods, play a vital role in providing essential nutrients, vitamins, and minerals, thereby enhancing the protein value in diets. Beyond their significance in human consumption, these crops contribute substantially to the country's economy. Notably, bananas occupy a unique position among fruits and vegetables due to their distinct characteristics, including non-seasonality. Bananas are a prominent fruit crop globally, cultivated in over 130 countries. The banana industry is characterized by a high degree of concentration in production, export, and import, with a few countries exerting significant influence on the global market. A comprehensive understanding of the technical and economic aspects of banana production and trade is essential for stakeholders in the industry. Botanically, bananas belong to the family Musaceae, with the genus Musa comprising multiple species. Edible bananas are categorized under the section EU Musa, and are classified as herbaceous fruit plants. Nutritionally, bananas are a rich source of carbohydrates, potassium, and vitamins C and B6, making them an important crop for both local consumption and commercial production. In India, bananas are widely cultivated and consumed due to their adaptability, nutritional value, and affordability. The fruit's year-round availability and convenience contribute to its popularity among consumers, while its nutritional profile underscores its significance as a valuable component of a balanced diet. The cultural significance of bananas in India is deeply rooted in its history, with evidence of consumption and utilization dating back to the Harappan period, around 5,000 years ago. Archaeological findings, such as the depiction of banana trees in ancient pottery, underscore the fruit's importance in Indian culture. In Hindu tradition, the banana plant is considered sacred, with its various parts holding spiritual significance. The use of banana leaves in temples and ceremonies highlights the fruit's role in Indian cultural practices. Historical records suggest that bananas were introduced to Europe by Alexander's invasion of India in 327 BC, which played a role in popularizing the fruit in the Western world. Ancient texts, including Greek, Chinese, and Hindu scriptures, mention bananas, demonstrating their significance in human history. Bananas are also referenced in Buddhist scriptures from 600 BC, highlighting their

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importance in traditional diets. The spread of bananas across the world has led to their integration into various national cultures and legacies. Understanding the historical and cultural context of banana cultivation and consumption can inform strategies for promoting sustainable production and consumption practices.

Nutritional and Health Benefits of Banana

Bananas are a nutrient-dense fruit that offers numerous health benefits, attributed to their rich content of essential micronutrients, fiber, and potassium. The consumption of bananas has been associated with improved digestive health, weight management, and enhanced cardiovascular health. The fiber content in bananas promotes regular bowel movements, prevents constipation, and supports healthy weight management. Additionally, bananas contain resistant starch, a type of fiber that acts as a prebiotic, supporting the growth of beneficial gut bacteria. The potassium content in bananas is beneficial for heart health, as it helps manage blood pressure and maintain healthy arteries, reducing the risk of heart diseases. Furthermore, bananas contain tryptophan, a precursor to serotonin, which may help alleviate symptoms of depression. The mineral content of bananas, including potassium, magnesium, and B vitamins, may also contribute to improved mental health and reduced symptoms of depression. Overall, incorporating bananas into one's diet can be a simple and effective way to support overall health and well-being. Bananas possess therapeutic properties that may contribute to alleviating symptoms and promoting healing, thereby making them a valuable component of a balanced diet. Research suggests that bananas may have potential benefits in managing various health conditions, including gastrointestinal disorders and nutritional deficiencies. The nutrient-rich profile of bananas, which includes natural sugars, essential vitamins (B1, B2, B3, B5, B6, and C), and important minerals (potassium, zinc, and magnesium), supports their incorporation into a healthy diet. The consumption of bananas can provide a natural source of energy and essential nutrients, making them a beneficial addition to a balanced dietary regimen.

Profile of Burhanpur District

Burhanpur District is located in the Indian state of Madhya Pradesh, with its administrative headquarters in Burhanpur city. The district covers an area of 3,427 square kilometers and has a population of 7.58 lakhs, according to the 2011 census. The population density is 221 people per square kilometer, and the sex ratio is 951. The literacy rate in Burhanpur is 64.36%, with males having a higher literacy rate of 71.80% compared to females at 56.58%. The district is situated on the northern bank of the Tapti River and is surrounded by ramparts with many huge gates. Burhanpur has a rich history, having been reputed as the capital during the Mughal period, and features important tombs, mosques, and historical monuments. The economy of Burhanpur District is driven by various industries, with the textile industry being a major contributor. The district is a center for the power loom industry in Madhya Pradesh, with several textile companies and mills operating in the region. Agriculture is another significant sector, with major crops including banana, cotton, soybean, barley, pea, wheat, gram, chilly, coriander, mango, and orange. The district is also home to a large paper mill, which is the largest in Madhya Pradesh. Other industries in the region include wood and wood-based furniture, cotton and oil mills, and agricultural equipment manufacturing.

Burhanpur District is a major banana-producing district in India, Burhanpur is the largest producer of bananas in Madhya Pradesh, and most of the bananas are supplied to North India, particularly to states like Delhi, Punjab, and Haryana. The banana crop is a significant contributor to the district's economy, and the region's favorable climate and soil conditions make it an ideal place for banana cultivation. Burhanpur district has emerged as a significant banana-producing region, with 25,239 hectares dedicated to banana cultivation, yielding 1,766,730 metric tons. A substantial number of farmers, approximately 18,325, are involved in banana cultivation, contributing to a remarkable turnover of ₹1,700 crore. The district's focus on banana production has not only boosted its agricultural economy but also led to the development of banana-based handicrafts and processing industries. With its recognition through the "Special Mention Award" in 2023-24 under the One District One Product initiative, Burhanpur's banana sector showcases promising growth prospects, including banana fiber textiles and diversified edible products.

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Map of Burhanpur District https://burhanpur.nic.in/en/map-of-district.

Research Problems

Banana cultivation is a vital agricultural activity in Madhya Pradesh, with Burhanpur district being a prominent hub. This crop not only provides livelihoods to thousands of farmers but also generates employment opportunities for numerous individuals involved in the supply chain, including traders, middlemen, retailers, and transporters. However, banana farming is a capital-intensive process that requires significant investment, and farmers often face various challenges throughout the production and marketing process.Some of the key challenges faced by banana farmers include:

1. Limited affordability: Small-scale farmers often struggle to engage in banana farming due to insufficient financial resources.
2. Lack of modern technology and awareness: Many farmers are not adopting modern techniques and technologies, which can improve productivity and efficiency.
3. Climatic risks: Banana farming is highly susceptible to climatic conditions, which can deter farmers from engaging in this activity.
4. Inadequate accounting systems: The absence of a well-organized accounting system makes it difficult for farmers to calculate actual costs and determine profitability.
5. Limited knowledge of costing tools and techniques: Farmers often lack awareness of costing tools and techniques that can help minimize production costs and maximize profits.
6. Pricing mechanisms: The pricing of bananas is often influenced by external factors rather than production costs, which can affect farmers' profitability.
7. Limited access to modern technology and government schemes: Many farmers are not aware of or do not have access to modern technology and government initiatives that can support their farming activities.
8. Commission agents: The presence of commission agents, such as "kela groups," can significantly impact farmers' profits, as they often take a substantial share of the revenue.
9. Marketing inefficiencies: While farmers may be efficient in production, they often lack the skills and knowledge to effectively market their crops.

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Objectives of the Study.

This study aims to achieve the following objectives:

1. Conduct a comprehensive analysis of trends in area, production, and productivity of banana cultivation in Burhanpur District, thereby providing a nuanced understanding of the dynamics of banana's production.
2. Investigate the challenges encountered by banana growers and traders in the study area, with the goal of informing evidence-based policy and practice.
3. Examine the price spread and market margin of various marketing channels for bananas, providing insight into the complexities of the marketing system.
4. Estimate the costs, returns, and profitability of banana production, with a specific focus on the impact of farm size on economic viability.

Significance of the Study.

Burhanpur District in Madhya Pradesh is a prominent banana-producing region, owing to its favorable climatic conditions and geographical location. Despite being a leading producer of bananas in Madhya Pradesh, Burhanpur has the potential to further enhance its production and export quality. However, farmers in the region face various challenges, including low prices, financial constraints, climate change, lack of government support, and inadequate storage and transportation facilities. This study aims to investigate the situation of banana farmers in Burhanpur District, highlighting the challenges they face and the opportunities for improvement. The findings of this research will be useful for existing and aspiring banana farmers, traders, middlemen, and government and non-government departments involved in the banana industry. Furthermore, this study has the potential to inform policies and interventions that can support the development of the banana industry in Burhanpur District, promoting entrepreneurship and employment opportunities for local people.

II. LITERATURE REVIEW

Gopala et al. (2012) conducted a study in Chickaballapur district, Karnataka, India, to investigate the constraints faced by farmers in banana production. The study was carried out in three taluks: Shidlaghatta, Bagepalli, and Chinthamani. The findings revealed that a significant proportion of participants (98.33%) identified the high cost of plant protection chemicals as a major production constraint. Additionally, 81.67% of non-participants cited the non-availability of labor at the right time as a significant constraint. The study also found that storage facilities being located far from villages was a major constraint for both participants (80.00%) and non-participants (71.67%). Furthermore, market price fluctuations were identified as a significant marketing constraint by 91.67% of participants and 83.33% of non-participants.

A study by S. Dhanalakshmi and R. Stephan (2014) emphasizes the significance of banana as a major horticultural crop, cultivated in over 120 countries worldwide. Recognizing its importance as a staple food source, the authors stress the need for scientific and systematic approaches to banana production and processing to minimize costs. Their research focuses on exploring low-cost options for banana production through plant tissue culture, highlighting its potential to improve nutrient sources, boost production, and provide healthy plant materials. The study suggests that adopting cost-effective methods, such as using mixed nutrient media, sword suckers as a source material, and modern plantation techniques, can reduce production costs. Furthermore, establishing low-cost tissue culture laboratories in local areas can enable farmers to increase banana plant production, ultimately contributing to improved yields and reduced costs.

Khushboo Chandrakar (2015) conducted a study on the constraints in banana cultivation and supply chain management in Raipur district, Chhattisgarh. The analysis was based on responses from 30 banana growers, selected from four villages in the district. The study revealed that the majority of respondents belonged to other backward castes, were educated, and had large landholdings, with an average farm size of 2.17 hectares. Banana cultivation was found to be intensive, with a cropping intensity of 259.89%. The farmers sold most of their produce (99.08%) through Channel-I, involving wholesalers, with transportation costs being a significant component of marketing expenses. The study identified high temperatures, electricity issues, and lack of improved varieties as major constraints in banana cultivation. Additionally, the absence of processing industries, price fluctuations, storage issues, and inadequate

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marketing systems were significant challenges in supply chain management. The study suggested that developing heat-tolerant varieties and improving the supply chain infrastructure could help mitigate these issues and enhance the overall efficiency of banana production and marketing in Raipur district.

A.Sivakumar (2015) examined the marketing efficiency of distribution channels in banana cultivation, emphasizing the critical role of marketing arrangements at various stages in determining price levels from farm gate to consumer. The study highlighted the distinct characteristics of fruit and vegetable marketing systems, particularly in terms of time, form, and space utilities. In India, the marketing efficiency of fruits and vegetables is gaining significance, yet producers and consumers often receive a reduced share of the final price, while intermediaries dominate the market without adding substantial value. This study aimed to analyze the factors influencing channel selection, marketing efficiency, and price spread in banana marketing. Using designed questionnaires and statistical techniques such as Shepherd's Formula, Acharya's model, and Composite Index technique, the study assessed the price spread across different channels. The findings revealed that Channel I had a relatively higher price spread compared to other channels, and Channel III (Farmers-Wholesalers-Retailers-Consumer) was identified as the most preferred channel.

Study conducted by Ruchi Sharma et al. (2016), aimed to investigate the trends in area, production, and productivity of banana cultivation in District Kaushambi, Uttar Pradesh, India. The district was selected purposively due to its significant scale of banana cultivation and its potential as a lucrative cash crop. The findings highlighted that rising input costs, including water, fertilizers, and quality planting material, coupled with plant protection measures, were major limiting factors in enhancing banana production. The study's objective was to evaluate the trends and challenges in banana cultivation, providing insights into the dynamics of this important crop.

Vincy (2016) investigated the production and marketing of bananas in Vilavancode Taluka, highlighting that agricultural development depends not only on increasing productivity but also on efficient promotion and organized marketing. The study revealed that banana farmers face significant financial challenges, including limited access to affordable credit services to finance cultivation expenses. Small farmers, in particular, are vulnerable to financial pressures, often forcing them to sell their produce immediately after harvesting at low prices. The perishable nature of bananas and inelastic demand further complicate price fixation. Additionally, the variability in banana quality makes grading and standardization challenging. Given the importance of agriculture in Vilavancode Taluka, Kanyakumari district, where over 60% of the population relies on farming, the study aimed to examine the socio-demographic profile, production and marketing processes, and issues faced by banana farmers. The research analyzed the technological gap, farmers' awareness of crop husbandry, and production and marketing constraints in banana cultivation.

Rupali Jadhav (2016) highlighted the growth of fruit cultivation in India, particularly bananas, since the implementation of the Fruit Production Development Programme in 1990-91. Maharashtra accounts for approximately 50% of the country's total banana production. However, the banana processing industry remains largely unorganized, with small savings groups (AlpaBachat Gat) dominating the sector. Various value-added products can be prepared from bananas using proper processing techniques, including banana chips, pulp, puree, powder, jam, jelly, and fruit bars. Jadhav emphasized the importance of maintaining product quality in the processing business to ensure success.

Madhu Naik (2018) in her article concluded that area under banana cultivation in India expanded significantly from 466,000 hectares in 2001-02 to 858,000 hectares, with annual production increasing from 14.209 million metric tons (MT) to 29.162 million MT. Over the 16-year study period, the compound annual growth rate (CAGR) of production area and production were 4.3% and 5.8%, respectively. However, banana productivity growth was relatively modest, with a CAGR of 1.4%, fluctuating between 31 and 37 tons per hectare. Globally, bananas are the fifth largest agricultural commodity, with India, Ecuador, Brazil, and China accounting for half of the world's total production. India's contribution to global banana production stands at 29.9%. Between 2000 and 2015, global banana production grew at a CAGR of 3.7%, reaching a record 117.9 million MT in 2015. The Indian banana industry differs from other major producers, characterized by small, polyclonal plantations and local consumption. Unlike large monoculture plantations in Central America and the Caribbean, India's banana cultivation exhibits significant intra-varietal diversity, providing economic advantages.

Abdul Ghani Qarluk, Manjeet Kaur, Rohit Saini (2021) stated that India is the world's largest banana producer, accounting for approximately 26% of global production during 2015-19. The country's banana production, area, and

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yield have grown at rates of 3.53% and 1.64%, respectively. State-wise analysis reveals varying growth rates, with Andhra Pradesh (7.95%) and Bihar (7.76%) exhibiting the highest growth rates in banana production. However, Karnataka experienced a negative growth rate in yield, while Bihar showed the highest growth rate at 5.89% among major banana-producing states.The study also highlights significant instability in area, production, and productivity across states, particularly in Madhya Pradesh, Karnataka, Andhra Pradesh, and Tamil Nadu. In contrast, Bihar demonstrated stability in these aspects. To address the demand-supply gaps and risks associated with fruit cultivation, policymakers should devise strategies to minimize instability in banana production, employment, and income distribution.

III. RESEARCH METHODOLOGY

This comprehensive study aims to investigate the intricacies of banana cultivation in Burhanpur district, strategically located in the heart of Madhya Pradesh, India. The research design entails collecting primary data from a representative sample of banana farmers residing in various tehsils of the district, including Burhanpur, Khaknar, and Nepanagar. To ensure a robust and reliable dataset, a sample size of 150 farmers will be meticulously selected through a random sampling technique. 50 respondents were taken from each tehsil, encompassing diverse villages within the district. This approach will enable the researchers to capture a broad spectrum of experiences, challenges, and opportunities faced by banana farmers in the region. The collected data will undergo rigorous analysis using an array of statistical tools and techniques. Specifically, descriptive statistics such as mean, percentage, and ratio will be employed to summarize and describe the key characteristics of the data. These statistical measures will facilitate the identification of trends, patterns, and providing valuable insights into the dynamics of banana cultivation in Burhanpur district. By adopting a systematic and scientific approach to data collection and analysis, this study aims to generate reliable and actionable findings that can inform policy decisions, extension services, and farming practices in the region.

IV. DATA ANALYSIS

Adoption of Tissue Culture and Sucker-Based Propagation among Banana Cultivators.

Method	No. of Farmers
Sucker Based Propagation	102
Tissue culture Plant	48
Total	150

A survey of 150 banana cultivators revealed a notable disparity in the adoption of tissue culture and sucker-based propagation methods. The results indicated that 48 cultivators, representing approximately 33.33% of the total sample, utilized tissue culture plants, while the remaining 102 cultivators, accounting for 67.67%, relied on sucker-based propagation. This significant difference in adoption rates suggests that sucker-based propagation remains the more widely used method among banana cultivators, despite the potential benefits of tissue culture, such as improved crop quality and disease resistance. Further research is necessary to investigate the factors influencing the adoption of these methods and to identify strategies for promoting the use of tissue culture among banana cultivators.

Quality Grading of Bananas.

Quality	**Grade 1**	**Grade 2**	**Grade 3**
Weight (in kg)	26-34	18-26	10-18

The quality of bananas is a critical factor in determining their market value, and it is primarily assessed based on the weight of the bunch. In the banana industry, three distinct grades have been established to categorize bananas according to their quality: Raas 1, Raas 2, and Raas 3. These grades are defined by specific weight ranges, with Raas 1 bananas exhibiting the highest quality and weight, averaging between 26-34 kg per bunch. Raas 2 bananas have a moderate weight range of 18-26 kg, while Raas 3 bananas have the lowest weight range, averaging between 10-18 kg.

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Quality Ratio of Sucker Based Propagation and Tissue Culture Propagation in Banana Production.

Quality	Grade 1	Grade 2	Grade 3
Weight (in kg)	26-34	18-26	10-18
Sucker based propagation	50%	25%	25%
Tissue culture method	80%	20%	-

A comparative analysis of traditional sucker-based propagation and modern tissue culture methods in banana farming reveals significant differences in product quality. In traditional sucker-based propagation, the product quality distribution across one acre of land is 50% Grade 1, 25% Grade 2, and 25% Grade 3. In contrast, tissue culture-based banana production yields a higher proportion of premium quality produce, with a distribution of 80% Grade 1 and 20% Grade 2. This disparity in product quality highlights the advantages of tissue culture in producing superior quality bananas, which can lead to improved marketability, increased revenue, and enhanced competitiveness in the global banana market.The prices of bananas are directly influenced by these quality grades, with higher-grade bananas commanding premium prices in the market. Furthermore, seasonal demand plays a significant role in determining banana prices, with fluctuations in demand and supply leading to variations in prices. Understanding the relationship between quality grades, weight ranges, and pricing is essential for banana producers, traders, and consumers to make informed decisions and optimize their market outcomes.

Banana Prices and Seasonal Fluctuations

Quality	Grade 1	Grade 2	Grade 3
Weight (in kg)	26-34	18-26	10-18
Seasonal Rate/ quintal	2000-2500 Rs	1500-2000 Rs	1000-1500 Rs
Offseason Rate/quintal	1200-1500 Rs	800-1200 Rs	500- 800 Rs.

The prices of bananas exhibit significant seasonal fluctuations, influenced by variations in demand and supply during peak and off-seasons. During peak seasons, such as Navratri and Ramzan, the prices of bananas tend to rise, reflecting increased demand and limited supply. Specifically, the prices for Raas 1 bananas range from ₹2,000 to ₹2,500 per bunch, while Raas 2 bananas fetch prices between ₹1,500 and ₹2,000 per bunch. In contrast, Raas 3 bananas, being the lowest grade, are priced between ₹1,000 and ₹1,500 per bunch. In contrast, during off-seasons, the prices of bananas decline, reflecting reduced demand and increased supply. The prices for Raas 1 bananas range from ₹1,200 to ₹1,500 per bunch, while Raas 2 bananas are priced between ₹800 and ₹1,200 per bunch. Raas 3 bananas, during off-seasons, fetch the lowest prices, ranging from ₹500 to ₹800 per bunch.

Sucker-Based Propagation in Banana Production

Sucker-based propagation is a traditional method of producing new banana plants using suckers, which are shoots that emerge from the base of mature plants. This technique is widely employed in banana cultivation due to its simplicity and cost-effectiveness. The primary advantages of sucker-based propagation include its ease of implementation and the ready availability of suckers from mature plants. However, this method also has certain limitations, such as the potential transmission of diseases from the mother plant to the offspring and the possibility of genetic variability among the propagated plants.

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Cost Sheet of Banana farming per acre land by Traditional method (Sucker-Based Propagation)

Particular		Amount
1.Pre-Plantation charges Gobarkhad (5000×4) Naagar Roater Med	 20000 1500 1000 600	 23100
2.Planting Seeds (1200×5) Seedling Wages (1200×0.5)	6000 600	 6600
3.Cultivation Cost	2000	2000
	Prime cost	**31700**
4. Irrigation cost Electric bill	 5000	 5000
5. Irrigation system Pipe Set and Instrumentation	 15000	 15000
6. Organic fertilizers Tonic (15 litre×400)	 6000	 6000
7. Chemical fertilizers Urea (15 bags×300) Potash (3 bags × 1600) Iffco (2 Bags × 1500) Superfast Phosphate (15 bags × 300)	 4500 4800 3000 4500	 16800
8. Insecticide & Pesticides	3000	3000
	Work cost	**77500**
9. Interest on Loan (200000×2%×12)	 48000	 48000
10. Guard Salary. (3000×12)	 36000	 36000
	Cost of production	**161500**
11. Cutting Charges	5000	5000
12. Loading Charges (1200× 5)	6000	6000
13. Miscellaneous charges	1500	1500
14. Commission to agent (Munshi of Kela Group)	10000	10000
	Total cost	**184000**

The cost sheet for banana farming per acre land using the traditional method of sucker-based propagation reveals a comprehensive breakdown of the expenses involved in this agricultural endeavor. With a total cost of production amounting to ₹184,000, it is evident that banana farming requires significant investments in various aspects, including pre-plantation charges, planting seeds, cultivation, irrigation, fertilizers, pest control, and labor costs. The substantial expenditure on irrigation systems, fertilizers, and pesticides underscores the importance of these inputs in ensuring optimal crop growth and yields. Furthermore, the inclusion of interest on loans and guard salaries highlights the financial and operational complexities associated with banana farming. Understanding these costs is crucial for farmers,

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policymakers, and stakeholders to make informed decisions, optimize resource allocation, and develop strategies to enhance the efficiency and profitability of banana farming operations. By analyzing this cost sheet, farmers can identify areas for cost reduction, improve their resource management, and ultimately increase their returns on investment. Moreover, policymakers can utilize this information to design targeted interventions, such as subsidies, credit facilities, and extension services, to support banana farmers and promote the sustainability of this agricultural sector. Ultimately, a thorough comprehension of the costs involved in banana farming can contribute to the development of more efficient, productive, and profitable farming practices, benefiting both farmers and the broader agricultural economy.

Tissue Culture in Banana Production

Tissue culture is a plant propagation technique that enables the production of large numbers of genetically identical plants in a controlled environment. In banana production, this method involves taking small tissue samples from high-quality banana plants and cultivating them in a laboratory to generate new plants. The advantages of tissue culture in banana production are multifaceted, including the production of disease-free plants, which reduces the risk of infection and pest infestation. Additionally, tissue culture ensures uniformity in yield, quality, and growth due to the genetic identicalness of the plants. Furthermore, this technique facilitates rapid multiplication, enabling large-scale production to meet commercial demands.

Cost Sheet of Banana farming per acre land
Modern Method (TissueCulture)

Particular		**Amount**
1.Pre-Plantation charges Gobarkhad (5000×4) Naagar Roater Med	 20000 1500 1000 600	 23100
2.Planting Tissue Plants (1200×20)	24000	24000
3.Cultivation Cost	2000	2000
	Prime cost	**49100**
4. Irrigation cost Electric bill	 5000	 5000
5. Irrigation system Pipe Set and Instrumentation	 15000	 15000
6. Organic fertilizers Tonic (15 litre×400)	 6000	 6000
7. Chemical fertilizers Urea (15 bags×300) Potash (3 bags × 1600) Iffco (2 Bags × 1500) Superfast Phosphate (15 bags × 300)	 4500 4800 3000 4500	 16800
8. Insecticide & Pesticides	3000	3000
	Work cost	**94900**
9. Interest on Loan (200000×2%×12)	 48000	 48000
10. Guard Salary. (3000×12)	 36000	 36000

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	Cost of production	**178900**
11. Cutting Charges	5000	5000
12. Loading Charges (1300× 5)	6500	6500
13. Miscellaneous charges	1500	1500
14. Commission to agent (Munshi of Kela Group)	10000	10000
	Total cost	**201900**

The cost sheet for banana farming per acre land using the modern method of tissue culture provides a comprehensive breakdown of the expenses involved in this agricultural endeavor. With a total cost of ₹201,900, it is evident that banana farming using tissue culture requires significant investments in various aspects, including pre-plantation charges, planting and seedling wages, irrigation, fertilizers, and labor costs. The cost of production amounts to ₹178,900, which includes expenses such as interest on loans (₹48,000), guard salaries (₹36,000), and work costs (₹94,900). Additionally, post-harvest expenses, including cutting charges (₹5,000), loading charges (₹6,500), and miscellaneous costs (₹1,500), contribute to the overall cost. The commission paid to agents (₹10,000) further adds to the total expenditure. Understanding these costs is crucial for farmers and policymakers to make informed decisions, optimize resource allocation, and develop strategies to enhance the efficiency and profitability of banana farming operations using tissue culture. By analyzing this cost sheet, farmers can identify areas for cost reduction, improve their resource management, and ultimately increase their returns on investment, thereby contributing to the growth and sustainability of the banana industry. Furthermore, policymakers can utilize this information to design targeted interventions, such as subsidies, credit facilities, and extension services, to support banana farmers and promote the adoption of modern farming techniques like tissue culture.

Comparative Analysis of Tissue Culture and Sucker-Based Propagation

The banana industry employs two primary methods of propagation: tissue culture and sucker-based propagation. A comprehensive evaluation of these methods reveals distinct advantages and limitations associated with each. Tissue culture offers several benefits, including the production of disease-free plants, uniformity in yield, quality, and growth, and higher multiplication rates. These advantages are particularly significant in commercial banana production, where consistency and quality are crucial for meeting market demands and ensuring economic viability. The uniformity achieved through tissue culture can lead to improved crop management, reduced variability in fruit quality, and enhanced marketability. In contrast, sucker-based propagation, although widely used due to its simplicity and cost-effectiveness, is often hampered by the risk of disease transmission and genetic variability. The use of suckers can lead to the spread of diseases, such as bunchy top virus and nematode infestations, which can significantly impact crop yields and quality. Furthermore, genetic variability among sucker-propagated plants can result in inconsistent yields, varying fruit quality, and increased management costs. A comparative analysis of sucker-based propagation and tissue culture in banana farming reveals distinct differences in costs and benefits. The traditional method of sucker-based propagation incurs a total cost of ₹184000 per acre, whereas tissue culture-based banana farming costs ₹201,900 per acre. Although tissue culture is more expensive, its benefits can lead to increased productivity, improved crop quality, and reduced disease management costs in the long run. The higher multiplication rate of tissue culture can also enable large-scale production, making it a viable option for commercial banana farming. In contrast, sucker-based propagation, while more cost-effective initially, may result in higher disease management costs and reduced yields due to genetic variability. The long-term benefits of tissue culture, including improved crop yields and reduced disease susceptibility, may outweigh the initial costs. Ultimately, the choice between tissue culture and sucker-based propagation depends on the specific needs and goals of the producer, as well as the resources available. A detailed cost-benefit analysis is essential to determine the most suitable method for specific farming operations.

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Revenue from Sucker Based Propagation (per acre land)

Particular	Quantity (No. Of Plant)	Weight (In Kg)	Average rate (per Quintal)	Amount (Weight × Rate)
Category 1	1200×50% = 600	(26-34) = 30	(1200 – 2500) = 1850	18000× 18.5 = 33300
Category 2	1200×25% = 300	(18-26) = 22	(800 – 2000) = 1400	6600 × 14 = 92400
Category 3	1200×25% = 300	(10-20) = 15	(500 – 1500) = 1000	4500 × 10 = 45000
Total				**470400**

Total Revenue 470400

The revenue generated from sucker-based propagation per acre land is ₹470,400, which is calculated based on the quantity, weight, and average rate of bananas in three different categories. The revenue is comprised of ₹333,000 from Category 1, ₹92,400 from Category 2, and ₹45,000 from Category 3. The calculation takes into account the varying weights and rates of bananas in each category, with Category 1 having the highest average weight and average rate, and Category 3 having the lowest. The total revenue indicates a significant income potential for farmers adopting sucker-based propagation methods. Understanding the revenue structure and factors influencing it can help farmers and policymakers make informed decisions to optimize their resources, improve yields, and increase profitability. By analysing the revenue data, farmers can identify opportunities to enhance their cultivation practices, negotiate better prices, and ultimately increase their returns on investment. Furthermore, policymakers can use this information to design targeted interventions, such as subsidies, market support, and extension services, to promote the growth and sustainability of the banana industry. Overall, the revenue generated from sucker-based propagation highlights the potential of this agricultural endeavours to contribute to the economic well-being of farmers and the broader agricultural economy.

Revenue from Tissue Culture (per acre land)

Particular	Quantity (No. Of Plant)	Weight (In Kg)	Average rate (per Quintal)	Amount (Weight × Rate)
Category 1	1200×80% = 960	(26-34) = 30	(1200 – 2500) = 1850	28800 × 18.5 = 532800
Category 2	1200×20% = 240	(18-26) = 22	(800 – 2000) = 1400	5280 × 14 = 73920
Total				**606720**

Total Revenue 606720

The revenue generated from tissue culture banana farming per acre land is ₹606,720, which is calculated based on the quantity, weight, and average rate of bananas in two different categories. Category 1 accounts for 80% of the plants, with 960 plants producing an average weight of 30 kg per plant, and fetching an average rate of ₹1850 per quintal, resulting in a revenue of ₹532,800. Category 2 accounts for 20% of the plants, with 240 plants producing an average weight of 22 kg per plant, and fetching an average rate of ₹1400 per quintal, resulting in a revenue of ₹73,920. The total revenue of ₹606,720 indicates a substantial income potential for farmers adopting tissue culture methods, with a notable increase in revenue compared to sucker-based propagation. The higher revenue from tissue culture can be attributed to the improved yields and quality of bananas, as well as the increased proportion of plants falling under Category 1. This highlights the potential benefits of adopting tissue culture technology, including improved crop uniformity, disease

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resistance, and increased marketability. By analysing the revenue data, farmers and policymakers can make informed decisions to optimize their resources, improve yields, and increase profitability, ultimately contributing to the growth and sustainability of the banana industry. The revenue generated from tissue culture banana farming underscores the potential of this technology to enhance the economic well-being of farmers and the broader agricultural economy.

Return on Investment (In Rupees)

Particular	Sucker Based Propagation	TissueCulturePropagation
Revenue	470400	606720
Cost	184000	201900
Profit	**286400**	**404820**

Return on Investment By Sucker Based Propagation.

(286400/ 184000) × 100 = **155.65%.**

Return on Investment By Tissue Culture Propagation.

(404820/201900) × 100 = **200.51%.**

The return on investment (ROI) analysis for sucker-based propagation and tissue culture propagation reveals a significant difference in profitability between the two methods. The ROI for sucker-based propagation is calculated to be 155.65%, with a profit of ₹286,400 on a cost of ₹184,000, and a revenue of ₹470,400. In contrast, the ROI for tissue culture propagation is substantially higher at 200.51%, with a profit of ₹404,820 on a cost of ₹201,900, and a revenue of ₹606,720. This indicates that tissue culture propagation generates a higher return on investment compared to sucker-based propagation, despite having a slightly higher cost. The increased ROI can be attributed to the improved yields and quality of bananas, resulting in higher revenue. The analysis suggests that tissue culture propagation is a more profitable and efficient method of banana farming, providing farmers with a higher return on their investment. This information can be valuable for farmers and policymakers in making informed decisions about the adoption of tissue culture technology, and in identifying opportunities to optimize resources and improve profitability in banana farming. By adopting tissue culture propagation, farmers can potentially increase their income and contribute to the growth and sustainability of the banana industry.

III. KEY FINDINGS, CONCLUSION AND SUGGESTIONS.

1. Soil Preparation and Fertility Enhancement: Pre-plantation charges constitute a significant proportion of the overall expenditure in banana farming, with a substantial component attributed to the application of organic amendments such as gobarkhad and manure to enhance soil fertility and promote optimal plant growth.
2. Input Costs for Crop Management: The judicious application of chemical fertilizers, insecticides, and pesticides is a crucial aspect of banana cultivation, necessitating significant financial outlays. These inputs are essential for promoting plant growth, managing pests and diseases, and ensuring optimal yields, but they also contribute substantially to the overall cost structure of banana farming.
3. Economic Challenges in Banana Cultivation: Banana cultivation is a capital-intensive agricultural practice that requires significant investments in inputs, labour, and infrastructure. Smallholder farmers, in particular, face considerable challenges in bearing the costs associated with banana production, highlighting the need for innovative financing solutions and support services to promote the sustainability and profitability of this important crop.
4. Inadequate Utilization of Formal Credit Channels: Despite the availability of government-sponsored crop loan schemes, many farmers continue to rely on informal credit sources, such as moneylenders, to finance their banana cultivation activities. This phenomenon is concerning, as it leads to exorbitant interest rates, increased production costs, and decreased profitability for farmers. The persistence of this trend underscores the need for further research into the underlying factors driving farmers' preferences for informal credit sources, as well as the development of targeted interventions to enhance awareness and accessibility of formal credit channels, thereby reducing the financial burden on farmers and promoting the sustainability of banana cultivation.

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5. Transaction Costs in Agricultural Marketing: The payment of commissions to the Munshi of kela groups constitutes a significant transaction cost for farmers, effectively functioning as an informal bribe to ensure timely crop harvesting and procurement. This practice contributes to increased production costs for farmers, thereby reducing their profit margins and potentially compromising their economic viability. The prevalence of such informal payments highlights the complexities and inefficiencies inherent in agricultural marketing systems, underscoring the need for further investigation into the dynamics of transaction costs and their impact on farmer livelihoods. By examining the role of intermediaries and the nature of informal payments, researchers can inform policy interventions aimed at promoting more efficient and equitable market structures.

6. Impact of Modern Technology on Farm Profitability: The adoption of modern technologies and farming practices has been shown to enhance farm profitability, despite the associated increase in production costs. Notably, our research findings indicate that tissue culture propagation of bananas yields a higher return on investment compared to traditional sucker-based propagation methods. This suggests that the benefits of modern technologies, such as improved crop yields and quality, can outweigh the additional costs, resulting in increased profitability for farmers. The comparative analysis of tissue culture and sucker-based propagation methods provides valuable insights into the economic viability of modern farming practices, highlighting the potential for technology-driven solutions to improve agricultural productivity and farmer livelihoods.

7. Market Intermediation and Farmer Livelihoods: In the study area, a significant proportion of farmers rely on the Kerala group, a key intermediary in the marketing channel, to facilitate the sale of their crops. While the Kerala group provides essential services, including timely crop harvesting, prompt payment to farmers, and financial assistance during the production process, this intermediation comes at a cost. Specifically, farmers receive lower prices for their crops compared to what they could potentially earn through direct sales. This highlights the trade-offs inherent in market intermediation, where farmers benefit from reduced transaction costs and increased market access, but may sacrifice some of their potential earnings. Further research is needed to explore the dynamics of market intermediation and its impact on farmer livelihoods, as well as the potential benefits and drawbacks of alternative marketing arrangements.

Conclusion.

This study highlights the complexities and challenges of banana cultivation, including high production costs, inadequate access to formal credit channels, and inefficiencies in agricultural marketing systems. However, the research also identifies opportunities for improvement, such as the adoption of modern technologies and farming practices, which can enhance farm profitability and productivity. The findings underscore the need for targeted interventions to promote sustainable and equitable banana cultivation practices, including improving access to formal credit channels, reducing transaction costs, and promoting more efficient market structures. By addressing these challenges and opportunities, policymakers and stakeholders can work towards enhancing the livelihoods of banana farmers and promoting the long-term sustainability of this important crop.

Suggestions.

Based on the research findings, it is suggested that policymakers and stakeholders take steps to promote access to formal credit channels, reducing reliance on informal credit sources and promoting sustainable banana cultivation. Additionally, investing in modern technologies such as tissue culture propagation can improve crop yields, quality, and profitability. Furthermore, efforts should be made to improve market efficiency by investigating the dynamics of transaction costs and market intermediation, and developing policy interventions to promote more efficient and equitable market structures. Support services and innovative financing solutions should also be provided to smallholder farmers to enhance their sustainability and profitability. By implementing these measures, banana cultivation can become more sustainable, profitable, and beneficial for farmers, ultimately improving their livelihoods.

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