SUSTAINABLE AGRICULTURE IN TAMIL NADU

MSc International Procurement and Supply Management

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Candidate Declaration

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I certify that the dissertation entitled: **SUSTAINABLE AGRICULTURE IN TAMIL NADU** submitted for the degree of MSc in International Procurement and Supply Management is the result of my own work and that where reference is made to the work of others, due acknowledgment is given.

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Yours truly,

Padma DivyaSabareeswari Selvam

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Abstract

Agriculture is the principle source of sustainable livelihood for more than 40 percent of the population in Tamil Nadu. The crops provide wage goods for the non-agricultural sector as well as raw materials for the industrial sector. The research study attempts to bring together the different issues in the supply chain management of the crops and the way sustainability is maintained for the farmers in Tamil Nadu. The initial part of the study focuses on the introductory chapter by setting a background analysis for promoting sustainable agricultural development in Tamil Nadu. With the establishment of the research aims and objectives, the significance of the study is being specified. Further, the literature review section of the study identifies the facts about smart farming and various challenges the farmers face in agricultural farming in Tamil Nadu.

By evaluating the organic farming and the role of supply chain management in crops in Tamil Nadu, the sustainability of the sector is determined. The research methodology chapter of the study demonstrates the pattern in which the research is being carried out by the researcher. The researcher has applied the application of both the primary and secondary data collection technique and the data analysis is conducted in the form of interview responses that have been obtained from a selected sample size for the research study. The information obtained through the interview questionnaires has helped in developing a discussion on the sustainable agricultural practices in Tamil Nadu. The final chapter of the study that is the conclusion and recommendation part deals with the future scope of the study by evaluating the limitations for this research work.

Chapter 1: Introduction

1.1 Overview

Sustainable Agriculture is a farming process obtained by farmers for meeting requirements and needs of the society without compromising with the existing and future capabilities of the generation. The key purpose of the section is to highlight the importance of sustainable agriculture for enhancing economic and social development in the long run. Therefore, the research fellow has selected a topic related to 'Sustainable Agriculture in Tamil Nadu'. India is known as one of the leading economies to produce and distribute agricultural products across the globe. Hence, the current chapter will reflect on different dimensions associated with sustainable agriculture for gaining in-depth understanding of its impact on the growth and development of the economy.

1.1.1 Research background

Sustainable agriculture is determined to be an effective procedure for producing and delivering high quality agricultural products and services to the customers through meeting its requirements and needs. The key aim of sustainable agriculture is to meet the demands and needs of the society irrespective of over-utilizing natural resources for production purposes. The practitioners of sustainable agriculture are to integrate major three objectives, which are economic profitability, social and economic equity and a healthy environment (Yadav, *et al.* 2017). Minimizing use of water and reducing pollution level are two important goals of sustainable agriculture for promoting soil health. Tamil Nadu is recognised for its overriding agriculture sector. Approximately 70% of the state's populace are associated with agricultural activities that help in increasing economic growth and enhance social development. Some of the key crops that are cultivated in Tamil Nadu are ragi, rice, maize, jowar, cotton, coffee and coconut. Therefore, the state government of Tamil Nadu focuses on using advanced techniques and methods for promoting sustainable agriculture (Adhikari, *et al.* 2018). Organic Farming technology is regarded as an effective tool implied by Tamil Nadu for promoting sustainable development in the agriculture sector. Further, this helps in reducing secret impact related to environmental degradation. Moreover, farmers are provided with accurate and relevant data information about using this technology for improving the existing soil condition based on which sustainable development in agriculture can be attained appropriately in Tamil Nadu.

1.2 Research purpose

The primary aim of the research paper is to reflect on the effectiveness of sustainable practices in the agriculture sector of Tamil Nadu. Thus, the research fellow has considered Tamil Nadu for gaining in-depth knowledge related to various techniques and approaches considered for sustainable development. The focal point of the research process is to identify and examine the factors and attributes taken into consideration by the state government of Tamil Nadu for practising sustainable agriculture in Tamil Nadu.

1.3 Significance of the research

Sustainable agriculture will be beneficial for the agricultural sector to mitigate challenges and issues. The key purpose of sustainable agriculture is to enhance skills of farmers for applying effective techniques to produce huge masses of crops and agriculture. Tamil Nadu can acquire effective competitive advantage due to implying effective and advanced methods such as organic farming for improving productivity level along with acquiring sustainability in the agriculture sector (Sangeetha, *et al.* 2020). On the other hand, it is imperative for the agriculture sector to use appropriate methods and techniques through helping farmers produce high quality crops based on which economic growth and development can be improved and acquired in the long run.

1.3.1 Research rationale

1.3.1.1 What is the issue?

The given research issue is developing an effective understanding of sustainable agriculture that is existing in Tamil Nadu India. Sustainable agriculture has been increasing at a huge rate by means of using smart farming techniques, organic farming procedures, integrated pest management controls, and tools and techniques that are being used in order to ensure that the process of farming is less time consuming and involves lower expenses in comparison to the traditional farming processes. Tamil Nadu has been one of the major states in India, which are strictly initiating the processing, and use of sustainable agriculture development that further aims in delivering high profit to the industry and helps in assuring better quality for agriculture products being produced.

1.3.1.2 Why is it an issue?

The extensive use of pest and other chemicals have negatively impacted on the quality and growth of the farming process. Environmental concerns such as deforestation, livestock overgrazing and soil degradation adversely impact on the sustainability and production process of agriculture (Sivaraj, P., Philip, *et al.* 2017). Thus, there is a need for mitigating these challenges which creates barriers for farmers to acquire sustainable growth and development. On the other hand, lack of knowledge and information related to advanced farming processes and techniques enhances several risks and challenges. These challenges are associated with inappropriate use of land and soil erosions. It is imperative for the farmers through collaborating with the government to do sustainable practices for using land and resources appropriately (Brown, 2019). It is evident that Tamil Nadu focuses on implementing organic farming techniques for achieving sustainable development and growth based on which it can attain strong comparative advantage in the market.

1.3.1.3 Why is it an issue now?

The use of sustainable agriculture has been highly intriguing due to its on-going benefits that allow the farmers and the economy to sustain with better growth rate and increasing profit margins. It has been noted that the use of an extensive amount of pest and improper management of the agricultural products has consecutively reduced the quality of the products leading to the rise of chronic diseases in the country as well as globally. The rising concern has led to the selection of the identified topic that further demonstrates the ability of the state Tamil Nadu in achieving its suitable production process and brings a higher rate of efficiency in the agriculture industry processing.

1.3.1.4 What could this research shed light on?

The given research would effectively help in identifying the possible benefits that are obtained from the use of sustainable agriculture processing. The research would allow the understanding of the different approaches that have been considered by the Tamil Nadu agriculture industry considering the approaches and the initiatives taken by the government as well as the different non-governmental organisations in blooming such initiatives. The research also allows the collective understanding of the different challenges that have been faced in the development of sustainable agriculture in Tamil Nadu along with the possible measures that have been considered by the state. The research would help in analysing the overall attributes of the supply

chain processes that helps in increasing the effectiveness of the sustainable agriculture industry in the state.

1.4 Research objective

The research worker is required to follow and maintain research objectives for acquiring effective outcomes from the research process. Thus, the research objectives that are required to be maintained are mentioned below:

- Analysing effectiveness of smart farming for developing sustainable agriculture
- Identifying the importance of sustainable practices in agricultural sector of Tamil Nadu
- Observing the need for organic farming for sustainable agriculture in Tamil Nadu
- Examining role of supply chain in agriculture market in Tamil Nadu
- Observing the need of integrated pest management for sustainable agriculture
- Identification of challenges related to sustainable agriculture
- Examining factors related to sustainable agriculture practice
- Identification of tools and techniques that can be used for sustainable agriculture
- Development of appropriate solutions to mitigate challenges related to sustainable agricultural practices
- Examining the impact of the solutions development for reducing issues and concerns associated with sustainable agriculture

1.4.1 Research question

The research questions that are needed to be answered are mentioned below:

- In what ways does smart farming helps to develop sustainable agriculture.
- What is the significance of sustainable practices in agricultural sector of Tamil Nadu?
- In what ways does organic farming helps in developing sustainable agriculture in Tamil Nadu
- What are the roles of supply chain in agriculture market in Tamil Nadu?
- How does integrated pest management is beneficial for sustainable agriculture.
- What are the issues and challenges associated with sustainable agriculture?
- What are the solutions that can be applied for eliminating challenges related to sustainable agricultural practices?
- In what ways does the proposed solutions helps in reducing issues and concerns associated with sustainable agriculture.

1.5 Structure of the study

The structure that has been followed in order to conduct the given study is focused on developing five chapters in a systematic approach. The current chapter has highlighted various dimensions associated with sustainable agriculture. It is to be noted that research fellows will be using both primary and secondary data for gaining relevant knowledge and information about the topic. The second chapter is the literature review that helps in drawing understanding and knowledge on the different kinds of literature that have been drawn by various researches. The literature review chapter plays a major role in developing the themes of the data that is to be collected as it is focused on drawing the evidence and answers to the research questions as well as research objectives that have been formed in the given chapter. The third chapter is the research methodology that is based on developing a discussion on the research methodologies that are to be used in order to conduct the practical activities of the research-based on data collection and analysis for the research. The fourth chapter is based on drawing the findings and the discussion on the finding by aligning them with the objectives and questions of the research paper. The last chapter develops different thoughts on the research contribution, the limitations, and the suggestions for future research.

Chapter 2: Literature review

2.1 Overview

Sustainable agriculture highly focuses on the modern method of agriculture and it seeks to sustain farmers by considering the sustainable practices. This helps to bring effective sustainable approaches by considering the safety of the environment, people and society (Walter *et al.* 2017). The main aim of the sustainable agriculture is the process of providing better scopes to the future generations to their needs o wants by saving or compromising with the present resources in an effective way.

Mostly, three major aspects are included in sustainable agriculture; this includes economic profitability, a healthy environment and economic or social equity (DeLonge*et al.* 2016). Sustainable agriculture adds value to the producers and the products that are produced. The farmers in recent times are highly focused towards the organic farming approaches. This section of this research paper has discussed the aspect of sustainable agriculture by considering Tamil Nadu. This has provided complete ideas based on the topic by increasing knowledge, various facts and ideas. Further, this research has reviewed past studies to gather relevant information regarding the topic by identifying the research gaps. Besides, this research has highlighted various theoretical perspectives by presenting it through a conceptual framework for deeper insights related to the topic.

2.2 Smart farming is the key to develop sustainable agriculture

Agriculture has witnessed many revolutions with the passing years. In the recent years, agriculture has witnessed major transformation due to the involvement of smart devices and technologies. Autonomous and robotic vehicles have developed better farming purposes. Besides, the use of ICT (Information and Communication Technology) in agriculture has proposed effective growth by managing the agricultural land and environment (Hochman and Lilley, 2020). Smart farming has reduced the implications based on ecological footprints. It has further minimized the specific site application of the pesticides and fertilizers. It has been witnessed that smart farming has helped to create better profits for the farmers.

In turn, the process of decreasing the resource inputs has helped to save money, labours and increased the liability regarding the explicit data. Smart sustainable farming approaches have

increased the consumer acceptance (Zhang *et al.* 2016). The possibilities based on the digital era has totally transformed the farming measures and brought diversification on farms (Ramakrishnan, 2020). The use of the Internet of Things has helped the farmers to manage the standard farming situations. Further, the smart farming has provided a concerted path by maintaining strong polarisation and market segmentations. The concept of optimising the management has increased the product quality and standards (Nayar, 2020).

2.3 Various challenges regarding sustainable agriculture

However, there are certain hurdles that are faced by the organisations. Lack of awareness between the farmers and governmental policies has created barriers to bring changes in the farming approaches of various farmers. Thus, the issues based on ecological footprints and traditional methods have restricted the farmers to sustain in the competitive market for a longer time. It has been acquired that extreme variations in the rainfall has reduced the availability of water to agriculture in Tamil Nadu (Ruttan, 2019). Further, it is acquired that this issue has caused a significant fall in the groundwater table by around 37%. IT has been anticipated that well-designed strategy can help in the sustainable production of the corps by the farmers. Thus, a well-designed upscaling strategy has been included. It has helped to improve the fertility of the soil and has built up the organic matter. The Rice intensification system has offered an attractive opportunity by increasing the food production by enhancing the use of water per unit.

2.4 Sustainable agriculture in Tamil Nadu

The technology has played an effective role in the sustainable farming. The government is highly focused on the process of equal footing (Altieri*et al.* 2017). Thus, the Confederation of Indian Industry (CII) has been taken into consideration. The conference has focused on the technology implementation in the agriculture; this will help to make the agriculture productive, consistent and will help to manage the resources. Various initiatives have been taken by the Indian government for educating the farmers. Farmer Producer Organisations has initiated to bridge the gaps between the farmers and technologies. Further, it has been seen that the government of Tamil Nadu has introduced the Green Revolution in the state for increasing the farmer-friendly strategies. This has fostered the innovative crop specific agricultural farm productivity (Busby *et al.* 2017). Paddy that is the staple crop of Tamil Nadu has extensively cultivated in Vellore has witnessed new strategies to raise the productivity (Zhang *et al.* 2016).

State government has taken initiatives for introducing the multifarious high-end technologies under different schemes. SRI technology has helped the farmers to adopt the conventional method of cultivations. The government has reduced the weariness of farmers by promoting the transplantation process of the paddy with the involvement of the schemes under SRI. System of Pulses has helped to increase the productivity (DeLonge, Miles and Carlisle, 2016). The Tamil Nadu government has helped to enhance the utilisation the rice fallow by improving the packaging of the practices of black gram, red gram, cropping systems. Sustainable agriculture has helped to incorporate the viable technologies by focusing on the production of oilseeds, millets and cotton. The program has helped to involve the cluster approach by providing training and development programs. Tamil Nadu sustainable agriculture has launched a landmark initiative farming system, this has increased the productivity. The Rainfed Area development has focused on the improvement of the production of oilseeds by adopting water conservation measures. Water-saving interventions have helped the farmers to include the micro-irrigation process.

Green revolution has created better scopes for the farmers to get a better production system. Based on this, it can be said that sustainable agriculture must reduce the problems of farming and farmers. However, in the coming years, it requires proper strategies to cope up with the chronic issues related to droughts and dryland of Tamil Nadu. In this process, the advanced technologies can play an effective role in managing the sustainability of the agricultural processes and practices (Zhang *et al.* 2016).

2.5 Organic farming on Tamil Nadu

Since, the debate on use of Organic farming and conventional agriculture, in an event held on the American Centre Auditorium in Chennai, broke down the barriers of the organic farming in South India, especially in Tamil Nadu evolved, the emergence of chemical-based cultivation practices came into practice. Framed upon the ideas of Sustainable farming in India, especially Tamil Nadu, the aspect of inducing a Green Revolution within the farming intricacies came into force (Palaniappan and Annadurai, 2018). Despite the concept or Organic farming came into practice, yet the debate on its credibility remained argumentative.

According to the findings of The Hindu, it has been noted that Tamil Nadu, which is a leading state in India, in respect to agriculture still wallowed in the darkness of the probabilities and acceptance of sustainable and organic agriculture in the long haul. According to Panneerselvam*et al.*(2015), Organic farming could be the best strategy to completely replace chemical farming ,leading to the formation of a more sustainable and greener agriculture in the country. Mannargudi S. Ranganathan, general secretary of the Cauvery Delta Farmers' Welfare Association states that although Tamil Nadu has a significant number of farmers, still there is inadequacy in the possibilities of adopting a more sustainable farming policy (Alagappan and Venkitaswamy, 2016).

According to the findings of National Bank for Agriculture & Rural Development (**NABARD**), some of the leading states in South India, including Tamil Nadu are lacking policies in sustainable farming. In the past three decades, it has been noted that awareness about organic farming and sustainable agriculture has been given utmost priority in Tamil Nadu. However, the public awareness has been created primarily by the activists, compared to the interventions of the Tamil Nadu Government (Sivaraj*et al.*2017). Excepting for states like Sikkim, Kerala, Karnataka, Uttarakhand, Nagaland, Mizoram, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh who have their respective governmental policies pertaining to organic farming and sustainable agriculture, the other states are still behind.

Tamil Nadu similarly faces the issue of policy lacking due to deficiency in governmental interventions. The findings of Pamayan, one of the leading organic farming activists, under the banner of Thalaanmai Uzhavar Iyakkam (Self Reliant Farmers Movement) states that no action is being taken proactively in response to dealing with the issue of organic farming and sustainable agriculture in the state of Tamil Nadu (Kalyani and Murugan, 2018). September 2012 witnessed the formation of a committee to create a draft in developing an organic farming policy with experts sharing their opinion on the committee. However, the policy did not receive ratification from the Tamil Nadu Government.

Further, statements made by R Selvam, coordinator, Tamil Nadu Organic Farmers Federation, reflect on the proper establishment of a compatible organic farming and sustainable agriculture policy in Tamil Nadu with immediate effect. The study conducted by Organic Farming Association of India finds out that Organic farming and sustainable agriculture happens to be the

best farming policy for the state since, it is water starved (Karpagavalli, 2018). Despite citing reasons behind the justification of engaging an organic farming and sustainable agriculture policy, the state still lacks that interim governmental intervention to solve the issue.

2.6. Benefits of organic farming

According to Kavitha and Kumar (2019), organic farming is a science of agriculture that utilizes the biological means of the crops that creates a useful aspect in gaining high profitability in the traditional way of agriculture. One of the major benefits of organic farming is that it is cost-efficient and the production cost for the crop can be reduced to nearly 25 percent in comparison to the traditional method of farming and agricultural process. Seethalakshmi and Thangasamy(2020) have stated that the use of organic farming in maintenance of sustainable agriculture also helps in reducing the soil erosion to approximately 50 percent leading to the increase of productivity in farming. Another most important benefit that can be gained through organic farming is the clarity and purity in the food crops and the crops that is achieved through fertilization and fermentation process of the organic food products. Swain and Kaur (2016) have explained that the application of biological manures and useful microorganisms helps in increasing the fertility of the soil of the organic food crops and stimulates nitrogen fixation in the soil.

2.6.1 Sustainable livelihoods through organic farming

Achudhan*et al.* (2018) have stayed for the small and marginal scale farmers in Tamil Nadu sustainable practices in agriculture are mostly conducted through the new means of farming that is through an organic process. Khanday(2019) have explained that the first initiation of maintaining sustainable livelihood through organic farming was introduced in Kanchipuram, Dindigul, and Nagapattinam in the year 2009. Currently only the chemically cultivated seeds and the crops have been proposed for involving the organic farmers who produce these seeds and enabling access to good quality organic agricultural supplies. Kavitha and Kumar (2019) have explained that seeds of paddy variety crops, groundnut, black gram, and sesame can mix the content of organic elements like green manure seeds, neem cake, bio fertilizers for gaining beneficiaries in the agricultural product. Moreover, to improve the culture of organic farming practices among the small and marginal scale farmers in various parts of Tamil Nadu, training in production of organic farming is given to the farmers. Kalaivani(2019) have stated through a

certified seed production training the livelihoods income and earning of the farmers is developed and it is sustainably maintained so that the farmers are benefitted from the new way of agricultural production. In order to create awareness among the farmers for the sustainability of the organic farming food festivals are being organized in various districts of Tamil Nadu so that the farmers are aware about the benefits and favourable practice of organic agricultural products.

2.7 Trends in overall agricultural production

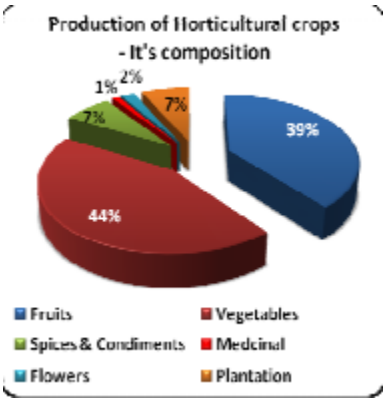


Figure 1: Trends in Horticulture production

(Source: Swain and Kaur, 2016)

Mehala*et al*. (2019) have stated the overall agricultural production in the TN state has gone up at an average annual rate of more than 60 percent due to the overall performance of the agricultural sector. The potential increase in the yield of the crops during the year 2007-12 has however decreased by 0.4 percent due to the farmer's shortage and introduction of modern technologies and equipment in farming technology. Muralidharan(2017) have stated that the grain production of the state has been consecutively good in number during the year 2013-15 but the latest economic appraisal of the TN Government has shown that for tackling agricultural production, the growing impact of the food inflation has created substantial changes. In the case of food crops, both the area and the yield period have faced a negative growth rate in the 11th plan period due to the increase in the yield of the agricultural and dairy crops. Varadarajan and Mari (2019) have explained that production alone was not the deciding factor for the growing food inflation in TN but the severe drought situation during the year 2014 has reduced the decrease of the production in the overall state.

Prabu (2019) have explained in the recent time, the usage of the modern fermentation technology has become mandatory for all the farmers that have allowed in maximization of the crops and the productivity of the agriculture has increased per hectare in the expandable farmers land. Pattanayak and Mallick (2017) have argued through increasing fragmentation in the agricultural landholding that the small and marginal group of farmers will benefit from approximately 92 percent. However, the lack of scale in the farmland is hindering the implementation of modern technology, thus generating a poor yield result for the crops. However, in comparison to the global standards, the overall production trend is lower in TN despite practicing and adopting organic farming practices by most of the farmers. Therefore, to increase the yield of the crop production Government schemes and infrastructural support are considered essential for the overall agricultural production.

2.8 Role of supply chain in agriculture market in Tamil Nadu

Supply chain is regarded as flow of products and information across supply chain entities for distribution purposes. In other words, supply chain management plays a significant role for the agriculture market in Tamil Nadu as it helps in procurement of materials along with transforming materials into final goods. In addition to it, an integrated supply chain is known to be an effective process for distributing products to the customers within due time. This helps the agriculture sector to increase its economic growth through meeting requirements and needs of customers. Although, supply chains of agriculture products in India vary which enhances the risk and challenges (Dar, *et al.* 2018)? Therefore, it is important for the agriculture sector to use appropriate and effective supply chain management systems and approaches for delivering quality products to the consumers. Ineffective SCM (Supply Chain Management) creates hindrance for the agriculture sector to acquire strong comparative advantage and growth in the long run as the companies will be unable to meet requirements of the consumers. The department of agriculture industry of Tamil Nadu is working towards implementing an appropriate SCM scheme for creating sustainability (Calabi-Floody, *et al.* 2018). The schemes will render cold storage facilities for the farmers for storing perishable goods along with equipment to sort and package the produced goods.

About ₹38 crore has been invested by Tamil Nadu government to provide tools and technologies such as cold storage, packaging and pre-cooling equipment to the farmers. This further will assist

farmers to deliver their products to the customers without failing to meet deadlines. In addition to that, the participation of farmers in the SCM process is regarded as an important factor for developing the sustainable agriculture sector in the Indian market. This has been observed that the state government of Tamil Nadu aims at setting up two markets in which farmers will be allowed to participate in taking decisions (Meena, *et al.* 2016). Two groups such as FIGs (Farmer Interest Groups) and FPG (Farmer Producer Group) will be formed as they will be shared with relevant knowledge and information related to the effective farming process. Further, produced goods by the farmers will be collected and taken to the supply chain plats. Moreover, the skilled employees will be responsible for cleaning, sorting, grading and packaging products for final deliveries to the customers (Sazvar, *et al.* 2018). Therefore, it can be stated that the supply chain is a crucial and vital aspect for the agriculture sector as it helps in acquiring sustainability in the long run. It has been observed that agricultural supply chains in India are evolving due to the implication of integrated supply chain management systems. Again, marketing channels for fruits and vegetables helped Tamil Nadu to create sustainable agricultural markets based on which effective economic growth and comparative advantage is acquired. For instance, most of the vegetable and fruit production is transacted via the wholesale market (Thorlakson, *et al.* 2018). However, it depended on the commodity and state regulations. Moreover, farmers may sell their products directly to the populace.

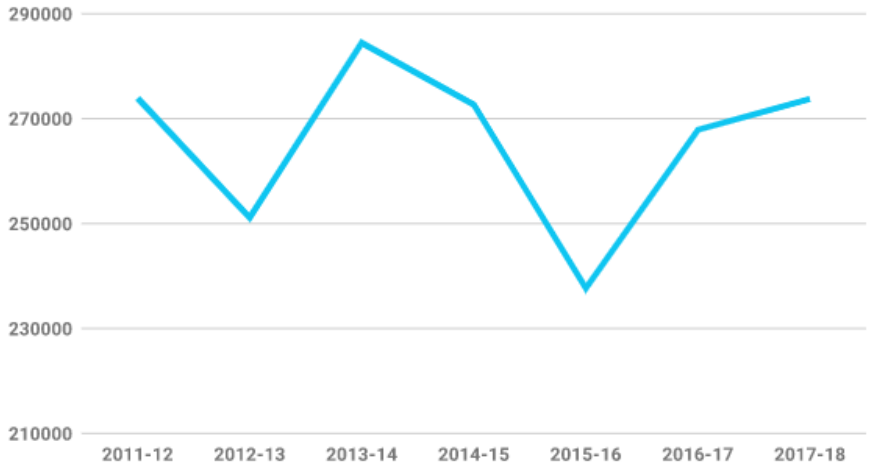


Figure 2: Market Growth Rate of Tamil Nadu

(Source: Meena*et al.* 2016)

2.9 Marketing issues in agriculture

Agriculture marketing is a service where moving the agricultural product from farm to consumer is the main motto; during time of services or moving products some major issues have seen due to the lack of planning and organizing. In farming or agricultural marketing, the major problems such as insufficient infrastructure of market, transportation cost, poor marketing information, inadequate storage facility, lack of processing units, price variation (Kalyani*et al.* 2018). The entire agriculture marketing system can be hampered by these major issues. Due to the low marketable excess in agriculture products or goods, all the farmers cannot farm for the market. As a result, the quantity of agricultural products is not enough according to the market demand. The price of agricultural goods is not decided by the farmer, that is why the actual selling price is not known by the farmer; the outcome of growth is not even measured by revenue also. Due to absence of storage facilities, the farmers or the producers of agricultural goods sell their products to the market either getting low profit or even no profit (SahayaPrincy*et al.* 2019). Though the transportation system is increasing, the cost of transportation is high according to the farmers in agriculture. After producing the agricultural goods, the supply chain process is quite a long agricultural market. The wholesalers, commission agents, brokers, retailers and others are worked as the intermediaries. As the products pass by individual intermediaries, the cost also increases. Although, internet is available, few agriculture farmers do know how to access the methods for getting actual prices or information about their agricultural goods and products.

2.10 Loss of agricultural productions due to natural hazards

According to Muralidharan(2017), in the year 2011-12, a devastated cyclone has caused extensive damages to the agricultural food crop production in the state. Crops like paddy, millet, pulses in the districts of Cuddalore, Thanjavur, and Nagapattinam have been largely destroyed in most of the years during the monsoon period. The total area of more than 2 hectares of land was largely affected and there was a loss in the total production value of the crops to nearly 1000 crores. The uneven rainfall and the spread of monsoon during the rainy season have affected the agriculture widely in Tamil Nadu during the year 2012-13. Varadarajan and Mari (2019) have stated that majority of the districts in Tamil Nadu is largely affected by drought and other earthquakes like natural calamities most often that leads to the sufferings of majority of farmers and their agricultural lands. On an average the loss of per hectare agriculture results in between

Rs 35,000 crore in the state. Mahesh *et al*. (2018) explained the tremendous food that has taken place during the year 2016 have largely damaged most of the crop production in the agricultural land and this has made a loss in the yield of the total production to nearly 1.33 lakh hectares of land.

2.11 Appropriate strategies to mitigate the identified challenges in Tamil Nadu agriculture

There are several challenges found due to the monsoon, ecological hazards, economic issues, social and environmental losses; these all are identified by the accurate strategies for reducing the impact of issues in agriculture at Tamil Nadu. Due to the drought in Tamil Nadu, it is needed for long term development challenges by the responses of multi-sectoral and multi-dimensional (Agarwal*et al.* 2017). That is why, the strategies are required for managing drought and increasing the strength of farmers or producers. The technology of integration, institutional and policy options are required for such weather shocks. By using the appropriate strategies, the farmers and producers of Tamil Nadu can reduce risks in their agriculture. The strategies are followed:

a. Methylobacterium (PPFM) liquid biofertilizer: The Gram-bacteria like Pink Pigmented Facultative Methylotrophs (PPFMs), which is essential for diminishing the unfavourable impact in poor monsoon (Rao*et al.* 2016). This PPFM technology has developed in the agricultural process of Tamil Nadu in both powder and liquid forms.

b. Direct Sowing of Rice: Direct spreading in dry soils or in wet soils or transplanting the seedlings in puddled fields is an essential method for establishing the rice in several places of Tamil Nadu (Sapkota*et al.* 2019). By reducing the escalating labour cost, direct sowing process is a form of alternative manual transplanting.

c. Rice Intensification System: This system is a method of defibrillation in transplanting rice cultivation; and by this system utilization the potentiality of rice can be growth in favourable environments to increase the production of economic returns.

d. Sustainable Sugarcane Initiative: This initiative includes the implementation of techniques from the starting stage of seeds during the harvesting and cultivating time.

e. Rainwater Harvesting: Through the water shedding development, the crops can be benefitted by availability of water.

2.12 Impact of solution development in reducing the issues of agricultural advancement

The issues of agricultural advancement can be mitigated by impacts of solutions to developments like agricultural technologies. The agricultural technologies are beneficial for higher crop production; and, can decrease water usage, fertilizers and pesticides and adverse impacts on natural ecosystems. Through the innovation in technology, the agricultural process is constantly changing. The new technologies help the agricultural process for more production with the support of sustainable finite resources (Sanbagavall*et al.* 2017). The technological advancements on the farm which increases the integration of FMS for extending the entire capacity of farmers or producers. The better system of FMS includes one-on-one for supporting the farm management in agronomy and crop marketing. Through the implementation of the FMS system, the farm or agriculture of Tamil Nadu can be benefitted by increasing the efficiency of farmer productivity. The positive impacts in solution developments like applying appropriate chemicals and fertilizers to mitigate application errors, reducing surface water and groundwater pollution, increasing operations timelines and others. The essential tools help farmers to meet market demands; if there are any environmental issues this technological tools help them to protect their crops yield. The technological development helps in farm management, sustainability, and profitability by reducing the adverse impacts in agriculture (Pannirselvam*et al.* 2018). Poor irrigation system and mechanization system are the challenges to farm in Tamil Nadu. Due to the low rainfall, drought the farmers of Tamil Nadu are affected for lack of water supplements in agriculture farms. That is why, technological developments are important to implement in the crisis time of agriculture of Tamil Nadu.

2.13 Tools and techniques for sustainable agriculture

The tools and techniques which are used for sustainability in the agriculture process can be backpack sprayers for small-scale, organic or urban farms; aerated bin composting for efficiency and speed; season extension and crop protection with the use of high tunnels; environmental and economical sustainability with leaves by improving soils. There are several keys for farming the practices through sustainability. The farming methods involve organic farming, multi-crop farming, vertical farming, green house farming; though these methods are dependent on soil types, land size and other factors (Vijay *et al.* 2018). Sustainability is needed in agriculture as

this practice maximizes crop productivity while diminishing the destruction of the environment. The techniques which help to emerge the agriculture process in Tamil Nadu such as:

Crop rotation & diversity embracing: The farmers try to produce crops with a rotation process so that the fertilization of soil can be increased (Vishwakarma*et al.* 2018); this process crop rotation process helps to enhance the productivity of entire agriculture systems.

Applying pest management integration: The farmers or producers try to use less pesticides and fertilizer powder so that the soil can keep its own fertilization.

Agroforestry practices adaptation: Through the technologies and other land use systems like woody perennials, the farmers try to adopt these practises.

2.14 Schemes for the sustainable agriculture growth in Tamil Nadu

As there are many issues in the agriculture process of Tamil Nadu, the Department of Agriculture has decided to implement several schemes by uses of practises. These practises and schemes not only support the farmers also increase higher crop yields with the help of fewer inputs (Kavitha*et al.* 2019). There are several schemes which are used in sustainability for the growth in agriculture process of Tamil Nadu:

a. Seed Multiplication Scheme: All those seeds which are produced by the farmers of Tamil Nadu provide the incentive through the help of components of welfare scheme and its benefits. Under this scheme, the farmers produce and supply the seeds on the contract basis process to the Agricultural department (Priyan*et al.* 2017). The farmers can enrol and register their seed farms under this programme. The seeds which are needed are supplied by the Agricultural department through the payment process of Agricultural Extension Centres. Through this scheme, the given guidelines should be followed by the farmers or producers for seed certification so that they can maintain the quality.

b. The Crop Productivity by Macro Management Mode Scheme: The farmers of Tamil Nadu follow the concept of seed village for maintaining the quality of seed distribution. Under this scheme, all the farmers can be eligible for availing the subsidy. The farmers can demonstrate the rice intensification system by assisting the improving seeds. The farmers can operate in all the districts of Tamil Nadu with the help of this Cereals Development Programme (Singh *et al.* 2020). Under this scheme, the farmers of Tamil Nadu can integrate pesticides management demonstration cum training @30 per training.

c. Water body restore management and agriculture modernization of Tamil Nadu: The farmers of Tamil Nadu are benefited by this water users' association under this scheme.

d. Scheme of Seed Village: The farmers of Tamil Nadu use this scheme for getting the certified seeds at 50 percent costs; this 50 percent cost helps them to produce quality seeds (Subash*et al.* 2016). Under this scheme, the farmers get training for three days on the production of seed technology. More than this, the farmers can be facilitated by the supply of storage bins. The farmers of Tamil Nadu can produce the quality of seeds in their own lands and distribute to the other farmers of this state.

2.15 Supply chain for agricultural products in Tamil Nadu

According to the supply chain management scheme, the Government of Tamil Nadu has approved a scheme where the statement is that, the farmers are benefited by the actual production cost; there is no middleman or no agent. According to the National Bank for Agriculture and Rural Development (NABARD), this supply chain management scheme has been approved. In this supply chain management, the schemes also include infrastructure of warehouses (Priya*et al.* 2016). The advanced machinery processing centres have been processed in the agriculture department of marketing. Under this supply chain scheme, the infrastructure of post-harvest such as cold storage, irradiation plant, quick freezing, packaging facilities have been treated.

2.16 Importance of integrated Pest Management

Lack of knowledge among farmers related to use of different techniques and approaches about sustainable agriculture enhances challenges and risks within the industry. It is often seen that farmers are unaware about the benefits of implying an integrated pest management (IPM). It is important for the government to develop effective programs for the farmers to educate them about using effective techniques to protect crops and vegetables. The implementation of IPM will be beneficial for Tamil Nadu to acquire sustainable growth and development for the agriculture sector. IPM is known to be an approach that integrates corrective and preventive measures for keeping pests away from the crops and vegetables. Adoption of IPM will help Tamil Nadu to promote healthy plants and sound structures. In addition to that, it will be helpful for the farmers to reduce environmental concerns associated with pest management. On the other hand, implementation of IPM strategy renders economic beneficiaries as it helps in acquiring sustainable development (Amarnath and Brindha, 2017). Moreover, IPM assists in increasing

productivity level through reducing pest damages. This is often seen as a pest damaging crops for which farmers face economic concerns. It has been observed that a huge number of farmer suicides due to lack of equipment and pesticides. Widespread insecticide resistance is known to be a crucial challenge and concern in sustainable agriculture. Thus, the agriculture sector of Tamil Nadu is focusing on using effective IPM approaches for protecting crop and pasture through combining various pest control methods. This will further help the state government to reduce the utilization of synthetic pesticides (Baksh, *et al.* 2017). As mentioned earlier that the key focal point of sustainable agriculture is to produce crops without causing environmental harms, thus, implementation of this particular approach will help in meeting this particular criteria (Kalyani and Murugan, 2018). In this way, the Tamil Nadu will be able to develop a sustainable agriculture market based on which farmers will be able to acquire effective economic benefits and growth in the long run.

2.17 Conceptual Framework

Considering the subject of the study to exclusively focus on the aspects of sustainable agriculture in Tamil Nadu along with touching glimpses of engaging supply chain operations, the conceptual framework of the study needed to be conducted using the most suitable framework. Therefore, the conceptual framework of the study is developed based on using the FAO (Food and Agriculture Organization) framework suggested by the United Nations to develop a secure understanding of the subject.

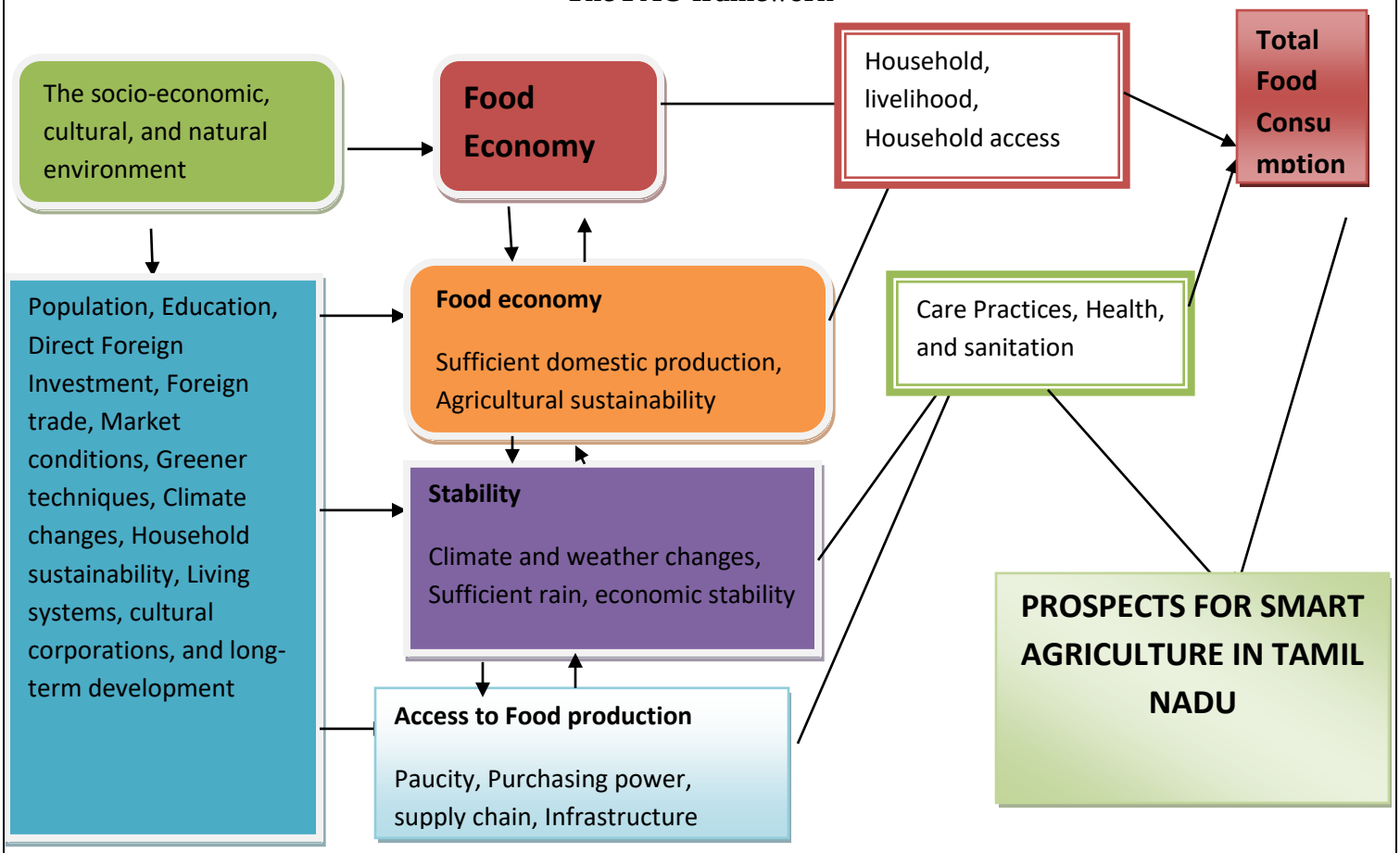
"Food is the moral right of all who are born into this world"

- Norman Borlaug

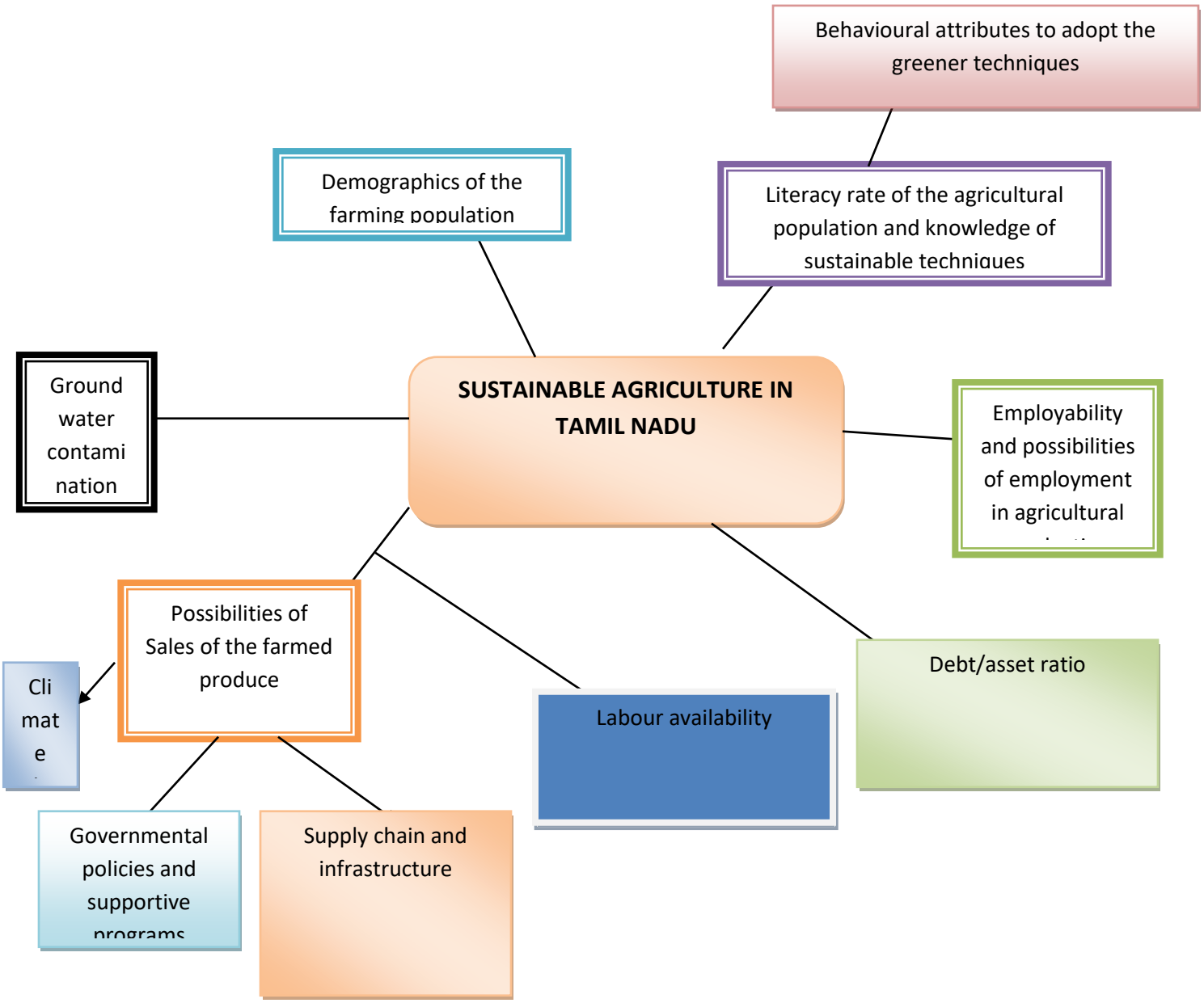
According to the FAO directive, it is evident that the notion of food security is existent regarding creating a situation whereby all the individuals of a state of nation have enough physical and economic access to safe and nutritious food and healthy life (Kelley and Knowles, 2016).

Considering the creation of a sustainable situation in food production and consumption, it needs to be stated that the prospects of adequate utilization refer to the apt use of the agricultural methods and sustainable techniques to come up with the maximum amount of products addressing the demand chain of a nation (Setiawaty*et al.*2015). The research provides a comprehensive detailing of the sustainability of agricultural production in Tamil Nadu, India, with over 70% of the people engaged in this work. Finding on the core aspects and fundamental aims of the agricultural activities, it needs to be stated that the conceptual framework of the study is evaluated and structured based on the developing linkages between the overall development of the state economy along with undertaking individual measures to induce wellbeing. Additionally, apart from the inclusion of the FAO framework, the research shall also include a justification of the core dependent and independent variables keeping in connection with the FAO framework.

The FAO framework



The Dependent and Independent variable framework



Considering the above two frameworks that have been used to develop the conceptual framework of the research generates with a critical appraisal of a two-dimensional approach that delineates recognition of both the dependent and independent variables along with the appreciation of FAO framework (Beaulieu *et al*.2015). Both the framework acknowledges a complete creation of an overall development scenario to ensure the secured adoption of a sustainable agricultural framework in Tamil Nadu along with greener supply chain operations.

2.18 Literature Gap

The sustainability process in agriculture of Tamil Nadu is known for good agricultural practises. The farmers of this state face the marketing issues in the agriculture process. During the supply chain management, as the farmers only produce the crops, they do not have much knowledge about the actual price of their goods or products. The intermediaries fix the prices according to their profit. Due to this, the economical portion of the agricultural process has been less discussed.

2.19 Summary

In this literature review, the sustainability of agriculture in Tamil Nadu has been discussed. The concept of organic farming is discussed by its benefits. The sustainability is used through organic farming livelihoods, so that the farmers can enhance their whole agriculture production in Tamil Nadu. In Tamil Nadu, the farmers face the marketing issues which have been discussed in this part. Due to the losses in agriculture production is evaluated. The appropriate strategies, impact of solutions and tools techniques for reducing the issues is considered as agricultural advancement. The schemes of Tamil Nadu help the farmers to maintain the agriculture process by giving them training and certified seeds.

Chapter 3: Methodology and Research Design

3.1 Overview

The given chapter is focused on conducting a discussion on the research methods that have been used in order to execute the research paper. The discussion of research metrology helps in identifying the different attributes of the conducting research that has been considered by the researcher to execute the research and obtain the desired results as indicated. It is important to note that the given chapter is analysing the philosophy that has been considered while conducting the research. It includes a discussion on the approach that has been taken into account to derive the data that has been collected and the strategies that have been used to complete the analysis of the research data collection process along with the tools and instruments being used.

3.2 Research philosophy and approach

The research philosophy helps in deriving the phenomenon that has been used in order to complete the given research. In this research paper, there has been the use of positivism research philosophy that has been effective considering the topic of the research that is based on the factual data that would be gathered from the different resources that would be discussed in the later sections (Ryan, 2018). The consideration of the positivism research philosophy has been appropriate for the given research as sustainable agriculture and its existence in Tamil Nadu cannot be understood through assumed theories and farmers. There is the requirement of gaining knowledge on the facts and the statistics that are present in terms of measures that have been considered by the various agricultural companies in the state. The development of actual data is the major outlook of the positivist philosophy that has led to the focus of using the philosophy in the given research.

The philosophy of the research has been baked on the principles of the positivist research process, which abides by the development and gathering of data based on scientific knowledge instead of gathering data based on theoretical understanding only (Žukauskas *et al.* 2018). The positivist approach has been appropriate for the given research in order to provide an independent on the different approaches instead of making the variables and the results gathered to be dependent on any existing theory which is not yet proved or factual. The use of science and the focus developed on scientific approach has been a constant consideration in order to gain an

idea on the sustainable measures and the application processes that have been developed and taken into account in Tamil Nadu to preserve their agriculture. As these measures and the applications processes are based on scientific development, the positivism philosophy has been effective in demonstrating the scientific view of the data that has been gathered considering the research objectives and the questions that have been developed (Hughes and Sharrock, 2016).

On the other hand, considering the research philosophy, there has been the use of deductive research approach to proceed with the research methods that have been used in the given research paper. It is to denote that the use of the deductive research approach has enabled the justification of the objectives that have been developed for conceiving the research paper. These objectives act as the hypothesis of the research paper that is the core foundation of the deductive research approach (Tjora, 2018). It is important to note that the selection of the deductive research approach has been effective in developing a link between the different approaches along with the processes that are present in the sustainable agriculture development with the ones that have been taken up by the Tamil Nadu agriculture department. The use of positivism research philosophy is more aligned with the use of the deductive approach to the research development process that has been the core objective for using the approach in the given paper. The deductive apache has enabled the identification of various sources, which have been effective in defining the results that have been obtained from the data collected for the research. The research is primarily focused on completion by using primary data, which restrict the availability of the resources (Kyngäs and Kaakinen, 2020). The use of the deductive approach has been effective in meeting the resources required to complete the research paper as well bring in better insights on the objections and the research questions that have been developed. The four months' time that has been allocated to conduct the given research has been utilized efficiently using the deductive research approach.

3.3 Research strategy

The research strategy helps in defining the research methods and the instruments that have been possibly used in the research in order to gather the required data and then analyse the data that has been gathered. In the given research, there has been the use of qualitative research strategies as it is more involved in the development of a research paper based on the open-ended communication-based research process. To gather data based on the sustainability usage in the

agriculture industry in the state Tamil Nadu, there is the requirement for carrying out effective communication with the different officers who are present in the industry and understand the different attributes of their sustainable processes (Lune and Berg, 2016). These data can be effectively developed by the use of the qualitative research process. The use of qualitative research strategies has been carried out in the given research considering the intensity of the research topic, which requires the understanding of the actual causes of the data that has been gathered. To understand the impact and the different attributes present in the sustainable agriculture development in Tamil Nadu, it is important to ensure that the research is being carried out by maintaining sight on the research meanings. The use of qualitative data allows the development of relationships among the various articles and theories, which have been developed prior in order to justify the existence of the source of the research analytics.

The use of the qualitative research strategy has been entailed in the given research paper in order to ensure that there is effective data present to develop the content which would help in meeting the research objective and further develop answers for the research questions that have been created (Abdalla *et al.* 2018). The focus of the qualitative research is mostly to understand the attitude of the research sources that helped in defining the finding that had been gathered in the research paper. There has been the use of a primary research data gathering process that can be judged to draw the results by analysing the behaviours and the body languages of the participant volunteered to provide the research with real-time data. This has led to a reduction in the number of expenses that might have occurred in the usage of quantitative research processes based on the primary data collection concept.

3.4 Collection primary data

3.4.1 Sources

In the given research, the data collection method that has been selected is the interview process. The selection of interview data collection has been carried out in order to ensure that the data are based on the exploration of the different attributes that could be possibly identified from the participants of the interview. The given interview has been carried out over Skype calling in due to location differences among the participants who have been selected for the research process. The interview-based data collection method has been selected to ensure that the data are accurate and real-time which would help in presenting the opinions of the participants of the interview.

The obtaining of the data has enabled the gathering of knowledge on the attributes of the response that has been given; the behaviours that have been presented while delivering the response, the feelings and attitude of the participants could be observed (King *et al.* 2018).

The participants that have been selected for the given research is based on non-probability sampling technique that involves the use of purposive sampling. The use of purposive sampling technique has been selected as the research has involved interviewing the agriculture officers that are present in the different departments of the agriculture production process (Etikan and Bala, 2017). This has led the focus of the interview participants to be majorly based on the agriculture industry and the officers who are involved with the development of innovation being a part of the sustainability approaches in the industry. There has been the section of five officers belonging to the administrative process, supply chain processes, farming initiatives and management process.

3.4.2 Access and Ethical Issues

In order to access the different resources and the data that has been gained from the data collection process, there has been efficient maintenance of the confidentiality of the background of the participants as requests from them not to disclose their background and personal identity. It has been noted that the development of confidential access to the data that has been collected in the research is important in order to maintain the integrity and originality of the research paper. This has further allowed the maintenance of ethical consideration in the research process by ensuring that the responses that have been gathered from the interview are not manipulated or biased with the agriculture industry that is operating in Tamil Nadu. The data that has been collected is entirely based on the responses that have been presented by the officers with quotes as stated with the original comparison being made from the theoretical paper that has been drawn to develop the literature review linking with the objectives and research questions.

3.5 Approach to data analysis

In order to analyse any data that has been gathered, it is important to use a data analysis approach that would help in guiding the researchers to develop links among the research objectives questions and the variables present with the data gathered. The given research is based on primary data collection methods that obtained its data from the use of open-ended interview questions. This had led to the use of descriptive data analysis technique. It has been noted that

the use of the descriptive analysis technique is highly important as it helps in developing an identification of the characteristics of the participants that has been interviewed on the research data collection process. The focus of the research is to gather knowledge on the sustainable agriculture that is prevalent in Tamil Nadu along with its various attributes present remarking the challenges and the different consequences faced by the industry in India. The focus has been highly evaluated by the use of descriptive data analysis technique.

The use of the descriptive data analysis technique has been selected for the research as the data that are gathered are based on real-time data that has not been manipulated by any individuals. This requires the presence of observations which is highly obtained by the use of the given analysis technique. The understanding of the response that has been obtained from the officers who are working in the agriculture sector of Tamil Nadu can be more prevalent and accurate using descriptive analysis process. Understanding sustainable agriculture development in any country or location is highly based on the development of a market research process that is more affordable and effective because of applying the descriptive analysis process. It has been noted that the use of qualitative study indicated the presence of theoretical aspects of the sustainable approaches present in the agriculture industry that has been used to understand and compare the barriers faced by the Tamil Nadu agriculture development process with the ones that are present globally. This leads to the presence and requirement of a cross-sectional study that is initiated using the descriptive analysis technique.

3.6 Conclusion

Thus, it is to be concluded that the research methodology that has been selected for the given research is highly focused on the development of accurate and real-time data by using interview data collection process that is a part of qualitative research strategy. There has been the use of descriptive analysis technique that has been maintained using strict ethical balance during the development of the results of the data.

Chapter 4: Presentation and discussion of the findings

4.1 Overview

In this part of the research, the interview will be conducted on the selected respondents through developing an open-ended questionnaire. The open-ended questions are helpful to get the feedback, opinions and ideas of the respondents elaborately. There will be 15 open ended questions, which will be answered by five selected respondents through their experience and knowledge in the field. Through this way, the researcher can develop knowledge about sustainable farming in Tamil Nadu along with its benefits and challenges. After the interview, a discussion will be done based on the answers given by the respondents to analyse the topic effectively.

4.2 Findings

4.2.1 What is the concept of smart farming?

Respondent 1: In smart farming, a management procedure is used to manage various aspects of farming using modern technology in order to enhance its benefits.
Respondent 2: The technologies such as scanning of soil, big data, GPS technology along with internet of things and others are used highly in the smart farming procedure. It is helpful to identify any issues and make effective solutions fast and with cost-effective procedures.
Respondent 3: Through using smart farming procedure, the farmers can monitor their farming procedure, any issues of improvements and take steps accordingly. It is helpful to develop awareness within the farmers and they can be more empowered regarding their work.
Respondent 4: Through using smart agriculture, the variations within the farming fields can be measured effectively along with various strategies for farming. Farmers can enhance the efficiency of using fertilizer, various pesticides and others more selectively.

Respondent 5: The smart farming procedure is helpful for the farmers to figure out their needs along with their animals and work on maintaining nutrition level accordingly. It is helpful to keep the farmers and their animals healthy and farmers can use their animals more efficiently in the field.

4.2.2 How does smart farming contribute to sustainable agriculture in Tamil Nadu?

Respondent 1: Through using smart farming, the farmers can plant various crops in the same field that will be useful to develop healthy soil, reduce erosion and pest control is also improved.
Respondent 2: Planting the cover crops is the part of smart farming that is mostly used at the time of off-season. It is helpful to reduce erosion and keep the soil healthy and reduce the requirements for herbicides.
Respondent 3: Through using smart farming, farmers can grow the plants without imposing higher effects on the environment. The farming procedure is fast and scientific through which negative impact on the environment is less through which sustainability can be maintained.
Respondent 4: The integrated pest management procedure is used in smart farming procedures through which the population of pests can be controlled without using the harmful pesticides highly. It can reduce the negative effect of farming on nature and foods, which is helpful to keep sustainability.
Respondent 5: Farmers can protect the plants, water resources and animals by mixing the shrubs and trees in smart farming procedure. The uncultivated and areas can also be treated through sustainable farming procedures that help in controlling soil erosion, protecting

nutrition and biodiversity.

4.2.3 How does sustainable agriculture can be beneficial?

Respondent 1: Sustainable agriculture is helpful to prevent negative impact on the environment in Tamil Nadu. The foods are healthy for people and animals are treated with respect that are associated with farming.
Respondent 2: Sustainable farming is helpful to provide financial benefits to the farmers and helps to develop rural communities in Tamil Nadu. It also helps to reduce soil erosion and maintain required nutrients in soil.
Respondent 3: The wastage of farming in sustainable farming procedures are controlled with proper planning through which the external environment is not affected negatively. The cost of transportation and purchasing fossil fuel is also reduced in this procedure.
Respondent 4: Through sustainable farming, various plants and animals are produced. The plants are planted rotationally that keeps the soil healthy, prevent disease and control the pests. The animals are also treated fairly, and they are grown in a natural way and not harmed for farming.
Respondent 5: The farmers are given the correct price for the farming so that they can live and grow. The usage of non-renewable energy resources is used less, and farming techniques are shaped to provide benefits to the environment.

4.2.4 How does organic farming contribute to sustainable agriculture in Tamil Nadu?

Respondent 1: The organic farming uses less to no pesticides that are harmful for the environment and people and the farming is done through developing effective scientific planning. It helps in maintaining sustainability in farming procedure.
Respondent 2: The food grown through sustainable farming is much healthier and safe for people because any harmful pesticides are not used for farming. The overall farming procedure is completed through a planned way so that it can contribute to sustainable farming procedure.
Respondent 3: The organic farming is planned in a way to rotate the plants in every season. It is helpful to reduce erosion of soil and contribute to conservation and sustainability.
Respondent 4: In order to execute organic farming, various measures are taken to control the soil erosion, pests and other harmful processes by using natural and scientific procedures. It is helpful to reduce negative environmental effects, develop healthy foods and maintain sustainability.
Respondent 5: Organic farming consists of the ways to impose less effect on the environment and foods that are farmed. It also takes lesser costs for the farmers by using certain scientific methods and contributes to sustainability.

4.2.5 What are the trends of agricultural production in Tamil Nadu?

Respondent 1: The government of Tamil Nadu has introduced various packages for the farmers for their development and contribute to the overall farming procedure. It can be seen through the growth of farming products over the last few years.
Respondent 2: Many farmers in Tamil Nadu are focusing on organic farming through which one can focus on using lesser to no harmful pesticides. The organic foods have separate market

demand that helps in growth of the farmers.
Respondent 3: The scientific methods for farming are highly used in Tamil Nadu in order to develop sustainability in the procedure. The farmers plant the crops and use various materials in a scientific way and those cannot have negative environmental impact.
Respondent 4: The farmers in Tamil Nadu get support from the government in terms of money and other supports. However, there are certain problems regarding water and electricity that restricts the farming procedure.
Respondent 5: The smart farming is mainly focused by the government of Tamil Nadu that supports organic farming along with maintaining sustainability in the procedure.

4.2.6 How do the natural hazards restrict the production of agriculture in Tamil Nadu?

Respondent 1: The natural hazards such as natural disasters can damage crops and can be the reason for huge economic loss for the farmers. A high number of crops can be damaged for which a number of farmers can face economic hardship for a larger time period.
Respondent 2: If the crops are damaged for natural hazards, then it cannot meet the demand in the market and for this reason, the price of the crops can be increased in the market. A larger number of people might not afford it due to its higher price.
Respondent 3: The natural hazards can restrict the farmers to play the corps at the correct time. In this context, the crops might not get required timing for growth and next season or off season might arise for which there can be a crisis for food.
Respondent 4: In the rural areas, not all the farmers have corrected training to deal with the

damages created by natural hazards. It is the reason, most of the farmers from rural areas face challenges due to high damage.
Respondent 5: The natural hazards can create damage on farming procedure and framers can face economic loss.

4.2.7 Why is integrated pest management necessary for maintaining sustainability in Tamil Nadu agriculture?

Respondent 1: The integrated pest management system is helpful to implement effective structure for farming and the plants can remain healthy that contributes to sustainability.
Respondent 2: The bio alternatives are used for controlling the pests that might have no to less negative environmental effect that helps to maintain sustainability.
Respondent 3: The nutrients in soil can be kept and no harmful chemical can be mixed within the food chain through using integrated pest management procedure.
Respondent 4: This procedure helps to restrict the exposure of people and other animals to harmful pesticide and they can remain healthy.
Respondent 5: Integrated pest management is a cost-effective procedure and it cannot harm the foods and maintain healthiness. The negative effect on nature is lower and it helps to keep sustainability.

4.2.8 What types of challenges are associated with maintaining sustainable agriculture in Tamil Nadu?

Respondent 1: I believe that the first and foremost challenge in maintaining sustainable agriculture in Tamil Nadu would be the lack of enough technological infrastructure. Our country lacks an enough framework along with the required skills to adopt the sustainable agricultural methods in Tamil Nadu.
Respondent 2: I think that the most important challenge of sustainable agricultural development in Tamil Nadu is the lack of adequate skills in engaging innovative technologies like Smart farming and artificial intelligence. Agriculturists in our nations, specifically our states are more interested to take up the profession as a part of their hereditary profession rather than learning about the new technologies to maintain agricultural sustainability
Respondent 3: I think one of the biggest challenges of maintaining sustainability in the agricultural activities of Tamil Nadu are the frequent changes in the climate. Tamil Nadu often faces extreme temperatures along with the deficit of adequate rains
Respondent 4: Looking at the current conditions of Tamil Nadu, I feel that the aspects of contamination in groundwater and shortage of water flows have largely affected the sustainable agriculture activities in the state.
Respondent 5: Most of the farmers are illiterate about the current innovation in agriculture and the policies of the government. They are ignorant about the right use of fertilizers and pesticides. These factors also pose strong challenges to maintaining sustainable agriculture in Tamil Nadu.

4.2.9 Why is managing an effective supply chain important for developing agriculture in Tamil Nadu?

Respondent 1: Only having skills in agricultural activities is not enough to conduct sustainable agriculture. Some additional responses are also required. The importance of supply

chain operations cannot be denied in this regard. I feel that having effective supply chain operations contribute to the reduction of losses of agricultural produces during the transportation process.
Respondent 2: I feel that an effective supply chain process is important in tracking the transportation and movement of the supply chain process and thereby contribute to the increase in procuring intact agricultural produce
Respondent 3: Having a robust technique in tracking the supply chain process contributes to greater visibility in the agricultural products transportation process
Respondent 4: Agriculture is one the major contributor to the overall economy of India, and Tamil Nadu is a significant contributor to the overall produce emphasizes on maintaining sustainability in agriculture. I feel that it helps farmers in having better control of the product safety and quality
Respondent 5: The importance of having an aggressive supply chain operation in agriculture helps in preserving better information about the flow of the products and technologies.

4.2.10 Do the issues about electricity and lack of water affect agriculture in Tamil Nadu?

Respondent 1: Due to the changes in the framework of electricity supplies over the last few years following the bailout packages, in the form of subsidized electricity supply, the impact is visible on the agricultural sector of Tamil Nadu.
Respondent 2: I feel that electricity-based groundwater irrigation has a significant impact on securing the supply of enough farm produce. Therefore, it is important for the Tamil Nadu government to come up with measures that will support the electricity-based groundwater irrigation to make the agricultural process easier.

Respondent 3: It is an evidentiary fact that Tamil Nadu faces severe drought due to extreme climate conditions. Due to the recent conversions of agricultural land for industrial use, the severity of the drought has increased.
Respondent 4: Tamil Nadu is said to experience incessant rainfalls for 9 consecutive months are possible opportunities to enhance agricultural production in the state.
Respondent 5: Due to multiple reasons including lack of proper irrigation facilities, failed water preservation provisions and lake rejuvenation projects tend to impact the agricultural prospects of Tamil Nadu.

4.2.11 How does the government help in developing sustainable agriculture in Tamil Nadu?

Respondent 1: I remember one of the schemes named **Seed Multiplication Scheme of Paddy,** which refers to the encouraging all the farmers in are given incentives based on the amount of Paddy to be provided.
Respondent 2: Yes, the government has certainly contributed to the development of sustainable agriculture in Tamil Nadu in areas of cereal development, water bodies restoration, and adoption of innovative techniques in agricultural activities.
Respondent 3: I believe that more effort needs to be given on restoring water.
Respondent 4: The **IAMWARM** seems to be significantly beneficial.
Respondent 5: The state-level support for developing sustainable agriculture in Tamil Nadu can be seen in multiple schemes likely seeds and fertilizers.

4.2.12 How pricing for farmers is affecting agriculture in Tamil Nadu?

Respondent 1: Yes, the aspects of variable pricing on the agricultural products of Tamil Nadu has a strong impact on the security of produces
Respondent 2: According to the CM of Tamil Nadu, it has been noted that an amount of Rs 10 lakh would be awarded to the farmer producer firms to secure continued production
Respondent 3: I think the pricing strategies have certainly impacted on the agricultural products that can be seen in the form of removing the agricultural product traders to pay 1% of the market fee as a token of their reasonable prices to the consumers.
Respondent 4: In case of any difficulty faced by farmers to sell their products in the market, they can contact the Deputy Director of Agriculture.
Respondent 5: I do not have much of an opinion regarding the pricing plans but I feel that it should be strategic pricing that would benefit both the farmers and the customers

4.2.13 Does the groundwater law affect sustainable agriculture Tamil Nadu?

Respondent 1: As far as I know it allows equitable access to groundwater
Respondent 2: It empowers the individual landowners to have control on the groundwater
Respondent 3: The overwhelming power bestowed to the landowners is just not right while considering groundwater to be the main source of water
Respondent 4: The level of contamination of the groundwater is a big challenge
Respondent 5: The law lacks the possibility of delivering enough availability of groundwater

at the aquifer level.

4.2.14 How does food festivals in Tamil Nadu contribute to sustainable agriculture?

Respondent 1: Most of the food festivals that have been organized by us were focused on increasing the overall awareness of the farmers on the different types of nutritional value that is essential to be present and maintained in the framing process.
Respondent 2: We have organized traditional food festivals in order to ensure that the different non-governmental organisations are able to understand the effect that has been put up by our farmers in order to develop a sustainable agriculture environment and process their farming attributes.
Respondent 3: the food festivals have helped in increasing the knowledge on the traditional food recipes that are present in Tamil Nadu. It further allowed the farmers to participate in the festival and bring out more productivity to theories of sustainable agriculture by understating the nutrients that are important to be present in the ingredients being farmed.
Respondent 4: I do not think the food festivals are effective enough in contributing to the process of developing sustainable agriculture as most of the profits that are obtained are retrieved by the owner of the festival who has sponsored it on the first hand.
Respondent 5: I think the major effect that has been provided by the development of food festivals is providing a platform to the farmers to highlight their skills in developing traditional food items that in future helps in increasing their ability to develop a network for farming.

4.2.15 How do training programs for the farmers and staff for monitoring farming can contribute to sustainable farming in Tamil Nadu?

Respondent 1: the training programs are beneficial as it helps the farmers to gain knowledge on the different technologies that are available to use for the respective farming crops and ingredients.
Respondent 2: the training programs help the farmers in increasing their skills in maintaining innovation in their farming process making it more reliable and effective.
Respondent 3: the training program helps in educating the farmers that further allows them to avail new processes and methods of inducing framing. These processes are mostly related to optimizing technological equipment.
Respondent 4: most of the farmers who are working in the remote areas are not educated thus; training them does not help in benefiting their farming process based on sustainability.
Respondent 5: the major benefit that is obtained is increasing the productivity of the farmers through an easy framing process and ensuring that the expense rate is also low for them.

4.3 Discussion

The agricultural farming in Tamil Nadu is ready to make a turnaround with the emerging market trends and the constraints in the availability of the inputs. The adoption of technology and modern methods in the agricultural process has enabled crop diversification and innovative practices in the agricultural fields as well as among the farmers (Lalwani and Lalwani, 2020). In order to develop and maintain sustainable agricultural products the livelihood of the small scale and marginal farmers in TN has undergone drastic changes with the new equipment and technology. Although there has been strong theoretical and empirical evidence that has been gathered in the research study through the help of the secondary data analysis about the condition of the agricultural practices and the challenges faced by the farmers, designing policies for the farmers is still a challenging task for the farmers. The involvement of the watershed development

within the agricultural production within intra-village operation is largely controlled by the TN Government and the district wise subordinate heads (Mehala*et al*. 2019). Moreover, to address the availability of the groundwater issues between the Cauvery war related issues that prevails between Karnataka and Tamil Nadu is a long term debate that affects the production of the agricultural and seasonal crops and this has been a considerable area of problem for improving the sustainability of the agriculture within the state.

The first question that is being asked to the interview participants by the researchers in the study focuses on the concept of smart farming practices in the agricultural profitability and development in Tamil Nadu. The respondents have replied that ***Smart farming technology***, along with the implementation of the autonomous and robotic technologies in the farming process have not only helped in bringing effective growth to the agricultural land but it has also enhanced the farmers for using modern technology. Many of the respondents have also agreed with the fact that smart farming processes have reduced the ecological footprints, and this has minimized the application of pesticides and other chemical fertilizers to the agricultural and harvested crops.

Smart farming has a sustainable contribution to the agricultural growth and development in TN and other Indian states. The researcher when interviewed selected research participants for evaluating the effective ***application of smart farming*** in increasing sustainable growth of the agriculture have stated that it has helped in saving the labourers efforts in working for prolonged hours in the scorching heat at the fields and has reduced the operational cost as well. Moreover, with the introduction of the modern approaches and technologies in the agricultural field the farmers have not only gained benefit in terms of gaining customer expectation, but this has also made them self-dependent and start their individual farming operations in the field. The training in using smart agricultural technologies and IT based tools in the fields have made the farmers self-dependent and this has increased the overall production of the agriculture within the state as well as outside the country.

The research participants have further explained that practising sustainable agricultural farming adds great ***benefit to the modern-day farmers*** as well. The overall human health benefits as well as environmental benefits can be largely obtained with the help of practising sustainable agriculture by the farmers (Immanuel, 2019). One of the research participants have explained

that the most important benefit of sustainable agriculture is that it helps in reducing the harmful chemicals and artificial flavours that are being added in the crop for making the crop look fresh for a longer period. Moreover, in terms of human health the crops that are being grown through sustainable agriculture are better for the people as they are not being exposed for consuming the synthetic materials. On the other hand, sustainable agriculture also helps in promoting the fertility of the soil through a proper decomposition process.

The effective ***application of organic farming*** improving sustainable agriculture is also a most common question that is being asked to the research participants while conducting the primary research method. The respondents have agreed that organic farming from the last few years has a significant contribution in maintaining the sustainability of agriculture. With the increasing population and stability in the agricultural production, the scientists have realized that *Green Revolution* and organic farming helps to increase the production of the agriculture in a sustainable manner (Benrajesh and Rajan, 2016). The respondents have further said that ***organic farming*** not only helps in improving the fertility of the soil but also helps in excessive management of livestock farming. Therefore, from the evaluation of the data that is being obtained it can be discussed that organic farming creates a positive impact to the farming system as well as conserving wildlife and contributing to environmental protection.

The respondents have analysed that in the recent time and by looking at the current agricultural production in TN the ***recent trends in the farming*** is to increase the yield per hectare for all the crops that are essential like wheat, rice, coarse cereals and pulses. Moreover, the respondents have also analysed that with the introduction and the growing demand for organic food products and agro based crops in the market, the effective implementation of organic farming practices can be considered as recent trends within the TN agricultural farming. Therefore, organic farming and the essential food crops are the most recent trends that helps in benefitting sustainable growth in agriculture.

While asking the respondents about the ***impact of natural hazards*** like drought and flood on the sustainable growth of agriculture the response came differently. The most important evaluation that is stated by the interviewees in this question is that drought in Tamil Nadu is a major concern for the farmers in maximum period of the year and this hinders the growth for sustainable agriculture. As Tamil Nadu is a state that comprises extreme humidity and climate

temperature rainfall is very less in the state and this often destroys the plucking of the new crop production. On the other hand, sometimes-heavy rainfall and flood damages all the fully-grown crops and therefore the natural hazards consequences cannot be more determined.

The importance of the ***integrated pest management*** is something that is also not neglected by the respondents in the interview questions. The researcher while conducting the primary research asked the respondents about the importance of pesticide control on the framing land. Majority of the participants believed that implementation of pest management acquires sustainable growth and it helps the farmers to protect the crops from being damaged by harmful pesticides. In order to increase the productivity level of the crops and improve the soil condition, pest management control is an effective measurement that helps in creation of sustainable agricultural practices (Deccan Herald, 2020).

Sustainable agriculture has its different set of challenges as it has been evaluated from the primary research findings. One of the ***major challenges*** that are faced by the farmers in TN are the extreme variations in the climatic condition of the state that does not allow the farmers to pre plan anything before harvesting any crop in any season. Moreover, the irrigation and availability of groundwater related problems is another major challenge that are faced by the agricultural farmers and it hampers the growth of sustainability in their profession. The lack of farmers' awareness on the Governmental policies and schemes for promoting sustainable agricultural practices is another challenge that grasps the framers of the crops.

The findings of the primary data have also identified that ***supply chain management*** has a significant role in distributing the crops to the consumers and the wholesalers thus gaining sustainable livelihood advantage. Moreover, the effective SCM process not only helps in gaining strong competitive advantage in the end but also is also capable of creating a cold storage facility for the farmers to store their perishable goods with the packaged goods and products (Baliah*et al*. 2016). Therefore, SCM in sustainable agriculture helps the farmers in cleaning, sorting and packing the products to create a greater marketing benefit. The respondents of the primary research analysis that is being obtained from the interviews have also agreed with the fact that water and electricity is a major area of concern for the people and farmers in Tamil Nadu. The long-debated issues on the Cauvery river crisis between Karnataka and TN have created a major challenge for various farmers. The ***lack of electricity problem*** in the district level and the

farming land has created a significant drop in the production level of the crops, thus affecting the sustainable development of the farmers. Moreover, the water crisis and the underground drainage system in the field is not well equipped and there is lack of Governmental support on this, which has hindered the way for developing irrigation facilities on the farming land.

The Governmental support and help for the farmer's sustainable growth and development is something that is not ignored even by the research respondents. The analysis of the data that has been obtained from the primary research signifies, that the Govt. of India have contributed largely in raising the funds for the farmers and providing them with farmers credit card facilities and loans. The ***financial funding*** that is provided to the farmers has not only helped in increasing the sustainable growth of livelihood but has also helped in promoting the expandable sustainable farming efforts through smart farming technology. The ***pricing of the farmers*** is not adequately granted as it has been analysed from the response of the interview conducted. The TN farmers want the right prices for their produce and not the subsidies they produce (Deccan Herald, 2020). However, the farmers' association have stated that the Government provides maximum price rise for the subsidiary that is being produced by the farmers and not on the original crop that is being harvested. This has incurred losses in their overall production and most of the farmers have quitted farming practices due to this. Therefore, the prices have created a negative impact on the sustainable agricultural practices in TN.

By looking at the crisis of the groundwater level in Tamil Nadu and considering the sustainable practices for the farmer's livelihood, the Government of the state has passed a Groundwater law that addresses the water crisis that prevails within the state. The information that is collected from the primary responses identifies that under the law the state can establish an authority to regulate the ***groundwater extraction*** within the state for solving the water crisis at the farming lands (Dar *et al*. 2018). Moreover, the law also granted permission to the state authority to seize the notified areas who will take an attempt to break the premises where the extraction for groundwater is taking place. Therefore, the law has largely affected the sustainable agricultural growth in TN positively.

In order to maintain the sustainable agricultural growth in TN, food festivals and various other agricultural crop festivals have a large contribution to the farmers' lives and sustainability development. It has been observed from the primary findings that the main objective for this

food festival is to create awareness among the uneducated farmers of the state of the new adaptation and benefits of smart farming and organic farming for engaging in gaining sustainable advantage. Moreover, farmers from various other states participate in the festival for promoting the sustainable agricultural practices thus benefiting the growth of the local farmers in their daily livelihood development (Anbu*et al*. 2018). The respondents have also signified about the importance of the ***agricultural training program*** for the farmers that have helped the farmers of TN in maintaining a sustainable livelihood. The short-term training sessions that are arranged for the farmers to train about the organic farming technology and latest procedures in smart farming have helped in yielding better productivity of the agriculture, thus benefiting in soil fertility and maintenance of sustainable agricultural practices.

The Thematic analysis of the discussion based on the answers provided by the respondents in the interview is given below:

Themes	**Codes**	**Analysis**	
Smart Farming	• Implementation of autonomous and robotic technologies • Contribution to sustainable agriculture	• Effective growth to agricultural land • Reduced ecological footprints • Minimised the use of pesticides and chemical fertilizers • Made farmers self-dependent	
Sustainable Agriculture	• Human Health benefits as well as environmental benefits • Benefits to modern day farmers	• Application of smart farming helps in saving long working hours of farmers and reduced in operational cost as well • Helps in reducing the harmful chemicals and artificial flavours usage • Crops grown through sustainable agriculture are not exposed to synthetic materials • Promotes a proper decomposition process	
Organic Farming	• Contribution to Sustainable Agriculture • Green Revolution • Wildlife Conservation and Environmental protection • Current Trends	• Maintains sustainability in Tamil Nadu Agriculture • Improves soil fertility and livestock farming management is getting better • Growing demand for organic foods and agro based products increases the organic farming practice	

	• To increase yield per hectare • Demand for Organic food products		
Government's role	• Natural Hazards – a barrier to agricultural production • Challenges to maintain sustainability • Lack of electricity & Water • Integrated Pest Management • Supply Chain Management • Groundwater Law • Pricing of Farming	• Drought and flood hinder the agricultural production in Tamil Nadu. • Implementation of pest control acquires sustainable growth as it helps to protect crops from harmful pesticides. • Lack of farmers awareness on Government policies and schemes is a major challenge • Effective SCM process helps to maintain competitive advantage • Pricing has created a negative impact among farmers which has incurred loss to their production • Groundwater law and lack of electricity supply affects the sustainable growth in TN	
Food Festivals	• Contribution to farmers and sustainability development • Promoting Sustainable agricultural practices	• Helps in creating awareness among uneducated farmers • Promoting sustainable agricultural practice through the harvest festival	
Training programs	• Agricultural Training Program • Creating Awareness	• Helped the farmers in maintaining sustainable livelihood • Helped in better productivity and benefitting in soil fertility	

4.4 Conclusion

This chapter gives a brief overview of the study through the help of the primary data analysis. The primary form of the research method through conduction of interviews and gathering their responses have been done in the findings part. Moreover, to evaluate the data that are obtained

from the primary research a discussion section is critically the researcher from the study has obtained elaborate providing a detailed analysis of the data that.

Chapter 5: CONCLUDING THOUGHTS ON THE CONTRIBUTION OF THIS RESEARCH, ITS LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.1 Implications of Findings for the Research Questions

The major implication that has been obtained considering the research questions that has been identified in the research ensure that the process of sustainable agriculture in Tamil Nadu is highly focused on the development of organic farming process and smart farming process. In terms of the different types of organic farming application that has been taken into account by the industry, it can be noted that not all organizations of farmers in the industry are able to gain full advantage of the sustainable agriculture process. Organic farming is highly effective in demonstrating the overall process of sustainability in the agriculture processes that are being used by the farmers in Tamil Nadu. It is important to note that there are various initiatives that have been taken in order to ensure that the farmers are being able to derive training on developing the organic farming process. As Tamil Nadu belongs to a developing country India, use of sustainable approaches has been considered highly important in order to increase the demand of the farm products and increase the overall quality through nutrition development in the different products and ingredients that are being farmed.

There have been varied instances identified through the data developed which focuses on developing integrated pest control measures that would help in reducing the usage of pest in the framing process and has been seen that the Tamil Nadu farming culture is highly active in carrying out such processes. The process of sustainability has been highly insured due to the changing climatic condition that eventually leads to a reduction in the value of the crops that have been produced. The climatic condition also leads to the destruction of the different crops that has also favoured the use of sustainable measures that helps in increasing the productivity measures of the farming process and further helps in developing fast development of the crops. The sustainable measures also help in increasing the demand for the quality crop items that are being procured by the Tamil Nadu agriculture department. It is important to note that there are

various schemes that have been developed under the Tamil Nadu government which have been recognised to be the SRI system. These schemes have been identified to be effective in reducing the overall consequences that are being faced by the farmers when they used the traditional method of farming which eventually led to high utilization of the smart farming process.

The data that has been gathered has been effective in drawing the above-mentioned context on the sustainable agriculture development that has been carried out in the state of India. The research questions that have been set up in the given paper have been effectively analysed using the appropriate form of the interview-based research process which helped in justifying the objectives as well as answering the questions. It has been noted that the researchers are entirely focused on the overall prospects of sustainability, as it has been able to draw its findings on the government strategies that have been developed in order to increase the potential of sustainable agriculture in the state. It has also ensured the productive analysis of the data gathered which did not involve any business towards the sustainable agriculture process being used in Tamil Nadu that can be further drawn from the negative response that has been developed by the participants who have been interviewed in the research paper.

The research findings are effective in developing an understanding of the ways in which the pest control mechanism has been important in order to increase the overall demand for the use of sustainable agriculture. There has been collective understanding on the various instances in which the research process can be considered productive and has been able to justify the questions through thorough and productive findings being developed on the roles that have been played by the supply chain processes that are used in the agriculture department of the state. Another major finding that has been developed and has been effective in meeting the overall process of the research is gathering data on the challenges that are being faced by the state while initiating the process of sustainability and the different solutions that are present to be applied to mitigate the challenges. There has been an effective understanding that the major challenges identified are based on the climatic condition, funding and rise in the price of the equipment that is to be used based on the sustainable agriculture process.

5.2 Contributions and Limitations of the Research

The research has been highly effective in developing an effective understanding of the sustainable agriculture process that has been carried out in Tamil Nadu. The research has allowed developing insights on the major consequences that would be faced by any location that wants to implement the process of sustainable agricultural operations considering the processes of development and availability of technology in the state. The research further helps in developing effective insights on the other regions of the country India that has been effectively focusing on the use of sustainable agriculture operations in the country and finally developing better growth and development rate in the agriculture sector. The research also helps in developing an instance of the process of pest control mechanism that plays a major role in initiating the sustainable agriculture base in any location. It has been noted that the research has focused on the training approaches and the educational programs that have been developed for the farmers, which further helped in gaining more insights and learned the process of carrying out sustainable agriculture and mitigating the challenges.

The major limitation of the research is that the use of the interview process only has reduced the varied opinions that could have been obtained on the agriculture sustainability process that is occurring in the state. The use of the survey could have allowed more instances on the view of the processes of suitable approaches that are being used in the state. Another limitation has been time contrast, which has reduced the ability of the research to be restricted to only the interview process only, and that budget was available to conduct the research.

5.3 Recommendations for Practice

In order to ensure that the practice of the research can be enhanced further, there are few strategies that could be used as stated below.

- It is important to note that more focus is being given on the process of developing better insight and bringing in more articles to compare the data that has been gathered from the data collection process.
- It is important to note that the use of more than one data collection process for the research and the development of hypothesis would help in increasing the in-depth analysis of the research paper.

- It is important to note that the practice of research could be further enhanced by using both qualitative quantitative research approaches that would not only allow the gathering of more than one type of data but will also allow the research paper that has been developed to be more insightful and accurate.

5.4 Recommendations for Future Research

In future, the research can be carried out with better insights to be developed on the technologies like smart farming and the different solutions that have been considered effective in mitigating the issues and challenges of sustainable agriculture as it has been occurring in Tamil Nadu. The research can be highly effective in developing more focus on the strategies that are essential to be used in order to increase the effective development of the sustainable approaches in the agriculture sector of India as well as other regions that have initiated the use of sustainable agriculture. There can be more insights developed on the economic benefits that have been developed through sustainable approaches in agriculture of Tamil Nadu in entire India. It has been noted that the research lacks emphasis on developing insights on the productive analysis of the sustainable approaches that are ongoing in the state and the ways in which these approaches could be further improved.

5.5 Final Conclusion and Reflections

Thus, it can be concluded in the given research paper that Sustainable Agriculture in Tamil Nadu has been gaining higher instances in the small and medium sized industries that are present in the state. According to me, it is important for the government of the state to provide more emphasis on the funding process and infrastructure development that would support further rise in the use of sustainable approaches and strategies in carrying out the farming process. I believe increasing the knowledge of the farmers by providing them with high knowledge on the research process is efficient enough to dwell into the deeper processes of sustainability. This would also help in making the farming process in Tamil Nadu to be highly engulfed in sustainable approaches.

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