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Unveiling The Economics of Garlic Cultivation in Kerala: A Comprehensive Investigation in Kanthalloor

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1. INTRODUCTION

Kerala, commonly known as "God's Own Country," is situated in the southwest region of India. Renowned for its lush green landscapes, serene backwaters, and diverse cultural heritage, Kerala has long been associated with agriculture as a significant sector of its economy. The state's unique topography, favorable climate, and abundant water resources make it an ideal region for cultivating a wide range of crops. Agriculture forms the backbone of Kerala's economy, providing employment opportunities to a significant portion of the population and contributing substantially to its overall growth. The state's agricultural sector is characterized by a mix of small-scale and large-scale farming, with a strong emphasis on sustainable and organic practices. Farmers in Kerala employ traditional and modern techniques to cultivate a diverse array of crops, ranging from paddy rice and spices to coconut, rubber, and cashews. Among the various agricultural practices in Kerala, garlic cultivation holds considerable importance due to its economic viability and nutritional benefits.

Garlic, an essential ingredient in culinary traditions around the world, has gained significant economic importance in recent years. It is scientifically known as *Allium sativum*, is a popular and versatile herb that has been cultivated for centuries worldwide. It is renowned for its distinct flavor, culinary uses, and medicinal properties. Garlic cultivation has gained significant attention due to its peculiarities and the numerous economic benefits associated with its production. To begin with, it is a cool season crop, and possesses several peculiarities that make it distinct from other crops. Unlike many plants, garlic is grown from individual cloves rather than seeds. These cloves are typically planted in well-drained soil during the fall season, allowing them to establish

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roots before the onset of winter. Additionally, garlic requires a period of vernalization, where exposure to cold temperatures triggers bulb development. This specific growth pattern and the timing involved in garlic cultivation set it apart from various other crops, necessitating specialized knowledge and techniques for successful production.

The economic benefits of garlic cultivation are substantial and far-reaching. Firstly, garlic is in high demand globally, both as a culinary ingredient and for its medicinal properties. The versatility of garlic enables it to be used in numerous cuisines and food products, contributing to its steady market demand. Moreover, garlic has long been valued for its potential health benefits, including its antimicrobial and antioxidant properties. This has led to the production of various garlic-based supplements, further driving the demand for garlic cultivation.

Furthermore, garlic cultivation offers economic advantages to farmers. Garlic is a high-value crop that can provide a profitable return on investment. Compared to other crops, garlic requires relatively low input costs, making it an attractive option for small-scale farmers or those looking to diversify their agricultural activities. Additionally, garlic has a long shelf life and can be stored for extended periods, allowing farmers to stagger their sales and maximize profits.

In addition to the economic benefits for farmers, garlic cultivation contributes to the overall agricultural industry. Garlic is a rotational crop, meaning it can be planted in fields previously used for other crops, thereby promoting soil health and reducing the risk of disease and pest infestations. This crop rotation strategy helps maintain the productivity and sustainability of farmland, making garlic cultivation an environmentally friendly practice. Moreover, garlic farming can create employment opportunities within rural communities, providing a boost to local economies.

Hence, garlic cultivation presents unique peculiarities that set it apart from other crops, requiring specific knowledge and techniques for successful production. The economic benefits of garlic cultivation are vast, encompassing its high market demand, potential health benefits, the profitability for farmers, and contributions to the agricultural industry. But the farmers face a lot of challenges while engaging in the garlic cultivation due to a variety of reasons. For that, to understand the peculiarities of garlic cultivation and harnessing its economic advantages can open up opportunities for entrepreneurs, farmers, and the agricultural sector at large.

1.1 Context of The Study

Garlic cultivation plays a significant role in the agricultural sector of Kerala, contributing to both subsistence and commercial farming practices. In Kerala, Idukki is the only state which produces garlic. Among these, we can see garlic cultivation only in Kanthalloor and Vattavada regions of Idukki district. By examining the economic factors involved in garlic production, this study

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seeks to uncover the potential benefits, challenges, and opportunities for farmers engaged in garlic cultivation in Idukki. Kerala, located in the southwestern region of India, is known for its diverse agricultural practices. The Idukki district, in particular, has a favorable climate and soil conditions for the cultivation of garlic. However, despite its suitability for garlic farming, limited research has been conducted on the economic aspects of garlic cultivation in this region. This study aims to bridge this research gap by conducting a detailed analysis of the economic factors associated with garlic cultivation, including production costs, yield, market prices, and profitability. Such insights are crucial for farmers and policymakers to make informed decisions regarding garlic cultivation and to enhance the agricultural economy of Idukki district.

Here will consider various components of garlic cultivation, including the cost of inputs such as seeds, fertilizers, labor, and machinery, as well as the revenue generated from garlic sales. It will also explore the impact of market fluctuations, supply and demand dynamics, and market channels on garlic farmers in Idukki. By assessing the profitability of garlic cultivation, this study aims to identify the factors that contribute to the success or failure of garlic farming enterprises in the district. The findings of this research can serve as a valuable resource for farmers, agricultural extension services, and policymakers, providing them with insights to improve the economic viability and sustainability of garlic cultivation in Idukki, Kerala.

1.2 Statement of The Problem

Garlic cultivation plays a crucial role in the agricultural sector of Kerala, particularly in the Idukki district. However, despite its significance, there is a lack of comprehensive economic analysis that examines the profitability, sustainability, and potential challenges associated with garlic cultivation in this region. The absence of such research hampers the development of effective policies and strategies for garlic farmers, hindering their ability to optimize production, improve market access, and enhance their overall economic well-being. Therefore, there is a pressing need to conduct an in-depth economic analysis of garlic cultivation in the Idukki district of Kerala to address these gaps and provide valuable insights for policymakers, farmers, and other stakeholders.

The first aspect that requires attention is the profitability of garlic cultivation in Idukki district. While garlic has been traditionally grown in this region, the economic viability of this crop needs to be critically evaluated. The analysis should include a comprehensive assessment of the costs involved in garlic cultivation, such as land preparation, seed procurement, labor, fertilizers, pesticides, irrigation, and post-harvest handling. Moreover, it is essential to analyze the yield per unit area, market prices, and demand-supply dynamics of garlic in the district. By examining these factors, the study can determine the profitability of garlic cultivation and identify strategies to enhance farmers' income and returns on investment.

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Another crucial aspect that necessitates investigation is the sustainability of garlic cultivation in the Idukki district. Given the increasing concerns about environmental degradation and climate change, it is essential to assess the ecological impact of garlic farming practices. The study should analyze the use of chemical inputs, water consumption, soil fertility management, and their implications for long-term sustainability. Additionally, it is crucial to evaluate the adoption and feasibility of organic and sustainable farming practices in garlic cultivation. By examining the sustainability aspects, the research can provide recommendations for improving the environmental performance of garlic production, promoting resource conservation, and mitigating potential adverse effects on the ecosystem.

Lastly, the study should address the existing challenges and constraints faced by garlic farmers in the Idukki district, particularly in Kanthalloor region. This includes analyzing the socio-economic factors that affect garlic cultivation, such as access to credit, technical knowledge, extension services, market infrastructure, and value chain linkages. Furthermore, it is important to examine the role of government policies and support mechanisms in facilitating garlic farming and market development. By identifying the challenges and constraints, the research can suggest policy interventions, capacity-building initiatives, and institutional arrangements that can enhance the overall efficiency and competitiveness of garlic cultivation in Idukki district, ultimately improving the economic conditions of farmers and fostering sustainable agricultural development in the region.

1.3 Relevance of The Study

Kerala holds significant relevance for various stakeholders involved in agricultural practices and policy-making. By evaluating the costs involved in garlic cultivation, such as land preparation, seed procurement, labor, irrigation, fertilizers, and pest control, the study provides valuable insights into the profitability and sustainability of garlic farming. This analysis can guide farmers in making informed decisions regarding the allocation of resources and help them maximize their returns. Additionally, policymakers can utilize this information to formulate agricultural policies that support garlic cultivation and promote the overall economic growth of the region.

Understanding the market dynamics is crucial for both farmers and traders involved in the garlic supply chain. By examining the demand and supply patterns, price fluctuations, and market intermediaries, the study provides a comprehensive picture of the garlic market inside Idukki district and outside. This information is essential for farmers to make strategic decisions related to production levels, timing of harvest, and marketing strategies. Moreover, market analysis enables policymakers to identify any market imperfections or barriers that may hinder the growth of the garlic industry. By addressing these issues, they can foster a competitive market environment and enhance the profitability of garlic cultivation.

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Garlic cultivation involves various risks and uncertainties, including climate change, animal and pest attacks, diseases, fluctuating market prices, and lack of access to credit and technology. By conducting a comprehensive analysis of these constraints, the study provides valuable recommendations and solutions to overcome the challenges faced by garlic farmers. This not only improves the livelihoods of farmers but also contributes to the overall socio-economic development of the region. Moreover, policymakers can utilize this information to design targeted interventions and support systems that address the specific needs of garlic farmers and promote sustainable agriculture practices.

By assessing the economic feasibility, analyzing market trends, and identifying constraints faced by garlic farmers, the study provides valuable insights for farmers, traders, policymakers, and researchers. This information can be utilized to make informed decisions, formulate effective policies, and overcome challenges in the garlic cultivation sector. Ultimately, such endeavors contribute to the growth and sustainability of agricultural practices, economic development, and the welfare of farmers in the region.

1.4 Objectives of The Study

The main objectives of this study are the following:

1.4.1. To assess the economic feasibility of garlic cultivation in Kanthalloor.

1.4.2. To analyze the market structure and trends of garlic in Kanthalloor.

1.4.3. To identify the opportunities and challenges faced by garlic farmers in Kanthalloor .

1.5 Methodology

The methodology for this study involves the collection of data from both primary and secondary sources. Primary data was gathered from a sample of 60 garlic farmers located in the Kanthalloor region of the Devikulam block in the Idukki district. The data collection was collected through a personal interview method with the garlic farmers with the help of a questionnaire (See APPENDIX- I). This approach will provide first-hand information directly from the farmers regarding their garlic farming practices, challenges, and experiences. The area of study was limited to Kanthalloor region of Idukki district in Kerala.

On the other hand, secondary data obtained from various relevant sources such as Kanthalloor Krishibhavan data, government reports, research papers, and other credible sources. This secondary data will serve as a supplement to the primary data, providing additional information, statistics, and insights related to garlic farming in the region. By utilizing both primary and secondary data sources, this methodology aims to provide a comprehensive and well-rounded

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understanding of garlic farming in the Kanthalloor region of the Devikulam block of the Idukki district.

1.6 Limitations of The Study

- The study had only covered a few areas of Kanthalloor Panchayat of Idukki district. Hence, the study could only concentrate on the opinion given by these people.
- The sample size is limited to 60 garlic farmers only.
- Availability of secondary data related to economic analysis of garlic cultivation in Kerala is not available. So the comparison with the study area is limited too.

1.7 Chapter Scheme

- The first chapter is an introduction which explores the context of study, relevance, objectives and methodology.
- The second chapter contains a review of literature related to the topic.
- The third chapter provides a comprehensive overview of garlic cultivation, covering its distinctive features, various cultivation methods, and its production on a global scale, as well as in the Indian and Kerala contexts.
- The fourth chapter attempts to analyze the demographic profile of the respondents and assess the economic feasibility of garlic cultivation in Kanthalloor.
- The fifth chapter tries to analyze the market structure and trends of garlic in Kanthalloor.
- The sixth chapter attempts to identify the constraints and challenges faced by garlic farmers.
- The final chapter concentrates on the conclusion part of the study by throwing light on the major findings and suggestions regarding the subject matter.

2. Review of Literature

The review of the literature chapter presents a comprehensive exploration of the existing body of knowledge related to the economics of garlic farming. This chapter delves into the various scholarly works, academic articles, research papers, and relevant publications from reputable sources that have contributed valuable insights into the economic aspects of garlic cultivation. By critically examining the literature, this study aims to identify the key determinants of

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profitability, the challenges faced by garlic farmers, market trends, pricing mechanisms, and the economic impact of garlic cultivation on local and global economies.

N. Karthikeyan (2001) aimed to investigate the economic aspects of cultivating cool-season vegetables in a specific region. The study employed a robust sampling method, utilizing a purposive sampling technique to select 100 farmers actively engaged in the cultivation of cool-season vegetables in the Devikulam Block of Idukki district, providing valuable insights into the agricultural practices in that area. The major findings revealed that cool-season vegetable cultivation offered promising economic prospects for farmers, contributing significantly to their income. Additionally, the study shed light on the factors influencing the profitability of this type of farming, enabling policymakers and agricultural experts to devise strategies to further promote and improve cool-season vegetable cultivation in the region.

S.C. Srivastava, U.C. Sharma, B.K. Singh, and H.S. Yadava (2012) revealed significant trends and opportunities in the garlic production sector. The paper is based on secondary data analysis. The research highlighted the increasing demand for garlic both domestically and internationally, driven by its numerous health benefits and culinary uses. The study also pointed out the challenges faced by farmers in terms of fluctuating market prices and the need for improved post-harvest management techniques. Moreover, the authors identified potential growth areas, such as value-added garlic products, which could lead to enhanced economic opportunities for garlic farmers in India. Overall, the paper provides a comprehensive overview of the garlic production landscape, offering valuable insights for policymakers, agricultural researchers, and stakeholders in the garlic industry.

Lokesh Kumar Meena, Shoji Lal Bairwa, Kerobim Lakra, R Pardhi and N.K. Raghuwanshi (2013) revealed that garlic production in Baran District is economically viable, with the majority of farmers achieving a positive return on investment. The paper studies primary data were collected with the help of a well-structured interview schedule with a sample size of 60 farmers. The paper suggests various recommendations based on the research findings. First, the authors emphasize the importance of adopting modern irrigation techniques and efficient use of resources to enhance garlic yields and overall profitability. Second, they propose that farmers should be encouraged to form cooperatives or farmer groups to collectively purchase inputs, which could potentially reduce production costs. Third, the study recommends that policymakers and agricultural extension services provide financial and technical support to garlic farmers, particularly in areas with limited access to credit and modern agricultural practices.

J. Rai, Diwaker Nath Shukla, and Prabhakar Kumar (2014) explores the growth trends in the area, production, and productivity of garlic in the state of Uttar Pradesh (U.P.), India. The study

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spans over several years, enabling a robust analysis of the garlic industry's performance in the region. The major findings of the research indicate a positive growth trend in the cultivation area of garlic, reflecting an increasing interest among farmers in the U.P. to cultivate this crop. Additionally, the study highlights a notable growth in garlic production and productivity, suggesting that advancements in agricultural practices and technology have played a significant role in enhancing garlic yields. To ensure sustained growth and further improvement in the garlic sector, the authors suggest various measures. Firstly, promoting modern agricultural techniques, such as adopting improved varieties, implementing efficient irrigation methods, and using appropriate fertilizers, can lead to enhanced garlic productivity. Secondly, providing farmers with access to timely and relevant agricultural information, market intelligence, and credit facilities can help them make informed decisions and manage risks effectively. Furthermore, investing in research and development for garlic crops, focusing on disease-resistant varieties and pest management strategies, can contribute to overall industry growth. Lastly, the study emphasizes the importance of building a robust market infrastructure to reduce post-harvest losses and ensure fair prices for garlic farmers.

M.Manoharan and T.Ramalakshmi (2015) indicated a significant increase in the overall area under garlic cultivation in Dindigul district over the past decade. The study investigates a spatial analysis of the growth of production of Garlic grown in Tamil Nadu. The study emphasizes the importance of government support in the form of subsidies and incentives to encourage garlic farmers to adopt modern and sustainable farming methods.

Geetika Malik et al. (2017) aims to provide an overview of the current state and potential advancements in garlic improvement in India, with a focus on the long-day type. The study utilized a comprehensive review of the existing literature on garlic cultivation, genetics, and breeding in the Indian context. The sample size of the study was not explicitly mentioned, as it was a review of literature and not a primary research study. The paper reveals that the garlic improvement efforts in India have predominantly centered around the short-day cultivars, neglecting the untapped potential of long-day types. The authors emphasize the importance of considering the long-day varieties for cultivation in specific regions with distinct climatic conditions. The review also identifies the challenges faced in garlic breeding, such as limited genetic diversity, constraints in identifying desirable traits, and the lack of efficient breeding programs. To address these issues, the paper suggests the implementation of modern biotechnological tools, like marker-assisted breeding, to expedite the development of high-yielding and disease-resistant long-day garlic varieties. Additionally, promoting collaboration between researchers, farmers, and policymakers is recommended to enhance the adoption of improved garlic cultivars in India.

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Jalaja S. Menon, Shibana S.N. and Binoo P. Bonny Kerala (2018) presents a comprehensive study on garlic production in the rain shadow region of Idukki District, Kerala. The researchers utilized a representative sample of 200 garlic farmers from various villages within the region. Through a combination of structured interviews and field surveys, they gathered data on crop yields, farming practices, and challenges faced by farmers. It revealed that garlic cultivation in the rain shadow region of Idukki District is characterized by relatively low yields, primarily attributed to the limited availability of water resources and the prevalence of certain soil-borne diseases. The study also highlighted the importance of traditional knowledge passed down through generations in optimizing crop production under such adverse conditions. Based on their findings, the researchers suggest the implementation of tailored agricultural extension programs that focus on sustainable water management practices and disease control strategies specific to garlic cultivation in the rain shadow region. Moreover, knowledge-sharing platforms should be established to facilitate the exchange of traditional farming practices, fostering the adoption of effective techniques among farmers. By addressing these issues, it is anticipated that garlic production in the region can be significantly improved, leading to enhanced livelihoods and food security for local farming communities.

Akhand Pratap Singh, Amit Larkin, Rajesh Kumar and Dilip Kumar Sonwani (2018) investigate the economic aspects of garlic cultivation within a citrus-based agri horticulture system. It reveals that integrating garlic cultivation into a citrus-based agri-horticulture system can result in favorable economic returns for farmers. The study highlights that garlic cultivation not only complements the citrus crops but also contributes significantly to the overall farm income. The paper pointed out that farmers practicing this integrated system can achieve higher profitability and better risk management due to diversification. Additionally, the paper demonstrates that garlic's demand and market prices remain relatively stable, further supporting its economic viability in the agri-horticultural system. The paper suggests that this strategy can enhance income generation and mitigate risks associated with mono-cropping.

Lokesh Sharma, Manoj K Vaidya, Pardeep Singh and Kapil Dev (2018) investigate the input use efficiency of garlic cultivation in Himachal Pradesh's Sirmaur District. The study includes a sample of 60 farmers cultivating garlic, using multistage simple random sampling. The study identifies factors like education, experience, access to credit, and extension services as crucial determinants of input use efficiency among garlic farmers. Moreover, the research highlights the potential for enhancing efficiency through improved agricultural practices and better dissemination of information. The authors suggest that targeted interventions, such as farmer training programs and access to credit facilities, could help improve input use efficiency and overall garlic production in the region.

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S. Jalaja Menon and S.N. Shibana (2018) conducted the study to examine the performance of two genotypes Singapore and Mettupalayam in the plains of Kerala. The average yield per acre was found to be significantly higher than the national average, indicating the suitability of the region for garlic cultivation. The paper highlighted specific agricultural practices, such as proper irrigation and nutrient management, contributed to the successful performance of garlic crops. Additionally, the study emphasized the importance of using high-quality garlic seed varieties to achieve better yields. The paper suggested to promote the adoption of improved garlic seed varieties and providing farmers with access to technical training and information on best practices were recommended to enhance overall garlic production in the region.

Pradep Kumar Patidar, N. Khan and Santosh Kumar (2018) to exactly determine resource use efficiency and constraints of garlic production. The data were collected from randomly selected 60 farmers from three village areas of Ratlam block of Ratlam district of Madhya Pradesh. The study analysed the data using OLS regression method to estimate the production function and the ratio of marginal value product to marginal factor cost as the measure of resource use efficiency. The study attributed the positive outcome to various factors, including favorable weather conditions, low input costs, and high market demand for garlic. The study recommends implementing improved farming practices, such as the use of better-quality seeds, adopting modern irrigation techniques, and introducing integrated pest management strategies, to further boost garlic production and profitability. The study analysis pointed out that regression coefficients of human labour, fertilizer and irrigation were positively and highly significant in all farm size groups as well as in overall.

Reena Patidar, Towseef Mohi Ud Din (2018) aimed to explore the significance of garlic as an agricultural crop, which has emerged as a major source of income for impoverished farmers and contributed significantly to our country's share in foreign markets. The paper aims to highlight how garlic cultivation has become a lucrative venture for farmers, enabling them to earn substantial profits. Additionally, it sheds light on the crucial role played by garlic exports in bolstering our nation's presence in international markets, thereby enhancing economic growth and stability. By examining the economic impact and trade dynamics of garlic, this study endeavors to underscore its potential as a vital cash crop, providing valuable insights for policymakers and stakeholders involved in the agricultural sector. The paper suggests, the welfare of garlic cultivators should be a priority for the government, and they must ensure adequate support to enhance the efficiency of garlic farming, thereby contributing to the overall prosperity of our economy. Offering financial assistance, subsidies, and a minimum support price for garlic cultivation can significantly empower farmers in this sector. By providing these resources and support, the government can encourage farmers to adopt modern techniques and best practices, leading to increased productivity and a boost in economic growth. A thriving

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garlic farming community would not only bolster the agricultural sector but also positively impact the livelihoods of numerous families, fostering a sustainable and prosperous future for our nation.

S.N. Shibana and Jalaja S. Menon (2019) conducted a study to assess the performance of different garlic genotypes in the specific region of Kanthalloor, Idukki, Kerala, India. Certain genotypes exhibited superior performance in terms of bulb size, weight, and overall yield, indicating their potential suitability for commercial cultivation in the region. Additionally, the study also reported variations in disease resistance and adaptability to the local climate, which can aid farmers in making informed decisions regarding genotype selection for their specific farming practices. Based on the results, the researchers suggested that the high-yielding and disease-resistant garlic genotypes identified in this study should be promoted among local farmers to enhance garlic cultivation in Kanthalloor, Idukki, Kerala. By adopting these superior genotypes, farmers can potentially improve their garlic yield and quality, thereby contributing to the local economy and agricultural sustainability.

Sachin Kumar, Gurnam Singh, Parveen Kumar Nimbrayan, Sushila(2019) investigates the growth patterns of garlic cultivation in Haryana compared to the national trends in India. The researchers employed a robust sampling method by collecting data from various agricultural reports, government records, and surveys over a significant time span. The study highlighted that while garlic production in India has shown a gradual increase over the years, the growth rate in Haryana has been notably higher. This discrepancy was attributed to a combination of factors, including favorable climatic conditions, increased adoption of advanced agricultural practices, and government support for garlic cultivation in the region.

Harshil Piyushbhai Sojitra and N. J. Ardeshna (2021) study shed light on the significant role of farm size in influencing resource efficiency, suggesting that larger farms exhibited higher levels of efficiency due to economies of scale. It also identified certain inefficiencies in resource utilization, which the authors attributed to factors like limited access to modern agricultural technologies and inadequate extension services. The study focused on assessing the resource use efficiency and economic viability of garlic cultivation in the Saurashtra region of Gujarat, India with a random sample of 128 respondents. To enhance the overall economics of garlic cultivation in the region, the paper recommends the implementation of improved agricultural practices, increased availability of credit facilities, and the provision of better extension support to farmers.

Saptana, Atika Dyah Perwita, and Syahrul Ganda Sukmaya (2021) investigates the competitiveness of the garlic commodity market in Indonesia and assesses the influence of government policies on its performance. The sample size is of 5-10 respondents from each

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location of study region using stratified random sampling method. The study emphasized that the garlic markets faced significant challenges in terms of competitiveness due to fluctuations in both domestic and international market prices, supply chain inefficiencies, and reliance on imports during periods of low production. Moreover, government policies, such as import tariffs and subsidies, played a pivotal role in shaping the overall performance of the garlic commodity sector. While certain policies were found to stabilize prices and protect local farmers, others inadvertently disrupted market dynamics and created barriers to competitiveness. The paper also highlights the importance to implementing measures to enhance the efficiency of the garlic supply chain, such as improving storage and distribution facilities, to reduce wastage and increase market competitiveness, and suggests a balanced approach to government intervention is recommended, wherein policies must be carefully tailored to support domestic garlic production without hindering market flexibility.

Md. Golam Rabbani and Babor Ahmad (2021) examined the economic efficiency of garlic production through a substantial sample size of 51 farmers through mobile phone interview method. It was observed that farmers who adopted improved agricultural practices and utilized modern technologies achieved higher levels of economic efficiency compared to traditional farmers. The study suggests that promoting the adoption of modern agricultural practices, providing farmers with better access to credit and agricultural extension services, and enhancing market linkages could significantly enhance the overall economic efficiency of garlic production.

Ashish Srivastava, KK Singh, Ajay Singh, Aditya Bhooshan Srivastava and Ankit Kumar Shakya (2022) investigates the challenges faced in the cultivation and marketing of garlic. The study covered 120 farmers in the selected villages through a personal interview method with the help of a pretested schedule. The paper observed the primary limitations observed in production were the unavailability of credit, insufficient awareness about the latest production technologies, the absence of quality water supply, inadequate government support, and poor quality land. As for marketing, the challenges included price fluctuations, the absence of proper storage facilities, high transportation costs, low demand for produce in the local area, and a lack of scientific knowledge and training.

Gedefaw Kindu Wubet (2022) presents a comprehensive investigation into the garlic value chain in the specified region, with a focus on the impact of the COVID-19 pandemic. The sample size of 500 garlic farmers were used in the study through multistage random sampling technique. Statistical techniques encompassing both descriptive and inferential methods were utilized in the study. The study pointed out that amidst the COVID-19 pandemic, there was a notable surge in the demand for Garlic products, attributed to its perceived potential in treating COVID-19. Interestingly, this heightened demand also led to an increase in Garlic's price. Several factors played a crucial role in influencing the Garlic market supply. The positive factors affecting

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Garlic market supply included the quantity of Garlic produced, the extent of land allocated for cultivation, price dynamics over time, relevant market information, the experience of growers, and the use of oxen for agricultural purposes. On the other hand, certain factors had a negative impact on Garlic's market supply. These included the amount of credit available to farmers and the gender of the growers. These factors seemed to hinder the overall supply of Garlic in the market.

The study also highlights the numerous challenges of the Garlic value chain. According to 95.4% of farmers, one of these issues is the lack of improved seed availability. Additionally, 78% of farmers report struggling with the high cost of inputs required for cultivation. Moreover, diseases and pests also pose significant threats to the Garlic value chain. These factors collectively contribute to the difficulties faced by garlic farmers and hamper the overall productivity and profitability of the industry.

Ricardo Parreño et al. (2023) present a comprehensive review of the current state of garlic cultivation and explore potential perspectives for its modernization. The study encompasses a sample size of 35 research papers, spanning diverse geographical regions and agricultural practices, thus providing a broad and robust overview of the subject. The paper highlights that advancements in agricultural technologies, including breeding techniques, pest control, and cultivation practices, have the potential to revolutionize garlic production and transform it into a modern, high-yielding crop. Based on the findings, the authors suggest that stakeholders in the agricultural sector should invest in research and development to harness the full potential of garlic as a modern crop. Incorporating innovative technologies and adopting sustainable farming practices can enhance garlic yield, quality, and disease resistance.

2.1 Research Gap

The cultivation of garlic in Kerala, specifically in the Idukki district, is limited to a rare variety found exclusively in this region. However, there is a significant potential for expanding garlic cultivation throughout Kerala, offering opportunities for export and diversification. Despite its potential, garlic farmers face numerous challenges, including a lack of access to credit facilities and vulnerability to natural circumstances. As a result, they require substantial support to sustain and enhance their existing cultivation practices. Surprisingly, there is a notable research gap as no studies have been conducted to comprehensively analyze the economic aspects of garlic cultivation in Kerala. Therefore, there is a pressing need for research that addresses this topic, as it is highly relevant in the current agricultural and economic scenario. Such research could shed light on the viability, profitability, and sustainability of garlic cultivation in Kerala, providing valuable insights for policymakers, farmers, and stakeholders to make informed decisions and foster the growth of this potentially lucrative industry.

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3. The Art and Science of Garlic Cultivation: From Field To Table

Garlic, scientifically known as Allium sativum, is one of the most revered and widely used herbs in the culinary world. With a rich history dating back thousands of years, this pungent bulbous plant has left its aromatic mark on countless dishes across cultures and cuisines. Beyond its delightful flavor and aroma, garlic boasts an impressive array of health benefits, making it a superstar in traditional medicine and modern research alike.

3.1 Garlic: A Historical Odyssey

Garlic's historical significance can be traced back to ancient civilizations. Evidence of garlic consumption has been found in various archaeological sites, dating as far back as 5000 BCE in Mesopotamia (Zohary and Hopf, 2000). Ancient Egyptians not only used garlic for culinary purposes but also valued its medicinal properties. It was a part of burial rituals, as garlic bulbs were placed in the tombs of pharaohs as a symbol of protection and healing (Yoshida et al., 2016).

As civilizations expanded, so did the spread of garlic's influence. In ancient Greece, garlic was considered a powerful source of strength for athletes and warriors, and its consumption was believed to enhance endurance and vitality (Choi et al., 2014). The Romans also embraced garlic, using it for culinary and medicinal purposes. Additionally, Roman soldiers consumed garlic for its purported health benefits and to ward off infections during campaigns (Dini et al., 2013). The Age of Exploration in the 15th and 16th centuries significantly impacted the spread of garlic. As explorers traveled to new lands, they carried garlic with them, introducing it to regions such as the Americas and the Far East (Grivetti and Ogle, 2000). In return, new spices and ingredients from these regions were brought back to Europe, enriching culinary practices. It continued to play a vital role in medieval Europe, particularly during the time of the Black Death. While not entirely effective against the plague, garlic was believed to offer some protection, leading people to hang it in their homes and wear it around their necks (Conrad, 2018). Garlic's association with protection and warding off evil persisted in European folklore for centuries.

Garlic's medicinal properties have been well-documented throughout history. In ancient China, garlic was integrated into traditional medicine, where it was used to treat various ailments, including digestive issues, respiratory problems, and skin infections (Bayan et al., 2014). Indian Ayurveda and other traditional healing systems also incorporated garlic for its antimicrobial, anti-inflammatory, and antioxidant properties (Mukherjee et al., 2012).

Garlic's influence on global cuisine is undeniable. It has become a staple ingredient in various dishes across cultures, from Mediterranean cuisines to Asian stir-fries (Block, 2010). Garlic's

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unique flavor and aroma have led to its incorporation in a wide range of products, from condiments to pickles, sauces, and even beverages.

Beyond its culinary and medicinal aspects, garlic holds cultural significance in various rituals and celebrations. In some cultures, garlic is seen as a symbol of fertility, prosperity, and protection (De la Peña, 2005). Its use during specific festivals and ceremonies further highlights its importance in cultural practices worldwide.

In recent times, scientific research has reaffirmed garlic's potential health benefits. Studies have shown that garlic contains bioactive compounds like allicin, which exhibit antimicrobial, antiviral, and cardioprotective properties (Rahman and Lowe, 2006). It has been linked to reducing blood pressure, lowering cholesterol levels, and enhancing overall cardiovascular health.

3.2 Features of Garlic

- **Culinary Uses:** Garlic is widely used in cooking for its distinct flavor and aroma. It enhances the taste of various dishes, including soups, stews, sauces, and marinades.
- **Medicinal Properties:** Garlic has been used in traditional medicine for centuries due to its various health benefits. It contains bioactive compounds such as allicin, which have antimicrobial, anti-inflammatory, and antioxidant properties.
- **Cardiovascular Health:** Studies suggest that regular consumption of garlic may have a positive impact on heart health. It may help to lower blood pressure, reduce cholesterol levels, and improve blood circulation.
- **Immune System Booster:** Garlic is believed to boost the immune system, helping the body defend against infections and illnesses.
- **Pest Control:** Garlic extracts and garlic-based sprays are used as natural alternatives to chemical pesticides in agriculture. They can help repel insects and pests from crops, reducing the need for synthetic chemicals.
- **Economic Value in Agriculture:** Garlic cultivation can be economically viable for farmers. It is relatively easy to grow and has a good shelf life, making it a profitable crop for commercial purposes.
- **Industrial Uses:** Garlic oil is used in various industries, including food processing, pharmaceuticals, and cosmetics.

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- **Food Preservation:** Garlic has natural antimicrobial properties that inhibit the growth of bacteria and fungi. Historically, it was used as a food preservative before the advent of modern refrigeration methods.
- **Fertilizer:** Garlic residues can be composted and used as organic fertilizer, enriching the soil with nutrients.
- **Cultural and Culinary Traditions:** Garlic holds cultural significance in many societies. It is an integral part of the culinary traditions of various cuisines around the world, such as Mediterranean, Asian, and Middle Eastern cuisines.
- **Garlic Production and Trade:** Garlic is grown in many countries, and its trade is a significant part of the global agricultural economy. Major garlic-producing countries include China, India, South Korea, Russia, and the United States.
- **Garlic Supplements:** Garlic supplements are popular as an alternative to consuming fresh garlic. They are available in various forms, including capsules and oils.

3.3 Major Types of Garlic in The World

★ **Softneck Garlic (Allium sativum var. sativum):**

It is believed to have originated in Central Asia, specifically in the region encompassing modern-day Kazakhstan and Kyrgyzstan. It has been cultivated for thousands of years and is widely distributed across the globe. Softneck garlic is named for its flexible, pliable neck or stem, which makes it easy to braid for storage. The bulb of softneck garlic is generally medium to large in size and has multiple layers of cloves. It typically contains numerous cloves, ranging from 10 to 20 cloves per bulb. The cloves are densely packed and surrounded by multiple papery layers. The outer skin of softneck garlic bulbs is usually off-white or light cream in color, while the individual cloves are pale to light brown. It has a mild and subtle flavor compared to other garlic varieties. When raw, it offers a pungent and slightly spicy taste, but when cooked, the flavor becomes mellow and sweet.

★ **Hardneck Garlic (Allium sativum var. ophioscorodon):**

It is believed to have originated in Central Asia, like softneck garlic. Over time, it spread to other regions and adapted to various climates and environments is named for its rigid, woody stem that emerges from the center of the bulb. Unlike softneck garlic, hardneck varieties do not form a stem suitable for braiding. However, they produce vibrant and edible scapes (flower stalks) that can be used in cooking usually contain fewer cloves, ranging from 4 to 12 cloves per bulb. The cloves are typically larger and easier to peel compared to softneck garlic. The outer skin of

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hardneck garlic bulbs varies from pale white to shades of purple, pink, or red, depending on the variety. It is known for its robust and complex flavor. It can be quite spicy and assertive when raw, and its flavor intensifies when roasted or sautéed.

★ **Elephant Garlic (Allium ampeloprasum):**

Contrary to its name, elephant garlic (Allium ampeloprasum var. ampeloprasum) is not a true garlic but belongs to the leek family. It is believed that it initially originated in the Mediterranean region. It produces the largest bulbs among all garlic types. Despite not being a true garlic, it closely resembles garlic in appearance and flavor. Unlike traditional garlic, elephant garlic bulbs generally consist of only a few large cloves, usually 4 to 6 per bulb. It has a pale off-white to light brown outer skin, similar to softneck garlic. It has a milder flavor compared to true garlic varieties. It offers a subtle garlic taste, making it a favorite for those who prefer a gentler garlic flavor.

★ **Black Garlic:**

Its precise origin is uncertain, but it is believed to have been developed in Korea or Japan through a fermentation process that transforms regular garlic. It is not a specific garlic variety but rather a processed form of garlic. It is made by subjecting whole garlic bulbs to low heat and high humidity over several weeks, causing enzymatic reactions that result in its unique characteristics. Its bulbs contain multiple cloves like softneck garlic, but the individual cloves become soft and sticky during the fermentation process. As the name suggests, black garlic has a dark, almost black color due to the caramelization of sugars and Maillard reactions during the fermentation process. It has a remarkable taste profile, significantly different from raw garlic. It is sweet, tangy, and earthy with hints of umami, and its texture is reminiscent of soft, chewy caramelized garlic.

3.4 From Bulb To Bounty: Step-By-Step Garlic Cultivation

Step 1: Selecting Garlic Variety

Choose a garlic variety suitable for the climate and soil type. Softneck varieties are commonly grown in milder climates, while hardneck varieties thrive in colder regions. There are also different cultivars with varying flavors and bulb sizes, so choose one that suits your preferences.

Step 2: Preparing the Soil

Garlic thrives in well-draining, fertile soil. Start by clearing the planting area of any weeds, rocks, and debris. Loosen the soil to a depth of at least 8 inches (20 cm) using a shovel or a tiller.

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Incorporate organic matter, such as compost or well-rotted manure, to improve soil structure and fertility.

Step 3: Obtaining Garlic Seed Cloves

Garlic is propagated by planting individual cloves from the bulb. Purchase high-quality seed garlic cloves from a reputable supplier or use your own garlic bulbs if they are disease-free. Avoid using garlic from the grocery store, as it may not be suited for optimal growth.

Step 4: Breaking and Preparing Cloves

Carefully break the garlic bulb into individual cloves, being cautious not to damage them. Larger cloves tend to produce bigger bulbs. Leave the papery outer skin on the cloves intact, as it helps protect them during planting.

Step 5: Planting Garlic Cloves

Plant the garlic cloves in the prepared soil during the fall, about 4 to 6 weeks before the first expected frost date in your area. Space the cloves about 6-8 inches (15-20 cm) apart and plant them at a depth of 2 to 3 inches (5-7.5 cm) with the pointed end facing up. Ensure that the cloves are planted with sufficient space between them to allow room for bulb development.

Step 6: Mulching

After planting, cover the garlic bed with a layer of organic mulch, such as straw or shredded leaves. Mulching helps retain soil moisture, suppress weed growth, and insulate the garlic during winter. Make sure the mulch layer is around 3 to 4 inches (7.5-10 cm) thick.

Step 7: Watering

During the growing season, garlic requires consistent moisture but not waterlogged conditions. Water the garlic bed regularly, aiming to keep the soil evenly moist. Reduce watering as the garlic approaches maturity to avoid excessive moisture, which can lead to rot.

Step 8: Fertilization

Garlic is a moderate feeder and benefits from a balanced fertilizer application. About a month after planting, apply a nitrogen-rich fertilizer. Avoid using high-nitrogen fertilizers after the foliage begins to die back, as it may impact bulb development.

Step 9: Removing Scapes (Optional)

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Hardneck garlic varieties produce scapes, which are curly, flower stalks. Some gardeners prefer to remove the scapes as they emerge to divert the plant's energy towards bulb growth. Scapes are edible and can be used in cooking.

Step 10: Harvesting Garlic

Harvest time varies depending on the garlic variety and the planting time. Generally, garlic is ready to harvest when the lower leaves start to turn yellow and the tops begin to dry and fall over. Dig up the bulbs gently using a fork or shovel. Brush off excess soil and allow the bulbs to cure in a warm, dry, and well-ventilated area for 2 to 4 weeks.

Step 11: Storing Garlic

Once the garlic bulbs have cured, trim the roots and tops. Store the bulbs in a cool, dark, and dry place with good air circulation. Softneck garlic varieties tend to store longer than hardneck varieties.

3.5 The Pungent Powerhouse: A Global Overview of Garlic Production

Garlic (Allium sativum) is a widely cultivated and essential crop in the global context, valued for its culinary, medicinal, and economic significance. Belonging to the Allium genus, which also includes onions, shallots, and leeks, garlic has been cultivated for thousands of years and holds a prominent place in various cultures and cuisines worldwide. The cultivation of garlic on a global scale can be traced back to ancient civilizations, including those in Egypt, China, and Mesopotamia, where it was highly regarded for its medicinal properties and used as a flavoring agent in cooking. Over time, the popularity of garlic spread, leading to its introduction to different regions through trade routes and exploration.

Today, garlic is grown in diverse climates and geographical locations, making it a versatile crop that adapts well to various environmental conditions. Major garlic-producing countries include China, India, South Korea, Russia, Spain, and the United States. Its global cultivation encompasses a range of climates, from the temperate regions of North America and Europe to subtropical and tropical areas in Asia and Latin America.The global demand for garlic has increased steadily over the years, driven by its culinary applications, traditional medicine practices, and the growing recognition of its health benefits.

3.5.1 A Growing Global Trend in Industries and Health Benefits

The total world production for garlic in 2020 was 28,054,318 metric tonnes, which is slightly differ from 28,042,647 tonnes in 2019. According to the Food and Agriculture Organization, China holds the top position as the largest garlic producer globally, having produced a staggering

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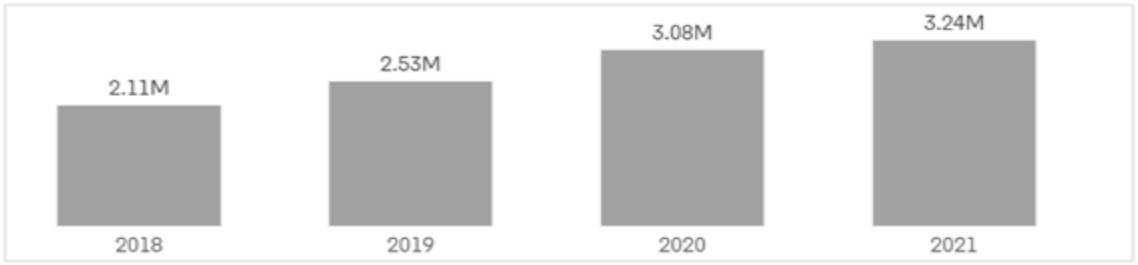
20.7 million metric tons in 2020. India follows as the second-largest producer, with a production of 2.9 million metric tons. Among the top garlic-producing countries, South Korea, Egypt, and Russia are also significant contributors to global garlic production.

The demand for garlic has been on the rise across various industries due to its versatile uses. The World Health Organization (WHO) has suggested that regular consumption of garlic may contribute to a reduced risk of cancer. As a result, garlic is not only enjoyed fresh but also finds application in the processing industry. Its presence is evident in a wide array of food preparations, including chutneys, pickles, curry powders, curried vegetables, meat products, and even tomato ketchup. Moreover, the appeal of garlic extends to second-generation products like garlic powder, garlic salt, garlic vinegar, garlic cheese croutons, garlic potato chips, and garlic bread. The continuous demand for these products is expected to sustain the garlic market over the foreseeable future. Additionally, garlic powder serves as a popular herbal medicine.

The recent surge in home cooking has further fueled the demand for garlic, and suppliers have successfully met the challenges posed by the increased volume. As a testament to its significance in global trade, the global import value of garlic reached USD 3,242,679 thousand in 2021, reflecting a notable 5.3% increase from the previous year. This trend is evident in the expanding area of garlic cultivation, with 1,585,933, 1,629,344, and 1,631,869 hectares harvested in 2018, 2019, and 2020, respectively. Clearly, garlic continues to play a crucial role in the world market due to its diverse applications and health benefits.

According to the Food and Agriculture Organization (FAO), the worldwide garlic production in 2020 amounted to 28.1 million metric tons, showing a notable rise of approximately 3.9% compared to the figures from 2018. This significant growth can be attributed to the surging demand for garlic in both the food and healthcare sectors, leading to increased cultivation and production to meet global market needs. The diverse applications of garlic in various industries have played a pivotal role in driving this upward trend.

Fig.3.1 Global Market: Import Value in USD thousand, Global 2018-2021



Source: ITC Trade Map

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Table 3.1 Garlic Production in Different Countries

Country/region	2020	2019	2018	2017	2016
China	2,07,12,087	2,06,04,480	2,08,79,169	2,06,52,612	2,02,81,659
India	29,17,000	29,10,000	16,11,000	16,93,000	16,17,000
Bangladesh	4,85,447	4,66,389	4,61,970	4,25,401	3,81,851
South Korea	3,63,432	3,87,671	3,31,741	3,03,578	2,75,549
Egypt	3,33,543	3,63,460	3,48,700	2,89,766	2,72,769
Spain	2,69,090	2,71,350	2,73,480	2,74,712	2,09,795
Uzbekistan	2,23,719	2,16,272	2,54,857	2,14,263	2,00,869
Ukraine	2,11,680	2,15,070	1,87,020	1,85,830	1,87,960
Myanmar	2,11,138	2,08,908	2,03,432	2,03,681	2,12,909
Russia	1,89,659	2,02,064	2,11,981	2,06,074	2,02,992
United States	1,75,674	1,94,497	2,60,340	2,32,010	2,04,780
Algeria	1,70,930	2,23,311	2,02,201	1,23,475	1,03,627
Brazil	1,55,700	1,30,900	1,18,869	1,20,896	1,32,361
Argentina	1,46,608	1,46,288	1,45,969	1,47,814	1,48,851
Ethiopia	1,14,945	1,52,595	1,95,740	1,78,222	1,38,664
Peru	90,612	82,991	1,04,703	94,887	78,205
Mexico	86,688	82,910	94,692	89,840	75,987
Pakistan	85,642	75,342	81,167	75,002	70,925
Indonesia	81,805	88,817	39,302	19,513	21,150
North Korea	76,867	77,120	76,312	77,170	77,878
Thailand	76,839	84,039	90,982	69,180	67,554
Nepal	73,859	71,902	59,500	56,668	50,426
Kyrgyzstan	68,350	69,201	55,523	52,670	42,666
Iran	58,941	58,654	58,367	59,355	59,169
Kazakhstan	49,222	49,125	44,881	38,831	33,481
Taiwan	44,947	47,464	60,075	43,738	44,497
Sudan	43,918	43,341	10,987	18,108	34,745
Guatemala	29,882	30,215	30,013	29,417	31,216
Turkey	28,552	23,351	25,519	26,328	135, 148
Italy	27,970	29,270	30,500	29,983	29,568
Romania	27,590	27,700	30,570	55,673	54,389
Azerbaijan	26,214	39,118	44,914	21,541	21,114
Tunisia	25,223	25,101	25,352	25,214	24,736
Syria	23,693	21,988	12,780	14,763	13,532
Chile	23,447	18,503	20,803	20, 165	15,692
France	22,430	28,140	20,120	20,464	21,932
Belarus	21,626	19,530	18,106	38,666	33,533
Japan	20,893	20,800	20,200	20,700	21,100
Albania	20,722	15,056	13,696	14,544	12,308
Mali	14,945	14,956	14,921	13,199	9,955
Tajikistan	14,158	16,459	15,643	5,896	3,255
Poland	13,500	15,100	15,830	*NA*	*NA*
Portugal	12,250	410	2,040	2,660	2,622
Cuba	12,094	14,988	17,320	19,462	23,257

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Morocco	11,953	10,319	13,611	13,660	12,562
Niger	11,238	7,449	4,937	4,260	3,761
Venezuela	11,062	12,113	14,895	14,599	13,906
Colombia	10,429	9,272	10,175	6,717	14,207
Montenegro	927	923	930	927	913
Uruguay	914	900	1,178	1,000	800
Slovakia	890	590	320	231	313
North Macedonia	4,904	4,515	4,134	4,214	4,221
Libya	4,695	4,658	4,620	4,578	4,578
Iraq	4,182	3,986	1,810	1,725	2,760
Kenya	3,860	2,175	1,726	2,493	2,372
Yemen	3,289	3,296	3,231	3,292	3,339
Serbia	3,176	3,092	3,615	5,025	4,803
Turkmenistan	3,112	3,102	3, 131	3,102	3,072
Lebanon	2,857	2,542	4,456	5,000	1,086
Georgia	2,700	2,100	4,600	3,500	2,900
Madagascar	2,677	2,665	2,706	2,659	2,632
Netherlands	2,540	2,470	2,390	0	0
Bolivia	2,476	2,230	2,569	2,777	3,731
Jordan	2,316	2,506	3,689	2,589	2,267
Dominican Republic	2,276	1,951	1,517	1,524	2,368
Nigeria	2,219	1,278	1,800	2,300	2,300
Czech Republic	2,020	1,640	1,690	1,340	835
Croatia	1,970	2,880	1,730	1,901	1,444
New Zealand	1,881	1,875	1,889	1,879	1,857
Bulgaria	1,600	2,220	1,770	18	59
Latvia	1600	1380	400	1884	610
Austria	1320	1210	1120	1091	1025
Ecuador	1,285	1,275	1,308	1,271	1,246
Canada	1,256	1,248	1,490	1,563	1,410
Israel	1,169	1,449	1,361	1,486	2,183
Slovenia	1,090	1,060	1,020	1,003	1,089
Palestine	1,057	1,075	1,093	1,051	1,098
Malawi	1,035	645	521	230	0
Lithuania	1,020	970	860	970	1,622
Haiti	1,003	998	1,012	1,000	983
Bhutan	691	791	550	708	1,176
Malta	540	540	580	358	479
Kuwait	487	623	432	280	351
East Timor	393	395	392	394	399
Paraguay	236	234	230	230	225
Estonia	210	130	130	356	185
Zimbabwe	207	206	207	206	205
Honduras	197	196	198	197	194
Switzerland	173	58	51	42	34
Sweden	120	50	40	0	0
Finland	110	70	10	75	141
Cape Verde	85	85	83	85	87
Mauritius	39	48	71	96	120

Source: FAOSTAT

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3.5.2 Asia-Pacific Dominates the Global Garlic Market

The garlic market is largely driven by the Asia-Pacific region, with China taking the lead as the top producer and exporter. In fact, China alone contributes to over 80% of the world's garlic production, as reported by the Food and Agriculture Organization (FAO). In 2020, China produced a staggering 20.8 million metric tons of garlic, surpassing the previous year's output of 20.7 million tons.

Not only does China excel in production, but it also stands as the largest exporter of garlic globally. The value of Chinese garlic exports in 2021 reached USD 2,033,585 thousand, reflecting a growth of approximately 2.1% compared to 2019 figures, which stood at USD 1,991,142 thousand, according to data from the ITC Trade Map. The main garlic supply comes from plantations in regions such as Jinxiang, Peizhou, Shandong, Jiangsu, Qixian Henan, Zhongmou, and Henan.

The demand for garlic extract is significant in the Asia-Pacific, particularly in China and India, where it serves as a fundamental ingredient in various cuisines. This versatile crop thrives in a climate with temperatures ranging from 12 to 24 degrees Celsius.

Indonesia ranks as the top importer of Chinese garlic, followed by Vietnam and Malaysia, while Europe also remains a substantial importer. However, the consumption of garlic extends far beyond trade statistics. Garlic holds great cultural and culinary importance in most Asian households and is widely used in the food industry. Its presence can be found in a variety of dishes, including pickles, chutneys, curry powders, curried vegetables, meat and meat product preparations, and tomato ketchup.

Given the widespread usage and demand for garlic in the region, the Asia-Pacific region continues to play a pivotal role in driving the growth of the garlic market.

3.5.3 Technological advancements

- **Precision Agriculture**: Precision agriculture involves the use of advanced technologies such as GPS, drones, and sensors to optimize agricultural practices. In the case of garlic farming, precision agriculture techniques allow farmers to monitor soil conditions, water levels, and nutrient requirements with precision. This ensures that garlic crops receive the right amount of inputs, leading to higher yields and better quality garlic. For example, in China, the largest garlic producer, precision agriculture has been adopted in many garlic farms to enhance productivity.
- **Improved Seed Varieties:** Research and development in garlic breeding have led to the development of improved garlic seed varieties. These varieties are disease-resistant, have

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higher yields, and better flavor profiles. For instance, Spain has been at the forefront of developing new garlic varieties like "Spanish Roja" that have gained popularity in international markets.

- **Mechanization:** Mechanization has revolutionized garlic farming by reducing the dependency on manual labor and increasing efficiency. Garlic planting, harvesting, and processing have all been mechanized in many garlic-producing countries. China, India, and South Korea are examples of countries that have embraced mechanization in garlic farming.
- **Post-Harvest Technologies:** Proper post-harvest handling is crucial to preserve the quality and shelf life of garlic. Advanced post-harvest technologies like cold storage, controlled atmosphere storage, and vacuum packaging have extended the storage life of garlic, enabling it to be transported over long distances. Mexico, a major garlic exporter, has invested in post-harvest technologies to maintain the quality of their garlic during transportation.
- **Biotechnology and Genetic Engineering:** Biotechnological advancements have been utilized to enhance garlic production. Genetic engineering has been used to create garlic plants with specific traits, such as increased disease resistance or altered phytochemical composition. While genetic engineering in garlic is not as widespread as in other crops, ongoing research shows promising results in countries like the United States and Argentina.
- **E-commerce and Global Trade:** The rise of e-commerce platforms and global trade networks has facilitated the worldwide distribution of garlic. It has enabled garlic producers from one part of the world to access markets in distant regions efficiently. Chinese garlic, for instance, is exported to various countries around the globe, and e-commerce platforms have made it easier for consumers to access garlic products from different origins.
- **Smart Irrigation Systems:** Water scarcity is a significant challenge in many garlic-producing regions. Smart irrigation systems, such as drip irrigation and sensor-based irrigation, have been implemented to optimize water usage and conserve resources. Egypt, a prominent garlic exporter, has adopted smart irrigation practices to address water scarcity concerns.

These technological advancements have contributed to the growth of the global garlic industry, enabling countries to increase production, improve quality, and expand their reach in international markets. However, it is essential to note that while these examples highlight various countries' efforts, collaboration and knowledge exchange among nations have played a crucial role in driving these advancements forward. Countries often share research findings, technologies, and best practices to collectively improve garlic cultivation on a global scale.

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3.5.4 The Garlic Gourmet: Crafting Exceptional Value-Added Products

Value-added products refer to products that have undergone further processing or enhancements to increase their value and appeal to consumers. When it comes to garlic, many countries produce a wide range of value-added products using this versatile and flavorful ingredient. Here are some examples of value-added garlic products and the countries known for producing them:

- **Garlic Powder and Granules:**

Garlic powder and granules are obtained by dehydrating fresh garlic and grinding it into fine powder or granular form. These products are used as convenient seasoning agents in various culinary applications. China is the leading producer of garlic powder and granules, followed by India and Spain.

- **Garlic Oil:**

Garlic oil is extracted from garlic cloves using various methods such as steam distillation or solvent extraction. This oil is used in the food industry for flavoring, in the production of medicines, and in cosmetics. Argentina is one of the significant producers of garlic oil.

- **Garlic Paste:**

Garlic paste is made by crushing fresh garlic cloves into a smooth, homogeneous paste. It is commonly used in Indian and Southeast Asian cuisines as a base for curries, marinades, and sauces. India, being a major garlic producer, also produces garlic paste in large quantities for both domestic and export markets.

- **Black Garlic:**

Black garlic is produced by fermenting whole bulbs of garlic under controlled temperature and humidity conditions. This fermentation process results in black cloves with a special flavor that is less pungent and sweeter than the raw garlic. South Korea and Japan are well-known for their production of black garlic.

- **Garlic Sauces and Condiments:**

Various countries produce garlic-based sauces and condiments, such as garlic chili sauce, garlic aioli, and garlic-infused dressings. These products add an exciting twist to dishes and are popular in many cuisines worldwide. Spain, with its rich garlic-growing heritage, is a prominent producer of garlic sauces like aioli.

- **Garlic Pickles:**

Pickling garlic in vinegar or brine is a common preservation method, creating tangy and flavorful garlic pickles. These pickles are often served as condiments or appetizers. Egypt is known for producing garlic pickles and exporting them to different countries.

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- **Garlic Supplements:**

Garlic supplements, available in the form of capsules or tablets, are popular for their potential health benefits. They are often used as dietary supplements to support heart health and boost the immune system. China and the United States are among the major producers of garlic supplements.

- **Garlic Sausages and Cured Meats:**

Garlic is frequently used in sausage-making and curing processes, adding a distinctive flavor to various types of meats. Italy and Germany are renowned for their garlic-infused sausages and cured meats.

- **Garlic Bread and Garlic Flavored Snacks:**

Garlic bread, a popular side dish and snack, is made by spreading garlic butter on slices of bread and toasting them. Additionally, there are various garlic-flavored snacks, such as garlic chips and crackers. The United States, Italy, and France are some of the countries producing and enjoying garlic-infused bread and snacks.

Each of these value-added garlic products contributes significantly to the culinary landscape and offers various health benefits. While certain countries have established themselves as leading producers of specific products, garlic's versatility and appeal make it a global favorite in various value-added forms.

3.6 Garlic Cultivation in India: Productivity and Economic Potential

India is one of the leading garlic-producing countries globally, with several regions providing favorable conditions for its cultivation. Garlic is the second most important crop in India. Madhya Pradesh stands first in area and production in India. Garlic is mainly cultivated as a rabi season crop in India but cultivation can be practiced in both seasons. In India area under garlic cultivation was 1.65 lakh per hectare with a production capacity of 8.34 lakh tonnes. Average productivity of garlic in India was 5.06 tonnes per hectare. Garlic has a higher nutritive value as compared to other bulb crops. In India garlic varieties are grown as short day types as a frost hardy cool season crop. In garlic recovery of cloves from bulbs ranges from 86 to 96%. The country's diverse agro-climatic zones, ranging from temperate to tropical, allow garlic to be grown throughout the year in different states. Madhya Pradesh, Gujarat, Rajasthan, Uttar Pradesh, Punjab, and Haryana are major garlic-producing states in India.

The popularity of garlic cultivation in India is attributed to its adaptability to different soil types and climate conditions. This hardy crop thrives in well-drained soils with good organic matter content, and it is relatively less demanding in terms of water requirements compared to other

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crops. Farmers often integrate garlic cultivation into their crop rotation systems, as it can help improve soil health and suppress pests and diseases.

3.6.1 Top States in Garlic Cultivation in India

- ***Gujarat:*** Gujarat is a major garlic-producing state in India, contributing significantly to the country's total production. The region's favorable climatic conditions, including a dry and warm climate, make it suitable for garlic cultivation. The well-drained sandy loam and clay loam soils of Gujarat facilitate good bulb development. Major garlic-growing regions in Gujarat include Mahuva, Bhavnagar, and Mehsana.
- ***Madhya Pradesh:*** Madhya Pradesh is another prominent garlic-producing state in India. The state's fertile black soils and relatively cooler climate during the winter months provide an ideal environment for garlic cultivation. The districts of Mandsaur, Neemuch, and Ujjain are renowned garlic-producing areas in Madhya Pradesh.
- ***Rajasthan:*** It is known for its robust garlic production, particularly in the northwestern regions. The sandy loam soils and arid climate create favorable conditions for garlic cultivation. The regions of Ajmer, Kota, and Udaipur are notable garlic-producing areas in the state.
- ***Uttar Pradesh:*** It is one of India's most populous states, and also contributes significantly to the country's garlic production. The fertile soils, well-distributed rainfall, and favorable temperature range support garlic cultivation. The districts of Hathras, Agra, and Etawah are important garlic-producing regions in Uttar Pradesh.
- ***Karnataka:*** In the southern part of India, Karnataka plays a significant role in garlic cultivation. The state's diverse agro-climatic zones offer opportunities for year-round garlic production. The districts of Belagavi, Dharwad, and Bagalkot are key garlic-producing areas in Karnataka.
- ***Maharashtra:*** Maharashtra, with its diverse climate and soil types, is another important garlic-producing state in India. The well-drained soils and cooler winter temperatures in some regions favor garlic cultivation. The districts of Nashik, Pune, and Satara are significant garlic-producing areas in Maharashtra.
- ***Tamil Nadu:*** located in the southern part of India, also contributes to garlic cultivation. The state's favorable weather conditions and well-irrigated areas support garlic production. The districts of Krishnagiri, Dharmapuri, and Erode are notable garlic-producing regions in Tamil Nadu.

These are some of the top most garlic producing states in India which contributes a greater share in garlic productivity in India.

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Table 3.3 Other Garlic Varieties in Different Regions of India

Variety	Developed by	Colour	Region	Days to maturity	Yield potential (t/ha)
Short day type					
Agrifound White (G-41)	NHRDF	White	Madhya Pradesh and Maharashtra	130-135	Dec-14
Yamuna Safed (G-1)	NHRDF	White	All India	120-130	15-17
Yamuna Safed-2 (G-50)	NHRDF	White	Northern India	120-130	15-20
Yamuna Safed-3 (G-282)	NHRDF	Creamy white	Chhattisgarh, Gujarat, Haryana, Madhya Pradesh, Maharashtra, Punjab, Rajasthan and Uttar Pradesh	120-130	17-20
Yamuna Safed-4 (G-323)	NHRDF	White	North and central India	165-175	16-17
Yamuna Safed-5 (G-189)	NHRDF	White	Andaman and Nicobar Island, Arunachal Pradesh,Bihar, Delhi Gujarat, Haryana, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Rajasthan, Sikkim, Tarai region of Uttar Pradesh, Tripuraand, Uttarakhand	150-160	17-18
Godavari	MPKV	Purple	Maharashtra	140-145	10-Nov
Shweta	MPKV	White	Maharashtra	130-135	10-Nov
Phule Baswant	MPKV	White	Madhya Pradesh and Maharashtra	135-140	10.-11
GG 4	JAU	White	Gujarat and Maharashtra	130-140	08-Oct
Intermediate type					
Ooty 1	TNAU	Dull white	Tamil Nadu	120-130	15-17
Long day type					
VL Garlic 1	ICAR-VPKAS	White	Bihar,Himachal Pradesh, Jammu & Kashmir, Punjab, Uttarakhand and Uttar Pradesh	180-190	Hills:14-15 Plains: 9-10
VL Lahsun 2	ICAR-VPKAS	White	Himachal Pradesh, Jammu & Kashmir and Uttarakhand	190-200	Mid hills:14-16 Above mid hills: 24-26
Agrifound Parvati	NHRDF	Purple	Hills of Himachal Pradesh, Uttarakhand, Jammu & Kashmir and high altitudes of North eastern states like Sikkim *etc.*	165-175	17-18
Agrifound Parvati-2 (G-408)	NHRDF	White	Hills of Himachal Pradesh, Uttarakhand, Jammu &Kashmir and high altitudes of North eastern states like Sikkim *etc.*	165-175	17-22

Source: ICAR & -Directorate of Onion and Garlic Research

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3.6.3 Economic Analysis of Garlic Farming in India

In India, garlic cultivation during the Rabi season (mid-September to end of October) requires a seed rate of 200 to 240 kilograms per acre. After a period of 130 to 180 days from planting, farmers can expect a yield of 32 to 48 quintals per acre.

Now, considering the average selling price at the Mandi (market) in 2019 estimates, which is Rs 50 per kilogram, we can calculate the potential profits and net income returns for garlic cultivation.

Let's assume a farmer plants garlic in one acre of land:

- Yield per acre:

Minimum yield (32 quintals) x 100 kg/quintal = 3200 kilograms

Maximum yield (48 quintals) x 100 kg/quintal = 4800 kilograms

- Total revenue from garlic cultivation:

Average selling price per kilogram = Rs 50

Minimum revenue = 3200 kg x Rs 50/kg

Maximum revenue = 4800 kg x Rs 50/kg

- Net income returns: It can be calculated by subtracting the cost of cultivation from the total revenue.

Minimum net income = Minimum revenue - Cost of cultivation

Maximum net income = Maximum revenue - Cost of cultivation

3.6.3.1 Estimated Cost for One Acre Garlic Cultivation

- **Cost of Garlic Seed Material:** The cost of high-quality garlic seed material is approximately Rs. 5000 per quintal. However, prices may vary depending on the supplier and quality.

- **Cost of Land Preparation:** For garlic cultivation, the land needs to be ploughed and prepared with fine tilt and beds of suitable size. This process often requires the use of farm machinery like a tractor, which may cost around Rs. 1600 per acre.

- **Cost of Planting:** Planting garlic can be done through various methods like dibbling, furrow planting, or broadcasting. On average, it requires about 5 laborers working for a day, with a total cost of approximately Rs. 1500.

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- **Cost of Weeding:** Weeding is crucial for effective weed control in garlic cultivation. Typically, 2-3 weedings are needed. Each weeding may require 3 laborers per acre, with a total cost of around Rs. 2500, depending on labor availability.

- **Pesticides and Fertilizers Cost:** Garlic cultivation usually requires incorporating 2-3 tonnes of farm yard manure during the last ploughing. Additionally, 24:14:24 kg of nitrogen, phosphorus, and potassium per acre is needed, costing around Rs. 1000. The cost of farm yard manure may vary and is approximately Rs. 3000. For pest and disease management, 2 to 3 sprays of pesticides and insecticides are necessary. The cost of these operations, along with labor, ranges from Rs. 1000 to 1500 per acre for a single spraying or Rs. 3000 to 4500 for 3 sprays.

- **Cost of Miscellaneous Activities:** This includes expenses for electricity, irrigation water, land rent, farm machinery rental, land revenue, depreciation, and other miscellaneous activities. On average, these costs add up to around Rs. 9000 for one acre of garlic cultivation.

- **Cost of Harvesting, Packaging, and Transportation:** Harvesting garlic typically occurs 130 to 180 days after planting when the tops turn yellowish or brownish and start drying. The harvesting process may require four laborers, costing around Rs. 1200. Additionally, labor cost for packing and loading the produce, including packaging materials, is approximately Rs. 1500. If the produce needs to be transported to a nearby market, transportation charges may be around Rs. 1000.

- **Total Estimated Cost for One Acre Garlic Cultivation**

Summing up all the costs mentioned above, the approximate total cost for one acre of garlic cultivation is Rs. 27,500. However, actual costs may vary based on location, labor rates, and market fluctuations.

3.6.4 Schemes for Farmers in India

- The **Agriculture Infrastructure Fund**, approved by the Union Cabinet in July 2020, is a nationwide scheme aimed at providing medium to long-term debt financing for post-harvest management infrastructure and community farming assets. Under this scheme, farmers can avail loans with an interest subvention of 3% per annum up to Rs. 2 crore, for a maximum period of seven years. Additionally, eligible borrowers can receive credit guarantee coverage for loans up to Rs. 2 crore, and the government will cover the fee for this coverage. The moratorium for loan repayment may vary but is subject to a minimum of 6 months and a maximum of 2 years.

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- The **Weather-Based Crop Insurance Scheme (WBCIS)** offers insurance protection for various notified food crops, oilseeds, and horticultural/commercial crops. The premium rates for farmers are uniform across the country, and the difference between the actual premium and the insurance rate is shared equally by the Central and State governments. In the event of deviations from the guaranteed weather indices for notified crops, farmers in the affected areas receive claim payments. The scheme also includes provisions for assessing individual farm-level losses caused by hailstorms and cloud bursts, with implementing agencies chosen through a bidding process by State Governments.
- The **PM Kisan Maan Dhan Yojana** is a voluntary and contributory pension scheme that provides a fixed minimum pension of Rs. 3,000/- to small and marginal farmers upon reaching the age of 60. To be eligible, farmers must fall within the age range of 18 to 40 years and own cultivable land up to 2 hectares as per their land records. The eligible farmers need to contribute to a Pension Fund with the Central Government matching their contribution.
- Under the **Pradhan Mantri Kisan Samman Nidhi** scheme, all landholding farmers' families receive a financial benefit of Rs. 6,000 per year, paid in three equal installments of Rs. 2,000 each every four months.
- The **Pradhan Mantri Krishi Sinchai Yojana**, launched in July 2015, aims to provide comprehensive solutions in the irrigation supply chain to promote efficient water use. It focuses on water resource management, distribution networks, farm-level applications, and popularizing micro-irrigation to ensure higher crop productivity.
- The Cabinet Committee on Economic Affairs approved a **unique package** of schemes for farmers, totaling Rs. 3,70,128.7 crore, in June 2023. These initiatives are designed to enhance the overall well-being and economic prosperity of farmers by promoting sustainable agriculture. The schemes target increasing farmers' income, fostering natural and organic farming practices, revitalizing soil productivity, and ensuring food security.

3.7 Overview of Garlic Cultivation in Kerala: Production And Characteristics

Garlic cultivation in Kerala is primarily concentrated in the Devikulam Block Panchayat, situated in the eastern part of the Idukki district. The cultivation of garlic is predominantly observed in the regions of Kanthalloor and Vattavada within Idukki.

The garlic grown in these areas is renowned for its distinctive flavor, pungency, taste, medicinal properties, and extended shelf life when compared to garlic from other regions. The local farmers primarily cultivate two main types of garlic in Kanthalloor and Vattavada: “Mettupalayam”, “Singapore (Sigappuppoondu)” and landrace “Malaipoondu”

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Sigappuppoondu is distinguished by slightly purple-colored outer scales on the freshly harvested bulbs, setting it apart from other garlic cultivars in the region. The name "Sigappuppoondu" originates from Tamil-Malayalam, with "sigappu" referring to the color red and "poondu" meaning garlic.

On the other hand, Malaippoondu is a traditional cultivar primarily preserved by the tribal communities in the area. These unique garlic varieties hold cultural significance and are valued for their exceptional characteristics.

3.7.1 Features of Kanthalloor Vattavada Garlic Bulbs

Kanthalloor Vattavada garlic is a variety known for its distinctive features. The plants have a height ranging from 53.00 to 81.00 cm and display a semi-erect attitude for foliage. Two-month-old plants typically have 4 to 9 leaves, with a mean length of 25.97 to 43.90 cm and a mean width of 0.87 to 1.19 cm. The leaves have a flat or slightly concave cross-section.

The bulb size of Kanthalloor Vattavada garlic varies, with smaller bulbs weighing 6-8 g and larger ones up to 38-40 g, containing 7-25 cloves per bulb. The bulbs have an ovate shape in the longitudinal section, and some cultivars, like Sigappuppoondu, may have flowering stem bulbils, while it is rare in Malaippoondu. The dry external scales exhibit purple or light purple coloration, with prominent anthocyanin stripes in Sigappuppoondu. External cloves are present in these cultivars, with a diameter ranging between 0.6 and 1.5 cm. Dry cured cloves weigh between 0.47 and 5.459 g. Some bulbs have a single clove, known as "Ottappoondu," which is highly valued in the market due to its believed superior medicinal properties. The scale color of the cloves is light purple, and the flesh is cream-colored. The crop duration is around 100-130 days, and the garlic is cured by smoking. It can be stored for 10-12 months. Both cultivars are pungent, and the average yield is 3000 kg per acre.

The medicinal properties of Kanthalloor Vattavada garlic are attributed to the content of volatile sulfur compounds, particularly allicin, which is responsible for its pungency and flavor. This garlic variety contains approximately 2.40-3.84 mg/g of allicin. It also contains Allyl methyl thiosulphinate (AMThs) ranging from 0.50 to 0.86 mg/g and Allyl trans-l-propenyl thiosulphinate (ATPThs) ranging from 0.20 to 0.23 mg/g. Phenolic compounds and flavonoids present in this garlic contribute to its medicinal value. The phenol content ranges between 58.11 and 58.67 mg/kg, while the flavonoid content ranges from 15.92 to 20.08 mg/kg. Additionally, the garlic has a protein content of 5.5-7.6 g/100g, total sugar content of 12.1-15.6%, and ascorbic acid content of 10.2-13.9 mg/100g.

The unique flavor of garlic comes from its sulfur compounds. Kanthalloor Vattavada garlic absorbs sulfate from the soil and incorporates it into amino acids and sulfur storage molecules,

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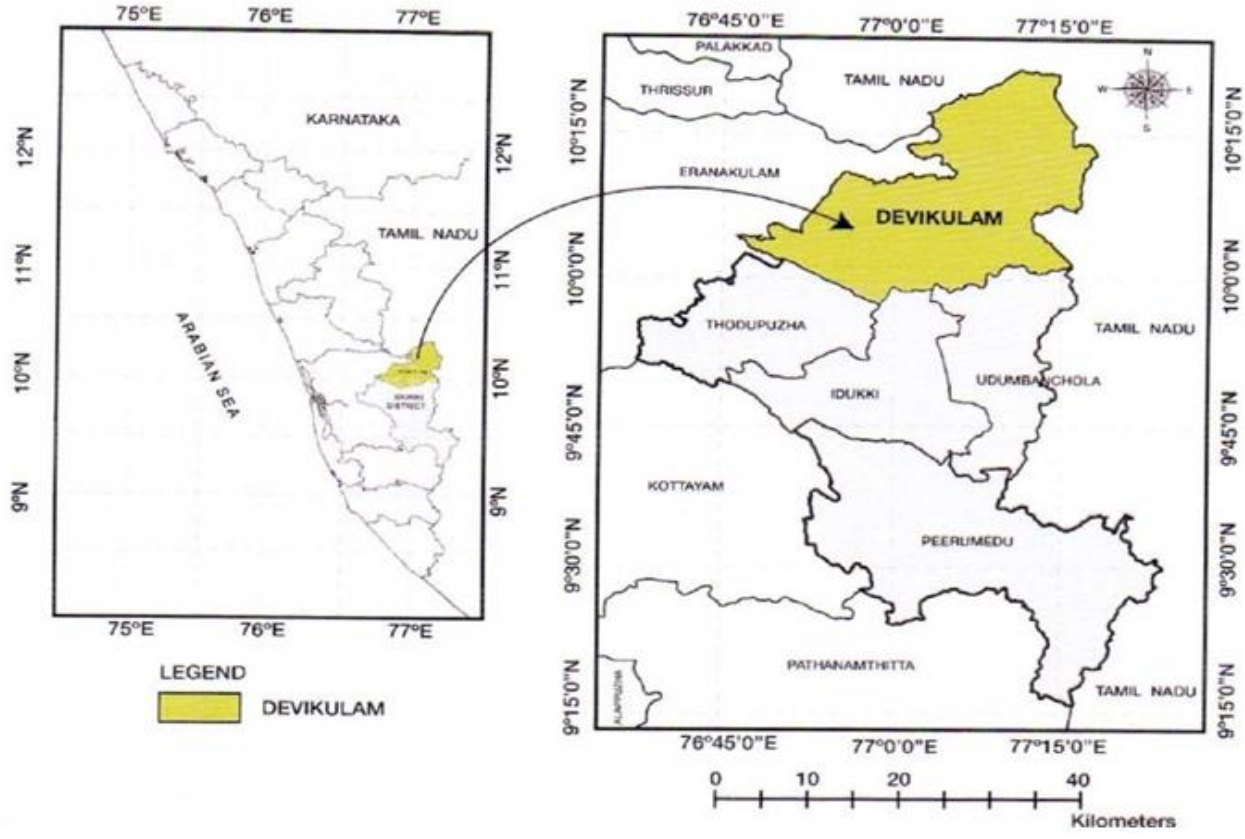
contributing to its strong smell and pungency. People in this region use this garlic for home remedies, especially for fever, stomach problems, and postnatal care.

The higher content of total sulphides and other sulfur compounds in Kanthalloor Vattavada garlic supports its unique medicinal properties, making it popular among consumers. The garlic contains total disulfide (39.95-48.01% area) and total trisulfide (49.94-56.92% area), with the percentage of total sulphides being 96.97-97.84% and cyclic octatomic sulfur at 1.39-3.94%.

Due to its curing method, Kanthalloor Vattavada garlic has a long shelf life of 10-12 months, unlike many North Indian varieties that start shriveling and sprouting after six months of storage. The garlic is smoked and then stored hanging on the room's roof, especially in the kitchen area of farmers' houses.

3.7.2 Geographical Regions of Garlic Cultivation

Figure 3.2. Area of Kanthalloor - Vattavada Garlic Cultivation



Source: *GI Journal No.159*

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Kanthalloor - Vattavada garlic is grown in the Devikulam Block Panchayat of Idukki district, Kerala, India. This agricultural region is situated amidst the lush surroundings of Tamil Nadu to its Northern and North Eastern sides.

The precise geographical coordinates defining the production area of Kanthalloor - Vattavada garlic are as follows: it spans between 77°15'0"E longitude and 10°21'29.647"N latitude in the North, 77°12'37.27"E longitude and 10°0'0"N latitude in the South, 77°14'4.263"E longitude and 10°18'26.706"N latitude in the East, and finally, 77°4'19.619"E longitude and 10°13'33.744"N latitude in the West.

3.7.3 Evidence of Source (Historical documentation)

In a significant document titled "The High Ranges of Travancore," written by J.D. Munro on 12 November 1880 (Pages 19, 20 & 21), gained valuable insights into the rich history of the regions encompassing Cochi (Mid Kerala) and Travancore (South Kerala) in present-day Kerala. J.D. Munro, a distinguished member of the British East India Company and former Diwan of the old Travancore and Cochin states, meticulously recorded various aspects of these areas.

The document offers captivating descriptions of the picturesque high ranges, shedding light on the local populace, their culture, agriculture, climate, and soil. It particularly centers on the region now known as the Idukki district. Among the noteworthy locations, Kanthalloor stands out as one of the five villages collectively referred to as "Anjunadu." The other four villages comprising Anjunadu are Keezhanthoor, Karayoor, Marayoor, and Kottakudi. Interestingly, the document mentions Anjunadu as "Unjenaad," signifying its historical significance.

The name "Anju nadu" itself carries a fascinating meaning, translating to "five regions" in the local language, which perfectly encapsulates the essence of the united villages. Additionally, the document highlights the cultivation of garlic in the area, further adding to our understanding of the region's historical practices and agricultural endeavors.

3.7.4 Area Description

In the region of Devikulam block, the garlic cultivation covers an estimated area where around 3560 farmers are currently engaged in cultivating this crop.

3.7.5 Climatic Factors of the Region

- **Temperature:** The temperature follows seasonal patterns, with higher temperatures observed from March to May, and lower temperatures during January and February. The area enjoys a cool climate, with mean minimum temperatures ranging from 6.0°C to

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14.9°C and mean maximum temperatures ranging from 19.3°C to 25.4°C. This favorable temperature range supports the cultivation of fruits, spices, and cool-season vegetables.

- **Rainfall:** Kanthalloor and Vattavada lie in the rain shadow areas on the eastern side of the Western Ghats. The average annual rainfall in this region is approximately 170.0-174.0cm.
- **Wind Speed:** The wind speed varies from 3.90 to 7.95 km/hour. Higher wind speeds are observed during the months of March to July and November to January.
- **Relative Humidity:** The region experiences varying relative humidity levels throughout the day. Mornings generally have higher humidity, while evenings have lower humidity. The relative humidity ranges from 8.69% to 441.80%.
- **Evaporation:** During the summer months of March to May, evaporation rates are higher, ranging from 1.11 to 5.00 mm/day. In the southwest monsoon season, evaporation rates range from 1.11 to 2.13 mm/day.
- **Sunshine Hours:** The region experiences varying sunshine hours throughout the year, ranging from 1.8 to 9.5 hours per day. The months of June to August usually record the minimum sunshine hours due to cloudy skies. Generally, the months from December to May enjoy good sunshine hours.

3.7.6 Garlic Production Method in Kerala

Devikulam Block Panchayat exhibits diverse topography, featuring a variety of geographical features such as mountains, rain forests, deciduous forests, riparian forests, brooks, rivers, waterfalls, rocky hills, sholas, and hamlets. The terrain is notably undulating, with altitudes ranging from 500 m at Chinnar to over 2300 m at Nandala malai.

Regarding soil composition, the region comprises clayey loam, forest loam, and alluvial soils with a substantial amount of organic matter. The soil is characterized by its acidity, with a pH ranging between 4 and 6. Additionally, it contains high levels of phosphorus and organic carbon. Forest loams are the result of weathering processes under forest cover and are distinguished by a surface layer rich in organic matter. These soils tend to be acidic, nitrogen-rich, and deficient in bases due to significant leaching. They appear as dark reddish brown to black with a loamy to silty loam texture.

On the other hand, alluvial soils are found in narrow strips along the riverbanks. They exhibit a range of surface textures, from sandy loam to clay, and are notably fertile.

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3.7.7 Status of Geographical Indication (GI) to Kanthalloor - Vattavada Garlic

A geographical indication (GI) refers to a distinctive marker employed on products that originate from a specific geographical region and exhibit qualities or a reputation that can be attributed to that particular origin. To qualify as a GI, the sign must effectively indicate that the product originates from a designated place.

Furthermore, the product's unique qualities, characteristics, or reputation should predominantly stem from its geographical place of origin. As these qualities are intrinsically linked to the specific location where the product is produced, a strong and evident connection exists between the product and its original place of production.

Kanthalloor Vattavada Garlic (Kanthalloor Vattavada Veluthulli) has been granted the status of Geographical Indication (GI) under Class 31, which covers agricultural products. The application for the GI was filed on 12th April 2021 by the Anchunad Vattavada Kanthalloor Veluthulli Udpadaka Karshaka Sangham. The geographical area associated with this GI is Kerala, India, and it holds priority protection in the country of India.

After the application process and examination, the GI was registered, and the certificate was issued on 30th November 2022, with certificate number 428. The availability of the GI status was published in the journal with journal number 159 on 29th July 2022.

Kanthalloor Vattavada Garlic is a unique agricultural product originating from the specific geographical region of Vattavada in the district of Idukki, Kerala, India. The GI registration ensures that only garlic produced in this specific region and meeting certain quality and authenticity criteria can bear the Kanthalloor Vattavada Garlic label.

Geographical Indication (GI) protection plays a crucial role in safeguarding the traditional knowledge and reputation of region-specific products, while also promoting rural economic development and preserving cultural heritage.

3.7.8 Garlic Production in Kerala over the years

Table.3.4 Garlic Production in Kerala

Year	Area (Hectares)	Production (Tonnes)	Productivity (Kg./Ha)
2002-03	616	10472	17000
2003-04	638	10846	17000

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2004-05	306	5202	17000
2005-06	65	1105	17000
2006-07	221	3750	16968
2007-08	350	5950	17000
2006-09	320	5440	17000
2009-10	336	5712	17000
2010-11	165	1508	9139
2011-12	155	1417	9142
20 12-13	72	658	9139
20 13-14	146	1314	9000
2014 15	75	625	8333
2015-16	62	375	6048
2016-17	77	380	4935
2017-18	71	398	5606
2018-19	70	345	4956
2019-20	191	990	5183
2020-21	203	1068	5267

Source: Kerala Agricultural Statistics

The data appears to represent the garlic cultivation in different regions or areas over a period of time. The "Year" column indicates the respective agricultural years during which the crop was cultivated. The "Area (Hectares)" column represents the total land area (in hectares) on which the crop was grown in each respective year. The "Production (Tonne)" column shows the total crop yield (in tonnes) for each year. The "Productivity (Kg./Ha)" column calculates the crop productivity, which is the yield obtained per hectare of land. It appears to be quite consistent with a value of around 17,000 kg per hectare, except for a few years. From 2002-03 to 2007-08,

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the cultivation area and production remained relatively stable, with minor fluctuations in the area and production levels. However, in 2010-11 and 2011-12, there was a noticeable decrease in the cultivation area, which had a direct impact on the crop production and overall productivity. The productivity dropped significantly during these years, as indicated by the lower values in the "Productivity (Kg./Ha)" column. In 2012-13, 2013-14, and 2014-15, the cultivation area remained quite low, which had a considerable impact on production and productivity. The data shows a positive trend from 2015-16 onwards, with an increase in cultivation area and corresponding improvements in production and productivity.

3.8. Conclusion

The garlic in Kerala has many more features like this. The present study aims to delve deeper into these unique aspects, with a particular focus on the garlic farming practices in the Kanthalloor region. By doing so, the study aims to shed light on the economic viability of garlic cultivation in Kerala, especially considering its status after obtaining geographical indication (GI) protection. Additionally, the study seeks to analyze the opportunities and challenges faced by garlic farmers in the Kanthalloor panchayat.

Garlic cultivation in Kerala has been historically significant, and the Kanthalloor region stands out as one of its prime locations. The study endeavors to uncover the key factors that contribute to the success of garlic cultivation in this specific area, including the region's soil composition, climate, and other geographical factors. These unique characteristics of the region might have played a vital role in securing geographical indication for Kerala garlic, adding value and protecting the product from imitation.

By examining the economics of garlic cultivation in the region, the study aims to gauge the profitability and sustainability of garlic farming in Kanthalloor. Factors such as production costs, market prices, and demand will be considered in this analysis. Furthermore, the study will delve into the potential economic benefits brought about by the GI status, such as increased market access, better prices for farmers, and enhanced branding opportunities.

In addition to exploring the positive aspects, the study also intends to identify the challenges faced by garlic farmers in the Kanthalloor panchayat. This examination will encompass various issues, including fluctuations in market prices, access to modern farming technologies, transportation hurdles, and labor shortages. By understanding these obstacles, the study aims to propose potential solutions to alleviate the hardships faced by garlic farmers and enhance the overall productivity of the sector.

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4. From Cloves To Coins: Performance of Garlic Cultivation's Economic Feasibility and Potential For Profitability

Garlic, a humble and ubiquitous herb, has been cultivated and utilized by various civilizations for centuries due to its culinary and medicinal properties. From ancient times, cloves of garlic have held a special place in the hearts and kitchens of people worldwide. However, the modern agricultural landscape demands a thorough examination of the economic feasibility and profitability of garlic cultivation to assess its potential as a lucrative venture. The study aims to provide a comprehensive understanding of the financial aspects associated with garlic farming, including investment costs, production expenses, and potential returns on investment. Garlic cultivation's resurgence can be attributed to its numerous health benefits, growing demand in the culinary industry, and its ability to adapt to diverse climatic conditions. However, despite these promising factors, there are several challenges that garlic farmers encounter, such as fluctuating market prices, pest and disease management, and labor-intensive farming practices. It is crucial, therefore, to evaluate the viability of garlic farming through a meticulous examination of its economic sustainability and profit potential.

The primary objective of the research is to assess the economic feasibility of garlic cultivation in Kanthalloor Panchayat. This section will try to find out the analysis for the research questions including: What are the total costs involved in garlic cultivation in Kanthalloor panchayat, Kerala, including expenses such as seeds, labor, fertilizers, leased land rent, intermediaries commission costs, transportation, and irrigation? How does the average seasonal yield of garlic in Kanthalloor panchayat compare to the yields of the two most recent years? Are there any noticeable trends or fluctuations in the yield? What were the selling prices of garlic for the two most recent years in Kanthalloor panchayat, and how do these prices impact the economic feasibility of garlic cultivation? What are the major sources of income for garlic farmers in Kanthalloor panchayat? How significant are these sources in contributing to the overall income of the farmers? What is the level of income satisfaction among garlic farmers in Kanthalloor panchayat? Are they content with their current earnings from garlic cultivation? How do different farmers in Kanthalloor panchayat manage and optimize their garlic cultivation processes to achieve higher profitability?

The study was conducted to analyse the all in all economic feasibility of garlic cultivation in Kerala especially in Kanthalloor region. From this study the population consists of 60 garlic farmers from Kanthalloor Panchayat of Devikulam Block of Idukki district in Kerala.

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4.1 Area and Sample Population

The sample population was entirely from Kanthalloor Panchayat of Idukki district. The choice of the sample population from the specific region of Kanthalloor Panchayat was made to narrow down the study's scope and to gain insights into the local practices, challenges, and opportunities related to garlic farming in that particular area.

The survey was entirely conducted through a personal interview method. Conducting the survey through personal interviews was a deliberate decision to establish a direct and interactive approach with the farmers. This method allowed the researchers to build a rapport with the participants, enabling them to gather more detailed and nuanced information. Personal interviews also provided the opportunity to clarify any doubts, delve into specific topics, and capture the farmers' unique experiences.

4.2 Panorama: Assessment of Economic Viability in Garlic Cultivation for Farmers

This study is based upon the survey conducted among 60 garlic farmers, asserting the economic assessment of garlic cultivation among them. The farmers range from different socioeconomic backgrounds. The major aspects of the primary objective of the study is regarding the economic feasibility of garlic cultivation in Kanthalloor panchayat by analyzing the costs involved, seasonal yields, selling prices, and overall profitability.

4.2.1 Demographic Profile

The following table shows the demographic profile of the respondents.

Table 4.1. Demographic Profile

CATEGORY	NO. OF RESPONSES	FREQUENCY	%
AGE	<40	6	9.8
	40-50	12	19.7
	50-60	27	44.3
	>60	15	24.6
GENDER	Female	48	78.7

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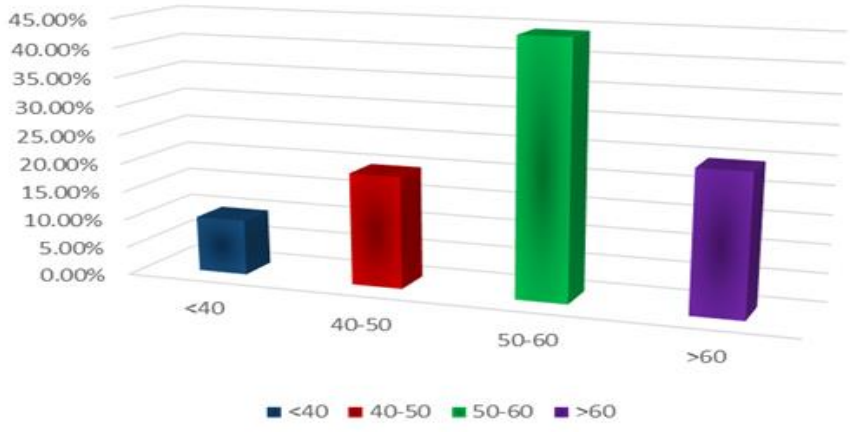
	Male	12	19.7
EDUCATIONAL BACKGROUND	Illiterate	16	26.7
	Primary education	29	48.3
	Secondary education	15	25.0
MONTHLY INCOME	<1500	7	11.7
	1500-2500	33	55.0
	2500-3500	14	23.3
	3500-4500	4	6.7
	>4500	2	3.3

Source: Primary data

4.2.1.1 Age group

The graph below shows the composition of various age groups of the respondents.

Figure 4.1 Age group of the Respondents



Source: Primary data

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Based on the given data, a survey was conducted with a total of 60 respondents, and they were categorized into different age groups. The age groups and their respective frequencies are as follows:

Age <40: There were 6 respondents in this age group, accounting for 9.8% of the total respondents.

Age 40-50: There were 12 respondents in this age group, making up 19.7% of the total respondents.

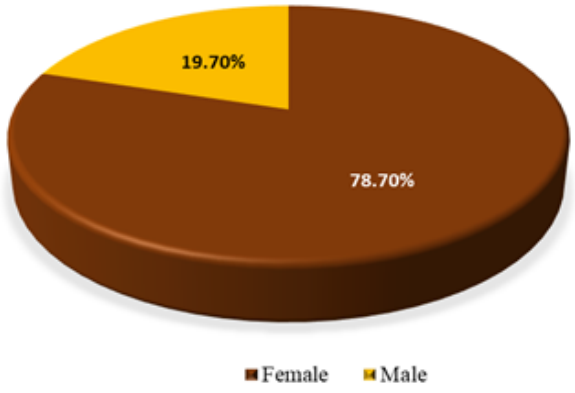
Age 50-60: This age group had the highest number of respondents with 27 individuals, representing 44.3% of the total respondents.

Age >60: There were 15 respondents in this age group, comprising 24.6% of the total respondents.

From the data, it can be observed that the majority of the respondents were aged between 50 and 60, accounting for the highest percentage among all age groups. The second-largest group was aged over 60, while the age groups under 50 constituted a smaller proportion of the total respondents.

4.2.1.2 Gender

Figure 4.2: Gender distribution



Source: Primary data

There were a total of 60 individuals included in the study. Among them, 48 individuals, or 78.7% of the total sample, were identified as female. On the other hand, 12 individuals, which accounts for 19.7% of the total sample, were identified as male.

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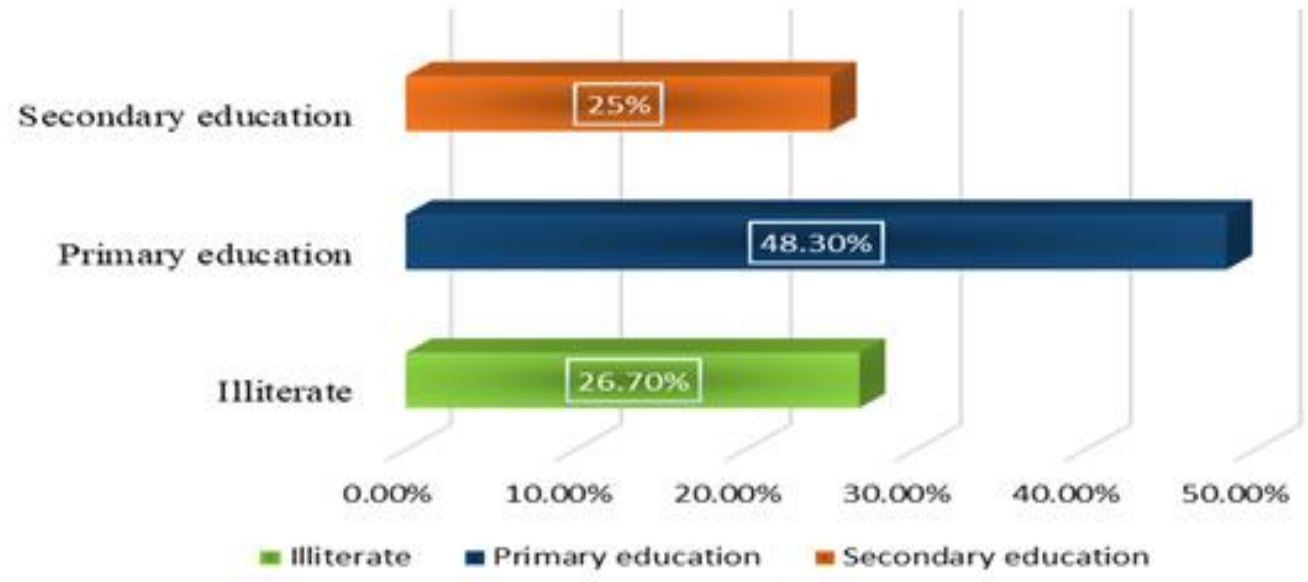
The data indicates that females were the more prevalent gender in the study, comprising a larger percentage of the total sample compared to males. Specifically, females constituted about four times the number of males in the dataset.

4.2.1.3 Educational Background

The educational qualification of the respondents is illustrated below:

Figure 4.3: Educational Qualification



Source: Primary data

In the survey conducted with a sample of 60 individuals, their qualifications were categorized into three groups: illiterate, primary education, and secondary education. The results revealed that 26.7% of the respondents were illiterate, 48.3% had completed primary education, and 25.0% had attained a secondary education. The study encompassed a diverse representation of educational backgrounds, with the majority having completed at least primary education. However, it also highlighted the presence of a significant illiterate population, emphasizing the need for educational initiatives and interventions to address this disparity.

4.2.1.4 Marital Status

The marital status of the respondents are given in the table:

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Table 4.2. Marital status of the respondents

Marital Status	Frequency	Percent
Married	53	88.3
Widow	7	11.7
Total	**60**	**100.0**

Source: Primary data

The data presented above illustrates the marital status distribution within a particular population, total of 60 individuals. The majority of individuals, constituting 88.3% of the group, are married. On the other hand, a smaller percentage, representing 11.7% of the total, are widowed. These figures shed light on the diverse marital circumstances within the studied population.

4.2.1.5 Family Composition

The below table represents the family size of the sample respondents and the line illustration represents its graphical representation:

Table 4.3. Family Size

Family size	Frequency	Percent
2	6	10.0
3	8	13.3
4	16	26.7
5	12	20.0
6	7	11.7
7	5	8.3

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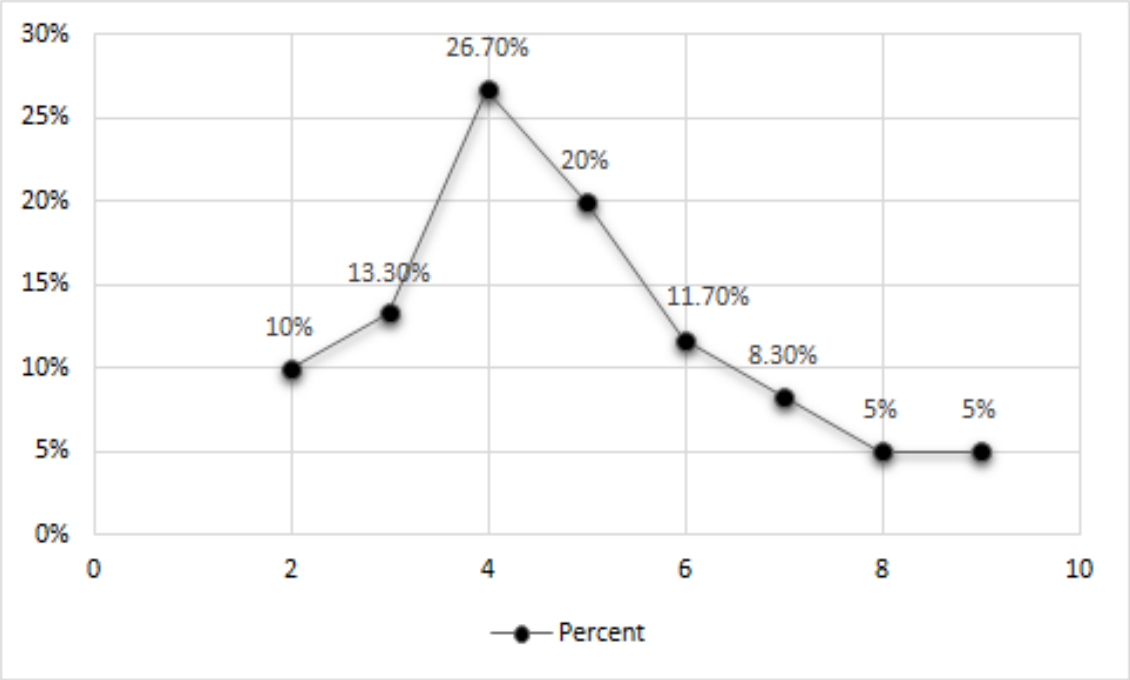
8	3	5.0
9	3	5.0
Total	**60**	**100.0**

Source: Primary data

Figure 4.4. Household size of the respondents



Source: Primary data

From the study population represents the family size distribution in a certain population. The table shows the frequency and percentage of families with different sizes. From the data, it can be observed that the majority of families have either 4 or 5 members, with each comprising 26.7% and 20.0% of the total population, respectively. Families with 3 members make up 13.3%, while those with 2 members account for 10.0%. Smaller families are also present, with 11.7% consisting of 6 members, 8.3% with 7 members, and 5.0% each for families of 8 and 9 members.

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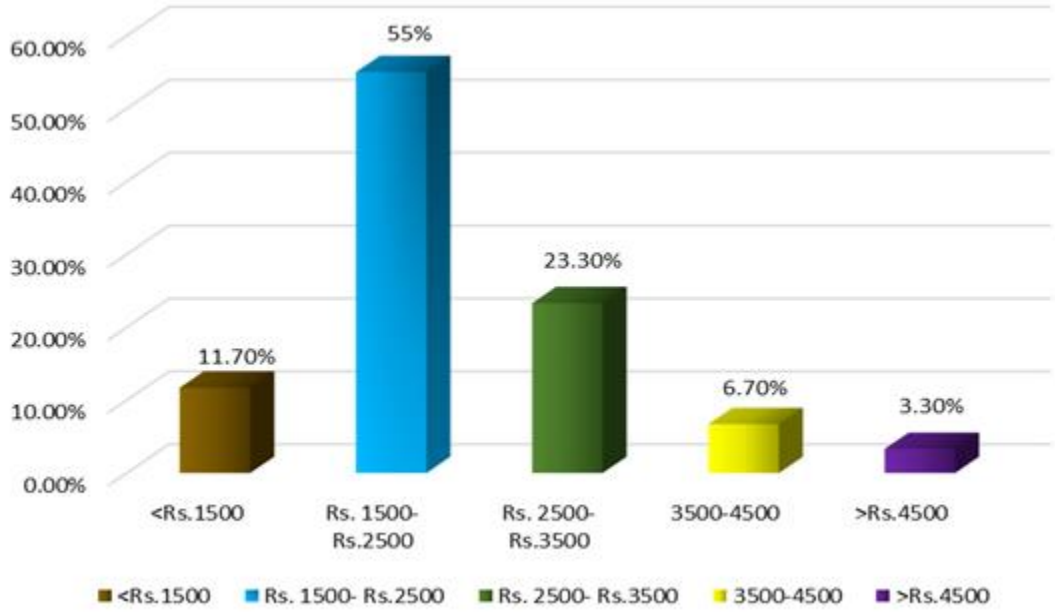
4.2.1.6 Monthly Income

Income is the most important factor which influences day-to-day life of every household. The monthly income distribution of the study population is given below:

Figure 4.5. Monthly income distribution



Source: Primary data

From the sample population, the lowest income bracket, earning less than Rs. 1500, comprises 7 individuals, making up 11.7% of the total sample. The majority of individuals, 55% or 33 people, fall into the next income range of Rs. 1500 to Rs. 2500. The following bracket, ranging from Rs. 2500 to Rs. 3500, is occupied by 14 individuals, accounting for 23.3% of the total. A smaller percentage, 6.7%, represents those earning between Rs. 3500 and Rs. 4500, constituting 4 individuals. Lastly, there are 2 individuals who earn above Rs. 4500, making up 3.3% of the group. Overall, the data provides insights into the income distribution within the surveyed population, highlighting the significant number of people earning lower incomes and a smaller proportion with higher earnings.

4.2.2 Possession of Land

The land possession which represents the status of respondents who own their own land. The below table represents the number of respondents own land:

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Table 4.4. Ownership of land

Owning Land	Frequency	Percent
No	8	13.3
Yes	52	86.7
Total	**60**	**100.0**

Source: Primary data

From the study samples, out of the total 60 respondents, 52 individuals, which accounts for 86.7% of the sample, reported owning land. On the other hand, 8 respondents, making up 13.3% of the sample, stated that they do not own any land.

4.2.3 Feasibility of Garlic Cultivation in Kanthalloor

Economic feasibility refers to by assessing the production costs, market demand, and potential revenue, and aims to determine the viability and profitability of this agricultural venture in the unique and thriving landscape of Kanthalloor.

4.2.3.1 Years Involved in Garlic Cultivation

Over the years, Kanthalloor farmers have devoted their time and expertise to the art of garlic cultivation, fostering a deep-rooted connection with this aromatic crop. With unwavering dedication, they have honed their skills and implemented sustainable practices, ensuring a bountiful harvest year after year. Their rich experience in garlic cultivation is a testament to their passion for agriculture and commitment to preserving traditional farming methods.

The below table represents the respondent farmers' years of experience in garlic farming:

Table 4.5. Years of Experience in Garlic farming

Years of experience in garlic cultivation	Frequency	Percent
<10	4	6.7
10-20	6	10.0

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20-30	14	23.3
30-40	19	31.7
40-50	11	18.3
>50	6	10.0
Total	**60**	**100.0**

Source: Primary data

From the dataset, it is evident that the majority of the respondents have significant experience in cultivation, with 23.3% having been involved in this field for 20-30 years and 31.7% for 30-40 years. Additionally, there is a considerable portion of respondents with 18.3% having 40-50 years of experience.

Interestingly, the survey shows a diverse range of experience levels, with 10% having less than 10 years of experience, and an equal percentage of respondents having over 50 years of experience. This indicates that the cultivation community includes both newcomers and seasoned veterans.

4.2.3.2 Size of Garlic Farm

The size of the farm which determines key factors such as acreage, planting density, and crop yield. So it can be an important part of garlic production.

Table 4.6. Size of Farm Land

Size of garlic farm (in cent)	**Frequency**	**Percent**
<25	9	15.0
25-50	27	45.0
50-75	2	3.3

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>75	22	36.7
Total	**60**	**100.0**

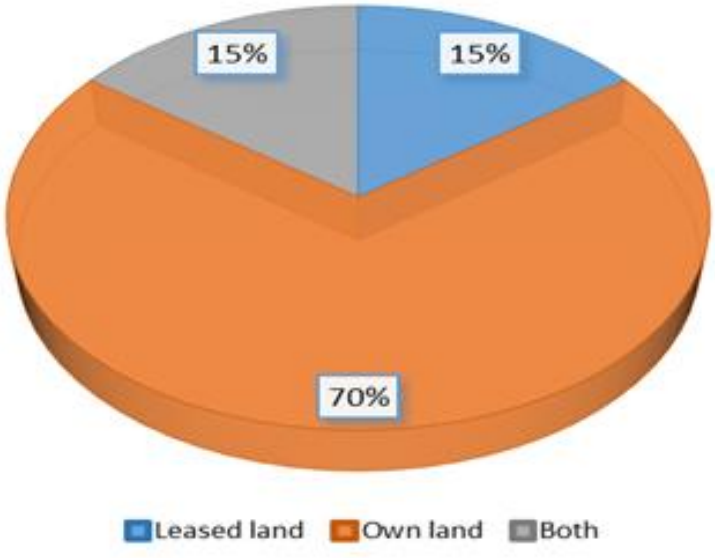
Source: Primary data

The sample population reveals that the majority of garlic farms, accounting for 45% of the total, fall within the size range of 25 to 50 cent units. This indicates that medium-sized farms are more prevalent in this study. Farms with sizes below 25 cent units constitute 15% of the total, indicating a notable proportion of smaller farms. On the other hand, larger farms with sizes exceeding 75 cent units make up 36.7% of the total, suggesting that there is a considerable number of larger garlic farms as well. Interestingly, there are only two farms, representing 3.3% of the total, falling within the size range of 50 to 75 cent units, indicating that this range has the least number of garlic farms among the given categories. This indicates the farmers have medium size farm lands as well as large scale farm lands.

4.2.3.3 Status of Farm Land

The below figure shows the status of farmland is whether owned or leased:

Figure 4.6. Status of Farm Land



Source: Primary data

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From the sample population, 15% of the respondents (9 individuals) reported that they have leased land for farming purposes. The majority, comprising 70% of the respondents (42 individuals), stated that they own the land they cultivate. Interestingly, an equal percentage of respondents, also representing 15% (9 individuals), reported having both owned and leased land for their farming activities.

4.2.3.4 Size of Leased Land

The below table shows the size of leased land of garlic farmers in the population:

Table 4.7. Size of Leased Land

Size of the leased land (in cent)	**Frequency**	**Percent**
<25	6	10.0
25-50	10	16.7
>50	2	3.3
Total	**18**	**30.0**

Source: Primary data

The sample population represents the size distribution of leased land, categorized into three groups: less than 25 cents, 25 to 50 cents, and greater than 50 cents. From the survey of 18 instances, it is observed that 10% of the leased land is less than 25 cents, while 16.7% falls within the range of 25 to 50 cents. The smallest proportion, 3.3%, belongs to land larger than 50 cents. These percentages highlight the distribution of leased land sizes, indicating that a significant portion lies in the 25-50 cents range. That means leased a larger area for the garlic cultivation purpose.

4.2.4 Productivity Trends of Garlic in Kanthalloor

The productivity trends of garlic in Kanthalloor reveal valuable insights into the agricultural performance of this region. By examining the fluctuations in garlic production over the past few years, we can gain a deeper understanding of how it influences economic and social aspects of the local economy. Here the productivity is analyze through the seasonal yield of garlic in the reference period: 2021-2022 and 2020-2021.

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4.2.4.1 Average Seasonal Yield of Garlic during 2021-22

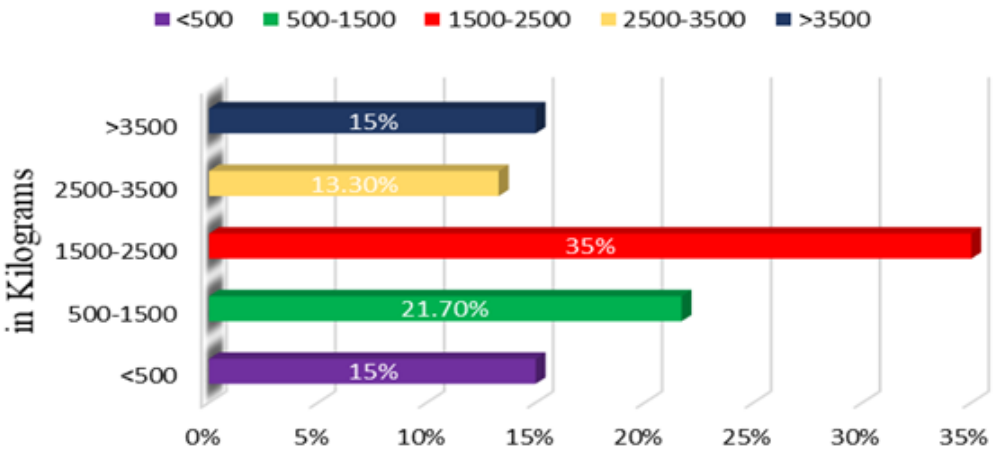
The table shows the approximate seasonal yield got by sample population in the period 2021-2022:

Table 4.8. Seasonal Yield in 2021-2022

Seasonal yield of garlic in 2021-2022 (in kilograms)	Frequency	Percent
<500	9	15.0
500-1500	13	21.7
1500-2500	21	35.0
2500-3500	8	13.3
>3500	9	15.0
Total	**60**	**100.0**

Source: Primary data

Figure 4.7. Average Seasonal Yield in 2021-2022



Source: Primary data

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The above figure shows the graphical representation of average seasonal yield in 2021-2022.

In the 2021-2022 season, garlic production exhibited diverse yields, with the sample population. The distribution of yields was categorized into different ranges, each representing a percentage of the total. The lowest range, comprising yields less than 500 kilograms, accounted for 15.0% of the data, indicating that a few farmers had relatively lower yields during this period. The range of 500-1500 kilograms was the most common, with 21.7% of the farmers falling into this category. This suggests that a significant portion of garlic growers achieved moderate yields during the season. The subsequent range of 1500-2500 kilograms represented the highest proportion at 35.0%, indicating that a considerable number of farmers experienced satisfactory harvests within this range. The succeeding category of 2500-3500 kilograms accounted for 13.3% of the data, indicating that a smaller percentage of farmers managed to obtain even higher yields. Finally, the category with yields exceeding 3500 kilograms constituted 15.0% of the data, signifying that a notable number of farmers achieved exceptional garlic harvests. Overall, this distribution highlights the varying levels of garlic production during the 2021-2022 season, showcasing both challenges and successes among garlic growers.

4.2.4.2 Annual yield of garlic during 2021-22

The table shows the approximate annual yield got by sample population in the period 2021-2022:

Table 4.9. Annual Yield in 2021-22

Annual yield in 2021-2022 (in kilograms)	Frequency	Percent
<1000	9	15.0
1000-3000	21	35.0
3000-5000	14	23.3
5000-10000	13	21.7
>10000	3	5.0
Total	**60**	**100.0**

Source: Primary data

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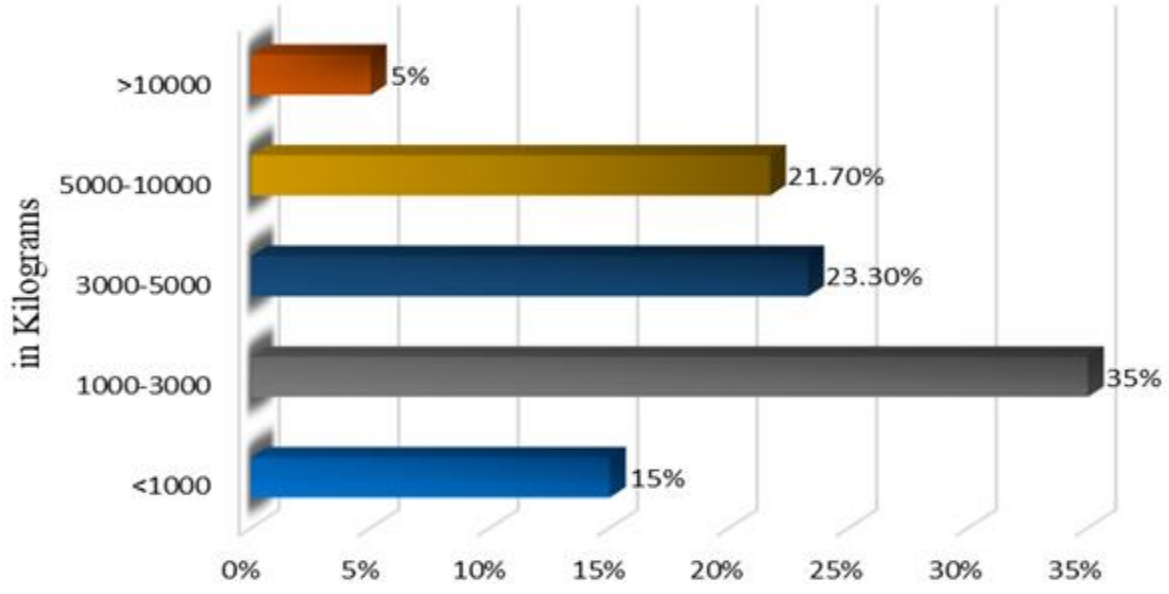
In the agricultural year 2021-2022, the yield shows that the largest group, comprising 35% of the total, falls within the range of 1000 to 3000 kilograms. This indicates that a significant number of crops produced a moderate annual yield. Furthermore, approximately 23.3% of the yields fell between 3000 to 5000 kilograms, demonstrating a notable proportion of crops with a higher output.

On the lower end of the scale, about 15% of the yields were less than 1000 kilograms, highlighting a subset of crops with lower productivity. Conversely, on the higher end of the scale, 21.7% of the yields were within the range of 5000 to 10000 kilograms, showing a substantial portion of crops achieving a relatively abundant annual harvest. Additionally, a smaller fraction, approximately 5% of the total, exceeded 10,000 kilograms, suggesting a minority of highly productive crops.

The below figure shows the annual average yield got in the year 2021-2022:

Figure 4.8. Annual average yield in2021-2022



Source: Primary data

4.2.4.3 Size of the garlic farm & annual yield in 2021-22

Here the sample data is statistically testing using different tools whether any relation between the size of the total garlic farm land and annual yield got in 2021-2022 period.

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Table 4.10. Relation between statistical variables with Size of farm land and annual yield (2021-2022)

Annual average yield of garlic during 2021-22 (in kilograms)										
Size of the garlic farm (in cent)	N	% of Total N	Sum	% of Total Sum	Minimum	Maximum	Range	Median	Mean	Std. Deviation
<25	9	15.0%	5670	2.2%	120	1800	1680	600.00	630.00	550.545
25-50	27	45.0%	80200	30.5%	800	7000	6200	3000.00	2970.37	1147.175
50-75	2	3.3%	5000	1.9%	2400	2600	200	2500.00	2500.00	141.421
>75	22	36.7%	172250	65.5%	1050	24800	23750	6200.00	7829.55	6042.955
Total	60	100.0%	263120	100.0%	120	24800	24680	3100.00	4385.33	4607.640

Source: Computed

The table shows four size ranges for the garlic farms. The majority of farms (45%) fall in the 25-50 cent range, followed by farms with size >75 cent (36.7%). Smaller farms with size <25 cent make up 15% of the sample, while farms in the 50-75 cent range constitute only 3.3% of the total garlic yield in kilograms for each size range, with the overall total yield being 263,120 kilograms. The range column shows the difference between the maximum and minimum yields, with the largest range of 6,200 kilograms found in the >75 cent size range. The median and mean yields for each range are 3,100 kilograms and 4,385.33 kilograms, respectively. The Standard deviation column reflects the extent to which the average yields deviate from the mean within each size range. Smaller values suggest more consistent yields, while larger values indicate greater variability. The largest standard deviation is seen in the >75 cent size range, indicating higher yield fluctuations among the larger farms.

The analysis reveals variations in garlic yields among different farm sizes. While larger farms tend to have higher average yields, they also exhibit greater variability. Smaller farms show relatively more consistent yields.

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Table 4.11. ANOVA Table of Size of farm land & Annual Yield (2021-2022)

			Sum of Squares	df	Mean Square	F	Sig.
Annual average yield of garlic during 2021-22 (in kilograms) * Size of the garlic farm (in cent)	Between Groups	(Combined)	449066101.582	3	149688700.527	10.432	.000
	Within Groups		803524391.751	56	14348649.853		
	Total		1252590493.333	59			

Source: Computed

The table F-ratio is 10.432, and its associated p-value (Sig.) is very low (approximately 0.000).

A low p-value (usually less than 0.05) indicates that there is a significant difference in the average yield of garlic across different sizes of garlic farms. In other words, the size of the garlic farm has a statistically significant effect on the annual average yield of garlic during 2021-22. The F-ratio of 10.432 also suggests that the variation in yield between different farm sizes is relatively large compared to the random variation within each group.

4.2.4.4 Average seasonal yield of garlic during 2020-2021

The table and figure below shows the average garlic seasonal yield in the period 2020-2021:

Table 4.12. Seasonal yield in 2020-2021

Seasonal yield in 2020-2021 (in kilograms)	Frequency	Percent
<500	11	18.3
500-1500	23	38.3
1500-2500	11	18.3

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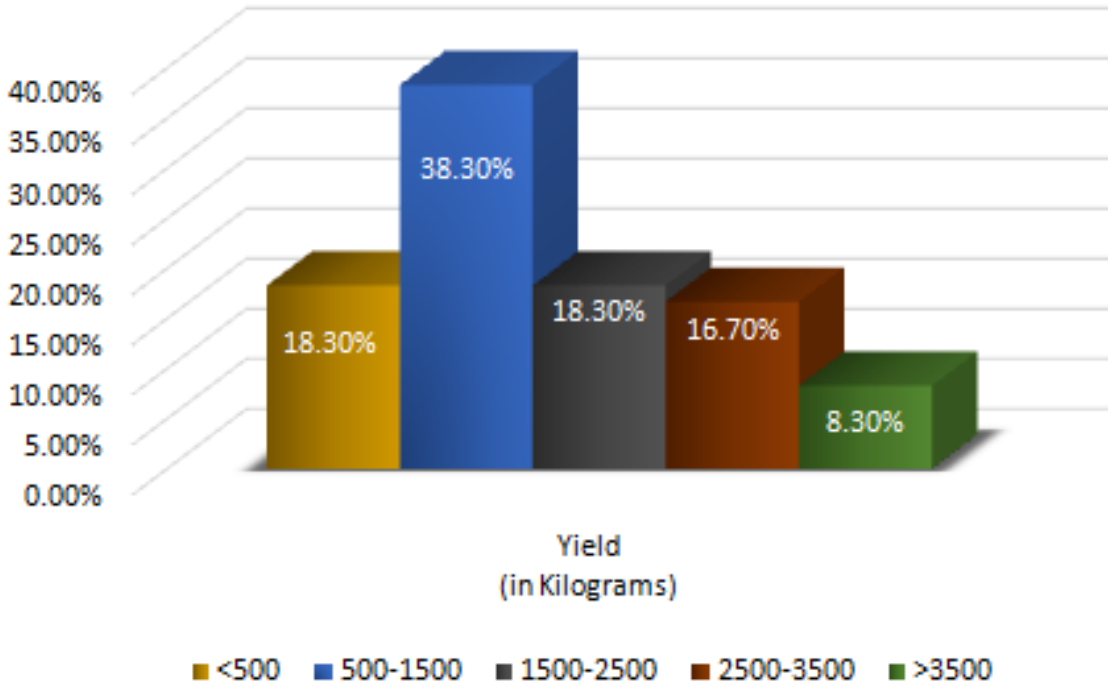
2500-3500	10	16.7
>3500	5	8.3
Total	**60**	**100.0**

Source: Primary data

Figure 4.9. Average seasonal yield of garlic in 2020-2021



Source: Primary data

In the 2020-2021 season, the samples shows that the majority of the yields fell within the 500-1500 kilograms range, accounting for 38.3% of the total frequency. Following closely behind were yields in the 1500-2500 kilograms range, representing 18.3% of the total. On the lower end, yields below 500 kilograms constituted 18.3% of the data. In contrast, yields above 3500 kilograms were relatively less common, making up only 8.3% of the total frequency. The findings indicate that the harvest distribution was skewed towards moderate yields, with a substantial portion of crops falling within the 500-1500 kilograms range during the specified season.

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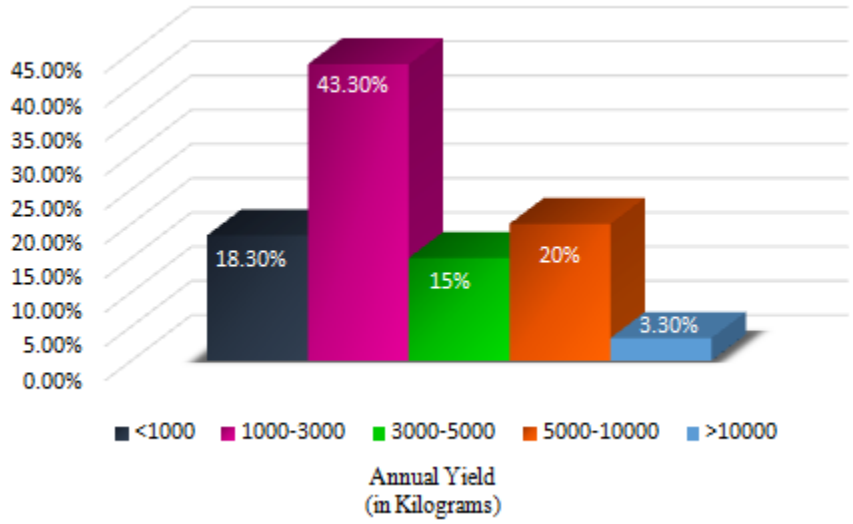
4.2.4.5 Annual average yield of garlic during 2020-21

The illustration and tables shows the appropriate annual garlic yield in 2020-2021:

Figure 4.10. Annual average yield of garlic in 2020-21



Source: Primary data

Table 4.13. Annual garlic yield in 2020-2021

Annual garlic yield in 2020-2021 (in kilograms)	Frequency	Percent
<1000	11	18.3
1000-3000	26	43.3
3000-5000	9	15.0
5000-10000	12	20.0
>10000	2	3.3
Total	**60**	**100.0**

Source: Primary data

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The sample population show that, in 2020-2021 the majority of the garlic farmers (43.3%) had a yield between 1000 and 3000 kilograms, while 20.0% reported yields in the range of 5000 to 10000 kilograms. Additionally, 18.3% of farmers had yields below 1000 kilograms, and 15.0% had yields between 3000 and 5000 kilograms. Only a small proportion (3.3%) of farmers reported extremely high yields of 10000 kilograms or more. This distribution suggests that a significant number of garlic farmers fell within the lower to middle yield ranges, while relatively few achieved exceptionally high yields.

4.2.4.6 Size of the garlic farm & annual yield in 2020-21

Here the sample data is statistically testing using different tools whether any relation between the size of the total garlic farm land and annual yield got in 2021-2022 period.

Table 4.14. Size of the garlic farm & annual yield in 2020-21

Annual average yield of garlic during 2020-21 (in kilograms)										
Size of the garlic farm (in cent)	**N**	**% of Total N**	**Sum**	**% of Total Sum**	**Minimum**	**Maximum**	**Range**	**Median**	**Mean**	**Std. Deviation**
<25	9	15.0%	5362	2.5%	100	1550	1450	340.00	595.78	556.718
25-50	27	45.0%	66010	30.9%	540	5800	5260	2450.00	2444.81	1015.785
50-75	2	3.3%	4550	2.1%	2250	2300	50	2275.00	2275.00	35.355
>75	22	36.7%	138040	64.5%	800	21800	21000	5400.00	6274.55	4754.824
Total	60	100.0%	213962	100.0%	100	21800	21700	2650.00	3566.03	3640.995

Source: Computed

The analysis pointed out the following results: The majority of garlic farms fall in the "25-50" and ">75" size categories, with "25-50" farms accounting for 45.0% and ">75" farms representing 36.7% of the total number of farms. The largest proportion of the total garlic yield comes from ">75" farms, constituting 64.5% of the overall yield. In contrast, the "<25" farms contribute the least to the total yield, with only 2.5%. The standard deviation for the ">75" farms (4754.824) is notably higher compared to the other size categories, indicating a wider spread of yields for larger farms. In summary, the data analysis shows that the majority of garlic yield comes from larger farms, especially those with a size of over 75 cent. Additionally, the yield

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from smaller farms is comparatively more consistent, while larger farms exhibit greater variability in their garlic production.

Table 4.15. ANOVA Table of Size of the garlic farm & annual yield in 2020-21

			Sum of Squares	df	Mean Square	F	Sig.
Annual average yield of garlic during 2020-21 (in kilograms) * Size of the garlic farm (in cent)	**Between Groups**	**(Combined)**	278070666.849	3	92690222.283	10.297	.000
	Within Groups		504083353.084	56	9001488.448		
	Total		782154019.933	59			

Source: Computed

Here, the F-statistic is 10.297 and the significance level (Sig.) or p-value of the test is used to determine if the observed differences in garlic yield among farm sizes are statistically significant. The p-value is compared to a pre-defined significance level (often 0.05) to make this determination. In this case, the p-value is less than 0.001 (indicated as .000), which means there is strong evidence to reject the null hypothesis and conclude that there are significant differences in garlic yield across different sizes of garlic farms during 2020-21. So, the ANOVA results indicate that the size of the garlic farm has a significant effect on the annual yield of garlic in 2020-21. The observed differences in yield among different farm sizes are not likely due to random chance, as the p-value is extremely small.

4.2.5. Price dynamics in Garlic Cultivation

The analysis of the cost of cultivation and profitability of garlic cultivation involves assessing various factors such as initial investment, land preparation, seed acquisition, labor costs, fertilizers, pesticides, irrigation, and other overhead expenses. By comparing these costs with the market value of garlic yields, farmers can determine the profitability of their garlic cultivation.

4.2.5.1 Expectation about Yield Price

The expected price of the yield refers to the projected value of a financial asset or investment based on market conditions and relevant factors. The expected price of the garlic yield by

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farmers may vary depending on factors such as regional demand, weather conditions, and overall crop supply. As market dynamics play a significant role, farmers should closely monitor market trends and factors influencing garlic prices to make informed decisions about their produce's potential value. Here also the sample population shares their expected price for the yield. The below table shows the expected price of the yield by the sample respondents:

Table 4.16. Expected Yield Price

Expected price of the yield per kilogram	Frequency	Percent
<150	5	8.3
150-200	32	53.3
200-250	11	18.3
>250	12	20.0
Total	**60**	**100.0**

Source: Computed

From the sample data, pointed out that the most common price range lies between 150 and 200, accounting for 53.3% of the total occurrences. The next significant range is above 250, contributing to 20.0% of the total. The least common price range is less than 150, with only 8.3% of the total occurrences. This data suggests that the majority of the yields are being sold in the 150-200 price range, indicating a stable demand in that segment. It would be important for businesses in the market to focus on this particular price range to maximize their sales potential. Additionally, the higher percentage in the greater than 250 range might indicate that there is a market for premium or higher quality products.

4.2.5.2 Actual selling price of garlic per kg in 2021-22

The table illustrates the actual rates got by garlic during the 2021-2022 period:

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Table 4.17. Actual selling price of garlic per kg in 2021-22

Actual selling price per kg in 2021-22? (INR)	Frequency	Percent
30	30	50.0
40	17	28.3
50	13	21.7
Total	**60**	**100.0**

Source: Primary data

The table shows that 50% of the selling occurred at a price of Rs. 30 per kilogram, 28.3% of the sales were at Rs. 40 per kilogram, and the remaining 21.7% were at Rs. 50 per kilogram. In total, there were 60 transactions recorded for this product during the specified period. From this data, it is evident that the majority of sales occurred at the lower price point of Rs. 30 per kilogram, while a smaller percentage of transactions took place at higher prices of Rs. 40 and Rs. 50 per kilogram. This data provides valuable insights into the price distribution of the product and highlights the prominence of the Rs. 30 price point in the market during the specified time frame. Here the high quality garlic bulbs are sold out just at very low cost due to the no demand from export markets due to the climatic and other economic reasons. So farmers were disappointed during this period due to their loss in the cultivation.

4.2.5.3 Annual selling price of garlic got during a season in 2021-22

Table 4.18. Annual selling price of garlic in 2021-22

Annual selling price got in 2021-2022 (in Rupees)	Frequency	Percent
<50,000	10	16.7
50,000-1,00,000	14	23.3
1,00,000-1,50,000	16	26.7

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1,50,000-2,00,000	6	10.0
2,00,000-2,50,000	4	6.7
25,0,000-3,00,000	2	3.3
>3,00,000	8	13.3
Total	**60**	**100.0**

Source: Primary data

From the data, we can observe that the majority of garlic prices fell within the range of 1,00,000 to 1,50,000 Rupees, accounting for 26.7% of the total. The second most common price range was between 50,000 and 1,00,000 Rupees, making up 23.3% of the data. Interestingly, there were relatively few instances of extremely high prices above 3,00,000 Rupees, constituting only 13.3% of the total. On the other hand, the lowest prices below 50,000 Rupees also had a relatively lower occurrence at 16.7%. The remaining price ranges accounted for the rest of the data.

4.2.5.4 Expected price for 1 kg of garlic & actual price for 1 kg in 2021-2022

Here the expected price assumed by farmers and the actual price they got for one kilogram of garlic is statistically testing to know the significance.

Table 4.19. Expected price for 1 kg of garlic & actual price for 1 kg in 2021-2022

Paired Samples Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
	What is the expected price of the yield per kilogram? (in Rupees)	204.75	60	48.846	6.306
	What is the actual selling price of garlic per kilogram during a season in 2021-22? (in Rupees)	37.17	60	8.045	1.039

Source: Computed

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Table 4.20. Paired Samples Correlations of expected price for 1 kg of garlic & actual price for 1 kg in 2021-2022

	N	Correlation	Sig.
What is the expected price of the yield per kilogram? (in Rupees) & What is the actual selling price of garlic per kilogram during a season in 2021-22? (in Rupees)	60	-.073	.579

Source: Computed

Table 4.21. Paired Samples Test of expected price for 1 kg of garlic & actual price for 1 kg in 2021-2022

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
What is the expected price of the yield per kilogram? (in Rupees) - What is the actual selling price of garlic per kilogram during a season in 2021-22? (in Rupees)	167.583	50.080	6.465	154.646	180.520	25.920	59	.000

Source: Computed

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The tables show that the mean expected price for 1 kg of garlic was 204.75 Rupees, while the mean actual selling price was 37.17 Rupees. The standard deviation of the expected price was 48.846 Rupees, and for the actual selling price, it was 8.045 Rupees.

In table the paired samples correlation between the expected and actual prices was -0.073, and it is not statistically significant (p = 0.579). This suggests that there is no strong linear relationship between the expected and actual prices.

Furthermore, in table 4. a paired samples t-test was conducted to compare the two sets of prices. The mean difference between the expected and actual prices was 167.583 Rupees, with a 95% confidence interval ranging from 154.646 to 180.520 Rupees. The t-value was 25.920 with 59 degrees of freedom, and the p-value was 0.000 (significant at the 0.05 level). The significant p-value indicates that there is a significant difference between the expected and actual prices for 1 kg of garlic. So, the sample data suggests that there is a considerable disparity between the expected and actual selling prices of garlic during the 2021-2022 season. The actual selling price was much lower than the expected price, indicating that the market conditions or other factors might have influenced the actual prices.

4.2.5.5. Actual selling price of garlic per kg in 2020-21

Table 4.22. Actual selling price of garlic per kg in 2020-21

Actual selling price in 2020-2021 (in Rupees)	Frequency	Percent
<150	17	28.3
150-200	39	65.0
>200	4	6.7
Total	**60**	**100.0**

Source: Primary data

The sample data pointed out that during the year 2020-2021, the actual selling price of garlic per kilogram in Rupees varied across different price ranges. The data shows that approximately 28.3% of the time, garlic was sold at a price below 150 Rupees per kilogram. In the price range

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of 150 to 200 Rupees per kilogram, garlic was sold around 65.0% of the time, making it the most common price range. On the higher end, garlic was sold at a price above 200 Rupees per kilogram only 6.7% of the time. These statistics indicate that the majority of garlic sales during this period occurred within the 150 to 200 Rupees per kilogram range, while a smaller proportion of sales happened at both lower and higher price points.

4.2.5.6. Annual selling price of garlic got during a season in 2020-21

Table 4.23. Annual selling price of garlic got during a season in 2020-21

Annual selling price got in 2020-2021 (in Rupees)	Frequency	Percent
<1,00,000	8	13.3
1,00,000-5,00,000	26	43.3
5,00,000-10,00,000	18	30.0
>10,00,000	8	13.3
Total	**60**	**100.0**

Source: Primary data

From the table infer that the majority of garlic sales (43.3%) fall within the price range of 1,00,000 to 5,00,000 Rupees. Moreover, approximately 30.0% of sales fall in the price range of 5,00,000 to 10,00,000 Rupees, showing a significant proportion of garlic sales in the higher price bracket. Sales below 1,00,000 Rupees and above 10,00,000 Rupees each account for 13.3% of the data, indicating that these extreme price ranges are relatively less common. Overall, this data highlights the distribution of garlic sales in different price segments during the mentioned year.

4.2.5.7 Expected price for 1 kg of garlic & actual price for 1 kg in 2020-2021

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Table 4.24. Paired Samples Statistics of Expected price for 1 kg of garlic & actual price for 1 kg in 2020-2021

		Mean	N	Std. Deviation	Std. Error Mean
	What is the expected price of the yield per kilogram? (in Rupees)	204.75	60	48.846	6.306
	What is the actual selling price of garlic per kilogram during 2020-21? (in Rupees)	167.75	60	21.676	2.798

Source: Computed

Table 4.25. Paired Samples Correlations of Expected price for 1 kg of garlic & actual price for 1 kg in 2020-2021

	N	Correlation	Sig.
What is the expected price of the yield per kilogram? (in Rupees) & What is the actual selling price of garlic per kilogram during 2020-21? (in Rupees)	60	.288	.025

Source: Computed

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Table 4.26. Paired Samples Test of Expected price for 1 kg of garlic & actual price for 1 kg in 2020-2021

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
What is the expected price of the yield per kilogram? (in Rupees) - What is the actual selling price of garlic per kilogram during 2020-21? (in Rupees)	37.000	47.382	6.117	24.760	49.240	6.049	59	.000

Source: Computed

From the sample data found that, table shows the mean expected price was 204.75 Rupees with a standard deviation of 48.846, while the mean actual selling price was 167.75 Rupees with a standard deviation of 21.676. The paired samples correlation between the expected and actual prices is 0.288, with a significance level of 0.025.

The paired samples test indicates that the mean difference between the expected and actual prices is 37.000 Rupees, with a standard deviation of 47.382 and a 95% confidence interval between 24.760 and 49.240 Rupees.

The t-value for the test is significant at 0.000, suggesting that the difference between the expected and actual prices is statistically significant.

So, the data reveals that the expected price of garlic per kilogram is higher than the actual selling price during the 2020-2021 period. The difference between the expected and actual prices is statistically significant, indicating that there is a significant variance between the two values.

4.2.6. Costs of Cultivation And Profitability in Garlic Cultivation

The table shows the major costs involved in the garlic cultivation pointed out by sample population:

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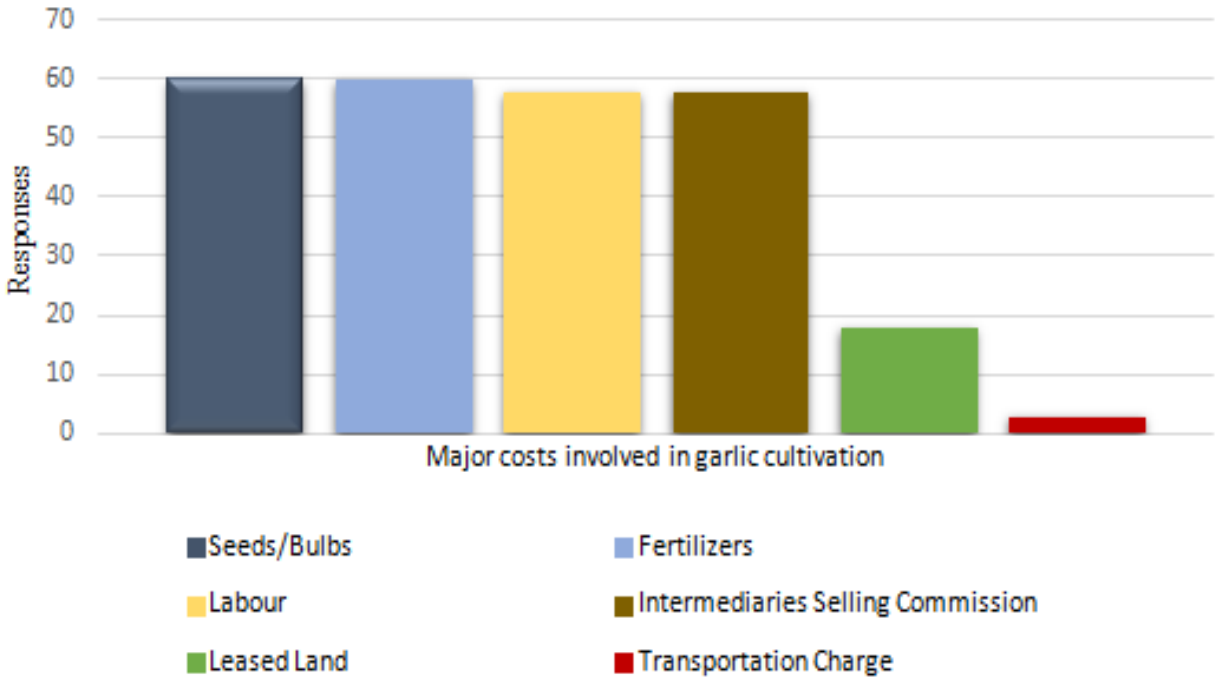
Figure 4.11. Costs in Garlic Cultivation



Source: Computed

Garlic cultivation involves several significant costs that impact the overall profitability of the venture. Firstly, the expense of acquiring high-quality seeds or bulbs is essential to ensure a successful crop. Secondly, fertilizers are crucial inputs to support the growth and development of garlic plants. Thirdly, labour costs play a significant role, as garlic cultivation often requires intensive manual work during planting, weeding, and harvesting. Additionally, there are expenses related to intermediaries' selling commissions, which may vary depending on the distribution channels used to bring garlic to the market. Moreover, if the farmers do not own the land, leased land rent adds to the overall production expenses. Lastly, transportation charges are a significant factor as they influence the cost of getting the garlic from the farm to the markets or processing facilities. To maintain a profitable garlic cultivation operation, farmers must carefully manage these costs and implement efficient agricultural practices.

4.2.6.1. Expenditure on Seeds/Bulbs

The table below shows the average expenditure the sample population is spend on buying seeds/bulbs for cultivation:

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Table 4.27. Expenditure on Seeds/Bulbs

Average expenditure spend on seeds/bulbs (per kg in Rupees)	Frequency	Percent
<200	7	11.7
200-250	30	50.0
>250	23	38.3
Total	**60**	**100.0**

Source: Primary data

From the analysis, we can observe that 11.7% of the respondents spend less than 200 Rupees per kilogram on seeds/bulbs. The majority, accounting for 50.0%, spend between 200 and 250 Rupees per kilogram. Additionally, 38.3% of the respondents spend more than 250 Rupees per kilogram on seeds/bulbs. Here the disparity begins with the actual price they got after selling and the seed/bulb rate.

4.2.6.2 Expenditure on Fertilizers

Table 4.28. Expenditure on Fertilizers

Average expenditure spend on fertilizer (in Rupees)	Frequency	Percent
<500	14	23.3
500-1000	24	40.0
1000-1500	18	30.0
>1500	4	6.7
Total	**60**	**100.0**

Source: Primary data

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The table shows that, 23.3% of the respondents spend less than 500 Rupees on fertilizer. The majority of respondents (40.0%) fall within the 500-1000 Rupees range. About 30.0% of the respondents spend between 1000 and 1500 Rupees on fertilizer. Only a small proportion of respondents (6.7%) spend more than 1500 Rupees. It indicates that most respondents tend to spend between 500 and 1000 Rupees on fertilizer, with a considerable number spending less than 500 Rupees as well. However, only a few respondents spend more than 1500 Rupees, suggesting that this group represents a smaller portion of the sample.

4.2.6.3. Expenditure on Labour

The table below represents the expenditure spent on labour per day (in Rupees) and the corresponding frequencies and percentages. The majority of the expenditures fall below 350 Rupees, with 86.7% of the total observations falling in this range. There are only a few instances where the expenditure is between 350 and 400 Rupees, accounting for 6.7% of the total. Similarly, expenditures exceeding 400 Rupees are even less frequent, making up only 3.3% of the total. The total number of observations in the dataset is 58, and the percentages add up to 96.7%, indicating a small percentage of missing data or rounding errors. Overall, this is the labour cost per day. While discussing with farmers understood that the female labour only got Rs. 300 and male labour would get up to Rs.600 per day according to the farming. This is another disparity among the labourers in garlic farming.

Table 4.29. Expenditure on Labour

Expenditure spend on labor per day (in Rupees)	Frequency	Percent
<350	52	86.7
350-400	4	6.7
>400	2	3.3
Total	**58**	**96.7**

Source: Primary data

4.2.6.4.Sources of Income from Garlic Cultivation

Figure below shows the major income sources from garlic cultivation:

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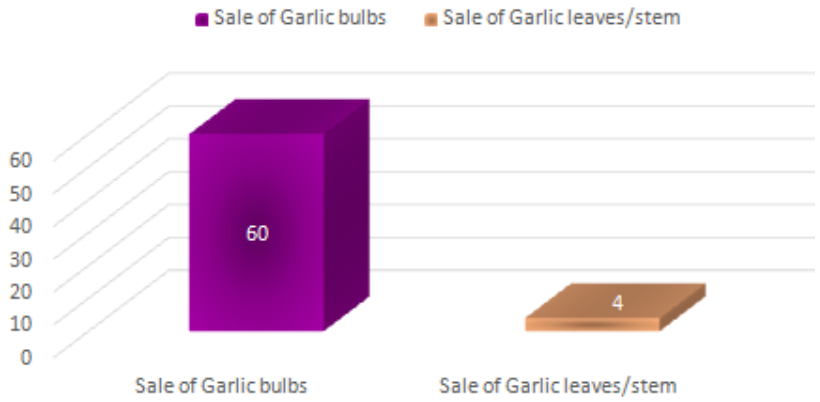
Figure 4.12. Sources of income from Garlic cultivation



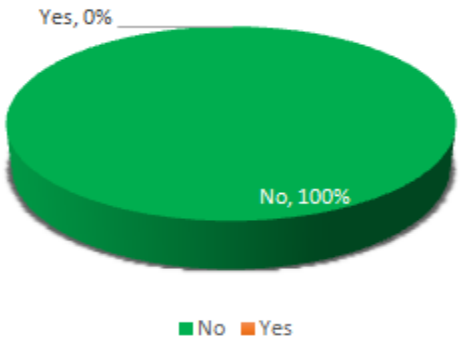
Source: Primary data

The sample data illustrates the distribution of income sources, with the sale of garlic bulbs accounting for a significant majority of 94%. This suggests that the primary revenue stream comes from selling garlic bulbs. On the other hand, the sale of garlic leaves or stems contributes to a smaller proportion of income at 6.666%. The stark contrast between the two percentages indicates that the main focus and profitability of the business lie in the production and sale of garlic bulbs.

4.2.6.5. Income Satisfaction

Figure below shows the satisfaction with income of sample population:

Figure 4.13. Income Satisfaction



Source: Primary data

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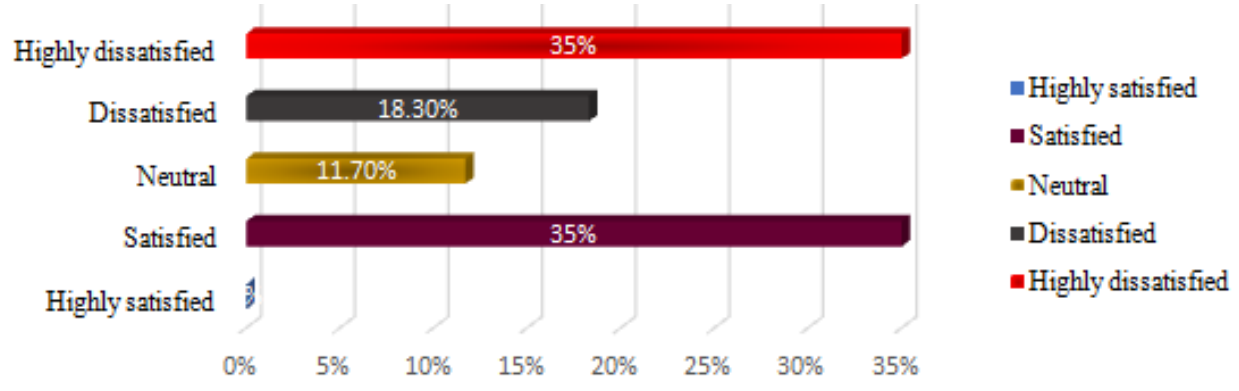
There were 60 respondents, and all of them answered "No" to the question, indicating that 100% of the participants were dissatisfied with their income. This implies that none of the respondents expressed contentment with their current earnings.

The most prominent reason for unsatisfied income was the high cost of cultivation, accounting for 100% of the responses. This suggests that agricultural expenses and input costs could be significantly impacting their earnings. Additionally, lack of access to credit facilities was cited by 71.67% of the respondents, indicating that limited financial resources might be hindering their ability to invest and expand their businesses. Another substantial factor was the lack of market volatility, mentioned by 81.67% of the respondents, which implies that stable and predictable markets could be crucial for their income satisfaction. Lastly, 61.67% of the respondents attributed their unsatisfied income to "Others," which would require further investigation to identify specific issues affecting their financial situation. Overall, these findings suggest that addressing the high cost of cultivation, improving access to credit facilities, and creating more market opportunities could potentially lead to enhanced income satisfaction for this group.

4.2.6.6. Profitability Satisfaction

From the sample data, it can be observed that 35.0% of the respondents were both "Satisfied" and "Highly dissatisfied" with the profitability of garlic cultivation, making it the most common responses. Additionally, 11.7% of respondents chose "Neutral," and 18.3% selected "Dissatisfied." This data suggests that while a significant portion of respondents are dissatisfied with the profitability of garlic cultivation, there is also a considerable number of individuals expressing a neutral stance.

Figure 4.14. Satisfaction about Profitability



Source: Primary data

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4.2.6.7. Farm size and Profitability

Here the statistical tools are using to find out the relationship with the size of the garlic farm and the profitability satisfaction among the sample population.

Table 4.30. Farm size and Profitability

Size of the garlic farm (in cent)	N	% of Total N	Sum	% of Total Sum	Minimum	Maximum	Range	Median	Mean	Std. Deviation
<25	9	15.0%	35	16.5%	2	5	3	4.00	3.89	1.054
25-50	27	45.0%	89	42.0%	2	5	3	3.00	3.30	1.265
50-75	2	3.3%	9	4.2%	4	5	1	4.50	4.50	.707
>75	22	36.7%	79	37.3%	2	5	3	4.00	3.59	1.436
Total	**60**	**100.0%**	**212**	**100.0%**	**2**	**5**	**3**	**4.00**	**3.53**	**1.295**

Source: Primary data

It is observed from the sample data that the mean profit is highest for farms with a size between 50 and 75 cents (mean = 4.50), followed closely by farms larger than 75 cents (mean = 3.59). The farms with sizes less than 25 cents have the lowest mean profit (mean = 3.89). The higher the standard deviation, the more spread out the profits are from the mean, suggesting greater variability in profitability. The category with the largest standard deviation is farms larger than 75 cents (Std. Deviation = 1.436), while the smallest standard deviation is found in farms between 50 and 75 cents (Std. Deviation = 0.707).

So, the results suggest that there may be a relationship between the size of garlic farms and their profitability. Farms between 50 and 75 cents in size appear to be the most profitable on average, while farms smaller than 25 cents show the highest variability in profits.

Table 4.31. ANOVA Table of Farm size and Profitability

			Sum of Squares	df	Mean Square	F	Sig.
Are you satisfied with the profitability of garlic cultivation? * Size of the garlic farm (in cent)	Between Groups	(Combined)	4.597	3	1.532	.910	.442

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	Within Groups	94.337	56	1.685		
	Total	98.933	59			

Source: Computed

The table shows the Sum of Squares, degrees of freedom (df), Mean Square, F-value, and significance level (Sig.) for the analysis. The F-value of 0.910 indicates that there is no significant difference in the profitability satisfaction between different farm sizes. Additionally, the p-value (Sig.) is 0.442, which is higher than the commonly used significance level of 0.05. This means that there is no statistically significant relationship between farm size and profitability satisfaction. Based on the ANOVA results, we can conclude that the size of garlic farms does not significantly affect the profitability satisfaction of garlic cultivation. Other factors not considered in this analysis may be more influential in determining the profitability of garlic farming.

4.2.6.8. Size of the garlic farm & Total Seasonal Expenditure on Seeds

The table below shows the approximate total seasonal expenditure spend on Seeds/Bulbs according to the sample population's farm size:

Table 4.32. Total Seasonal Expenditure on Seeds

Total Seasonal Expenditure on Seeds (in Rupees)	Frequency	Percent
<10,000	1	1.7
10,000-50,000	11	18.3
50,000-1,00,000	26	43.3
>1,00,000	22	36.7
Total	**60**	**100.0**

Source: Primary data

From the analysis, we can observe that the majority of respondents (43.3%) fall within the 50,000 to 1,00,000 rupees expenditure range, indicating that a significant portion of farmers or individuals spent within this budget on seeds during the season. The next significant group of respondents (36.7%) spent more than 1,00,000 rupees, reflecting that a considerable number of

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farmers may have larger farms or opted for premium seeds. On the other hand, a smaller percentage of respondents spent between 10,000 and 50,000 rupees (18.3%), while only 1.7% had an expenditure of less than 10,000 rupees. This data highlights the varying spending patterns and preferences among farmers when it comes to purchasing seeds for the season.

Table 4.33. Size of the garlic farm & Total Seasonal Expenditure on Seeds

Total Seasonal Expenditure on Seeds										
Size of the garlic farm (in cent)	**N**	**% of Total N**	**Sum**	**% of Total Sum**	**Minimum**	**Maximum**	**Range**	**Median**	**Mean**	**Std. Deviation**
<25	9	15.0%	18.00	9.5%	<10000	50000-100000	2.00	2.0000	2.0000	.50000
25-50	27	45.0%	77.00	40.7%	10000-50000	50000-100000	1.00	3.0000	2.8519	.36201
50-75	2	3.3%	7.00	3.7%	50000-100000	>100000	1.00	3.5000	3.5000	.70711
>75	22	36.7%	87.00	46.0%	50000-100000	>100000	1.00	4.0000	3.9545	.21320
Total	60	100.0%	189.00	100.0%	<10000	>100000	3.00	3.0000	3.1500	.77733

Source: Computed

From the table, we can observe that the majority of garlic farms fall into the 25-50 cent range, constituting 45% of the total farms, and their combined expenditure accounts for 40.7% of the total expenditure on seeds. The farms larger than 75 cents also contribute significantly to the overall expenditure, making up 36.7% of the total farms but contributing 46% of the total expenditure. On the other hand, farms smaller than 25 cents account for 15% of the total farms but have the least impact on the overall expenditure with only 9.5% contribution.

The table shows that the median expenditure (3.00) is lower than the mean expenditure (3.15), indicating that the data is slightly right-skewed, as the mean is slightly higher than the median. The standard deviation (0.77733) indicates that the expenditure data points are relatively close to the mean, signifying less variability in the dataset. The data provides an insightful analysis of the

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seasonal expenditure on seeds for different-sized garlic farms. The data suggests that larger farms tend to spend more on seeds compared to smaller ones.

Table 4.34. ANOVA Table of Size of the garlic farm & Total Seasonal Expenditure on Seeds

			Sum of Squares	df	Mean Square	F	Sig.
Total Seasonal Expenditure on Seeds * Size of the garlic farm (in cent)	Between Groups	(Combined)	28.788	3	9.596	78.313	.000
	Within Groups		6.862	56	.123		
	Total		35.650	59			

Source: Computed

Table shows the Mean Square for between groups (9.596) is obtained by dividing the Sum of Squares (28.788) by the degrees of freedom (3), while the Mean Square for within groups (0.123) is calculated by dividing the Sum of Squares (6.862) by the degrees of freedom (56). The F-ratio (78.313) is the ratio of the Mean Square for Between Groups to the Mean Square for within groups and is used to assess if the differences between the Size categories of garlic farms in terms of total seasonal expenditure on Seeds are statistically significant.

The p-value (0.000) associated with the F-test is used to determine the statistical significance. A p-value less than the conventional significance level (usually 0.05) indicates that there is a significant difference in Total Seasonal Expenditure on Seeds across the Size categories of garlic farms. Hence, the results of the ANOVA test indicate that there is a significant difference in the mean total seasonal expenditure on seeds across different size categories of garlic farms. The F-ratio is large, and the p-value is very low, suggesting strong evidence against the null hypothesis of no difference. This implies that the size of the garlic farm (in cent) has a significant effect on the total seasonal expenditure on seeds.

4.2.6.9. Total selling price of garlic got during a season in 2021-22 & Total Seasonal Expenditure on Seeds

Here the total selling price of garlic during a season and the total seasonal expenditure on seeds during 2021-2022 is statistically analysing using the correlation analysis.

Here for the total seasonal expenditure on seeds, the mean is 3.1500 with a standard deviation of 0.77733 and a standard error mean of 0.10035. On the other hand, for the Annual selling price of

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garlic in 2020-2021, the mean is 2.4333 with a standard deviation of 0.88999 and a standard error mean of 0.11490.

The paired samples correlation coefficient between the Total Seasonal Expenditure on Seeds and the Annual selling price is 0.811, which indicates a relatively strong positive correlation between the two variables.

In terms of the significance level (Sig.), it is indicated as 0.000, which is less than the typical threshold of 0.05. This means that the p-value is extremely small, suggesting strong evidence to reject the null hypothesis.

Table 4.35. Paired Samples Statistics of Total selling price of garlic got during a season in 2021-22 & Total Seasonal Expenditure on Seeds

		Mean	N	Std. Deviation	Std. Error Mean
	Total Seasonal Expenditure on Seeds	3.1500	60	.77733	.10035
	Annual selling price got in 2021-2022 (in Rupees)	3.3000	60	1.91603	.24736

Source: Computed

Table 4.36. Paired Samples Correlations of Total selling price of garlic got during a season in 2021-22 & Total Seasonal Expenditure on Seeds

	N	Correlation	Sig.
Total Seasonal Expenditure on Seeds & Annual selling price got in 2021-2022 (in Rupees)	60	.766	.000

Source: Computed

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Table 4.37. Paired Samples Test of of Total selling price of garlic got during a season in 2021-22 & Total Seasonal Expenditure on Seeds

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Total Seasonal Expenditure on Seeds - Annual selling price got in 2021-2022 (in Rupees)	-.15000	1.41211	.18230	-.51479	.21479	-.823	59	.414

Source: Computed

In conclusion, based on the results of the paired-sample t-test and the significant correlation, it can be interpreted that there is a significant relationship between the Total Seasonal Expenditure on Seeds and the Annual selling price of garlic during the 2020-2021 season. The positive correlation indicates that as the expenditure on seeds increases, the selling price of garlic also tends to increase.

4.2.6.10 Total selling price of garlic got during a season in 2020-21 & Total Seasonal Expenditure on Seeds

The below tables shows the correlation analysis of total selling cost and total seasonal expenditure on seed during 2020-2021:

Table 4.38. Paired Samples Statistics of Total selling price of garlic got during a season in 2020-21 & Total Seasonal Expenditure on Seeds

		Mean	N	Std. Deviation	Std. Error Mean
	Total Seasonal Expenditure on Seeds	3.1500	60	.77733	.10035
	Annual selling price got in 2020-2021 (in Rupees)	2.4333	60	.88999	.11490

Source: Computed

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For the Total Seasonal Expenditure on Seeds, the mean is 3.1500 with a standard deviation of 0.77733 and a standard error mean of 0.10035. On the other hand, for the Annual selling price of garlic in 2020-2021, the mean is 2.4333 with a standard deviation of 0.88999 and a standard error mean of 0.11490.

Table 4.39. Paired Samples Correlations of Total selling price of garlic got during a season in 2020-21 & Total Seasonal Expenditure on Seeds

	N	Correlation	Sig.
Total Seasonal Expenditure on Seeds & Annual selling price got in 2020-2021 (in Rupees)	60	.811	.000

Source: Computed

The paired samples correlation coefficient between the Total Seasonal Expenditure on Seeds and the Annual selling price is 0.811, which indicates a relatively strong positive correlation between the two variables.

Table 4.40. Paired Samples Test of Total selling price of garlic got during a season in 2020-21 & Total Seasonal Expenditure on Seeds

	Paired Differences					t	df	Sig. (2-tailed)
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			

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Total Seasonal Expenditure on Seeds - Annual selling price got in 2020-2021 (in Rupees)	.71667	.52373	.06761	.58137	.85196	10.599	59	.000

Source: Computed

In terms of the significance level (Sig.), it is indicated as 0.000, which is less than the typical threshold of 0.05. This means that the p-value is extremely small, suggesting strong evidence to reject the null hypothesis. Based on the results of the paired-sample t-test and the significant correlation, it can be interpreted that there is a significant relationship between the Total Seasonal Expenditure on Seeds and the Annual selling price of garlic during the 2020-2021 season. The positive correlation indicates that as the expenditure on seeds increases, the selling price of garlic also tends to increase.

4.2.6.11 Seasonal yield of garlic during 2021-22 (in kilograms) & Seasonal expenditure for intermediaries

Table 4.41. Seasonal yield of garlic during 2021-22 (in kilograms) & Seasonal expenditure for intermediaries

Seasonal exp. on intermediaries										
Seasonal yield of garlic in 2021-2022(in kilograms)	N	% of Total N	Sum	% of Total Sum	Minimum	Maximum	Range	Median	Mean	Std. Deviation
<500	9	15.3%	407000	1.9%	9000	76000	67000	53000.00	45222.22	25013.885
500-1500	12	20.3%	2264000	10.4%	0	265000	265000	228500.00	188666.67	81792.791

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1500-2500	21	35.6%	6222000	28.6%	0	430000	430000	294000.00	296285.71	87574.621
2500-3500	8	13.6%	4460000	20.5%	230000	820000	590000	560000.00	557500.00	185530.128
>3500	9	15.3%	8394000	38.6%	514000	2200000	1686000	640000.00	932666.67	617028.362
Total	59	100.0%	21747000	100.0%	0	2200000	2200000	280000.00	368593.22	373871.134

Source: Computed

From the analysis, the total garlic yield for the 2021-2022 season was 21,747,000 kilograms, with intermediary expenditures reaching a sum of 2,200,000 kilograms. The data indicates that the majority of garlic yields fall within the 1500-2500 kilograms range, making it the most common category, while the range of over 3500 kilograms showed the highest total yield and intermediary expenditure. The mean yield across all categories was approximately 368,593 kilograms, with a standard deviation of 373,871 kilograms, indicating some variability in the data.

Table 4.42. ANOVA Table of Seasonal yield of garlic during 2021-22 (in kilograms) & Seasonal expenditure for intermediaries

			Sum of Squares	df	Mean Square	F	Sig.
Seasonal expenditure on intermediaries * Seasonal yield of garlic in 2021-2022 (in kilograms)	Between Groups	(Combined)	4588493729351.627	4	1147123432337.907	17.604	.000
	Within Groups		3518724507936.508	54	65161564961.787		
	Total		8107218237288.135	58			

Source: Computed

The F-statistic is calculated as 17.604, and the significance level (Sig.) is reported as .000. The significance level indicates the probability of obtaining the observed results due to chance alone. In this case, the Sig. value is close to zero, which means there is a significant relationship between the seasonal yield of garlic and the seasonal expenditure on intermediaries.

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4.2.6.12. Seasonal yield of garlic during 2020-21 (in kilograms) & Seasonal expenditure for intermediaries

Table 4.43. Seasonal yield of garlic during 2020-21 (in kilograms) & Seasonal expenditure for intermediaries

Seasonal expenditure on intermediaries										
Annual yield in 2020-2021 (in kilograms)	**N**	**% of Total N**	**Sum**	**% of Total Sum**	**Minimum**	**Maximum**	**Range**	**Median**	**Mean**	**Std. Deviation**
3000-5000	2	3.4%	25000	0.1%	9000	16000	7000	12500.00	12500.00	4949.747
5000-10000	1	1.7%	29000	0.1%	29000	29000	0	29000.00	29000.00	.
>10000	56	94.9%	21693000	99.8%	0	2200000	2200000	290000.00	387375.00	374615.224
Total	59	100.0%	21747000	100.0%	0	2200000	2200000	280000.00	368593.22	373871.134

Source: Computed

Table 4.44. ANOVA Table of Seasonal yield of garlic during 2020-21 (in kilograms) & Seasonal expenditure for intermediaries

			Sum of Squares	df	Mean Square	F	Sig.
Seasonal expenditure on intermediaries * Annual yield in 2020-2021 (in kilograms)	Between Groups	(Combined)	388682612288.136	2	194341306144.068	1.410	.253
	Within Groups		7718535625000.000	56	137830993303.571		
	Total		8107218237288.136	58			

Source: Computed

From the sample data of 2020-2021 observed that, most garlic farmers (94.9%) had an annual yield greater than 10,000 kilograms, contributing significantly to the total yield of 21,747,000 kilograms for the season. However, their expenditure on intermediaries shows a wide range, with the minimum expenditure being 2,200,000 and the maximum going as high as 22,000,000. The

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mean expenditure was approximately 3,685,932, indicating the average cost incurred by the farmers for intermediary services.

The ANOVA results do not show any statistically significant difference in expenditure among the different yield groups, as the F-ratio of 1.410 is not significant at the 0.05 level. This suggests that the variations in expenditure on intermediaries are not strongly influenced by the different ranges of annual yields.

It suggests that the garlic farmers' annual yield primarily falls into the higher range, contributing significantly to the total yield for the season. However, the expenditure on intermediaries varies widely, and there is no significant correlation between the annual yield and intermediary expenses.

4.3. Conclusion

In conclusion, by assessing the economic feasibility of garlic cultivation in Kanthalloor panchayat by analyzing the costs involved, seasonal yields, selling prices, and overall profitability pointed out the various aspects of both economic and social factors of the cultivation. The comprehensive cost-benefit analysis of garlic cultivation in Kerala, taking into account various expenses such as seeds, labour, fertilizers, leased land rent, intermediaries commission costs, transportation,etc., to determine the profitability of the venture. But unfortunately the analysis founds that the satisfaction of income among the farmers is very low in nature. Compared the average seasonal yield of garlic cultivation in Kanthalloor panchayat between two recent years to identify any significant variations and potential reasons behind the differences which found that there is a slight variations happen year after year in the yields depending upon the factors like climate, fertility, quality of seeds etc. Along with costs and profitability the chapter investigates the major sources of income from garlic cultivation, selling prices of garlic obtained in recent years to understand the impact of price fluctuations on the income generated from garlic cultivation.

5. Market Structure and Emerging Trends of Garlic: Analysis of Kanthalloor Panchayat

Garlic, a widely consumed and economically significant agricultural commodity, holds a pivotal place in the global market due to its diverse culinary, medicinal, and industrial applications. A comprehensive analysis of the dynamics surrounding the garlic industry in this specific region, exploring factors that have shaped its market structure and examining the latest developments and trends that are likely to influence its future trajectory.

The objective of this chapter is to analyze the market structure and trends of garlic in Kanthalloor Panchayat. Understanding the nuances of garlic's market in Kanthalloor Panchayat is not only

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crucial for local farmers and traders but also provides valuable insights into the broader garlic market on a global scale. The research questions includes: What varieties of garlic are currently being cultivated by farmers or producers? Among the cultivated garlic varieties, which one is considered superior in terms of quality and taste? Which season is the most profitable for garlic cultivation among the different varieties? What are the primary market channels for selling garlic produce for farmers or producers? How do garlic farmers or producers perceive the demand for garlic in the market, and has it changed significantly in the past few years?

5.1. Varieties of Garlic

Kanthalloor Panchayat, nestled amidst the picturesque landscapes of the Western Ghats, stands as a living testament to the timeless art of garlic cultivation. The table below shows the varieties of garlic which are still cultivating in Kanthalloor region:

Table 5.1. Garlic Varieties

Varieties of garlic are cultivating	Frequency	Percent
Mettuppalayam	5	8.3
Singapore	1	1.7
Both	54	90.0
Total	**60**	**100.0**

Source: Primary data

From the sample population data collection, there were two varieties of garlic are still cultivating in the region in a large scale. They are “Mettuppalayam” and “Singapore” or “Singapoondu”. These are the local names of the garlic in Kanthalloor region. It is only cultivated in the regions of Kanthalloor region. The respondents states that majority (90%) of them are cultivating both the varieties of garlic in their farm fields.

5.2. Better Variety of Garlic

The table 5.1 below shows the better variety of garlic proposed by the sample population:

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Table 5.2. Better Variety of Garlic for Cultivation

Better garlic type	Frequency	Percent
Mettuppalayam	57	95.0
Singapore	3	5.0
Total	60	100.0

Source: Primary data

Out of a total of 60 samples, "Mettuppalayam" garlic is the most prevalent, accounting for 95% of the sample data. On the other hand, "Singapore" garlic represents a smaller portion, constituting only 5%. From this indicates that, "Mettuppalayam" garlic is the preferred or more commonly used type compared to "Singapore" garlic.

The reasons for the selection of the particular variety is indicating in the below table 5.2:

Table 5.3. Reasons for the selection better garlic

	Reasons for selection better garlic type	Number of Responses	Percentage
Mettuppalayam	**Long storage capacity**	57	100
	High Profitability	57	100
	Access to quality bulbs/seeds	53	92.98245614
	Market volatility	55	96.49122807
	Best pest control capacity	57	100
	Less weight loss	57	100
Singapore	**Access to quality bulbs/seeds**	1	33.3333333
	Market volatility	2	66.6666666

Source: Primary data

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Samples who select Mettuppalayam, six reasons were stating, and interestingly, all of them received an equal response of 57, representing 100% of the participants choosing those reasons. These reasons include long storage capacity, high profitability, best pest control capacity, and less weight loss, indicating that these factors are highly valued by garlic growers of Mettuppalayam variety. Additionally, access to quality bulbs/seeds and market volatility were selected by 53 (92.98%) and 55 (96.49%) respondents, respectively, highlighting their significant influence on garlic cultivation decisions.

On the other hand, those who select Singapore showed that only two reasons were considered for selecting a better garlic type. Access to quality bulbs/seeds was selected by one respondent (33.33%), while market volatility was chosen by two respondents (66.67%). Though the sample size Singapore variety acquires low preferences.

5.3. Profitable Season for Garlic Cultivation

In Kerala, Garlic cultivation is done during the two seasons of May-September and October-February in every year. The below table 5.4. represents the most profitable season for garlic cultivation in Kerala pointed out by sample population:

Table 5.4. Profitable Season

Profitable season	Frequency	Percent
May-September	57	95.0
October-February	3	5.0
Total	**60**	**100.0**

Source: Primary data

The cultivation of garlic appears to be predominantly profitable during the period from May to September, which accounts for 95% of the sample population responses. In contrast, the profitability during the October to February period is comparatively lower, constituting only 5% of the total responses. This data suggests that garlic cultivation is more viable and financially rewarding during the May-September season in Kerala, which is also known for the main season for garlic cultivation.

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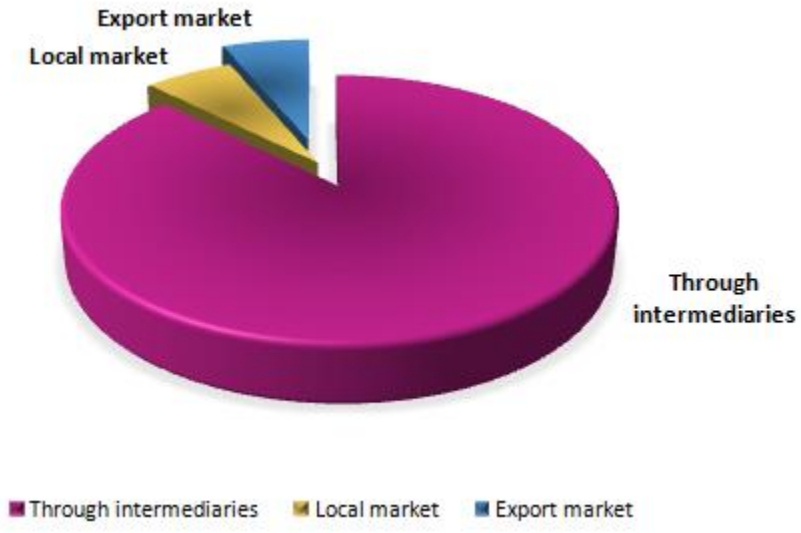
5.4. Primary Market Channels

The figure below shows the primary market channels through which farmers sell their garlic producers during every season:

Figure 5.1. Primary market channels of Garlic



Source: Primary data

Out of the total responses, 56 respondents stated that they sell their garlic through intermediaries, while only 4 respondents each mentioned selling in the local market and the export market namely Vadugapatti (Tamil Nadu). It suggests that the majority of garlic cultivators in Kerala prefer to use intermediaries as a means to sell their produce. Intermediaries may play a significant role in the distribution and marketing of garlic, acting as middlemen between the farmers and end consumers or retailers. They actually exploiting the garlic farmers by charging a fixed amount for transportation cost per kilogram of garlic produce. But the farmers have no other option or they were unable to understand this cruelty. However, it is worth noting that only a small proportion of respondents sell directly in the local and export markets. So it is to suggest potential opportunities for farmers to explore alternative selling channels, such as increasing direct sales in local markets or exploring export opportunities, to potentially increase their profits and expand their market reach.

5.5. Fluctuations in Demand and Price for Garlic Market

The garlic market experiences significant fluctuations in both demand and price, which can have profound effects on the overall industry. Analyzing the sample data reveals that these

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fluctuations can be influenced by various factors, such as seasonal variations, changes in consumer preferences, supply chain disruptions, and global economic conditions. From the sample data pointed out that most farmers or farmers' associations rely on communication with other farmers to stay updated about the market price of garlic. This informal network allows them to share information and gauge market trends, helping them make informed decisions about selling their garlic produce.

5.5.1. Demand for Garlic

The sample population pointed out the demand for garlic ratings in the market which is shown in the table:

Table 5.5. Trends in demand for Garlic in the market

Demand for garlic	Frequency	Percent
High demand	3	5.0
Moderate demand	51	85.0
Low demand	6	10.0
Total	**60**	**100.0**

Source: Primary data

Out of the total samples analyzed, 5% of the market experiences a high demand for garlic, 85% shows a moderate demand, while the remaining 10% reflects a low demand. These figures suggest that the majority of the market falls under the moderate demand category, indicating that garlic is relatively popular and sought after by consumers. However, it is essential to consider that the market is diverse, and demand patterns may vary based on factors like seasonality, consumer preferences, and economic conditions.

5.5.2. Changes in Garlic Prices

Fluctuations in garlic prices is due various reasons. The below and figure shows the dynamics in prices of garlic and reasons why the fluctuations happen:

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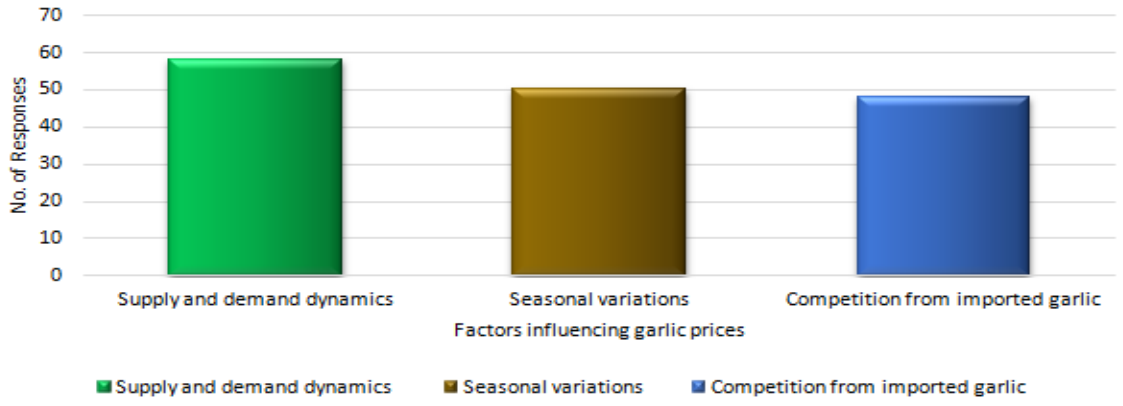
Table 5.6. Dynamics in Garlic prices

Changes in garlic prices	Frequency	Percent
Prices are fluctuating over the years	52	86.7
Prices have decreased significantly	8	13.3
Total	**60**	**100.0**

Source: Primary data

Over the past few years, the garlic market has experienced significant fluctuations in prices, as reported by 86.7% of respondents. This indicates a high level of volatility in the garlic industry, which can be influenced by various factors. Among the major reasons cited for the price changes, supply and demand dynamics were mentioned by 58 respondents. Fluctuations in supply and demand can lead to price instability, affecting garlic prices. Additionally, 50 respondents noted that seasonal variations play a role in influencing prices. Depending on the time of the year, garlic production levels can vary, impacting its availability and, subsequently, its prices. Furthermore, competition from imported garlic was highlighted by 48 respondents as a significant factor affecting domestic garlic prices. The influx of imported garlic can put pressure on local producers and influence price changes. Overall, these factors together contribute to the price fluctuations experienced in the garlic market over the past few years.

Figure 5.2. Reasons for Garlic price fluctuations



Source: Primary data

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5.6 Conclusion

This chapter aimed to shed light on various aspects of garlic cultivation and marketing in the region. The findings provide valuable insights not only for local farmers and traders but also for understanding the broader garlic market on a global scale. The research revealed the current varieties of garlic being cultivated by farmers and producers in Kanthalloor Panchayat. Additionally, it identified which variety is considered superior in terms of quality and taste, which is crucial information for improving production and meeting consumer preferences.

Furthermore, the study investigated the most profitable season for garlic cultivation among the different varieties, aiding farmers in optimizing their production schedules and maximizing profits.

Moreover, understanding the primary market channels for selling garlic produce is vital for farmers and producers to efficiently reach consumers and maximize their revenues.

Lastly, the research provided valuable insights into how garlic farmers or producers perceive the demand for garlic in the market and whether it has changed significantly over the past few years, which is essential for making informed decisions and adapting to market fluctuations.

6. Constraints and Challenges Encountered By Garlic Farmers in Kanthalloor Panchayat

Garlic farming is a significant agricultural endeavor that has been practiced for centuries. As with any agricultural sector, garlic farmers face a unique set of opportunities and challenges that can significantly impact their productivity and livelihoods. These constraints stem from a combination of natural factors, market dynamics, and operational hurdles. Understanding and addressing these opportunities and challenges is crucial to ensuring the sustainability and growth of the garlic farming.

The objective of this chapter is to identify the opportunities and challenges faced by garlic farmers in Kanthalloor Panchayat. The research questions includes: What government support schemes or initiatives are available specifically for garlic farmers in Kanthalloor Panchayat, and how aware are the farmers of these schemes? Have garlic farmers in Kanthalloor Panchayat availed any government support schemes for garlic cultivation, and if yes, for how long have they been part of these schemes? What are the major challenges faced by garlic farmers in Kanthalloor Panchayat? Do garlic farmers in Kanthalloor Panchayat communicate their concerns or deficiencies related to the government support schemes to the authorities, and have the officials made efforts to address their issues? Are there any existing farm associations or cooperatives that garlic farmers in Kanthalloor Panchayat are members of, and how have these associations supported them in their garlic cultivation journey?

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6.1. Opportunities and Challenges of Garlic Farmers

To better understand the opportunities and challenges faced by garlic farmers, a comprehensive study is essential. Identifying and addressing these aspects will enable garlic farmers to optimize their yields, boost profitability, and tackle potential hurdles more effectively, fostering a sustainable and thriving garlic farming sector.

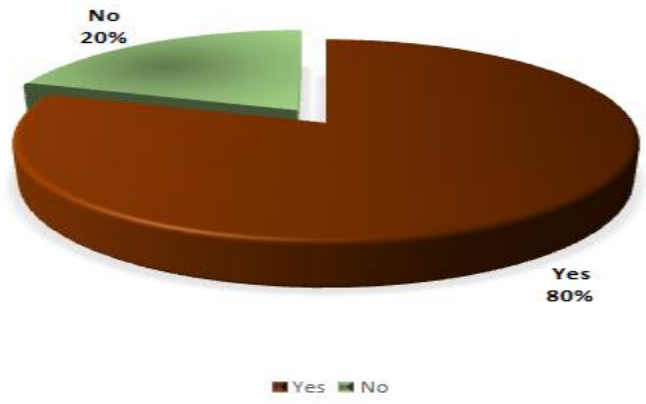
6.1.1. Schemes & Credit facilities

Schemes and credit facilities play a pivotal role in supporting garlic farmers by providing them with essential financial assistance and resources. These initiatives enable farmers to access improved agricultural technologies, purchase high-quality seeds and equipment, and receive training to enhance their garlic cultivation practices. By availing such support, garlic farmers can increase their yields, improve livelihoods, and contribute to the overall growth of the agricultural sector.

6.1.1.1. Awareness and availability of Government Support Schemes/Initiatives

The below figure shows the awareness about any government support schemes or initiatives specifically for garlic farmers by the same population:

Figure 6.1. Awareness about Government Support Schemes/Initiatives



Source: Primary data

Out of the total 60 garlic farmers surveyed, 80% (48 farmers) reported being aware of these schemes, while 20% (12 farmers) indicated that they had no knowledge about them. This data highlights a positive trend in terms of the majority of garlic farmers being informed about the available schemes. However, the percentage of farmers who are not aware still remains significant, indicating that there is room for improvement in the dissemination of information

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regarding these beneficial initiatives. To further support the garlic farming community, it is essential for relevant authorities and agricultural agencies to focus on enhancing awareness campaigns and outreach programs to ensure that all garlic farmers can avail themselves of the schemes' potential benefits.

Table 6.1. Avail of any government schemes/initiatives

Avail of the government schemes	Frequency	Percent
Yes	31	51.7
No	29	48.3
Total	**60**	**100.0**

Source: Primary data

51.7% of garlic farmers have availed of government schemes, while 48.3% have not taken advantage of such programs. The total number of respondents was 60. These statistics highlight that slightly more than half of the garlic farmers have accessed government schemes, indicating some level of awareness and utilization of available support. However, the fact that almost half of the farmers have not availed of these schemes suggests that there might be some barriers or challenges preventing them from benefiting from the government's initiatives.

Table 6.2. Time period in which benefitting from the scheme

Part of the scheme (in years)	Frequency	Percent
10	1	1.7
3	3	5.0
4	4	6.7
5	6	10.0
6	4	6.7
7	6	10.0
8	5	8.3

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9	2	3.3
Total	31	51.7

Source: Primary data

The above table shows the responses of sample population that they have been how long were part of the scheme/s.

6.1.1.2. Concerns or deficiencies related to the government support schemes

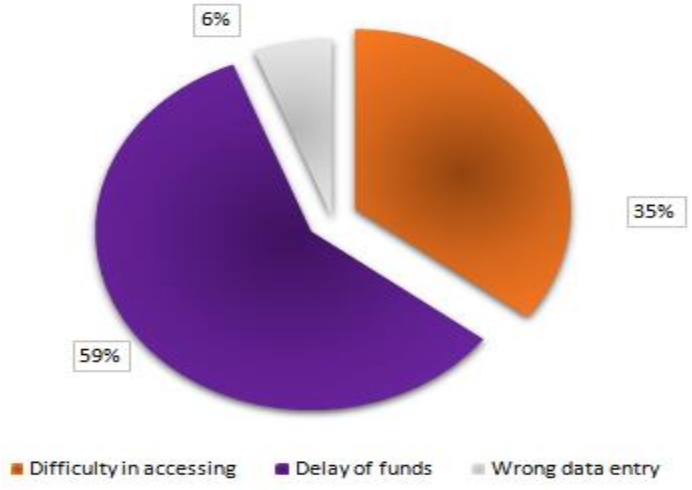
The below illustrations represents the difficulties faced by sample population who benefitted from the schemes/initiatives of garlic cultivation and the reasons behind the difficulties they faced.

Table 6.3. Difficulty faced being benefited from the scheme/s

Any difficulty while being benefited from the scheme/s	Frequency	Percent
Yes	31	51.7
Total	31	51.7

Source: Primary data

Figure 6.2. Reasons for the difficulties



Source: Primary data

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Table 6.4. Informed the authorities about the deficiencies of the scheme/s

Inform about the difficulties	Frequency	Percent
Yes	11	18.3
No	20	33.3
Total	**60**	**100.0**

Source: Primary data

The results indicated that out of the 60 respondents, 18.3% (11 individuals) acknowledged informing the authorities about the shortcomings of the scheme. On the other hand, a larger proportion of 33.3% (20 individuals) stated that they had not reported any deficiencies to higher authorities. The survey suggests that there is a division among participants when it comes to reporting issues with the scheme, with a significant number opting not to do so. This could be attributed to various reasons, such as concerns about potential consequences or uncertainty about the effectiveness of such reporting channels. Further analysis would be required to understand the factors influencing these differing responses and to encourage more proactive engagement in addressing the scheme's deficiencies.

Table 6.5. Authorities response to the difficulties of the scheme

Solve the difficulties	Frequency	Percent
Yes	1	1.7
No	10	16.7
Total	11	17.4

Source: Primary data

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Out of the 11 respondents, only 1 (1.7%) answered "Yes," indicating that officials have made attempts to address the difficulties faced by garlic farmers. On the other hand, the majority of respondents, 10 (16.7%), answered "No," suggesting that officials have not taken measures to solve the problems encountered by garlic farmers. The data highlights a significant disparity between the efforts made by authorities to resolve the issues in the garlic farming.

6.1.1.3. Effectiveness of Farmers' Associations or Cooperatives

Farmers' associations or cooperatives play a vital role in enhancing the effectiveness of garlic farming. By promoting collective action, these organizations enable garlic farmers to pool resources, share knowledge, and access various support services. Through collaborative efforts, farmers can negotiate better prices for their produce, gain access to improved agricultural practices, and collectively tackle challenges such as marketing and distribution, ultimately leading to increased productivity and profitability in garlic farming.

Table 6.6. Effectiveness of farmers' associations or cooperatives

Effectiveness of farmers' associations or cooperatives	Frequency	Percent
Highly supportive	2	3.3
Supportive	5	8.3
Neutral	6	10.0
Unsupportive	25	41.7
Highly unsupportive	22	36.7
Total	**60**	**100.0**

Source: Primary data

All respondents are members of Anchunad Vattavada Kanthalloor Veluthulli Udpadaka Karshaka Sangham. Only a small percentage (3.3%) of respondents found these associations to be highly supportive, while a slightly larger group (8.3%) considered them supportive. Interestingly, a significant portion (10.0%) remained neutral, indicating a lack of strong opinion either way. However, the majority of respondents (41.7%) expressed their dissatisfaction, labeling these associations as unsupportive. The most notable finding was that a substantial portion (36.7%) deemed farmers' associations or cooperatives to be highly unsupportive. These results highlight a diversity of perspectives within the Sangham.

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6.1.1.4. Credit Facilities for Garlic Farmers

Table 6.7. Availability of Credit facility

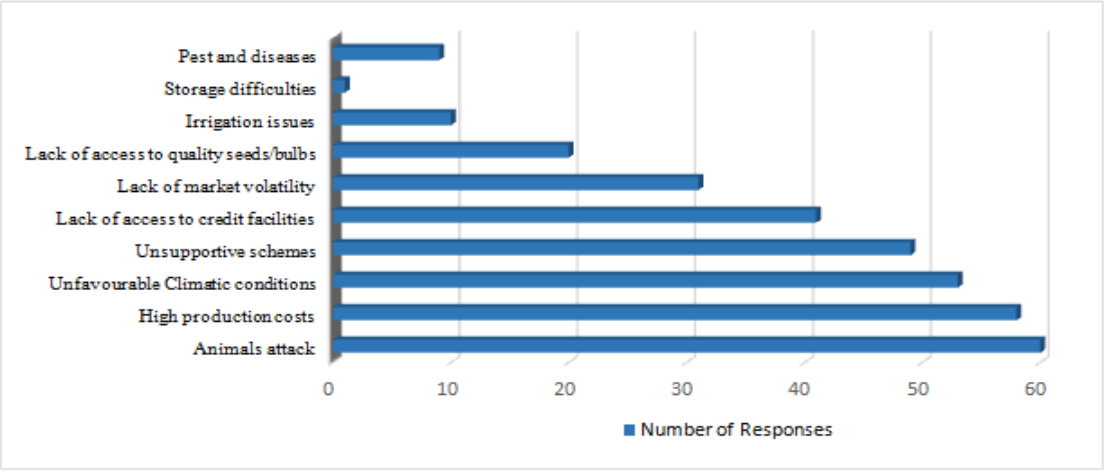
Credit facility	Frequency	Percent
Yes	27	45.0
No	33	55.0
Total	**60**	**100.0**

Source: Primary data

27 of them (45.0%) responded "Yes," while 33 respondents (55.0%) answered "No." This data indicates that the majority of respondents, 55.0%, do not have a credit facility, while 45.0% of them have availed credit facilities. The survey highlights that a significant number of individuals still do not use credit facilities, potentially indicating various reasons like personal financial preferences, limited access to credit options, or a cautious approach towards credit usage. Most of the credit facilities are available only to large land area owners, they can borrow loans from the banks like Union Bank of India, ESAF, Self-help groups like Kudumbashree etc. Others solely depend upon the moneylenders for big amount of money required for cultivation with a high rate of interests.

6.1.2. Challenges of garlic farmers

Figure 6.3. Major constraints faced by Garlic farmers



Source: Primary data

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The table above shows the major challenges faced by garlic farmers in the study area including: animals attacking crops or livestock appears to be the most common issue, with 60 respondents citing it as a major problem. High production costs follow closely behind, with 58 responses, indicating the financial burden on farmers. Unfavourable climatic conditions, including unpredictable weather patterns, are a significant concern for 53 respondents, impacting crop yields and livestock health. Furthermore, 49 individuals reported unsupportive schemes, suggesting a lack of governmental or institutional assistance in the agricultural domain. Access to credit facilities was a notable problem for 41 respondents, hindering farmers' ability to invest and expand. Market volatility was a concern for 31 participants, indicating difficulties in predicting and adapting to market fluctuations. Additionally, 20 respondents highlighted the lack of access to quality seeds or bulbs, affecting crop quality and productivity. Irrigation issues were reported by 10 respondents, impacting water availability for agriculture. Pest and diseases were mentioned by 9 respondents, signifying the threat they pose to agricultural outputs. Lastly, storage difficulties were mentioned by only one respondent, potentially indicating that storage solutions have improved compared to other challenges.

Table 6.8. Overall support and assistance provided by agricultural extension services for garlic farmers

Overall support and assistance from agricultural extension services	Frequency	Percent
Highly Unsupportive	42	70.0
Unsupportive	12	20.0
Supportive	6	10.0
Total	**60**	**100.0**

Source: Primary data

Out of the 60 samples, 70% expressed that they found the services to be highly unsupportive, suggesting that a significant portion of farmers or individuals involved in agriculture felt let down by the extension services. Additionally, 20% of respondents perceived the services as unsupportive, indicating a considerable dissatisfaction with the level of assistance provided. On

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the positive side, 10% of the respondents reported that they found the agricultural extension services to be supportive. These numbers underscore the need for improvements in the extension services to better meet the requirements and expectations of farmers and stakeholders in the agricultural sector. Addressing the concerns raised by the majority who perceived the services as unsupportive can lead to more effective and impactful agricultural extension programs in the future.

6.2. Conclusion

In summary, the garlic farmers in Kanthalloor Panchayat are experiencing very critical situation. Firstly, the awareness of government support schemes and initiatives specifically for garlic farmers in the region seems to be lacking among the farmers. This lack of awareness could be hindering them from availing the available support that might help improve their cultivation practices and overall agricultural productivity. Moreover, even if some garlic farmers have managed to access government support schemes, it remains unclear for how long they have been part of these initiatives. This suggests that there might be issues with the continuity and effectiveness of the schemes, as well as potential challenges in sustaining the benefits they offer to the farmers.

The major challenges faced by garlic farmers in Kanthalloor Panchayat are not explicitly mentioned, but they likely contribute to the overall dissatisfaction experienced by the farmers. These challenges could include issues related to market access, fluctuating prices, inadequate infrastructure, and adverse weather conditions, among others.

Furthermore, the communication between garlic farmers and the authorities regarding concerns or deficiencies related to the government support schemes seems to be inadequate. Effective communication channels are essential to address the issues faced by farmers and to ensure that the support schemes are tailored to their specific needs.

It is not clear whether there are existing farm associations or cooperatives that garlic farmers in Kanthalloor Panchayat are members of. However, such associations, if they do exist, can play a crucial role in supporting farmers by providing a platform for collective bargaining, knowledge sharing, and resource pooling. The lack of information about these associations indicates that their potential benefits might not be fully realized by the garlic farmers.

7. Findings, Conclusion & Suggestions

Kerala's agriculture sector relies heavily on garlic cultivation, particularly in the Idukki district, where it is the only state that produces garlic. The economic significance of garlic cultivation lies in its high global demand as a culinary ingredient and for its medicinal properties, making it a

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profitable crop for farmers. Moreover, garlic's unique growth pattern and timing set it apart from other crops, requiring specialized knowledge and techniques for successful cultivation. Besides its economic benefits for farmers, garlic cultivation also promotes soil health through rotational cropping and creates employment opportunities within rural communities, contributing to the overall agricultural industry. However, despite its importance, there is a lack of comprehensive economic analysis of garlic cultivation in the region. By conducting a detailed study of production costs, market dynamics, and profitability, this research aims to provide valuable insights for policymakers, farmers, and stakeholders to enhance the economic viability and sustainability of garlic cultivation in Idukki.

The study's relevance extends to various stakeholders, including farmers and policymakers. Farmers can benefit from understanding the profitability and market dynamics of garlic cultivation, enabling them to make informed decisions and optimize their resources. Policymakers can utilize the findings to formulate agricultural policies that support garlic farming and contribute to the overall economic growth of the region. Market analysis provides valuable information for traders, helping them strategize production levels and marketing efforts. Additionally, the study addresses the risks and constraints faced by garlic farmers, such as climate change, pests, and market fluctuations, offering recommendations to overcome these challenges. By supporting garlic farmers and promoting sustainable agriculture practices, the research contributes to the socio-economic development of the region and enhances the overall welfare of farmers. This chapter involves the major findings evolved from the study conducted. Along with this, there are some suggestions to overcome the issues involved.

7.1. MAJOR FINDINGS

Primary data is the major source of data used in the study. It contains the information collected from the garlic farmers of Kanthalloor Panchayat Idukki district, to understand the economic analysis of garlic cultivation in Kerala.

Here are some of the major findings of the study:

The data collected from the resident garlic farmers in Kanthalloor region:

- **Educational Status:** Most of them are educated only up to primary education, and along with this a majority the farmers are illiterate also.
- **Income Level:** From the sample study, it appears that the majority of respondents, accounting for 55% of the total, reported a monthly income ranging from Rs. 1,500 to Rs. 2,500. Only a few people in this area have a high level of income. Others belong to the middle income group.

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- **Possession of Land:** A large majority in the sample population owns their own land and it is utilized fully for the cultivation purposes. Because they solely depend upon the agricultural activities from the beginning itself.

- **Productivity:** Garlic is a seasonal crop. So the farmers mainly cultivate two varieties of garlic, namely “Mettupalayam” and “Singapore” in two seasons of cultivation. That is, May-September and October-February. In case of productivity study among the sample population, the yield of the crop may vary according to a number of reasons like natural circumstances, demand from exporting markets(Tamil Nadu) etc. which determine the profitability and productivity of the garlic crop. The garlic which is cultivated in Kanthalloor is only seen in the region itself. So the quality and taste of the garlic in Kanthalloor is distinctively diverse in nature. But it doesn't get that much of importance in the local markets or in Kerala markets itself. Comparing the factors of cultivation, the size of the garlic farm and the yield is closely related . When the farm size increases the productivity also increases.

- **Cost of Cultivation:** The garlic cultivation involves a various stages of cultivation process which is manually done by the farmers itself. No machines or technology were not yet used. So it involves a lot of cost to the cultivation process like labour charges, expenditure to buy seeds/bulbs, expenditure on fertilizers, irrigation, transportation, leased land rent, primary market selling commission to intermediaries etc. But when analysing the factors of garlic production with cost of cultivation, farm size and cost of expenditure are directly related if the farm size increases the cost of cultivation also increases. It needs extra expenditure for the cultivation. But from the views of analysing the factors of garlic production with cost of cultivation, farm-size and cost-of-expenditure are directly-related if the farm-size-increases the cost-of-cultivation-also-increases. It needs extra expenditure for the cultivation. But from-the-views-of- analysing the factors of garlic production with cost of cultivation, farm-size and cost-of-expenditure are directly-related if the farm-size-increases the cost-of-cultivation-also-increases. It needs extra expenditure for the cultivation. But from-the-views-of-respondents they were expanding their cultivation farm land year after year by expecting a better profitability from the garlic cultivation.

- **Profitability:** Comparing two consecutive years yield and revenue of the sample population, the prices are fluctuating year after year according to the market demand, climatic conditions, competition from imported markets etc. So the profit of garlic cultivation solely depends upon these factors. Here also the land size plays an important role in the profitability status of the farmer. When comparing with the garlic crop production, they were less satisfied in the case of revenue from the garlic cultivation. So

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they made intercroppings along with the cultivation and had to do extra work to earn income for their livelihood.

- **Opportunities and Challenges:** The garlic farmers have a lot of supporting schemes and credit facilities in the society. But unfortunately, due to their illiteracy or something else, they are facing a lot of challenges rather than opportunities. The garlic farmers in Kanthalloor Panchayat are currently grappling with a critical situation. One major issue is the lack of awareness among the farmers about the government support schemes and initiatives specifically designed for their benefit. This lack of awareness is likely preventing them from accessing the available support that could significantly enhance their cultivation practices and overall agricultural productivity. Additionally, for those who have managed to access government support, there are uncertainties about the duration of their involvement in these schemes, suggesting potential challenges with continuity and effectiveness. The farmers face various obstacles, including limited market access, fluctuating prices, high cultivation costs, inadequate infrastructure, and adverse weather conditions. Moreover, there is a significant communication gap between the garlic farmers and the authorities, hindering the effective resolution of concerns related to the government support schemes. Establishing better communication channels is vital to address the farmers' challenges and ensure that the support schemes are tailored to meet their specific needs.

7.2. Suggestions

Following are some of the suggestions put forward based on the entire study:

- Firstly, there is a pressing need for targeted awareness campaigns to educate the farmers about the various government support schemes and credit facilities available to them. This can be achieved through workshops, training sessions, and the involvement of local agricultural extension officers who can reach out directly to the farmers.

- To enhance profitability, farmers should be encouraged to diversify their income sources by exploring value-added products from garlic cultivation. This could involve processing garlic into products like pickles, powders, or garlic-infused oils, which could command higher prices in the market. Collaborating with local food processing units or forming farmer cooperatives for value addition could prove beneficial.

- Furthermore, there should be initiatives to promote better market linkages, both regionally and nationally. Encouraging farmers to engage more actively in farmer-producer organizations or cooperatives can help them collectively negotiate better prices

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and access larger markets. This can reduce their dependence on intermediaries and enhance their bargaining power.

- Investment in research and development of improved garlic varieties suited to local conditions could also boost productivity. Additionally, the adoption of modern farming techniques and technology, even on a small scale, could lead to more efficient cultivation processes and reduce labor costs.
- The government and relevant authorities should actively involve farmers in the decision-making process regarding support schemes and initiatives. Creating platforms for regular interaction and feedback can help identify gaps and challenges that need to be addressed, and ensure the schemes are designed to meet the specific needs of the farmers.
- Lastly, improving infrastructure for irrigation, storage, and transportation can significantly reduce post-harvest losses and increase overall profitability. By addressing these challenges and capitalizing on available opportunities, garlic farmers in Kanthalloor can achieve sustainable growth and better economic prospects for their livelihoods.

7.3. CONCLUSION

In conclusion, the study tried to examine the economic feasibility, market trends and garlic cultivation in Kanthalloor faces a variety of opportunities and challenges. The farmers mainly cultivate two varieties of garlic in two seasonal periods, but productivity varies due to natural circumstances, demand from export markets, and other factors influencing profitability. The unique quality and taste of Kanthalloor garlic, however, is not given much importance in local or Kerala markets. Farm size directly affects both productivity and cultivation costs, with farmers expanding their land size in hopes of better profitability. While garlic farmers have access to government support schemes and credit facilities, lack of awareness and communication gaps hinder their ability to fully benefit from these initiatives. Moreover, fluctuating prices, limited market access, high cultivation costs, and adverse weather conditions pose significant challenges to garlic cultivation. To ensure sustainable growth and improved agricultural productivity, establishing better communication channels and tailored support schemes are essential to address the specific needs of garlic farmers in Kanthalloor.

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