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RESEARCH ARTICLE

Evaluation of Protected Cultivation Methods in Vegetable Farming -A Case Study from the Western Zone of Tamil Nadu

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ABSTRACT

Vegetable production is constantly affected by both biotic and abiotic factors. Protected cultivation technology enables farmers to grow vegetables year-round in controlled environments. High initial investment, technical skills, and huge maintenance costs, as well as environmental impacts, are some of the limitations of protected cultivation. A study was conducted to gain further insights into the cost of vegetable cultivation in protected cultivation and to understand the current status, practices, challenges, and needs of farmers who use or intend to use this technique. Information was collected from a Tomato farmer involved in the protected cultivation of tomatoes. An open-ended interview method was used in this study. This study was conducted in the Thondamuthur Block of Coimbatore District. The study noted that budgetary constraints, inadequate logistics, and storage facilities for accessing far-off markets decreased farmers' incomes. The results of the study can be used to promote the protected cultivation of vegetables and inform policy interventions.

Keywords: *Protected cultivation, Biotic and Abiotic factors, open-ended interview, budgetary constraints*

INTRODUCTION

Protected cultivation methods represent a paradigm shift in the realm of vegetable farming, introducing sophisticated techniques that redefine agricultural practices. This comprehensive case study aims to meticulously evaluate and analyse the multifaceted aspects of various protected cultivation methods used in vegetable farming. By examining their effects on agricultural productivity, economic viability, environmental sustainability, technical feasibility, and societal implications, this study aims to provide a comprehensive understanding of their efficacy and potential in contemporary farming practices.

Traditional open-field farming has long been the cornerstone of agriculture; however, it faces inherent challenges, including susceptibility to adverse weather conditions, pest infestations, and diseases. Protected cultivation methods, including greenhouse structures, polyhouses, shade netting, hydroponics, and other innovative techniques, serve as a shield against these challenges. They create a controlled environment that allows precise manipulation of environmental factors crucial for plant growth, such as temperature, humidity, light exposure, and nutrient availability. This controlled environment often leads to enhanced yields, improved quality of produce, and extended growing seasons. The economic implications

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of adopting protected cultivation methods are multifaceted. Initial setup costs, ongoing operational expenses, and maintenance investments constitute significant considerations. Assessing the return on investment, comparative analysis against traditional farming practices, and exploring market opportunities for produce grown through protected cultivation are pivotal in understanding the economic viability of these methods. Furthermore, the study aims to evaluate the scalability of these techniques and their potential for integration into various economic models, including small-scale farming and commercial enterprises.

Environmental sustainability is a crucial aspect of modern agriculture, and protected cultivation methods offer potential solutions to mitigate environmental impacts. This case study aims to investigate how these techniques impact resource utilization, water conservation, energy consumption, and their overall ecological footprint. Analysing their ability to reduce water usage, minimize pesticide and fertilizer runoff, and optimize land utilization will provide insights into their role in promoting sustainable farming practices. The technical feasibility and adaptability of protected cultivation methods across diverse geographical regions and climates are paramount considerations. Variations in climate, soil types, and available resources significantly affect the efficacy of these techniques. Therefore, this study aims to assess the adaptability of various methods in different environments, identifying both challenges and opportunities for implementation.

Societal implications are equally crucial in evaluating the impact of protected cultivation methods. These methods have the potential to create employment opportunities, particularly in regions where traditional farming faces challenges due to environmental constraints or limited resources. Additionally, the study aims to analyse their role in enhancing food security, improving access to fresh produce, and contributing to local economies.

Through a holistic evaluation encompassing economic, environmental, technical, and social dimensions, this case study aims to provide a comprehensive understanding of the efficacy and implications of protected cultivation methods in vegetable farming. The insights derived from this study aspire to guide policymakers, agricultural practitioners, and stakeholders in making informed decisions regarding the integration and adoption of these innovative techniques. Ultimately, the goal is to optimize agricultural productivity, ensure food security, and promote sustainable practices within the domain of vegetable farming. Evaluation of Protected Cultivation methods in Vegetable farming - A case study from the Western zone of Tamil Nadu. The main objectives of the study are:

- To study the protected cultivation in vegetable farming
- To analyse the environmental impact of the protected cultivation method in vegetables
- To analyse the protected cultivation of vegetables in Thondamuthur block.

METHODOLOGY

The present study is based on information collected from farmers located in the Thondamuthur block. The method used to collect data is an interview schedule to obtain information about the cost of cultivation, challenges faced by farmers while using protected cultivation, factors motivating the adoption of protected cultivation, management of pests and diseases, and overall crop health.

Current scenario of vegetable production in India:

The global trade value of vegetables exceeds that of cereals. India and Tamil Nadu have a diverse and wide range of agroclimatic zones. Vegetable production has been restricted to seasonal and regional needs. Vegetable crops contribute 22% to the area and 40% to the production of the total Horticulture crops grown in the State. In terms of land use, vegetable production shares second place in crop production of Tamil Nadu with 3.34 lakh hectares, 82.02 lakh MT, 24.49 MT/ha. (TN policy Note 2022). The standard per capita requirement of vegetables for adults is 300 g/day/person (Recommended Dietary Allowance). However, in Tamil Nadu, based on our current production levels, 130 g/day can be supplied alone. (department of horticulture, Government of Tamil Nadu, 2018).

Review of literature:

1. The highly controlled greenhouses sprang up initially in the temperate regions, as growing vegetables in freezing temperatures was impracticable (Albright 2002), while the simpler greenhouses provided minimal climatic control and helped in producing an economic yield of the vegetable crops (Enoch *et al.,* 1986)

2. The greenhouse cultivation of vegetables, being an intensive activity, entails perfect planning and numerous phases of operation for its success. Greenhouse design varies depending on its location, whether in a desert, the tropics, or a temperate region (Jensen *et al.,* 2002).
3. In the temperate regions of the world, glasshouses are preferred, while in other subtropics and tropics, the 'shading effect' and 'windbreak effect' are provided by greenhouses. Rain shelters are the typical protective structures in rainy tropical regions to prevent flooding (Garnaud 1987), whereas in arid regions, the temperature and humidity inside the greenhouse provide an 'oasis effect' compared to the hot and dry heat outside the greenhouse (Sirjacobs *et al.,* 1988).
4. Today, Dutch protected cultivation is one of the most intensive farming systems in the world, characterized by high levels of output and the use of the latest technologies (Goncharova *et al.,* 2004).
5. With the high adoption of protected cultivation in Asia, there's continuous new development in agricultural crop analysis and production, as well as in the connected industries (Kang *et al.,* 2013).
6. Climate change is becoming an increasingly significant global problem that can no longer be ignored. The primary underlying cause is anthropogenic, i.e., the unsustainable use of fossil fuels, forest degradation for industrialization, and rapid urbanization with overpopulation (Mukherjee et *al.,* 2016).

RESULT AND DISCUSSION:

The farmer Thangaveni has 20 years of experience in agriculture. She has a land holding of 3 acres, of which 1.5 acres are under protected cultivation. She cultivates a variety of crops under protected cultivation (greenhouse) like tomato, chili, and cauliflower. She cultivates a variety of crops under protected cultivation (greenhouse), including tomatoes, chilli, and cauliflower, of which tomatoes hold a major share in the total production. The optimum months for sowing tomatoes are March to April, and the crop is ready for harvest from July to August. The average yield of tomatoes under protected cultivation is approximately 11 tonnes per acre. Yield varies month to month due to various reasons. Chilli and Cauliflower are produced and sold to the customers based on market demand. They have invested around 10 lakhs as capital in this protected cultivation. There are six skilled laborers employed on the farm to carry out the routine activities. The daily wage of the labourers per day is Rs. 250. The base material for the crops that portray and the shade net will be replaced once every ten years. Its replacement costs around 3 to 4 lakhs in total. One of the major problems is that the wear and tear of the covering material causes havoc to cultivation in uneven intervals.

The National Horticulture Mission encourages protected cultivation with a cluster-based approach in regions near cities. Infrastructure facilities, including cold storage, reefer vans, vending carts, and marketing arrangements, will be provided by the clusters. Protected cultivation, the production of Vegetable and cut flower crops under Protected conditions, not only provides year-round production but also increases productivity by 3-5 times over open field cultivation of these crops, with high water and nutrient use efficiency.

Increased crop yield: The case study showed how shielded agriculture significantly increased crop output. Compared to conventional open-field techniques, the controlled environment provided by buildings like greenhouses offers ideal conditions, accelerating plant growth and increasing production.

Effective Pest Management: It has been shown that protected farming methods are effective in controlling pests. Pest penetration was hindered by the physical barriers found in constructions like polytunnels, which decreased the demand for chemical pesticides. In addition to addressing environmental issues, this approach helps produce healthier and more sustainable vegetables.

Higher-quality produce: The investigation found that the produce was consistently of the highest calibre for the whole growing season under protected settings. Vegetables that were protected from unfavourable weather met strict market requirements. Due to its improved quality, the produce is positioned as a high-end product that may fetch a higher price on the market.

Financial Sustainability: Although the initial expenditure in infrastructure for protected cultivation was acknowledged, it was determined that the long-

term advantages outweighed the expenses. Improved quality, higher yields, and lower pest management costs all make protected farming economically feasible. However, the economic impact depends on several variables, including market dynamics, crop choices, and farming efficiency.

Local Conditions and Crop Selection: The particular crops grown and the local environmental factors are key factors in the success of protected farming. For best results, cultivation techniques must be adjusted to local climates. Vegetables may have different benefits in different protected contexts, which emphasizes the necessity for customized strategies.

Precision Farming Technologies: The research emphasised that a critical element in augmenting the effectiveness of protected agriculture is the incorporation of precision farming technologies. Real-time monitoring and decision-making are made possible by sensors, automation, and data analytics, which maximise resource utilisation and aid in effective crop management.

Greenhouse Sustainability: Environmental sustainability principles are aligned with resource-efficient procedures and reduced use of pesticides in protected farming. Due to the regulated environment, protected cultivation is a viable approach to sustainable agriculture, as it reduces the ecological impact of farming activities.

Dynamics of the Market: Economic factors emphasize the importance of understanding market dynamics. Even though there may be a large upfront cost, these expenses might be offset by the increased price premium that quality goods can command. The market's desire for vegetables grown responsibly raises the chances of protected agriculture from an economic standpoint.

Fig 1. Setup of farm inside protected cultivation

Benefits of protected cultivation:

Irrespective of weather conditions, protected cultivation helps farmers grow high-value crops throughout the year, reduces pest and disease incidence, minimizes the use of pesticides and chemical fertilizers, and improves water and nutrient use efficiency. Optimal Microclimate maintained in the protected cultivation can enhance crop quality and yield. Off-season produce of protected cultivation can fetch higher prices and profits for farmers. Organic farming methods can be easily practiced in protected cultivation, which also increases profitability.

Challenges of protected cultivation:

A huge initial investment for setting up structures and equipment, as well as maintenance costs, poses a serious challenge for protected cultivation. Fluctuating demand and supply of vegetables cause market risks and uncertainties, which have direct impacts on the revenue of protected cultivation. It also demands skilled labour and technical knowledge for managing crop production.

CONCLUSION:

Protected cultivation of vegetables has emerged as a vital and innovative approach to modern agriculture. Protected cultivation can help convert crop production into a promising and profitable venture for farmers in Tamil Nadu. The use of greenhouses, polytunnels, and other protective structures provides a controlled environment that shields crops from the challenges of climate change, water scarcity, pests, and diseases, as well as low productivity, and helps to meet demand. This method not only extends the growing season but also enhances the yield and quality of produce. The ability to manipulate variables such as temperature, humidity, and light creates optimal conditions for plant growth, resulting in higher productivity. Additionally, protected cultivation facilitates water conservation and reduces the need for chemical inputs, promoting sustainable and eco-friendly farming practices. Moreover, the precision control offered by protected cultivation over environmental factors, such as temperature, humidity, and light, fosters optimal growing conditions. This not only leads to increased productivity but also allows for

the cultivation of specific crops that might otherwise struggle in the local climate. The adaptability and flexibility of these protective structures cater to a diverse range of vegetables, providing a platform for farmers to experiment with and cultivate a variety of high-demand crops. Careful planning, investment, management, and marketing are essential for success in protected vegetable production. The selection of suitable crops and varieties based on market demand can improve the profitability of protected cultivation.

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