Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Management

Bachelor's Thesis

Farmer's Motivation toward the Adoption of Sustainable Agriculture Practices in India (Economics Impact)

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

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Business Administration

Thesis title

FARMER'S MOTIVATION TOWARD THE ADOPTION OF SUSTAINABLE AGRICULTURE PRACTICES IN INDIA (ECONOMICS IMPACT)

Objectives of thesis

This thesis aims to ascertain the adoption of sustainable agricultural practices by Indian farmers. Understanding their awareness and acceptance is critical to forecasting the future of India's agricultural sector. An irreplaceable role is also played here by considering what effect the introduction of sustainable agriculture will have on the economy of farm management.

Methodology

The thesis will begin with a review of the literature. It will discuss the notion of sustainable agriculture in general and agriculture in India in particular. The evaluation will also look at studies suggesting farmers' perspectives on sustainable agriculture; however, the study paper will focus only on Indian farmers. The questionnaire will be filled out during personal interviews with fifty farmers; the research will attempt to interview fifty farmers. The empirical portion of the endeavor will employ a questionnaire survey to ascertain Indian farmers' perceptions of sustainable agriculture. One section of the questionnaire will contain questions to elicit information on Indian farmers' attitudes toward sustainable agriculture. The remainder of the questionnaire will include demographic questions on the respondent's age, income, education level, land ownership, employment, and economic impact on the expected implementation of new sustainable agriculture.

The proposed extent of the thesis

40 – 60 pages

Keywords

sustainable agiculture, India, economics,

Recommended information sources

Beedell, J., and Rehman, T. Using social- psychology models to understand farmers' conservation behavior. Journal of rural studies. 2020; 16(1): 117-127

Factors enabling and preventing farming practice change: An evidence review 2021, Journal of Environmental Management

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Reimer, A. P., Thompson, A. W., and Prokopy, L. S. The multi-dimensional nature of environmental attitudes among farmers in India: implications for conservation adoption. Agriculture and human values. 2019; 29(1): 29-40.

Socioeconomic determinants that influence the agricultural practices of small farm families in northern India 2021, Journal of the Saudi Society of Agricultural Sciences

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Expected date of thesis defence

2022/23 SS – FEM

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Electronic approval: 7. 2. 2023

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Declaration

I declare that I have worked on my diploma thesis titled Farmer's Motivation toward the Adoption of Sustainable Agriculture Practices in India by myself, and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that it does not break the copyrights of any person.

In Prague on 14.03.2023 _____

(B.Sc. Bc. Komal Aravindbhai Gohil, BA)

Acknowledgment

I would like to thank my research supervisor doc. Ing. Vladimír Krepl, CSc. for his help in preparing the thesis and invaluable recommendations and provided invaluable support from the beginning of the topic selection until the completion of the thesis. I want to thank all professors at the Czech University of Life Sciences for gaining knowledge in topical and agriculture.

Farmer's Motivation toward the Adoption of Sustainable Agriculture Practices in India

Abstract

The thesis aims to evaluate farmer's perspective regarding the adoption of sustainable agriculture practices. It finds out factors affecting farmer's motivation towards acquisition of sustainable agriculture practices. It depicts perception of farmers about sustainable agriculture practices. It also focuses on identifying factors influencing adoption of sustainable agriculture practices by farmers. The analysis is conducted on sample of one hundred respondents from India. The findings of analysis indicated that the reduction in production cost influences farmers the most in terms of adoption of sustainable agriculture practices. The respondents get motivated by government initiatives and other farmers for acquiring sustainable agriculture practices. Sustainable agriculture practices are useful as they protect environment as well as main long-term productivity of farming system. However, there are some difficulties faced by respondents in obtaining information about sustainable agriculture practices.

Therefore, the farmers should be trained for adequate implementation of sustainable agriculture practices. The government should conduct training programmes for farmers regarding implementation of sustainable agriculture practices and it should organize various seminars to create awareness among farmers regarding how to adopt sustainable agriculture practices and how to access credit from financial institutions which will help farmers in adoption of sustainable agriculture practices. The government should also conduct seminars on financial literacy which will in turn create awareness among farmers about various financial products available for obtaining credit.

Keywords: Sustainable Agricultural Practices, Farmer Motivation, Farmer Attitudes, Farmer Adoption, India

Motivace farmářů k přijetí praktik udržitelného zemědělství v Indii

Abstrakt

Práce si klade za cíl zhodnotit pohled farmářů na přijetí udržitelných zemědělských postupů. Zjišťuje faktory ovlivňující motivaci farmářů k osvojování udržitelných zemědělských postupů. Zobrazuje vnímání farmářů o udržitelných zemědělských postupech. Zaměřuje se také na identifikaci faktorů ovlivňujících přijetí udržitelných zemědělských postupů zemědělci. Analýza je provedena na vzorku sta respondentů z Indie. Výsledky analýzy ukázaly, že snížení výrobních nákladů nejvíce ovlivňuje zemědělce, pokud jde o přijetí udržitelných zemědělských postupů. Respondenti jsou motivováni vládními iniciativami a dalšími zemědělci, aby si osvojili udržitelné zemědělské postupy. Udržitelné zemědělské postupy jsou užitečné, protože chrání životní prostředí i hlavní dlouhodobou produktivitu zemědělského systému. Respondenti však při získávání informací o udržitelných zemědělských postupech čelí určitým potížím.

Zemědělci by proto měli být vyškoleni k adekvátnímu zavádění udržitelných zemědělských postupů. Vláda by měla provádět školicí programy pro zemědělce týkající se zavádění udržitelných zemědělských postupů a měla by organizovat různé semináře, aby zvýšila povědomí mezi zemědělci o tom, jak přijmout udržitelné zemědělské postupy a jak získat přístup k úvěrům od finančních institucí, které pomohou zemědělcům osvojit si udržitelné zemědělské postupy. . Vláda by také měla uspořádat semináře o finanční gramotnosti, které zase vytvoří povědomí mezi zemědělci o různých finančních produktech dostupných pro získání úvěru.

Klíčová slova: Udržitelné zemědělské postupy, Motivace farmářů, Postoj farmářů, Adopce farmářů, Indie

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List of Abbreviations

CAP	-	Common Agricultural Policy
FAO	-	Food and Agriculture Organization
FPO	-	Farmer Producer Organizations
GDP	-	Gross Domestic Product
I-O	-	Input-Output
NAPCC	-	National Action Plan on Climate Change
NICRA	-	National Initiatives for Climate Resilient Agriculture
SI	-	Sustainable intensification
TBL	-	Triple Bottom Line

1. Introduction

Agriculture is critical to human life and societal well-being. Agriculture is inextricably linked to society. Agriculture is the foundation for resolving current societal difficulties since eco-friendly agricultural methods may nourish ecosystems upon which civilizations rely. Ecological imbalances, pollution, climate change, food shortages, various illnesses, and malnutrition continue to be key global concerns for future generations.

Sustainable agriculture is a practice that involves implementing agricultural practices that safeguard ecosystems, the environment, and human health while still producing an acceptable quantity of grains, meat, plants, or any other type of agricultural product for societal welfare. Agriculture has fallen far behind other industries regarding technology acceptability for automation and farming operations control.

Because the majority of outmoded or traditional agricultural approaches have only produced a marginal benefit in terms of yield maximization or low production costs. These systems apply fertilizers and insecticides as inputs to boost output levels (Preusse, V., & Wollni, M. 2021). Agriculture's economic and social viability is impacted by technology and innovation.

Thus, during the last few decades, experts have developed an interest in examining the agricultural technology adoption choice (Tey & Brindal, 2012). Numerous studies on adoption decisions in agriculture have been conducted on a worldwide scale. For example, if we look at industrialized nations, some technologies have been investigated, and acceptance factors are found.

To optimize farmers' adoption decisions, it is necessary to comprehend the phenomena. The primary aim of Indian agricultural economics is to manage all these challenges that consider the consequences of farmer decision-making. The decision of farmers in India to accept any innovation has been thoroughly studied during the last few years. Additionally, these studies have been accompanied by various other fields of study, including sociology, economics, agriculture extension, psychology, and marketing.

As a result, most adoption model scans anticipate the adoption choice using the above parameters. According to prior findings, they advised that formal integration of communication routes, socio-psychological constructs, and innovation characteristics could be incorporated into adoption models. This proposal should be addressed better to understand the farmers' decision-making process about adoption. The present research aims to understand better India's agricultural practices and their adoption by Indian farmers.

The agriculture industry in the nation is special in several ways. By 2050, two-thirds of the world's population is expected to live in cities. Rapid urbanization is anticipated in low- and lower-middle-income nations, notably Asia and Africa (United Nations, 2019). Urbanization entails a shift in how land is used in and around cities. Fragmentation of agricultural land and loss of cropland due to urban expansion can result in more intensive agricultural production in smaller areas of land-intensive agriculture, for example, excessive use of chemical farm inputs.

This can pressure natural habitats and ecosystem services, affecting agricultural productivity (Cumming et al., 2014; Tscharntke et al., 2012; Wenzel et al., 2020). Competition for scarce natural resources such as land, surface water, and groundwater intensify between farmers, industry, and urban people. Apart from urbanization-related issues, peri-urban farmers1 in developing countries are also confronted with climate change-related challenges.

To deal with the consequences of these occurrences on agricultural production, they must develop adaptation and mitigation methods in response to increased weather variability and climatic shocks such as droughts, floods, or heat (Birthal & Hazrana, 2019). Recent studies in India imply that farmers may migrate from rural to urban areas due to climatic shocks and environmental change.

Other research discovers that rural farmers re-allocate labour to non-farm revenue activities in response to water constraints, with no evidence of on-farm adaptation measures. Due to the widespread availability of non-farm jobs in urbanizing regions, there is an opportunity cost associated with agriculture. On the one hand, higher salaries in the urban non-farm sector may entice younger, more educated family members away from agriculture.

We include crop production on the outskirts of cities and rural areas but exclude agricultural output within city limits and animal operations. On the other hand, a peri-urban setting offers farmers possibilities owing to the potential benefits of commercial agriculture. Urbanization may improve infrastructure development and accessibility to agricultural input and output markets, make financing and other services more accessible to households, and promote human capital development.

This may help farmers transition from subsistence to more varied and marketed agriculture. Although small and marginal farmers account for the bulk of Indian agriculture, they are connected through conventional value networks that lack supporting environments with institutional and infrastructural systems, insufficient resources, and efficient coordination within value networks.

Farmer Producer Organizations (hereafter referred to as FPOs) are founded to connect small farmers to the agricultural marketing system and to provide remunerative pricing with low transaction costs. G. Singh, P. Budhiraja, and K. Vatta 2018).

2. Objectives and Methodology

2.1. Objectives

This thesis aims to ascertain the adoption of sustainable agricultural practices by Indian farmers. It is critical to understand their awareness and acceptance to forecast the future of India's agricultural sector. The survey consisted of fifteen questions, which were separated into two groups. The first half of the survey asks farmers demographic questions, while the second half focuses on farmer awareness and adoption of sustainable agriculture in India.

2.2. Research Methodology

A small-scale survey containing yes/no questions and multiple-choice answers and open-ended questions is favoured as the study approach. The survey was distributed to other framers in a village near Ahmedabad via a local farmer to receive fifty replies. It is a brief online questionnaire comprised of fifteen questions separated into two sections. Participants are asked to submit information on two topics: (1) their basic demographic and socioeconomic situation, such as age, education, monthly income, land ownership, and current indebtedness; and (2) whether they are aware of sustainable agriculture methods and the reasons for adopting them. The survey has multiple choice and yes/no questions, except for the final question, which incorporates a Likert scale. Despite the author's lack of knowledge and easy access to data collection, he wishes to survey with the assistance of a local cousin. Although this thesis covers a large subject, the option to combine quantity and quality was a reasonable one. Thus, a mix of quantity and quality is the most appropriate strategy to obtain many replies, such as those in this thesis research. This method involves posing frequent and open questions to Indian farmers to collect responses from fifty farmers.

2.3. Thesis Flow

The remainder of the thesis is as follows. Continuing the literature study, it discusses the newest sustainability and agricultural trends among Indian policymakers and the concept of sustainable agriculture in general. The analysis concludes with a detailed explanation of the idea and perspective of sustainable agriculture through the eyes of Indian framers. The approach used in this work includes a brief discussion of the research design chosen, a rating of the construction, a description of the data acquired, and data analysis. Following that, the study's findings will be presented and discussed briefly. Finally, the report will conclude with findings, limitations of the current research, and recommendations for future research.

2.4. Data Collection

The thesis will begin with a review of the literature. It will discuss the notion of sustainable agriculture in general and agriculture in India in particular. The evaluation will also look at studies suggesting farmers' perspectives on sustainable agriculture; however, the study paper will focus only on Indian farmers. The questionnaire will be filled out during personal interviews with fifty farmers; the research will attempt to interview fifty farmers in total. The empirical portion of the endeavour will employ a questionnaire survey to ascertain Indian farmers' perceptions of sustainable agriculture. One section of the questionnaire will contain questions to elicit information on Indian farmers' attitudes toward sustainable agriculture. The remainder of the questionnaire will include demographic questions on the respondent's age, income, education level, land ownership, and employment.

2.5. Data Analysis

All findings were compiled and described in a thorough review series. The results are often straightforward and are obtained through a personal interview conducted rationally and attentively. The writer will examine the data in isolation and then complete his analysis. The study findings will be discussed further in the thesis's subsequent chapter.

2.6. Key Determinants

Sustainable agriculture practices have gained significant attention in recent years as a way to promote food security, protect the environment, and improve the livelihoods of farmers. In India, agriculture is a critical sector that employs a significant portion of the population, especially in rural areas. However, traditional agricultural practices in India have often been associated with negative environmental impacts, such as soil degradation and water pollution.

Sustainable agriculture practices, on the other hand, offer a more sustainable and holistic approach to farming that emphasizes the conservation of natural resources, improved productivity, and economic and social benefits for farmers and rural communities. In this context, it is important to evaluate the advantages and disadvantages of sustainable agriculture practices in India to understand their potential impact and challenges in promoting sustainable agricultural development.

Major Advantages -

- ✓ Environmental conservation: Sustainable agriculture practices aim to reduce the negative impact of agriculture on the environment by reducing the use of synthetic fertilizers, pesticides, and other harmful chemicals. This helps in conserving soil health, improving water quality, and protecting biodiversity.
- ✓ Increased productivity: Sustainable agriculture practices such as crop rotation, organic farming, and integrated pest management can help increase productivity by maintaining soil fertility, reducing crop losses, and improving plant health.
- ✓ Economic benefits: Sustainable agriculture practices can help reduce production costs, increase the efficiency of resource use, and improve farmers' incomes. This is especially important for small farmers who may not have access to the same resources as larger commercial farmers.
- ✓ Social benefits: Sustainable agriculture practices can improve the social well-being of farmers and rural communities by reducing the risks associated with farming, such as pesticide exposure, and increasing access to nutritious food.
- ✓ Climate change resilience: Sustainable agriculture practices can help build resilience to climate change by reducing greenhouse gas emissions, sequestering carbon in soil, and promoting drought and flood tolerance in crops.

Major Disadvantages -

- ✓ Limited knowledge and resources: Many farmers in India may not have the knowledge or resources to adopt sustainable agricultural practices, which can limit their ability to benefit from these practices.
- ✓ Initial costs: Some sustainable agricultural practices, such as organic farming, may require more investment upfront in terms of time and money to implement. This can be a barrier for small farmers with limited resources.
- ✓ Reduced yields: Sustainable agricultural practices such as crop rotation and reduced tillage may lead to lower yields in the short term, which can be a disadvantage for farmers who rely on high yields for income.
- ✓ Limited market demand: Although demand for sustainable agriculture products is growing, the market for such products may still be limited, which can make it difficult for farmers to sell their products at a premium price.
- ✓ Lack of government support: Despite the potential benefits of sustainable agriculture practices, there may be a lack of government support for farmers to adopt these practices, such as limited access to credit, technical assistance, and market infrastructure. This can make it difficult for farmers to transition to more sustainable practices.

Overall, while there are some challenges associated with adopting sustainable agricultural practices in India, the benefits can be significant in terms of environmental, economic, and social sustainability.

3. Theoretical Part

3.1. Sustainability Concept

While the term sustainability is now one of the most often used in the scientific community in general and in the environmental sciences, tracing the emergence of such a notion is a challenging task. This is because records of frequently using a phrase, whose use in contemporary lexicon and political discourse is so prevalent, are dispersed. Until the late 1970s, the term sustainability was rarely used, usually to refer to the appropriate use of forest resources.

In other words, it has significant ties to the forestry sector, which some say is where it began. Apart from that, the term sustainability has historically been used interchangeably with terms such as long-term, durable, sound, and systematic. Indeed, when not used in conjunction with the English language, sustainable development is sometimes referred to as durable development in French, with word-for-word equivalents in German, Spanish, and Portuguese.

A critical question that one may raise at this point is repeated daily by millions of individuals worldwide (Leal Filho, W. 2000). The term sustainability was coined in Neo-Malthusianism discussions throughout the 1960s and 1970s, and its primary objective is to highlight the health of the natural environment. Sustainability is an ethical manner of behaviour, preferably habitual, in which an individual or organization seeks to minimize adverse consequences on the environmental, social, and economic domains and to maintain a harmonious connection with those domains conducive to a thriving existence (Hoffman, W. M., & McNulty, R. E. 2011).

The vagueness and polysemy of the term sustainability are frequent contentions for scholars. The prevalence of non-operative, different, and even contradicting definitions complicates selecting a viable idea of sustainability. (OrtizMuoz, S. M. Even most research articles that mention sustainability in their titles do not define it, which represents a methodological mistake. Scholars and researchers frequently use sustainability to incorporate a set of social-environmental criteria or attributes into human activity.

These activities might be connected to goods or processes, but they always indicate links between humans and ecosystems. As a result, these acts might constitute a component of social-ecological systems. Thus, from this vantage point, sustainability is defined as incorporating or applying social-ecological criteria or characteristics throughout the planning, design, and operation of specific reference systems (OrtizMuoz, S. M. 2019). Sustainable agriculture has become a popular buzzword for agricultural practices that are ecologically responsible, productive, commercially viable, and socially desired.

This article discusses the growing interest in agricultural sustainability (primarily the unintended, negative consequences of conventional farming), the proposed ends and means of sustainability, and two frequently debated issues — the profitability of sustainable farming and the adequacy of food production from sustainable systems. Agricultural sustainability is difficult to define precisely because it entails a way of thinking and a method of farming operations.

The latter cannot be described as definitive solutions. As a result, individuals' views and values will continue to shape public perceptions of the notion. Two distinct perspectives on sustainable agriculture exist. One is that fine-tuning traditional agriculture through more cautious and efficient farming with sensitive technology can mitigate or remove many of conventional agriculture's negative consequences. The other is that substantial agricultural reforms are required, requiring a significant shift in cultural attitudes.

Those who feel that only minor adjustments are necessary frequently contend that sustainable agriculture is intrinsically unprofitable. If broadly implemented, it would not be as effective in feeding the world's growing population as traditional agriculture. Those who feel that more fundamental changes are required in traditional systems argue that sustainable farming even more profitable than conventional farming, particularly when all the benefits and costs of farming are included in the profit calculation.

Additionally, resource conservation, environmental preservation, and farming in collaboration with nature all contribute to increasing, not decreasing, global food production. Other challenges, such as the links between sustainable agriculture and the rest of the food and fibre system and the consequences of sustainability for rural communities and society, have yet to be addressed (Caldwell, L. K. 1998). Although sustainability has been articulated in many ways, the objective has frequently been the physical preservation of human civilizations and their cultures, institutions, social structures, and regimes.

Psychological, behavioural, and institutional variables have affected how humans comprehend and manage their economic and environmental concerns and the importance of sustainable sanative aims and practices. Science exerts a strong cognitive impact on how people see their surroundings in the current world. The consequences have been inconsistent. While science as a servant and creator of technological innovation has resulted in significant gains in human existence, it has also powerfully reinforced the notion of conquest of nature, which has far too frequently resulted in environmental destruction due to improperly deployed technology.

Science as a teacher enables us to comprehend how the natural world works but has been less successful in explaining human behaviour. The future viability of human society is contingent upon people's ability and desire to direct their behaviour and institutions toward ecological integrity in their interactions with the environment. For this purpose, a logical and informed idea of sustainability must be integrated into human society's ethos and ethics and applied critically to conceptions of growth, development, and the environment (Caldwell, L. K. 1998).

The link between human actions and the planet may be characterized by resource depletion and its repercussions, including environmental pollution, global temperature increase, ocean acidification, ozone layer thinning, deforestation, excessive water waste, and species extinction. The food supply chain and its phases can be viewed as significant resource users and contributors to environmental pollution. Indeed, food operators have undertaken several initiatives to mitigate the food sector's environmental impact, including increasing biodiversity, protecting the environment, reducing food waste, and raising consumer awareness about these issues.

These issues are connected to achieving the three goals of sustainable development, i.e., the triple bottom line, which is sometimes aided by institutional interventions, to pursue economic growth while safeguarding natural resource conservation through the integration of the circular economy concept (Bollani, L., Bonadonna, A., & Peira, G. 2019). To incorporate these notions, it is necessary to update consumption habits that impact the dynamics that lead to the production of products and their use.

High-income per capita countries appear to have followed a path of change supported by the phenomenon of qualitative substitution, which, in its most virtuous connotation, demonstrates a feasible strategy for maintaining food expenditure while reducing waste, including through a return to a circular economy long forgotten, such as the peasant economy. However, so-called sustainable food items have pricing constraints that are often greater than traditional products, excluding low- and middle-income customers and limiting their spread. Additionally, the difficulty of locating them and the little customer understanding of the issue further diminish the financial viability of these items.

Nonetheless, some customers are beginning to adopt more sustainable consumption habits. The change may be ethical, such as concern for animal welfare, environmental, such as the pressures produced by intensive farming, health-related, such as reduced saturated fat consumption, or cultural, like the Mediterranean diet.

To address these needs, governmental and commercial sector actors have devised a variety of measures to boost consumption in the food industry, including the European quality system for organic farming and certification and labelling schemes emphasizing a food product's sustainability (Gayevskaya, Z. A., & Rakova, X. M. 2014). On the one hand, these new market dynamics in terms of products and associated services are critical components of the system's transformation processes.

Indeed, they have the potential to contribute to the creation of value for a variety of stakeholders. On the other hand, it appears reasonable to enquire about consumers' interest in and perceptions of various initiatives. A comprehensive perspective is the most suitable way to analyse the various facets of sustainability.

3.2. Sustainable Agriculture

Sustainable agriculture aims to meet civilization's nutritional demands, even though future generations of agricultural practitioners lack the cooperative ability to manage their issues and needs. Sustainable agriculture is a hot topic of discussion and controversy in many parts of the world. The disagreements are motivated by divergent views on what constitutes sustainable agriculture.

Sustainable agriculture is described as a system that over time, improves the environmental quality and resource base upon which agriculture depends; meets basic human food and fibre needs; is economically viable, and improves the quality of life for farmers and society. Numerous meanings evolved from this remark, but the principle of agricultural sustainability remained constant.

Additionally, sustainable agriculture is a dedication to meeting human food and fibre requirements while also improving the quality of life for farmers and society, both now and in the future. As a result, no concise, universally agreed definition of sustainable agriculture had developed yet. This is because sustainable agriculture is frequently considered a management philosophy rather than an operating technique.

Accepting or rejecting any definition is highly subjective and dependent on one's value system. However, regardless of its specific definition, most agriculturalists believe that sustainable agriculture is critical to the long-term viability of our biosphere and its ever-growing human population. Sustainability is predicated on a 'Triple Bottom Line (TBL)' approach that considers environmental changes and their influence on society (people), the environment (planet), and economic value (profit). It is increasingly recognized that the aspects of people, profit, and the environment are inextricably intertwined.

A significant challenge for public and commercial policy is considering them all (Finn, J., Kelly, E., & Uthes, S. 2016). Agriculture has seen enormous transformations, particularly after World War II. Productivity in food and fibre rose due to modern technology, mechanization, greater chemical usage, specialization, and government regulations that favoured output maximization. Agriculture is vulnerable to climate variability and its associated consequences (Janker, J., Mann, S., & Rist, S. 2019).

Food security and the preservation of a healthy ecological balance are key concerns for philosophers, academics, environmentalists, and policymakers. Sustainable agriculture should be viewed as an ecosystem approach in which soil, water, plants, and other living things coexist in peace with a well-balanced equilibrium of food chains and their associated energy balances.

The objective is to address environmental concerns associated with natural resource management to sustain significant increases in farm productivity through efficient use of land and other resources while also providing individuals with higher economic returns and contributing to the overall quality of life and economic development. It is critical to employ innovative technology to promote sustainable agriculture and production through advanced irrigation systems, better varieties, enhanced soil quality, and resource conservation technologies.

While these modifications have had several beneficial consequences and decreased numerous dangers in agriculture, they have also incurred enormous expenses. Among these include soil depletion, groundwater contamination, the demise of family farms, persistent disregard for farm laborers' living and working circumstances, rising production costs, and the breakdown of rural communities' economic and social situations. Sustainable agriculture arose due to a rising critique of the adverse environmental impacts of unchallenged current farming practices.

While sustainable agriculture is still relatively new, it has gained increasing support and acceptance within conventional agriculture. Sustainable agriculture solves several environmental and social challenges, providing farmers, consumers, and policymakers with new and commercially viable alternatives. This study aims to catalogue the concepts, practices, and policies that comprise our definition of sustainable agriculture. The agriculturalists' difficulties revolve around the agricultural engineers' ability to design and apply modern technology that will enable farmers to maintain and grow agricultural product yields while boosting ecological efficiency (Janker, J., Mann, S., & Rist, S. 2019).

Developing a composite indicator of agriculture's environmental impact is a challenging task. B. Czyewski identifies twenty-five different markers of environmental sustainability. Water use, agricultural subsidies, climate change, agricultural productivity, ecosystem biodiversity, and land usage were critical factors. Other perspectives include pesticide, herbicide, and fungicide usage in agriculture and organic and synthetic fertilizers, plant protection products, and crop rotation (Czyewski, B., Matuszczak, A., & Muntean, A. 2019). In the 1990s, the phrase eco-efficiency was coined as a practical way to quantify sustainability. The World Business Council for Sustainable Development refers to a management philosophy that encourages enterprises to seek environmental changes resulting in economic gains.

A viable approach to farm sustainability is determining whether environmental impacts reduce or grow in proportion to the value of financial products. However, we are concerned about whether such an increase in eco-efficiency reflects an increase in sustainability, which we define as the responsible use of ecological resources that meet human needs while preserving them for future generations. The eco-efficiency ratio quantifies the proportional magnitude of environmental pressure concerning economic activity volume.

Sustainability is more closely related to the absolute levels of environmental pressure. Thus, the eco-efficiency strategy may appear to be at odds with environmental sustainability, which should consider the environmental impact of farms. Additionally, the EU Common Agricultural Policy is evolving. In addition to its basic aims of food safety and financial assistance for farmers, the policy includes additional objectives such as environmental stewardship and the development of public goods, particularly environmental ones.

Thus, it is important to determine how agricultural support provided via various Common Agricultural Policy (CAP) programs contributes to the improvement in the eco-efficiency of farms and the extent to which it contributes to their eco-effectiveness. A conflict between eco-effectiveness and eco-efficiency is possible at this stage since policy supports programs that significantly influence eco-efficiency concerns and those that prioritize eco-effectiveness. This conflict obstructs agriculture's long-term development.

Thus, the findings of this research will contribute to the debate over the EU's Common Agricultural Policy's future after 2020 and national and regional agricultural policies. The critical question is whether output measures should be utilized in input-output (I-O) methodologies to assess environmental sustainability. Additionally, current agricultural finance helps achieve sustainable development goals, and to what extent does it consolidate the industrial model of production - where efficiency will be critical (Czyewski, B., Matuszczak, A., & Muntean, A. 2019).

Perspectives Economic and Social - Sustainability is applied to farmers and rural communities and assures long-term food production and environmental quality. For many observers, agriculture's sustainability can be quantified by examining its economic returns. Farms cannot generate adequate profits in commercial economies due to low farm product prices, decreased yields, increased production expenses, or other non-self-sustaining factors.

As a result, agricultural sustainability requires the availability of economic returns sufficient to maintain farm companies and appropriately compensate producers. Additionally, a more extensive definition of sustainable agriculture incorporates the notion of farm viability into the preservation of rural community systems. According to this view, the best chances for environmentally friendly agriculture that is efficient in food production and equitable in benefit distribution exist when agriculture operates within a healthy rural community framework that prioritizes local decision-making and stewardship.

The concept of fairness spans food, environmental, and producer goals and is widely used to describe sustainable agriculture. For many, sustaining productive capacity, ecological integrity, or family farming through time is a critical component of sustainability. Thus, intergenerational fairness in agriculture refers to safeguarding future generations' rights and chances to benefit from today's resources. Agricultural techniques that jeopardize long-term food production prospects, degrade water quality, or degrade other natural resources are not considered sustainable regardless of their short-term advantages.

Concerns about equity are not confined to ensuring agriculture's future. The notion has been used to explain the rights of disadvantaged groups in society to access basic food supplies and the opportunity and resources necessary to farm sustainably. Thus, intergenerational equity refers to the equal sharing of agricultural advantages within and among countries, regions, and social groupings (Mohammed S., and M. L. Attanda 2013).

3.3. Global Perspective

Artificial intelligence is advancing at a breakneck pace due to the global industrial, current scientific, and technology revolutions. The emergence of modern artificial science and technology systems enabled farmers to save time, labour costs, and personnel while facilitating the speedy delivery of commodities across great distances. Social groupings and nations become increasingly dependent on other countries for food and products.

This global behaviour resulted in enormous advantages for global civilization, including increased human life expectancy (Lichtfouse, E., Schwarzbauer, J., & Robert, D. (Eds.). 2011). On the contrary, this also has global repercussions, such as World Wars I and II. Additionally, global agriculture is impacted by artificialization through global climatic changes, monsoon changes, decreased gross domestic product (GDP), increased global average temperatures due to greenhouse gas emissions, occupational health risks, and pollution in the air, water, and soil (Lichtfouse, E., Schwarzbauer, J., & Robert, D. (Eds.). 2011).

However, as human-induced ecosystem simplification and species loss increase globally, a substantial corpus of experimental and theoretical research examining the impacts of biodiversity loss on ecosystem functioning has developed. Our civilization must prioritize numerous environmental features, from agricultural output and crop impregnation to preserving sustainable species populations.

Thus, a critical evaluation must investigate the consequences of species loss on many ecosystem functions concurrently to determine whether sustainable agriculture may help bridge the divide between an affluent society and a healthy ecosystem (Polasky, S. 2002). Sustainable agriculture aims to maximize society's benefits from the agricultural production of food, fibre, and ecosystem services. This will need enhanced agricultural productivity, increased nitrogen, phosphorus, and water usage efficiency, improved soil nutrition, pollution-free air, ecologically sound management methods, prudent use of pesticides and antibiotics, and significant modifications in some livestock production practices.

Fundamental advances in agroecology, biogeochemistry, and biotechnology related to breeding programs can significantly contribute to sustainability (Polasky, S. 2002). The fundamental interaction between sustainable agriculture and the ecosystem in terms of biodiversity. The actual developments in nanotechnology are spreading throughout physics, engineering, chemistry, and biology, agriculture, and food sciences due to technological convergence (Naeem, S. 2012).

However, public perceptions and regulatory understanding are markedly different regarding nanotechnologies in agriculture and food. As a result of the controversy over the use of genetically modified organisms in agriculture and food, nanotechnology uses, and the ecosystem's relationship with humanity. The loss of biodiversity and its consequences for humans have been demonstrated (Naeem, S. 2012).

Biodiversity is the most remarkable characteristic of an ecosystem's activities and services. Biodiversity loss can have a detrimental effect on the ecosystem's functioning and services. Ecological services are contingent upon biodiversity and ecosystem function. Ecosystem services are a collection of benefits provided by ecosystems to humankind. Regrettably, the reality of the planet reflects that human actions are destabilizing ecosystems, eradicating genes, species, and biological features at an alarming rate, resulting in worldwide severe changes and challenges.

One of the necessary components of developing a healthy society is a sound eco-friendly socioeconomic theory for the sustainable use of global resources to ensure the welfare of all inhabitants of the world's ecosystem. Nanomaterials are frequently subjected to scrutiny, even by authorities. Despite decades of scientific and regulatory debates concerning the advantages and hazards of nanotechnology in agriculture and food, it remains challenging to acquire an overview of the present status of research and development in this field (Pramanik, S., & Pramanik, G. 2016).

Thus, integrating nanotechnology into agriculture in an eco-friendly manner may benefit agriculture's long-term growth. Additionally, the primary component required for establishing a healthy society is a sound eco-friendly socioeconomic theory for the sustainable use of global resources to ensure the welfare of all individuals who share the earth with humans.

3.4. Indian Scenario

Several factors determine agricultural production. These include the availability and quality of agricultural inputs such as land, water, seeds, and fertilizers, access to agricultural loans and crop insurance, and the certainty of remunerative pricing for agricultural products. This study summarises the current situation of agriculture in India. It examines issues affecting agricultural productivity and post-harvest activity.

Apart from providing a living for farmers and labourers, the agricultural industry also contributes to the nation's food security. The United Nations Food and Agricultural Organization (FAO) defines food security as a state where all people have physical and economic access to adequate, safe, and nutritious food that fits their dietary needs and food choices for a healthy, active lifestyle. 10 Despite the country's elevated levels of output, 15% of the population remains malnourished.

In 2013, India adopted the National Food Security Act. The 2013 Act aims to ensure people's food and nutritional security by ensuring they have access to an appropriate supply of nutritious food at affordable costs. The 2013 Act provides subsidized food grains (wheat, rice, and coarse cereals) to specified groups of people. As of 2015, the Act covers 68 percent of the population, or eighty-one crore people (77 percent of whom live in rural regions and 23% in urban areas).

With rising per capita income and increased availability to a range of food groups during the last few decades, the country's food consumption pattern has shifted (Deshpande, T. 2017). The reliance on grains for nourishment has declined, whereas protein consumption has grown. Protein sources include lentils, meat, fish, and eggs. According to Finance Ministry research on incentives for pulse production in the country, low nutrition levels imply that the government's policy focus should increase protein consumption.

According to the analysis, pulses are a more affordable source of protein than other types. India is now experiencing a pulses scarcity, which is being compensated for by imports (Deshpande, T. 2017). Agriculture is a victim of climate change and its perpetrator (Kang and Banga, 2013). Climate change impacts a country's food security and economy, particularly in a developing country like India. For instance, Climate change will affect all four dimensions of food security: food availability, food accessibility, food consumption, and the stability of food systems.

It will affect human health, livelihood assets, agricultural productivity, and food delivery networks. Global Warming and Its Potential Impact on Agriculture in India Climatic change and climate variability affect all agricultural commodities (Chauhan, B. S., Mahajan, G., Randhawa, R. K., Singh, H., & Kang, M. S. 2014). India's current population is predicted to surpass Japan's in the next two decades, and its economy will shortly exceed Japan's to become the world's third largest.

Increased agricultural productivity or increased food imports will be required to meet the ensuing rise in food demand. Regulation of land ownership is a significant institutional issue limiting agricultural production in India. Before independence, the government enacted land reforms that capped property holdings to address India's extremely concentrated land ownership structure. As a result, many small, family-owned farms dominate India's agriculture.

According to the most current estimates, around one hundred million families participated in agricultural production in 2002, accounting for 70% of all rural households and falling just slightly short of the percentage of rural households engaged in agriculture in the early 1960s. Over the last 50 years, the proportion of farming households tending plots of land less than one hectare has increased from 60% to just under 80%, while the average farm size has decreased to around one hectare, with only 12% of households farming more than ten hectares (Cagliarini, A., & Rush, A. 2011).

By the early 1990s, most Indian states had implemented tenancy laws granting ownership to tenants who could afford to purchase the land they farmed at a reasonable price, reinforcing the decade's trend toward growing fragmentation of landholdings. Additionally, the growth of the RBA population has resulted in smaller landholdings. In contrast, the partition of original family landholdings over generations has left many families with land holdings that are insufficient to generate an acceptable revenue source.

Farmers with tiny landholdings are unwilling to employ capital-intensive farming practices, as the productivity increases from capital-intensive farming techniques such as mechanization and economies of scale are negligible. Additionally, larger landholdings enable farmers to participate in multiple crops, which reduces their vulnerability to severe weather circumstances and diversifies their revenue source (Cagliarini, A., & Rush, A. 2011).

Private investment in agriculture has also been constrained by limited access to finance and insurance; however, access has increased significantly over the last decade, with lending to agriculture rising. Rural Areas and Urbanization - Rural communities' localized character, seclusion, and self-sufficiency have been undermined. They now have many ties to metropolitan regions whose limits are expanding, with urban lifestyles significantly affecting rural living patterns.

Three distinct strata form in rural communities: a wealthy elite at the top with a solid outward orientation and significant economic and political influence; an intermediate layer of energetic farmers with agricultural origins; and landless or landless rural poor. Village identity has deteriorated (Mishra, M. 2013). Nobody wants to live in the countryside; even the poor prefer urban slums! While infrastructure and services have improved, communities show a gloomy picture.

Villages must be viewed as open systems while developing a rural development plan. While maximizing local resources' use is critical, it would be a mistake to expect that this will suffice to create rural areas (Chandra, D. G., & Malaya, D. B. 2011, April). The transformation mentioned above in rural communities must be considered in the broader trend of urbanization, in which urban limits grow spatially and rural bounds contract.

Certain villages expand in size and finally acquire metropolitan characteristics. The average distance between a hamlet and a city decreases. Rural residents increasingly work in surrounding metropolitan areas and progressively become urbanites. The idea is that urbanization is not synonymous with rural migration to cities and towns. It entails the spatial spread of urban and rural regions adopting urban characteristics and the development of urbanite-like populations in rural areas.

The percentage of rural residents who live in the metropolitan areas is an insufficient metric of urbanization since an increasing number of rural residents will begin to look, think, and behave like urbanites. Our perceptions of rural people as passive victims living in seclusion and subsisting on agriculture need to shift. It may not be as simple for policymakers in the future as it was in the past to disregard agriculture and stay insensitive to rural people's plight. (V. M. Rao 2008)

Agriculture in India after COVID-19 - COVID-19 has disrupted a few agribusiness and supply chain operations. Fundamental reports indicate that the inaccessibility of temporary employment is impeding some collection efforts, particularly in northwest India, where wheat and heartbeats are gathered (Kanagavalli, D. G. 2020). Supply chains experience disruptions because of transportation challenges and other factors. While costs for wheat, vegetables, and various yields have decreased, purchasers continue to pay more.

According to media sources, the closure of inns, cafés, sweet stores, and coffeehouses under the lockdown is now inhibiting milk transactions. Meanwhile, falsehoods have gravely harmed poultry ranchers, particularly those spread via web-based social networking sites, claiming chickens are carriers of COVID-19 (Kanagavalli, D. G. 2020). The Covid-19 epidemic has had a tremendous effect on the world economy. Before the pandemic, the global economy faltered, unemployment grew, and high inequality levels.

Unemployment was increasing. Every country was accumulating debt. Thus, the epidemic first struck a frail global economy in February and March 2020. As a result of the stringent lockdowns, most economical operations came to a standstill. This created immense uncertainty, not merely about rapid economic growth and people's lives but also about the very viability of capitalism in its current form (Khanna, A. 2020). If not halted, a lockdown implies that the production and supply of products and services are interrupted.

Consumption of goods and services is insufficient to fulfil current demand. Simultaneously, as economic units close, individuals lose employment and earnings. When lockdowns are in effect, people refrain from purchasing products and services. As a result of decreased consumption, aggregate effective demand decreases as well. Recent crises in the real global economy have been triggered by either demand slowdowns, supply shocks, or financial market speculation (Ramakumar, R. 2020).

The Covid-19 shutdown was remarkable in that it resulted in a decline in both demand and supply. This was not a typical occurrence; only a few times in history has such a convergence of demand and supply shocks happened simultaneously in all economies due to a non-economic, exogenous factor. When economic activity is decreased, most debt repayments cease. On the other hand, a protracted shutdown may result in a banking and financial disaster.

Export-dependent sectors will see a decline in export demand and pricing. In industries that rely on intermediate products or raw materials, imports and, consequently, manufacturing cease. Covid-19 and Agriculture remittances, eroding foreign exchange reserves. Thus, the pandemic evolves from a health catastrophe to a worldwide economic crisis (Ranasinghe, R., & Herath, J. (2021). It is self-evident that such a pandemic would negatively affect agriculture.

Through begin, farmers encounter challenges in all aspects of farming, from input acquisition, seeding, and labour use, to harvesting, selling, and processing. Labour utilization issues are more apparent in places that rely heavily on migrant labour. Supply chain disruption results in contracting markets and declining output prices. In terms of consumer pricing, even if farm gate prices drop, market arrangements and supply chain disruptions might increase retail costs.

Consumers have difficulty obtaining enough food at reasonable rates. Inadequate food supplies and rising retail food costs increase hunger and malnutrition, particularly among the poor (Ranasinghe, R., & Herath, J. 2021). COVID-19's unparalleled spread should serve as a wake-up signal for us. This epidemic is unquestionably putting the whole food chain system to the test. It is past time for action, and farmers' efforts must be prioritized alongside police and health personnel.

3.5. Influencing Factors

Agricultural systems are modified ecosystems that exhibit a range of characteristics. Agro ecosystems in the modern age have evolved toward high throughput systems, with energy supplied by fossil fuels being diverted out of the system (deliberately for harvests or accidentally through side effects). In the future decades, agricultural systems will be impacted by resource limits related to water, soil, biodiversity, and land. Sustainable Agro ecosystems benefit natural, social, and human capital, whereas unsustainable systems deplete these assets, leaving less for future generations (Pretty, J., & Bharucha, Z. P. (2014).

Sustainable intensification (SI) is a technique or system that increases agricultural production without causing severe environmental impacts or requiring more non-agricultural land to be converted. The notion does not express or advocate for any agricultural vision or technique of production. Rather, it prioritizes outcomes over means and does not predetermine technology, species composition, or specific design components. Sustainable intensification implies that desired results related to increased food production and enhanced environmental goods and services may be accomplished in several ways. Nonetheless, it continues to be contentious for some (Pretty, J., & Bharucha, Z. P. 2014).

For more than a decade, the relationship between intense conventional methods and agricultural deterioration has been repeatedly stressed. Symptoms include a considerable negative influence on the ecosystem, an adverse effect on soil due to farmers' excessive ploughing and tilling operations, the extermination of natural enemies of pests, and the general threat to the environment caused by pesticide overuse. In particular, the examples of developing nations, which have been persistent consumers of pesticides outlawed in developed countries, have aggravated the situation.

Additional issues include the growing problem of food poverty in developing countries; the extraordinary rise in global food costs; soil erosion and fertility loss; and biodiversity loss, which poses spiralling problems for conserving natural resources. These issues may be solved through sustainable agriculture's integrated system approach. Sustainable agriculture is no longer a new notion in agricultural research, farming methods, or policy.

The Food and Agriculture Organization (FAO) defines sustainable agriculture as having the following characteristics: (1) it is resource-conserving, (2) it is environmentally friendly, (3) it is technically adequate, (4) it is commercially viable, and (5) it is socially justified. Sustainable agriculture is described as an agricultural system that incorporates sustainable agricultural techniques while also ceasing or minimizing the use of environmentally damaging agricultural activities.

The agricultural industry must address significant economic, social, and environmental concerns, all of which are weighted equally in the notion of sustainable agriculture. Nowadays, most societal concerns are interconnected worldwide and fast evolving. Sustainable agriculture offers effective solutions for establishing and strengthening a secure agricultural, food system, and safe energy system for a healthy and sustainable future (Pretty, J. 2018).

In the previous two decades, incredible breakthroughs and technological advancements have resulted in hopeful improvements and potential for sustainable agriculture. Still, the agricultural industry globally continues to confront multiple difficult obstacles. The agricultural sector is required to provide sufficient food, fibre, and feedstock and contribute to biofuel production to fulfil the requirements of a growing global population. Still, it is also expected to do so in an era of diminishing natural resources and climate change.

Growing understanding of the unintended consequences of some agricultural production techniques has increased society's expectations for agriculture to meet higher environmental, community, labour, and animal welfare standards (Pretty, J. 2018). Three non-linear stages have been proposed for transitions to sustainability: efficiency, substitution, and redesign. While efficiency and substitution are critical, they alone are insufficient to maximize the co-production of good agricultural and environmental consequences.

Efficiency is concerned with making the best possible use of on-farm and imported resources within existing farm designs. Numerous agricultural systems are inefficient, allowing deterioration of natural capital inside the farm or the escape of agrochemical inputs over system borders, resulting in external costs on- and off-farm. Post-harvest losses diminish food availability and addressing them immediately leads to efficiency gains and enhances the advantages of other yield increases.

On-farm efficiency increases can be realized by focusing on and rationalizing fertilizer, pesticide, and water inputs to maximize impact, minimize consumption and cause the least damage to natural capital and human health. Precision farming necessitates sensors, detailed soil mapping, drone mapping, pest scouting, weather, and satellite data, information technology, robotics, improved diagnostics, and delivery systems to ensure that targeted inputs (e.g., pesticide, fertilizer, and water) are applied at the appropriate rate and time to the correct location only when necessary.

Agricultural trucks and machines automatically controlled and navigated through satellites can improve energy efficiency and reduce soil compaction. The term substitution refers to replacing technology and processes. Substitution is used to develop new crop varieties and livestock breeds to replace inefficient system components, such as plant varieties that are more efficient at converting nutrients to biomass, which can withstand drought and increases in salinity, and that are resistant to specific pests and diseases.

Other kinds of replacement include releasing biological control agents to replace agrochemical inputs, using RNA-based gene silencing insecticides to replace the soil in hydroponics, and no-tillage systems that replace inverted ploughing with novel methods of direct sowing and weed management. The third step is critical for SI to reach scaled sustainability. Redesigning Agro ecosystems is critical for leveraging natural processes like predation, parasitism, allelopathy, herbivore, nitrogen fixation, pollination, and trophic dependency.

A primary objective is to reduce greenhouse gas emissions, provide safe drinking water, optimize carbon sequestration, enhance biodiversity, and distribute and mitigate the effects of pests, diseases, and weeds. While efficiency and substitution are typically additive and incremental improvements to existing production systems, the redesign should be the most transformative. Redesign entails social and institutional issues, as well as agricultural ones. Unintended repercussions must also be discovered and managed as part of the redesign process. J. Pretty. 2018).

Population growth and resource depletion challenges in the humid tropics make the construction and maintenance of increasingly productive but sustainable agricultural systems more critical than ever. This is especially true for small-scale farmers, who account for the bulk of the impoverished in many nations. Numerous agricultural strategies that can sustainably increase productivity are already widely acknowledged.

These include improved fallow management, fertilization, manure management, tillage methods, intercropping, and agroforestry (Charlton, C. A. (1987). While the scientific community has made considerable progress in the humid tropics, the potential contribution of indigenous cultivators is being increasingly acknowledged, and advancement will need their inclusion in the research and development process (Charlton, C. A. (1987).

The pursuit of sustainable production must overcome several natural limits and numerous economic, social, and political constraints. The broader development process is anti-sustainable agriculture and promotes more exploitative modes of production. This is demonstrated, for example, by the migration of inexperienced, impoverished farmers into humid tropical colonization zones. Effective dissemination of environmentally sound agriculture in the humid tropics needs to incorporate a comprehensive socioeconomic viewpoint as part of an interdisciplinary approach to this critical land management challenge.

3.6. Farmer Perception

Tropical forest conversion to agricultural systems is the principal human activity driving the rapid loss of primary habitat in tropical developing nations (Sinu, P. A., Kent, S. M., & Chandrashekara, K. 2012). The widespread loss of primary habitat has sparked renewed interest in human-influenced forest landscapes that have historically been managed and changed for various objectives, including agriculture, agroforestry, and biodiversity conservation plantings (Sinu, P. A., Kent, S. M., & Chandrashekara, K. 2012).

Recognizing the critical role of local communities in habitat protection, more forests are being delegated to local communities internationally, and an increasing level of local enforcement for habitat conservation is being urged. The Western Ghats biodiversity hotspot has a long tradition of managing natural resources and forests through sacred forests, home gardens, and Soppinabetta woods (Singh, R. K., Singh, A., Kumar, S., Sheoran, P., Sharma, D. K., Stringer, L. C., & Singh, D. 2020). Sacred woods are off-limits to anthropogenic change and have traditionally aided in forest conservation.

Home gardens are diverse and sustaining niches that have been formed by the intimate interaction of nature and human civilizations. Soppinabetta woods are managed forests that are assigned to betel nut farmers, the major commercial crop, for harvesting green foliage and leaf litter for compost manufacture (Singh, R. K., Singh, A., Kumar, S., Sheoran, P., Sharma, D. K., Stringer, L. C., & Singh, D. 2020). As a result, the Soppinabetta woodlands are critical to the local economy.

Despite almost two thousand years of continuous cultivation, a culture of sustainable agriculture has enabled the Western Ghats to retain considerable forest cover and stable economic production. Sustainable groundwater management is vital in India and involves effective community engagement and technical, social, economic, policy, and political contributions. Access to groundwater is also an expressive and sensitive issue for farming communities, as their livelihood and existence are dependent on it.

This essay aims to discuss trans disciplinary ways to identify the difficulties, challenges, and opportunities for enhancing the sustainability of groundwater usage in the Indian states of Gujarat and Rajasthan. The study for this project, titled Managed Aquifer Recharge by Village Level Intervention, is focused on establishing an appropriate participatory strategy and methodology and accompanying technologies to aid in improving groundwater supply and demand management (Rao, P. 2014).

In 2008, India adopted the 'National Action Plan on Climate Change to expedite adaptation. State governments have also established 'State Action Plans on Climate Change in response to the NAPCC (DoE 2014), however, with an almost sole emphasis on top-down measures. The study state of UP, which is grappling with climate variability and severe occurrences, has also created strategies to reduce and adapt to climatic and biophysical stresses but has ignored the socioeconomic and political stressors that exacerbate such climate consequences (Tripathi and Mishra 2017).

As a result of several national and state initiatives, systematic research on climate change adaptation in agriculture began with establishing four National Initiatives for Climate Resilient Agriculture (NICRA) projects (ICAR 2011). Contingency plans and long-term plans (MoA&FW 2016) for farmers in many states, including Uttar Pradesh, were prepared. Simultaneously, state governments are improving agricultural development programs through frequent assessments of meteorological factors and the distribution of weekly and monthly recommendations to farmers (NICRA 2016; MoA&FW 2016).

However, the process is still being directed from the top down (DoE, 2014). Farmers' perceptions of climatic variability-induced stresses and related risks may vary considerably depending on their localized knowledge of agricultural management techniques and other contextual variables (Government of India 2008) While these on-the-ground issues, which change in time and place, are critical for sustainable adaptation, they are little understood at the formal level, and hence do not factor into evaluations of climate-induced stressors or the creation of adaption strategies.

4. Practical Part

The thesis identifies the famer's motivation towards adoption of sustainable agriculture practices. The primary objective of thesis is to find out which factors are motivating farmers for adopting sustainable agriculture practices. It also examines the perception of farmers regarding sustainable agriculture practices. Moreover, it determines the factors influencing farmers to adopt sustainable agriculture practices.

The primary data as well as secondary data is used for conducting research. The secondary data is gathered from plethora of sources i.e., websites, online periodicals, journals, and publications. The secondary data helps in getting better understanding about the topic. While the primary data is collected through survey method.

In survey method, the one hundred respondents are interviewed with the help of structured questionnaire. The respondents are from India who has been asked several questions which includes some demographic questions as well as some questions related to their perception about sustainable agriculture practices. The demographic factors such as age, level of education and no. of years of farming experience are explained first with a view to know about the role of sustainable agriculture practices in farming as well as factors influencing and motivating farmers towards adoption of the same.

After collection of primary data, the analysis is conducted on collected data. The analysis is done using Statistical Package for Social Sciences Software which is provided by International Business Machine. A number of statistical tools such as frequency analysis, chi-square and correlation testing are used for the purpose of analysis. The chi-square and correlation testing are performed on data for examining the hypothesis. The insights of analysis are provided under the section of findings.

4.1. Frequency Analysis

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 20	9	9.0	9.0	9.0
	21-30	37	37.0	37.0	46.0
	31-40	20	20.0	20.0	66.0
	41-50	8	8.0	8.0	74.0
	51 & above	26	26.0	26.0	100.0
	Total	100	100.0	100.0	

Table 1: Age

(Source: Own calculations)

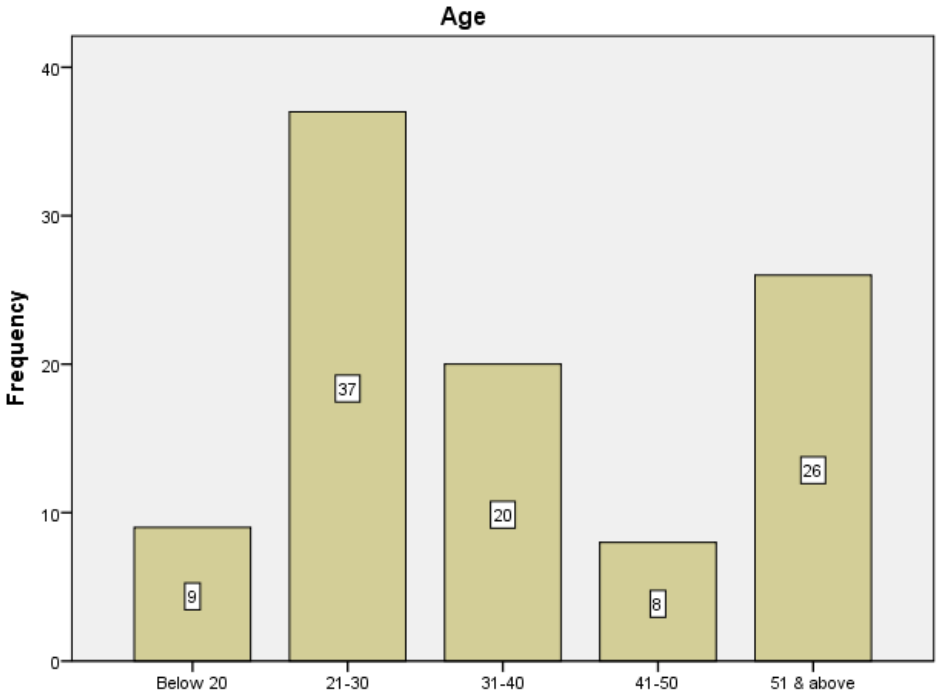

Figure 1: Age

(Source: Own illustration)

Out of 100 respondents, 37 respondents are from the age group of 21-30. There are 26 respondents who have their age above around 51 or more. 20 respondents fall into the age group of 31-40 and 9 respondents have their age below 20. The remaining respondents belong to the age group of 41-50.

Level of education

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Non	11	11.0	11.0	11.0
	Primary	21	21.0	21.0	32.0
	Secondary	16	16.0	16.0	48.0
	HSC	6	6.0	6.0	54.0
	SSC	7	7.0	7.0	61.0
	Bachelor's degree	10	10.0	10.0	71.0
	Master's degree	21	21.0	21.0	92.0
	PHD	8	8.0	8.0	100.0
	Total	100	100.0	100.0	

Table 2: Education Level

(Source: Own calculations)

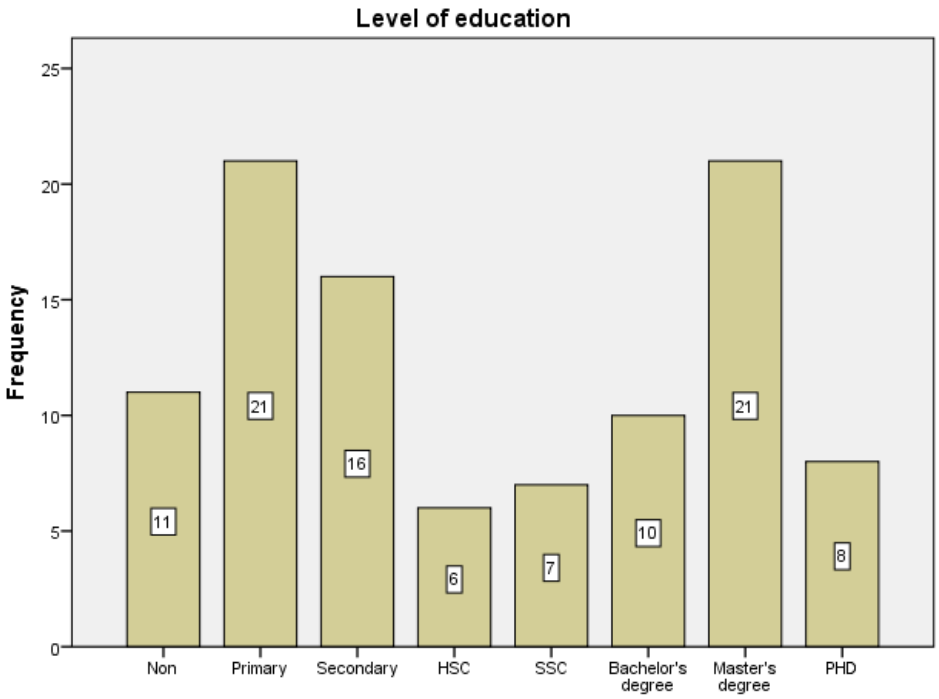

Figure 2: Education Level

(Source: Own illustration)

From the analysis, it has been found that there are 21 respondents who completed their studies till primary while another 21 respondents have completed their post graduation and obtained Master's degree. 16 respondents are studied till secondary. There are 11 respondents who haven't taken any education. 10 respondents have completed graduation. 7 respondents have passed SSC and remaining respondents have completed HSC.

Do you have access to credit facilities from financial institutions?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	34	34.0	34.0	34.0
	No	66	66.0	66.0	100.0
	Total	100	100.0	100.0	

Table 3: Credit Facilities

(Source: Own calculations)

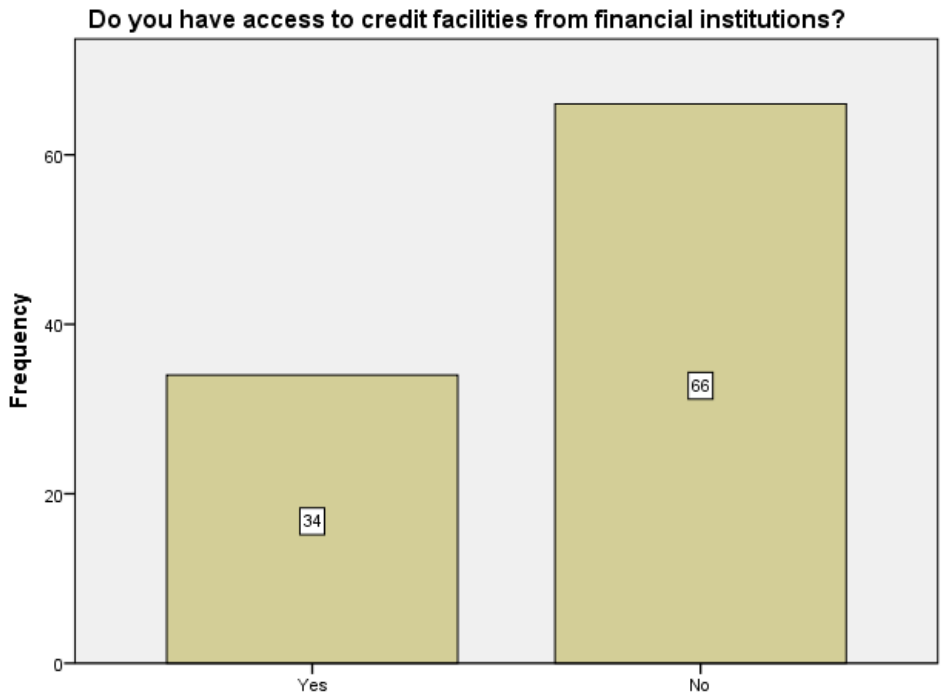

Figure 3: Credit Facilities

(Source: Own illustration)

66 respondents said that they don't have access to credit facilities from financial institutions whereas 34 respondents said that they have access to credit facilities from financial institutions.

What kind of land ownership do you have?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Customary/Traditional land	59	59.0	59.0	59.0
	Private land	41	41.0	41.0	100.0
	Total	100	100.0	100.0	

Table 4: Ownership Type

(Source: Own calculations)

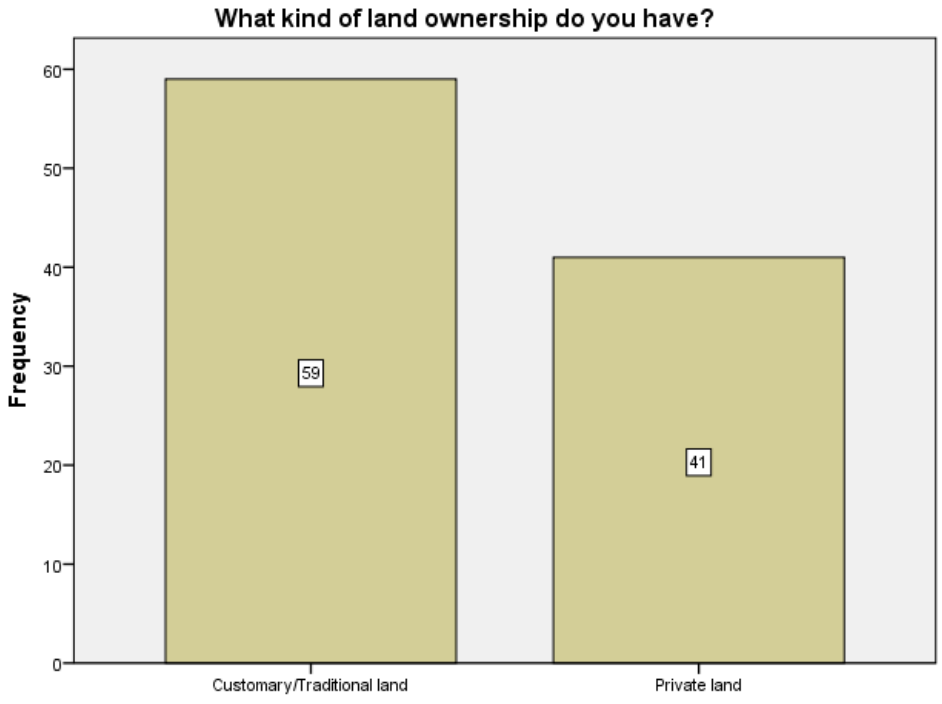

Figure 4: Ownership Type

(Source: Own illustration)

There are 59 respondents who have Customary/Traditional land ownership. While 41 respondents have private land ownership.

No. of years farming experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	10	10.0	10.0	10.0
	2	20	20.0	20.0	30.0
	3	14	14.0	14.0	44.0
	4	19	19.0	19.0	63.0
	5	18	18.0	18.0	81.0
	More than 5	19	19.0	19.0	100.0
	Total	100	100.0	100.0	

Table 5: Framing Experience

(Source: Own calculations)

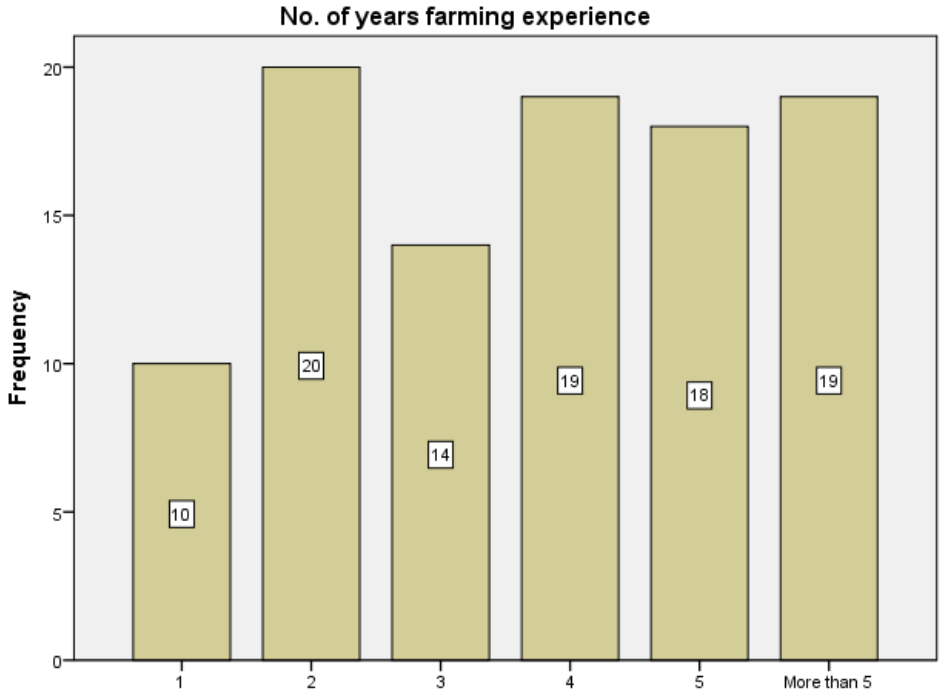

Figure 5: Framing Experience

(Source: Own illustration)

20 respondents have 2 years of farming experience. 19 respondents are doing farming since more than 5 years. 18 respondents had begun farming in last 5 years. 19 respondents said that they have 4 years of farming experience and 10 respondents have around 1 year of farming experience.

Household size

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	1	6	6.0	6.0	6.0
	2	13	13.0	13.0	19.0
	3	16	16.0	16.0	35.0
	4	18	18.0	18.0	53.0
	5	26	26.0	26.0	79.0
	More than 5	21	21.0	21.0	100.0
	Total	100	100.0	100.0	

Table 6: Household Size

(Source: Own calculations)

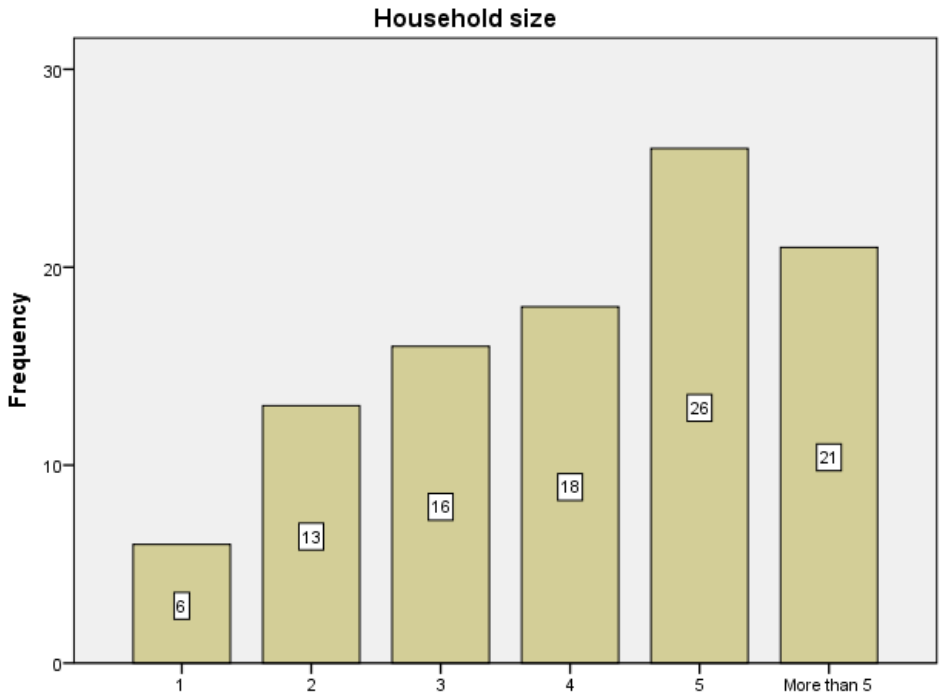

Figure 6: Household Size

(Source: Own illustration)

As per survey, 26 respondents have 5 members in their family. 21 respondents said that their family includes more than 5 people. 18 respondents have 4 members in their family. 16 respondents have 3 family members, 13 respondents have 2 family members and 16 respondents have only 1 member in their family.

Farm size (in hectares)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0.01	11	11.0	11.0	11.0
	0.03	18	18.0	18.0	29.0
	0.04	14	14.0	14.0	43.0
	0.05	10	10.0	10.0	53.0
	0.06	4	4.0	4.0	57.0
	0.09	7	7.0	7.0	64.0
	0.6	13	13.0	13.0	77.0
	8h	14	14.0	14.0	91.0
	18h	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Table 7: Farm Size

(Source: Own calculations)

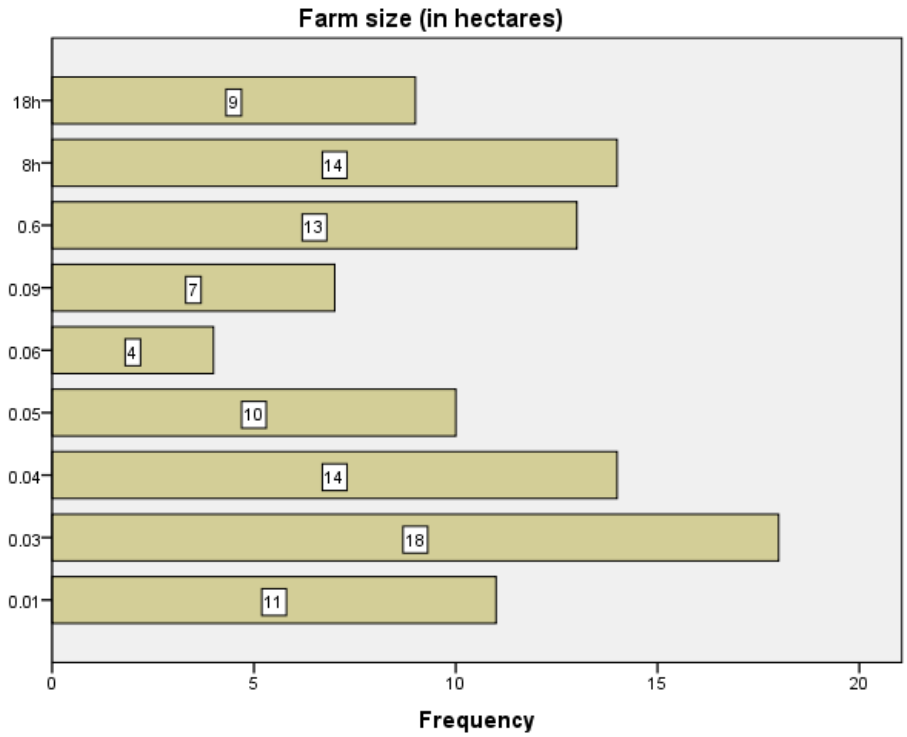

Figure 7: Farm Size

(Source: Own illustration)

Most of the respondents have their farm size of 0.03 hectors. 14 respondents have 0.04 hectors of farm. 13 respondents have 0.6 hectors of farm. There are 11 respondents who said that their farm size is 0.01 hector. 10 respondents have 0.05 hectors of farm, 4 respondents have 0.06 hectors of farm, 7 respondents have 0.09 hectors of farm, 9 respondents have 18 hectors of farm and 14 respondents have 8 hectors of farm.

What type of farming system is followed by you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Crops	55	55.0	55.0	55.0
	Animal	21	21.0	21.0	76.0
	Mixed	24	24.0	24.0	100.0
	Total	100	100.0	100.0	

Table 8: Farming System

(Source: Own calculations)

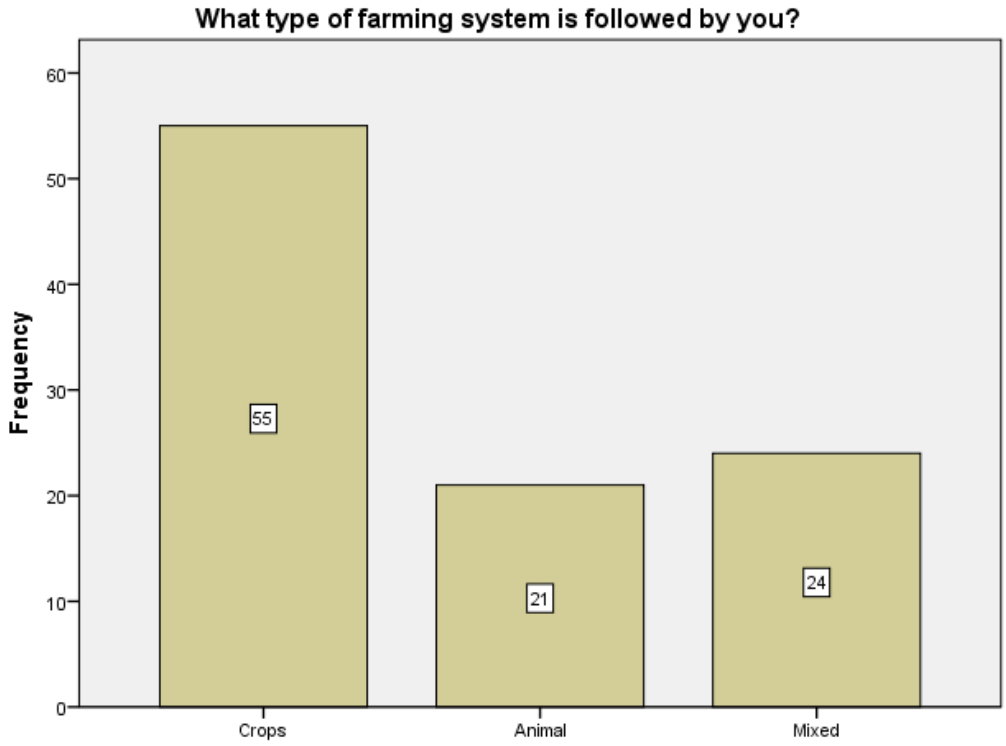

Figure 8: Farming System

(Source: Own illustration)

Crops farming system is majorly followed by respondents as compare to animal and mixed farming system. 24 respondents follow both crops as well as animal farming system. There are 21 respondents who follow only animal farming system.

Which of the following sustainable agriculture practices do you use in farming?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Mulching	4	4.0	4.0	4.0
	Crop rotation	30	30.0	30.0	34.0
	Diversified farming	6	6.0	6.0	40.0
	Agroforestry	9	9.0	9.0	49.0
	No-Till farming	7	7.0	7.0	56.0
	Contour farming	2	2.0	2.0	58.0
	Organic animal raising	20	20.0	20.0	78.0
	Biodynamic farming	8	8.0	8.0	86.0
	Bio intensive Integrated Pest Management	6	6.0	6.0	92.0
	Natural Pest Predators	2	2.0	2.0	94.0
	Permaculture	2	2.0	2.0	96.0
	Cover crops	4	4.0	4.0	100.0
	Total	100	100.0	100.0	

Table 9: Following Practices

(Source: Own calculations)

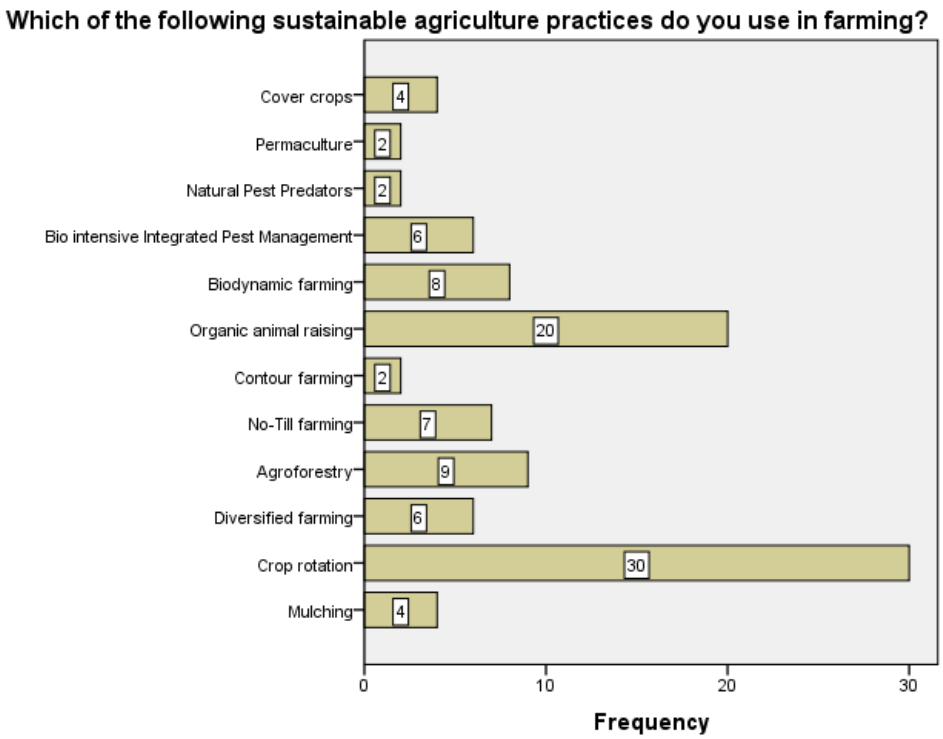

Figure 9: Following Practices

(Source: Own illustration)

30 respondents said that they follow crop rotation practice among other sustainable agriculture practices such as mulching, diversified farming, agroforestry, no-till farming, contour farming, organic animal raising, biodynamic farming, bio intensive integrated pest management, natural pest predators, permaculture and cover crops. Organic animal raising practice is used by 20 respondents for sustainable farming. 9 respondents have implemented agroforestry practice whereas 7 respondents have adopted no-till farming sustainable agriculture practice for farming. 8 respondents follow biodynamic farming as compare to other practices. 6 respondents follow diversified farming and another 6 respondents follow bio intensive integrated pest management practice. Mulching is used by 4 respondents and cover crop practice is used by another 4 respondents. There are only 2 respondents who follow permaculture practice as well as natural pest predators practice for doing farming.

What is the main reason behind adoption of sustainable agriculture practices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Prevent pollution	14	14.0	14.0	14.0
	Ensure better quality & healthier food	7	7.0	7.0	21.0
	Promote social & economic growth	6	6.0	6.0	27.0
	Help in reducing farming cost	26	26.0	26.0	53.0
	Increase profit	30	30.0	30.0	83.0
	Prevent soil erosion	8	8.0	8.0	91.0
	Biodiversity	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Table 10: Adoption Reasons

(Source: Own calculations)

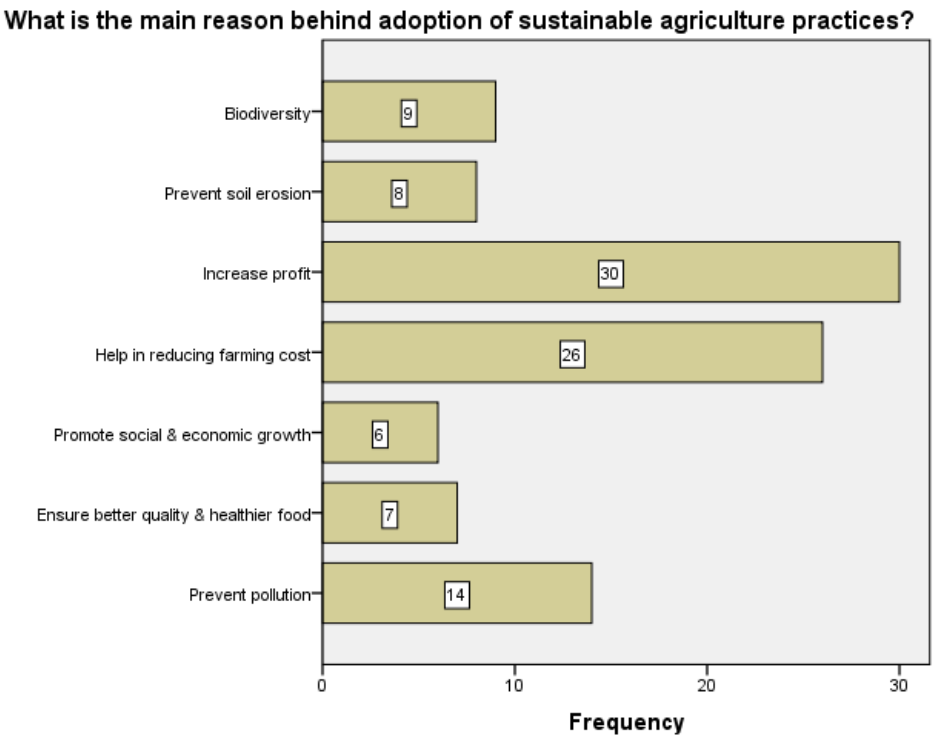

Figure 10: Adoption Reasons

(Source: Own illustration)

There are many reasons for adoption of sustainable agriculture practices in farming but increase in profit is one of the main reasons behind adoption of sustainable agriculture practices. As per 26 respondents, sustainable agriculture practices help in reducing farming cost due to that they implemented sustainable agriculture practice. While 14 respondents reported that it prevents pollution. 9 respondents said that it promotes biodiversity and 8 respondents think that it prevents soil erosion that's why they adopted sustainable agriculture practices in farming. Sustainable agriculture practices not only ensure better quality & healthier food but also promote social & economic growth according to 7 respondents and 6 respondents respectively.

Which of the following factor influence you in adoption of sustainable agriculture practices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Reduction in production cost	31	31.0	31.0	31.0
	Increase in crop yields	29	29.0	29.0	60.0
	Availability of markets	12	12.0	12.0	72.0
	Access to credit	9	9.0	9.0	81.0
	Availability of input	8	8.0	8.0	89.0
	Land ownership	11	11.0	11.0	100.0
	Total	100	100.0	100.0	

Table 11: Influencing Factors

(Source: Own calculations)

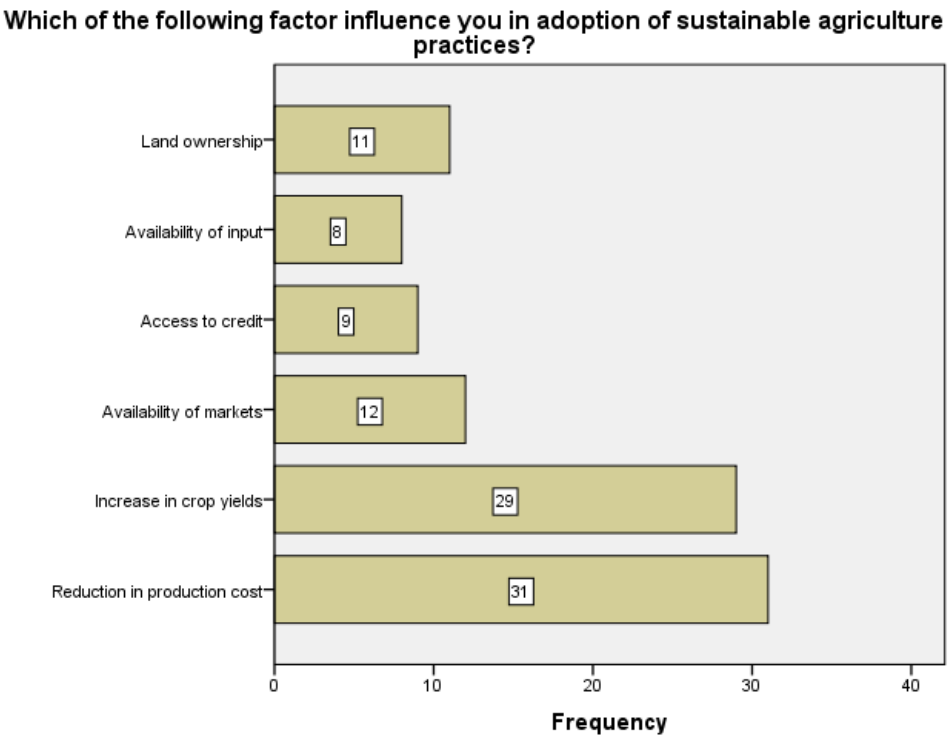

Figure 11: Influencing Factors

(Source: Own illustration)

The reduction in production cost influences most of the respondents for adopting sustainable agriculture practices among other factors. 29 respondents said that they got influenced by benefit of increase in crop yields for implementation of sustainable agriculture practices. Availability of markets influence around 12 respondents whereas land ownership influence 11 respondents for adopting sustainable agriculture practices. There are 8 respondents who adopted sustainable agriculture practices in farming due to availability of input.

From the following who motivates you regarding the acquisition of sustainable agriculture practices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Family	24	24.0	24.0	24.0
	Other farmers	30	30.0	30.0	54.0
	Government initiatives	30	30.0	30.0	84.0
	Farm advisors	16	16.0	16.0	100.0
	Total	100	100.0	100.0	

Table 12: Motivational Factors

(Source: Own calculations)

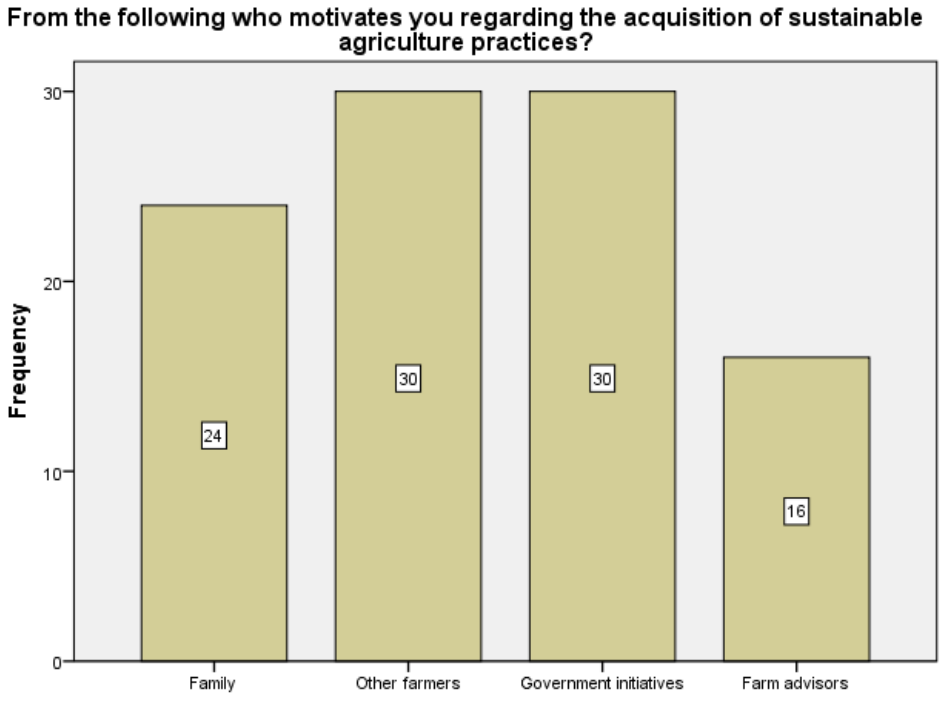

Figure 12: Motivational Factors

(Source: Own illustration)

Government initiatives as well as other farmers motivate respondents for acquiring sustainable agriculture practices. Other farmers motivate 30 respondents and government initiatives motivate another 30 respondents in order to adopt sustainable agriculture practices. 24 respondents get motivated by their family members. While 16 respondents get motivated by farm advisors.

Sustainable agriculture practices are useful in protecting environment.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	43	43.0	43.0	43.0
	Agree	47	47.0	47.0	90.0
	Neither Agree nor Disagree	10	10.0	10.0	100.0
	Total	100	100.0	100.0	

Table 13: Practice Usefulness

(Source: Own calculations)

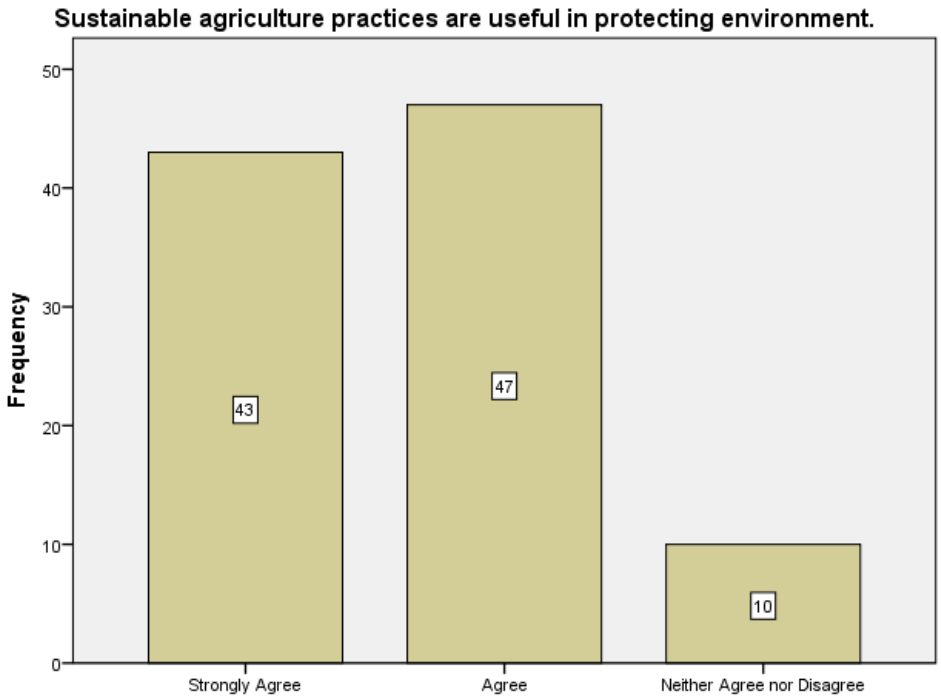

Figure 13: Practice Usefulness

(Source: Own illustration)

There are 47 respondents who agreed with the statement that sustainable agriculture practices are useful in protecting environment. 43 respondents strongly agreed and 10 respondents have neutral opinion regarding the statement.

Sustainable agriculture practices are useful for maintaining long-term productivity of farming system.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	48	48.0	48.0	48.0
	Agree	32	32.0	32.0	80.0
	Neither Agree nor Disagree	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

Table 14: Practice Productivity

(Source: Own calculations)

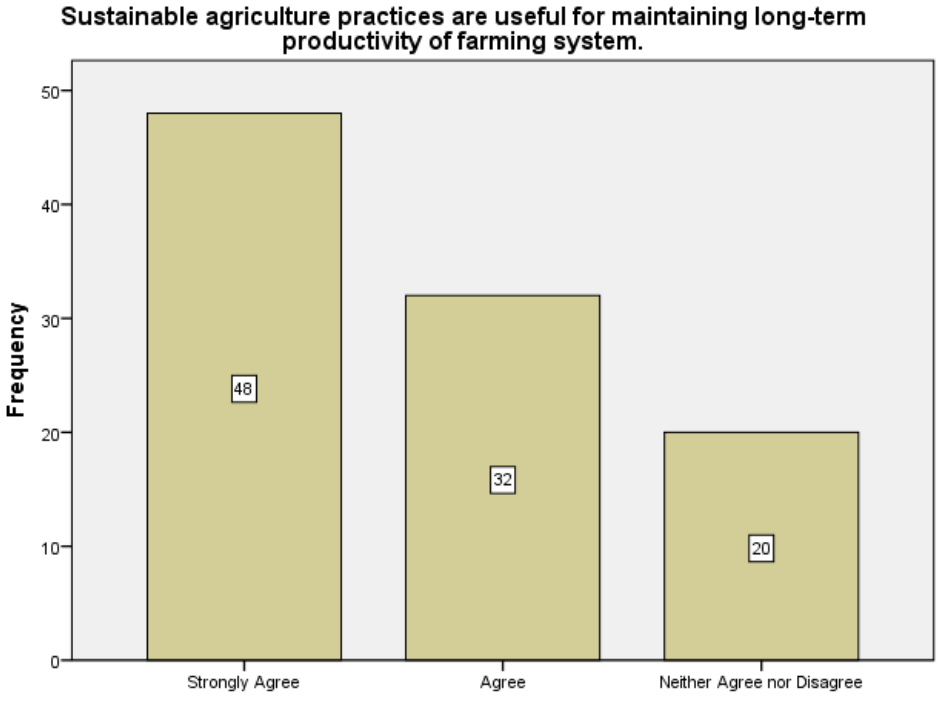

Figure 14: Practice Productivity

(Source: Own illustration)

48 respondents are strongly agreed and said that sustainable agriculture practices are useful for maintaining long-term productivity of farming system. As per 32 respondents, they are agreed with the statement that sustainable agriculture practices are useful for maintaining long-term productivity of farming system whereas remaining respondents have neutral opinion about the statement.

Obtaining information about sustainable agriculture practices is difficult.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	7	7.0	7.0	7.0
	Agree	52	52.0	52.0	59.0
	Neither Agree nor Disagree	22	22.0	22.0	81.0
	Disagree	16	16.0	16.0	97.0
	Strongly Disagree	3	3.0	3.0	100.0
	Total	100	100.0	100.0	

Table 15: Practice Information

(Source: Own calculations)

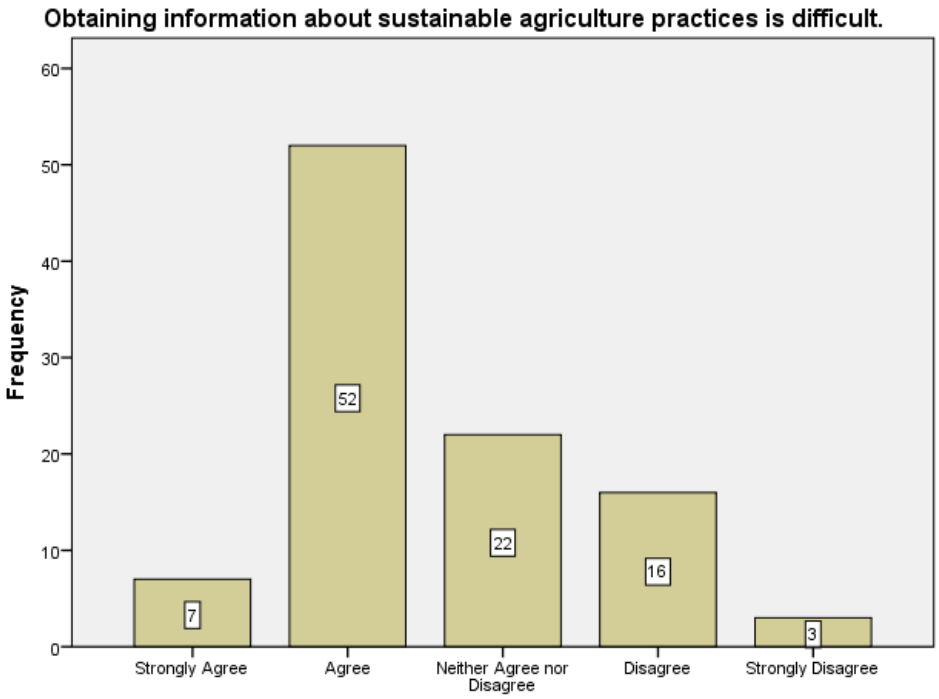

Figure 15: Practice Information

(Source: Own illustration)

There are 52 respondents who are agreed and said that they face difficulties in obtaining information about sustainable agriculture practices. 22 respondents said that they are neither agreed nor disagreed with the statement. 16 respondents reported disagreement and 3 respondents reported strong disagreement with the statement.

Farmers should be trained for using sustainable agriculture practices.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	41	41.0	41.0	41.0
	Agree	36	36.0	36.0	77.0
	Neither Agree nor Disagree	20	20.0	20.0	97.0
	Disagree	3	3.0	3.0	100.0
	Total	100	100.0	100.0	

Table 16: Practice Training

(Source: Own calculations)

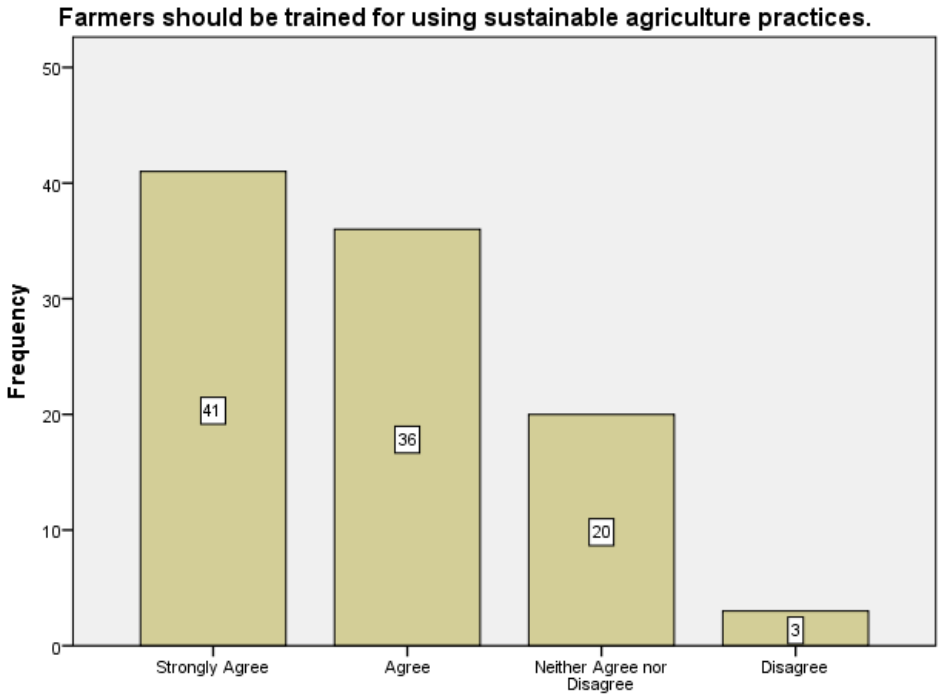

Figure 16: Practice Training

(Source: Own illustration)

The farmers should be trained for adequate implementation of sustainable agriculture practices according to 41 respondents as they showed strong agreement with the statement. There are 36 respondents who are agreed, 3 respondents are disagreed and 20 respondents have neutral opinion about the statement.

The new technology encourages to adopt sustainable agriculture practices.

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Strongly Agree	46	46.0	46.0	46.0
	Agree	34	34.0	34.0	80.0
	Neither Agree nor Disagree	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

Table 17: Practice Technology

(Source: Own calculations)

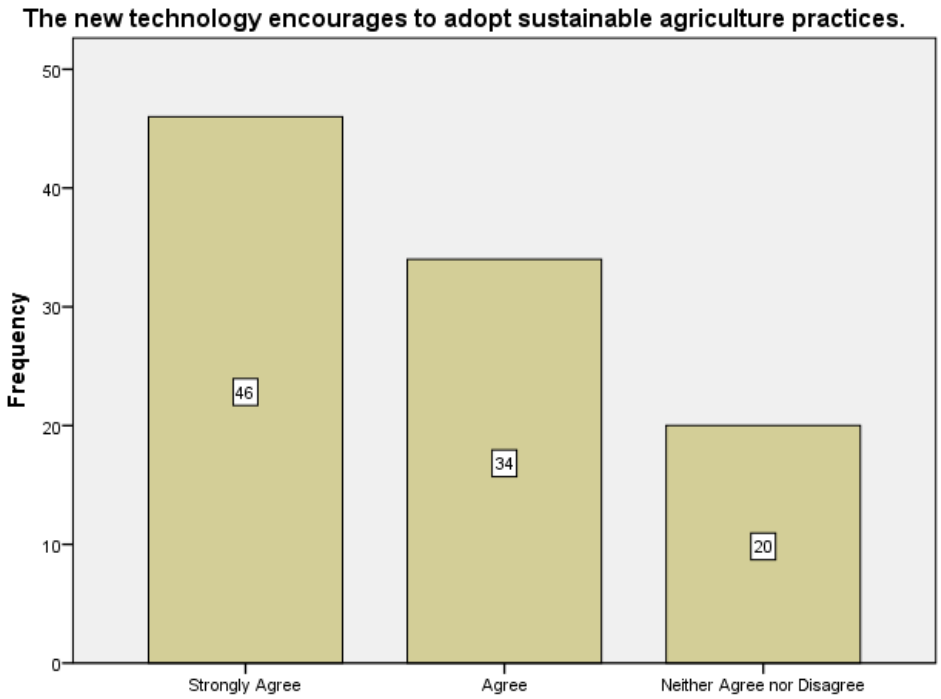

Figure 17: Practice Technology

(Source: Own illustration)

46 respondents strongly believe that the new technology encourages the adoption of sustainable agriculture practices. 34 respondents are agreed and 20 respondents are neutral about the statement.

The skill and knowledge required to implement sustainable agriculture practices.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	45	45.0	45.0	45.0
	Agree	39	39.0	39.0	84.0
	Neither Agree nor Disagree	16	16.0	16.0	100.0
	Total	100	100.0	100.0	

Table 18: Practice Skills

(Source: Own calculations)

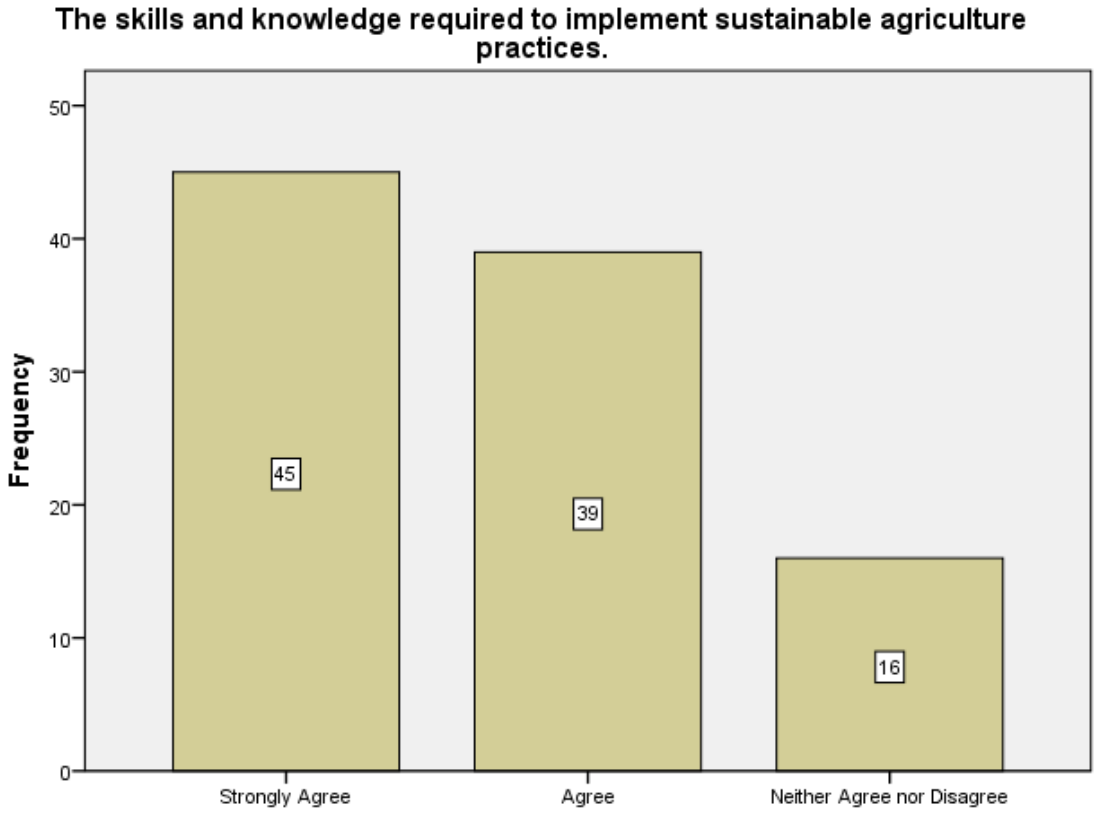

Figure 18: Practice Skills

(Source: Own illustration)

As per 45 respondents, the skill and knowledge are required in implementation of sustainable agriculture practices. 39 respondents are agreed with the statement and 16 respondents have neutral opinion regarding the statement.

Government schemes & initiatives encourage to adopt sustainable agriculture practices.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	43	43.0	43.0	43.0
	Agree	37	37.0	37.0	80.0
	Neither Agree nor Disagree	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

Table 19: Practice Initiatives

(Source: Own calculations)

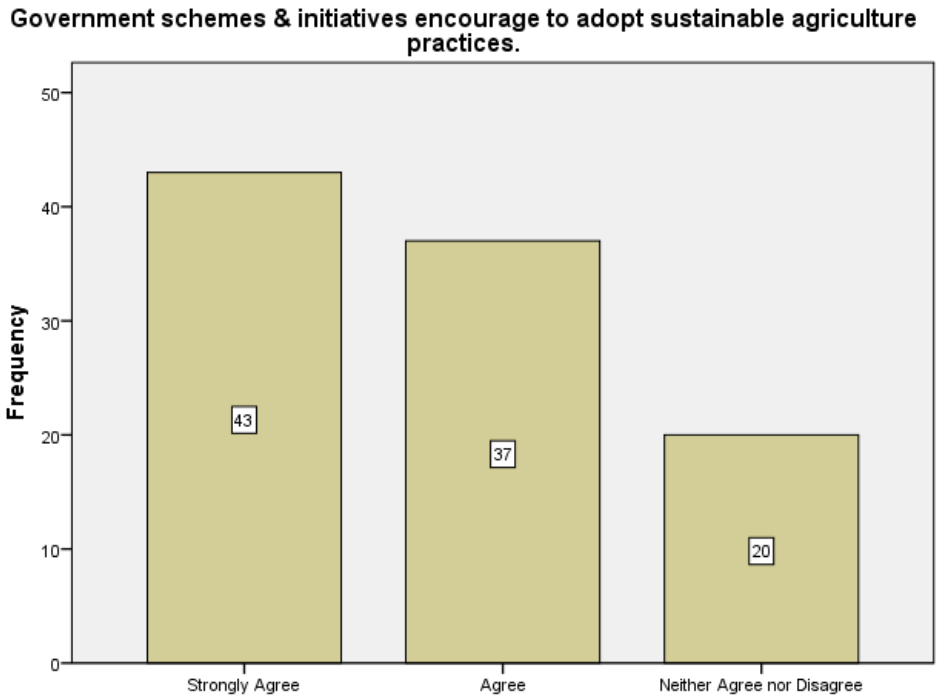

Figure 19: Practice Initiatives

(Source: Own illustration)

There are 43 respondents who are strongly agreed with the statement as they believe that government schemes & initiatives encourage to adopt sustainable agriculture practices. 37 respondents agreed and said that government schemes & initiatives encourage them in adoption of sustainable agriculture practices. 20 respondents have neutral opinion regarding the same.

4.2. Hypothesis Analysis

Hypothesis 1

H0: There is no significant relationship between level of education and factors influencing adoption of sustainable agriculture practices.

H1: There is a significant relationship between level of education and factors influencing adoption of sustainable agriculture practices.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.987[a]	35	.832
Likelihood Ratio	31.505	35	.638
Linear-by-Linear Association	.953	1	.329
N of Valid Cases	100		
a. 44 cells (91.7%) have expected count less than 5. The minimum expected count is .48.			

Table 20: Hypothesis 1 (Chi-Square Tests)

Symmetric Measures					
		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	-.098	.099	-.976	.331[c]
Ordinal by Ordinal	Spearman Correlation	-.101	.101	-1.009	.315[c]
N of Valid Cases		100			
a. Not assuming the null hypothesis.					
b. Using the asymptotic standard error assuming the null hypothesis.					
c. Based on normal approximation.					

As per analysis, the P-value of statistics is 0.832 for chi-square which is more than 5% level of significance. Therefore, the alternate hypothesis is rejected and null hypothesis is accepted. This shows that there is no significant relationship between level of education and factors influencing adoption of sustainable agriculture practices.

As per Pearson's correlation, there is no significant relationship between level of education and factors influencing adoption of sustainable agriculture practices as the P-value of statistics is 0.331 for Pearson's correlation is which is higher than 5% level of significance.

The Pearson's correlation values differ from +1 to -1 where +1 signifies perfect positive correlation, -1 shows perfect negative correlation and 0 signifies there is no linear correlation at all. As per analysis, the Pearson's correlation value is -0.098 which shows the very slight negative correlation between level of education and factors influencing adoption of sustainable agriculture practices.

Hypothesis 2

H0: There is no significant relationship between age and factors motivate regarding the acquisition of sustainable agriculture practices.

H1: There is a significant relationship between age and factors motivate regarding the acquisition of sustainable agriculture practices.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.288[a]	12	.762
Likelihood Ratio	7.717	12	.807
Linear-by-Linear Association	.019	1	.891
N of Valid Cases	100		
a. 11 cells (55.0%) have expected count less than 5. The minimum expected count is 1.28.			

Table 21: Hypothesis 2 (Chi-Square Tests)

Symmetric Measures					
		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	-.014	.098	-.136	.892[c]
Ordinal by Ordinal	Spearman Correlation	.001	.099	.009	.993[c]
N of Valid Cases		100			
a. Not assuming the null hypothesis.					
b. Using the asymptotic standard error assuming the null hypothesis.					
c. Based on normal approximation.					

As per Chi-square analysis, there is no significant relationship between age and factors motivate regarding the acquisition of sustainable agriculture practices as the P-value of

statistics is 0.762 which is higher than 5% level of significance. Thus, the alternate hypothesis is rejected and null hypothesis is accepted.

For Pearson's correlation, the P-value of statistics is 0.892 which is higher than 5% level of significance. Thus, the null hypothesis is accepted which in turn shows that there is no significant relationship between age and factors motivate regarding the acquisition of sustainable agriculture practices. The Pearson's correlation value indicates very slight negative correlation between age and factors motivate regarding the acquisition of sustainable agriculture practices as it has a negative value of -0.014.

5. Results and Discussion

The primary data is analysed by using various statistical tools. After analysis, the data is presented in the form of bar chart among other types of charts which helps in getting adequate understanding related to the farmer's motivation for adoption of sustainable agriculture practices in India. The highlights of analysis are explained below which shows the perception of farmers with respect to adoption of sustainable agriculture practices.

The sample size includes one hundred respondents who have been interviewed for obtaining primary data. Out of one hundred respondents, most of the respondents are from the age group of 21-30 and have completed their studies till primary. However, there are some respondents who are not educated. Majority of the respondents said that they do not have access to credit facilities from financial institutions which may be the cause of lack of education among respondents.

Respondents majorly have Customary/Traditional land ownership along with 2 years of farming experience. As per survey, respondents mostly have five members in their family and have the farm size of 0.03 hectors. Crops farming system is majorly followed by respondents as compared to animal and mixed farming system. Respondents said that they follow crop rotation practice among other sustainable agriculture practices such as mulching, diversified farming, agroforestry, no-till farming, contour farming, organic animal raising, biodynamic farming, bio intensive integrated pest management, natural pest predators, permaculture, and cover crops.

There are many reasons for adoption of sustainable agriculture practices in farming but increase in profit is one of the main reasons behind adoption of sustainable agriculture practices. Beside this, not only the reduction in production cost influences but also government initiatives as well as other farmers motivate most of the respondents for acquiring sustainable agriculture practices among other factors.

There are some respondents who believe that sustainable agriculture practices are useful in protecting environment as well as they are useful for maintaining long-term productivity of farming system. However, they face difficulties in obtaining information about sustainable agriculture practices. Therefore, the farmers should be trained for adequate implementation of sustainable agriculture practices.

Apart from this, respondents strongly believe that the modern technology encourages the adoption of sustainable agriculture practices which further requires adequate skill and knowledge for implementation of same. They also believe that government schemes & initiatives encourage the adoption of sustainable agriculture practices

The calculation of hypothesis testing showed that there is no significant relationship between level of education and factors influencing adoption of sustainable agriculture practices according to Chi-square and Pearson's correlation. Moreover, as per Chi-square analysis as well as Pearson's correlation, there is no significant relationship between age and factors motivate regarding the acquisition of sustainable agriculture practices.

The results from the questionnaire can be summarized as follows: the farmers are less educated part of society, who may have good experience of farming practices but they lack in the knowledge about latest techniques. Farmers are becoming more aware about taking credit from the financial institutions but there can be more potential ways to sell the crops at better market rates. Looking at the current scenario, farmers are tend to opt for mixed farming including crops and dairy.

Indian farmers are majorly following sustainable agricultural practices such as crop rotation and organic animal raising, which can be very useful for them. According to the farmers, this practices can help then in increasing profits as well as reducing farming cost. The motivation to adopt such practices usually comes from ongoing government initiatives. This study can be helpful to understand the sustainable agricultural practices scenario in India but same can be replicated for other emerging markets as well.

5.1. SWOT Analysis

Sustainable agriculture is an important issue in India, where agriculture plays a significant role in the country's economy and culture. A SWOT analysis of sustainable agricultural practices in India reveals several strengths, including a rich agricultural heritage and diverse agro-climatic zones that allow for a wide range of crops to be grown sustainably. However, there are also weaknesses, such as a lack of access to resources and education for small-scale farmers. Opportunities include the potential for improved soil health and fertility, increased demand for sustainably grown crops, and government initiatives that support sustainable agriculture. Threats include climate change and other environmental factors, global trade policies, and political instability.

Strengths -

- ✓ India has a large and growing population that provides a stable market for agricultural products, encouraging farmers to adopt sustainable practices to meet demand.
- ✓ Traditional knowledge and practices of sustainable agriculture have been developed over centuries and are still used by many farmers in India, providing a strong foundation for the adoption of sustainable practices.
- ✓ India has a diverse range of crops and farming systems, which can help mitigate the risks of climate change and other environmental factors that can impact agriculture.

Weaknesses -

- ✓ Infrastructure and transportation systems in rural areas of India may be inadequate, making it difficult for farmers to access markets and resources needed to adopt sustainable practices.
- ✓ Lack of access to credit can be a significant barrier for small-scale farmers looking to adopt sustainable practices, as they may not have the financial resources to invest in new technologies or techniques.
- ✓ Lack of awareness and education about the benefits of sustainable agriculture can also be a barrier, as farmers may not understand the long-term benefits of these practices.

Opportunities -

- ✓ Sustainable agriculture can contribute to the achievement of several United Nations Sustainable Development Goals, such as zero hunger, climate action, and sustainable cities and communities, providing opportunities for international funding and partnerships.
- ✓ Increasing consumer demand for sustainably produced food in both domestic and international markets can create new opportunities for Indian farmers to access premium prices for their products.
- ✓ New technologies such as precision agriculture and vertical farming can help Indian farmers adopt sustainable practices while improving efficiency and yields.

Threats -

- ✓ Climate change and extreme weather events can have a significant impact on agricultural productivity, affecting the ability of farmers to adopt and maintain sustainable practices.
- ✓ Global trade policies and price fluctuations can create volatility in the agricultural sector, making it difficult for farmers to invest in sustainable practices that may have a longer-term payback.
- ✓ Political instability and social unrest can impact the ability of farmers to access markets and resources needed to adopt sustainable practices, leading to increased reliance on less sustainable methods of farming.

Overall, sustainable agriculture in India presents many opportunities for farmers who adopt these practices, but also faces significant challenges in terms of access to resources, environmental factors, and broader economic and political trends.

6. Conclusion

The essential objective of thesis is to determine the factors which motivate farmers for adoption sustainable agricultural practices in India. The thesis gives a proper knowledge about role of sustainable agriculture practices in farming. It investigates the factors affecting the decision of adoption of sustainable agriculture practices by farmers. It also portrays farmer's perspective with respect to adoption of sustainable agriculture practices.

The research is conducted by collecting both primary data and secondary data. The secondary data is gathered to get theoretical insights about the topic. Various websites, journals, periodicals, and articles are used for obtaining the secondary data whereas the primary data is accumulated by interviewing one hundred respondents via questionnaire.

The primary data is examined through SPSS Software. Frequency analysis, chi-square and correlation are applied on primary data for getting results from analysis. From the analysis it has been found that most of the respondents are from the age group of 21-30 and have completed their studies till primary. However, there are some respondents who are not educated. Majority of the respondents do not have access to credit facilities from financial institutions due to lack of education.

Crops farming system is majorly followed by respondents as compared to animal and mixed farming system. Crop rotation is the most followed practice by farmers among other sustainable agriculture practices as it provides the benefit of increase in profit. The reduction in production cost influences farmers the most in terms of factors influencing farmers for adoption of sustainable agriculture practices. The respondents get motivated not only by government initiatives but also by other farmers for acquiring sustainable agriculture practices.

Respondents believe that sustainable agriculture practices are useful as they protect environment as well as main long-term productivity of farming system. However, there are some difficulties faced by respondents in obtaining information about sustainable agriculture practices. Therefore, the farmers should be trained for adequate implementation of sustainable agriculture practices.

The modern technology encourages the adoption of sustainable agriculture practices among farmers which further requires adequate skill and knowledge for implementation of same. The government schemes & initiatives also encourage the adoption of sustainable agriculture practices among farmers.

The insights of hypothesis testing showed that there is no significant relationship between level of education and factors influencing adoption of sustainable agriculture practices according to Chi-square and Pearson's correlation. Moreover, as per Chi-square analysis as well as Pearson's correlation, there is no significant relationship between age and factors motivate regarding the acquisition of sustainable agriculture practices. The Indian farmers get motivated by government schemes, government initiatives and other farmers for acquiring sustainable agriculture practices.

Thus, the government should provide training to farmers regarding implementation of sustainable agriculture practices, and it should organize various seminars to create awareness among farmers regarding how to adopt sustainable agriculture practices and how to access credit from financial institutions which will make easier for farmers to adopt sustainable agriculture practices.

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8. Appendix

Questionnaire

Farmer's Motivation for Adoption of Sustainable Agricultural Practices in India

Dear Sir/Madam, I am a student from Czech university. I will be very thankful if you can spare 5 minutes from your valuable time to answer the questionnaire which will help me to know about Farmer's Motivation for adoption of sustainable agricultural practices in India. Please answer all the question honestly and without any forced influence.

Disclaimer: This questionnaire is prepared for the purpose of research project. The information will be kept confidential and will not be used for any other purpose than project.

1. Name *

2. Age *

- Below 20
- 21-30
- 31-40
- 41-50
- 51 & above

3. Level of education *

- Non
- Primary
- Secondary
- HSC
- SSC
- Bachelor's degree
- Master's degree
- Other:

4. Do you have access to credit facilities from financial institutions? *

- Yes
- No

5. What kind of land ownership do you have? *

- Customary /Traditional land
- Private land

6. No. of years farming experience *

- 1
- 2
- 3
- 4
- 5
- More than 5

7. Household size *

- 1
- 2
- 3
- 4
- 5
- More than 5

8. Farm size (in hectares) * _____

9. What type of farming system is followed by you?*

- Crops
- Animal
- Mixed

10. Which of the following sustainable agriculture practices do you use in farming? *

- Mulching
- Crop rotation
- Diversified farming
- Agroforestry
- No-Till farming
- Contour farming
- Organic animal raising
- Biodynamic farming
- Bio intensive Integrated Pest Management
- Natural Pest Predators
- Permaculture
- Cover crops
- Other:

11. What is the main reason behind adoption of sustainable agriculture practices? *

- Prevent pollution
- Ensure better quality & healthier food
- Promote social & economic growth
- Help in reducing farming cost
- Increase profit
- Prevent soil erosion
- Biodiversity
- Other:

12. Which of the following factor influence you in adoption of sustainable agriculture practices?*

- Reduction in production cost
- Increase in crop yields
- Availability of markets
- Access to credit
- Availability of input
- Land ownership
- Other:

13. Which of the following who motivates you regarding the acquisition of sustainable agriculture practices? *

- Family
- Other farmers
- Government initiatives
- Farm advisors

14. Given below are some statements, you are requested to state your degree of agreement/disagreement on each of the statement regarding adoption of sustainable agriculture practices as mentioned below on a 5-point scale? *

Statements	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Sustainable agriculture practices are useful to protect the environment.					
Sustainable agriculture is useful to maintain long-term productivity of farming system.					
Obtaining information about sustainable agriculture practices is difficult.					
Farmers should be trained for using sustainabl agriculture practices.					

15. Given below are some statements, you are requested to state your degree of agreement/disagreement on each of the statement regarding motivation for adoption of sustainable agriculture practices as mentioned below on a 5-point scale? *

Statements	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
The new technology are encourages to adopt sustainable agriculture practices.					
The skills and knowledge required to implement sustainable agriculture practices.					
Government schemes & initiatives encourage to adopt sustainable agriculture practices.					