JPB REVIEW
INTERNATIONAL JOURNAL OF PROFESSIONAL BUSINESS REVIEW
ISSN: 2525-3654
OPEN ACCESS

WOMEN FARMER'S PERSPECTIVES ON CLIMATE CHANGE AND INTENTION TO ADOPT SUSTAINABLE AGRICULTURE

Roshan Raj Bhujel[A], H. G. Joshi[B]

ARTICLE INFO

Article history:

Received 17 March 2023

Accepted 13 June 2023

Keywords:

Sustainable Agriculture;
Women Farmer;
Climate Change;
Organic Farming;
Vermicomposting.

ABSTRACT

Purpose: This study highlights the significance of sustainable agriculture and delves into the views of women farmers on climate change and their aspirations to adopt sustainable farming practices.

Theoretical framework: The opportunity comes in creating fresh methods, abilities, and interventions that foster innovation. The challenge is figuring out ways to mitigate its effects and search for alternatives. Women farmers in particular need creative behaviour and decision-making power to adapt to climate change since they face resource, cultural, societal, and personal constraints.

Design/methodology/approach: To better understand how farmers think about climate change, sustainable agriculture, and related topics, we conducted structured, open-ended interviews with them. Twenty-six female farmers in the Himalayan state of Sikkim were chosen using convenience sampling. Qualitative data analysis tools were used to analyse the interview data. A web-based tool was used for sentiment analysis, which also contributed to identifying the themes.

Findings: Positive sentiments were identified in the use of organic farming for sustainable agriculture. Most respondents believed that government support is required for large-scale use of organic farming. The respondents also acknowledged the positive effects of vermicomposting. The analysis showed that vermicomposting provides good health and growth to plants and crops. Resilient crop selection was identified as a method that assists in standing against weather fluctuations.

Research, Practical & Social Implications: Crop selection based on seasons is vital for good yields. The thematic analysis also presented a positive response toward applying crop rotation, intercropping, and companion cropping. Compared to women with lower decision-making and inventive skills, women with these traits embraced more sustainable agricultural practises.

Originality/Value: Giving women in agriculture greater autonomy will thereby enhance the adoption of sustainable agricultural techniques, so enhancing food security and reducing climate change. This outcome will help achieve the Sustainable Development Goals of gender equality and climate action set by the United Nations.

Doi: https://doi.org/10.26668/businessreview/2023.v8i6.1210

PERSPECTIVAS DAS MULHERES AGRICULTORAS SOBRE AS MUDANÇAS CLIMÁTICAS E A INTENÇÃO DE ADOTAR A AGRICULTURA SUSTENTÁVEL

RESUMO

Objetivo: Este estudo destaca a importância da agricultura sustentável e investiga as opiniões das mulheres agricultoras sobre as mudanças climáticas e suas aspirações de adotar práticas agrícolas sustentáveis.

[A] *PhD. Research Scholar. Manipal Institute of Management, Manipal Academy of Higher Education (MAHE). Udupi, Karnataka, India. E-mail: roshan.bhujel@learner.manipal.edu*
Orcid: https://orcid.org/0000-0002-1895-9338
[B] *Professor. Manipal Institute of Management, Manipal Academy of Higher Education (MAHE). Udupi, Karnataka, India. E-mail: harish.joshi@manipal.edu Orcid: https://orcid.org/0000-0003-2229-106*

Estrutura teórica: A oportunidade está na criação de novos métodos, habilidades e intervenções que promovam a inovação. O desafio é descobrir maneiras de mitigar seus efeitos e buscar alternativas. As mulheres agricultoras, em particular, precisam de comportamento criativo e poder de decisão para se adaptarem às mudanças climáticas, pois enfrentam restrições de recursos, culturais, sociais e pessoais.
Projeto/metodologia/abordagem: Para entender melhor como os agricultores pensam sobre mudanças climáticas, agricultura sustentável e tópicos relacionados, realizamos entrevistas estruturadas e abertas com eles. Vinte e seis agricultoras do estado de Sikkim, no Himalaia, foram escolhidas por meio de amostragem de conveniência. Ferramentas de análise de dados qualitativos foram usadas para analisar os dados das entrevistas. Uma ferramenta baseada na Web foi usada para análise de sentimentos, o que também contribuiu para identificar os temas.
Resultados: Foram identificados sentimentos positivos em relação ao uso da agricultura orgânica para a agricultura sustentável. A maioria dos entrevistados acredita que o apoio do governo é necessário para o uso em larga escala da agricultura orgânica. Os entrevistados também reconheceram os efeitos positivos da vermicompostagem. A análise mostrou que a vermicompostagem proporciona boa saúde e crescimento para as plantas e culturas. A seleção de culturas resilientes foi identificada como um método que ajuda a resistir às flutuações climáticas.
Implicações sociais, práticas e de pesquisa: A seleção de culturas com base nas estações é vital para obter bons rendimentos. A análise temática também apresentou uma resposta positiva em relação à aplicação da rotação de culturas, do cultivo intercalar e do cultivo associado. Em comparação com as mulheres com menos habilidades inventivas e de tomada de decisão, as mulheres com essas características adotaram práticas agrícolas mais sustentáveis.
Originalidade/valor: Dar maior autonomia às mulheres na agricultura aumentará, portanto, a adoção de técnicas agrícolas sustentáveis, melhorando assim a segurança alimentar e reduzindo as mudanças climáticas. Esse resultado ajudará a atingir as Metas de Desenvolvimento Sustentável de igualdade de gênero e ação climática estabelecidas pelas Nações Unidas.

Palavras-chave: Agricultura Sustentável, Mulheres Agricultoras, Mudança Climática, Agricultura Orgânica, Vermicompostagem.

PERSPECTIVAS DE LAS AGRICULTORAS SOBRE EL CAMBIO CLIMÁTICO E INTENCIÓN DE ADOPTAR UNA AGRICULTURA SOSTENIBLE

RESUMEN
Objetivo: Este estudio destaca la importancia de la agricultura sostenible e investiga las opiniones de las agricultoras sobre el cambio climático y sus aspiraciones a adoptar prácticas agrícolas sostenibles.
Marco teórico: La oportunidad reside en crear nuevos métodos, habilidades e intervenciones que promuevan la innovación. El reto consiste en encontrar formas de mitigar sus efectos y buscar alternativas. Las mujeres agricultoras, en particular, necesitan un comportamiento creativo y poder de decisión para adaptarse al cambio climático, ya que se enfrentan a limitaciones de recursos, culturales, sociales y personales.
Diseño/metodología/enfoque: Para entender mejor cómo piensan las agricultoras sobre el cambio climático, la agricultura sostenible y temas afines, les realizamos entrevistas estructuradas y abiertas. Veintiséis agricultoras del estado himalayo de Sikkim fueron elegidas mediante un muestreo de conveniencia. Para analizar los datos de las entrevistas se utilizaron herramientas de análisis de datos cualitativos. Se utilizó una herramienta web para el análisis de sentimientos, que también ayudó a identificar temas.
Resultados: Se identificaron sentimientos positivos hacia el uso de la agricultura ecológica para una agricultura sostenible. La mayoría de los encuestados cree que el apoyo gubernamental es necesario para el uso a gran escala de la agricultura ecológica. Los encuestados también reconocieron los efectos positivos del vermicompostaje. El análisis demostró que el vermicompostaje proporciona buena salud y crecimiento a plantas y cultivos. La selección de cultivos resistentes se identificó como un método que ayuda a resistir las fluctuaciones climáticas.
Implicaciones sociales, prácticas y de investigación: la selección de cultivos basada en las estaciones es vital para obtener buenos rendimientos. El análisis temático también mostró una respuesta positiva hacia la aplicación de la rotación de cultivos, los cultivos intercalados y los cultivos intercalados. En comparación con las mujeres con menos capacidad inventiva y de toma de decisiones, las mujeres con estas características adoptaron prácticas agrícolas más sostenibles.
Originalidad/valor: El empoderamiento de las mujeres en la agricultura aumentará, por tanto, la adopción de técnicas agrícolas sostenibles, mejorando así la seguridad alimentaria y reduciendo el cambio climático. Este resultado ayudará a alcanzar los Objetivos de Desarrollo Sostenible de igualdad de género y acción por el clima fijados por las Naciones Unidas.

Palabras clave: Agricultura Sostenible, Mujeres Agricultoras, Cambio Climático, Agricultura Ecológica, Vermicompostaje.

INTRODUCTION

Since the mid-twentieth century, the global agricultural sector has witnessed tremendous expansion. The increase, fueled by the technologies of the Green Revolution, though assuring food security for a growing population, has made a large hole in the global supply of food grains. The next phase of expansion poses a significant problem concerning sustainability. In contrast to developing nations, which face the issue of resource sustainability as their greatest challenge, wealthy nations face the issue of excessive input usage.

These concerns have led to a growing awareness, in many parts of the world, of the need to transition away from the input-intensive agriculture practised during the time of the Green Revolution and toward a more sustainable system. This transition is necessary because of the effects that intensive agriculture has had on the environment. While the necessity for a paradigm change in the strategic plan is widely acknowledged, the transition from input-intensive agriculture to sustainable agriculture has inherent challenges. Despite the recent surge in manufacturing and services and the diminishing percentage of agriculture in the national revenue, India can still be considered an agricultural nation, as most of its workforce (65%) is still involved in agriculture and allied sectors.

Since time immemorial, farming has been the noblest profession in India and is practiced sustainably. Large-scale forests, grazing, and wastelands have only recently been transformed into croplands to accommodate the growing population, resulting in ecological imbalance and air pollution. Efforts have been undertaken to maximise the growth of food grains utilising high-yielding varieties of seeds, fertilisers, and irrigation, as well as technologically updated farm equipment, as there is no more room for land development (Ra &Rb, 2022).

However, the so-called green revolution is limited to a few crops, namely wheat, rice, and maize. It has only been possible in confined regions, namely Punjab, Haryana, and Western Uttar Pradesh, as well as a few selected districts of Andhra Pradesh, Maharashtra, and Tamil Nadu. Much effort is required to elevate farming to a degree where it is least susceptible to monsoon fluctuations and requires less from the outside farm, i.e., reduced reliance on chemical fertilisers and water. The modest success of the green revolution was a mixed bag since it spawned a new set of challenges, including excessive water and fertiliser use. The excessive

usage of water results in waterlogging and salinisation, whereas the excessive use of fertilisers and pesticides results in the contamination of water bodies and groundwater. India has the most irrigated land (55 million hectares), roughly one-third has already deteriorated, and seven million hectares have been abandoned (Sarjiman et al., 2023).

For a successful agricultural revolution, a renewable and long-lasting alternative must arise, namely sustainable agriculture. In this work, the importance of sustainable agriculture from the perspectives of women farmers has been underlined. Possible activities for sustainable agriculture and organic farming in India are discussed.

UN Bruntland Commission defined sustainability in 1987 as “meeting the present wants without compromising the flexibility of unborn generations to fulfill their own needs”. The United Nations Outcomes Document refers to economic, social, and environmental progress as 'dependent and mutually supportive pillars of sustainable development. Sustainable development is also referred to as 'green development' (UN, 2017).

These pillars are all interdependent on one another. Indigenous peoples have also argued, through various international discussion boards like The UN Sustainable Forum on Indigenous Problems and Convention on Biodiversity, which are the four foundations for sustainable development, serve as the 4th of these pillars. According to this perspective, cultural diversity is the fourth policy issue that pertains to sustainable development. Cross-culturalism is as essential to existence as biodiversity is to nature"; it is one of the reasons for becoming one of evolution that is understood not only in terms of but also as a means of achieving a more satisfying emotional, intellectual, moral, and spiritual reality(SDG, 2018).

Sustainable agriculture considers three primary objectives: the preservation of the natural environment, the maximisation of economic profit, and the promotion of social and economic justice. These objectives have been advanced by applying various ideas, policies, and practices(Hobbs, Sayre & Gupta, 2008). The conception of sustainability rests on the idea that we, as a society, must satisfy the now and then risk the capability of coming generations to do the same(Horrigan, Lawrence & Walker, 2017). This vision has been shared by people acting in various positions, ranging from producer to consumer, and they have contributed to it. Despite the wide variety of people and points of view, the following topics consistently appear in discussions regarding what constitutes sustainable agriculture.

Natural resources and land stewardship entail preserving or improving the current level of a vital resource base throughout an expanded period (Montgomery, 2017). As an outcome, the accountable management of human and natural resources is the most important. When

managing mortal coffers, it is essential to consider social scores, similar to the hearthstone and working conditions of sloggers social scores, the needs of pastoral societies, and the health and consumer security, both in future and current.

A systems approach is necessary to have proper knowledge of sustainability. The ecosystem is imagined in its most total sense, beginning with a single farm and extending to the local ecology and the local and global communities impacted by this agricultural system. Putting more of a focus on the system enables a broader and more in-depth examination of the effects of farming techniques on human populations and the natural environment(Smith, 2018). we are provided with the tools through the systems approach necessary to investigate the links between farming and other parts of our environment. An approach based on systems also requires interdisciplinary efforts in education and research. Not just scholars from a wide variety of fields but also farmers, agricultural workers, customers, legislators, and other types of people are required to contribute to this effort.

Shifting toward more sustainable agriculture takes time (Tilman, Balzer, Hill & Befort, 2018). The move from conventional to sustainable farming typically requires the farmer to take several manageable, incremental steps. Farmer's progress toward or away from sustainable farming is influenced by their family's financial position and aspirations. Realising that even seemingly insignificant choices can impact and help move the entire system along the "sustainable agriculture continuum" is an essential step that must not be overlooked. The resolve to take the initiative is essential to progress in any endeavor (Eisler, *et al*., 2019).

It is essential to emphasise that achieving the objective of sustainable agriculture is the shared obligation of all stakeholders in the system. In order to build a stronger community, all members of the agricultural industry, including farmers, farmhands, legislators, scientists, merchants, shoppers, and businesses, must perform their roles and contribute to the community of sustainable farmers.

Sustainable agriculture can be defined as any set of economically viable, ecologically sound, and socially desirable agricultural science methods. These three criteria are necessary for sustainable agriculture. If a cropping system needs many fertiliser inputs, and some of that fertiliser exits the system and pollutes drinking supplies, offshore fisheries and groundwater, the system may be economically sustainable. The long-term supply of fertiliser is stable, and its financial impact is easily borne by large grain manufacturing; however, the system is not socially or environmentally retainable because it does not cover the cost to society or ecological destruction(Nicole, 2013).In other words, the system is not sustainable. Organic farming is

distinguished by its emphasis on'living soil',increasing the efficiency of using biological processes and avoiding using artificial chemicals and fertilisers(Rigby & Cáceres, 2016).

Those supporting environmentally responsible farming agree with the biological approach and aim to reduce, but not necessarily eliminate, the use of chemicals. Another widely used term for sustainable agriculture is 'alternative agriculture'. The definition of sustainable agriculture as alternative agriculture provides much light on the functional dimensions of retainable agriculture(Reay, 2002).

The term 'conventional agriculture' refers to the standard agricultural practices that include irrigation, chemical fertiliser, pesticides, and a wide variety of crops with high yields. Conventional farming significantly contributes to the contamination of both inland water bodies and coastal waters because of the increasing use of chemical fertilisers and pesticides(Horrigan, Lawrence & Walker, 2017). The practice of conventional agriculture is coming under increasing scrutiny for the external costs and side effects that it imposes on local communities, the environment and the health of individuals. Concerning the indicators of sustainability, there is not a single prescription that applies to all of them. Sustainable activities will differ depending on the cropping system, the local environment, and the socio-economic structure (Kremen, Iles & Bacon, 2012). However, our trend tells us that domestically sustainable systems are more resourceful and efficient than less sustainable systems. They depend more on ecosystem services and less on external inputs within their boundaries.

The goal of this study is to evaluate how innovative and empowered women farmers are in making decisions and how they contribute to the adoption of various sustainable agriculture practises at the farm level.

LITERATURE REVIEW

Food self-sufficiency does not necessarily correspond to agricultural sustainability, as the policies of the Government of India have always emphasised the country's ability to produce its food (Hobbs, Sayre & Gupta, 2017). The expansion of agricultural production and productivity, which had increased substantially throughout the 1970s and 1980s, slowed down considerably over the 1990s. Since the year 2000, these slowdowns have been even worse. From2000-01 to 2002-03, the overall agricultural and food grains production showed negative growth rates(Eisler, *et al.*, 2014). There is a severe problem with the growth rate of agricultural production. As a result, it is essential to thoroughly analyse the strategies for developing sustainable agriculture. This experiment needs to be defined not only because of India's

continued need tomaintain self-sufficiency in food but also because of the results of exposure internationally(Reddy, 2010).

Organic agriculture for sustainable agriculture, agricultural intensification through large-scale adoption of high-yield farming, increased use, and greater exploitation of synthetic inputs such as chemical fertilisers and pesticides have all been achieved in the last three decades. Agriculture intensification through large-scale adoption of high-yield cultivation, promotion of artificial inputs such as pesticides and chemical fertilisers, suppression of irrigated agricultural potential of land and agricultural mechanisation, and surface water resources have all contributed to the remarkable achievement, primarily in food grains. Regardless, there is a growing awareness that renewable natural resources are being used (Montgomery, 2007).

Overexploitation, as well as the haphazard and illogical use of synthetic inputs such as dead pesticides and fertilisers to produce as much as possible from each unit of land, is seriously disrupting and endangering the environment's integrity. High-yielding horticulture is more fertiliser-responsive, which frequently leads to an escalation of the pest problem. The plants become so succulent that various agricultural pests can feed on them (Tilman, 2017). Because of this, an ever-increasing volume of insecticides will be required to deal with the infestation problem. Pesticide use has recently been identified as a potential threat to environmental sustainability, threatening the existence of all forms of life on the planet. Pesticides cause long-term damage to the food chain, so the risks and dangers associated with their use have been thoroughly demonstrated. Pesticide residues have been found not only in plant-based foods but also in animal foods. The pesticide concentrations of milk, milk products, fish, meat, and eggs are much higher than levels considered safe for humans in various experiments conducted across the country (Bowman &Zilberman, 2013).

As a result, turning to an Eco-farming or ecological system is unavoidable when there is a viable option to meet both objectives, given the apparent contradiction between our need for nutritional security and ecological sustainability on the one hand. The latter term refers to agriculture that focuses on cultivating land and growing crops in environmentally friendly conditions (Giovannucci, *et al.*, 2012). It emphasises the importance of limiting synthetic chemicals like inorganic fertilisers and fungicides. Alternatively, it employs an integrated approach to crop management that incorporates cultural, organic and natural inputs. The introduction of living fertilisers such as farmyard manure, recycling of organic waste, compost, green manure, and organic sources such as vermin compost and organic fertilisers, among other

things, are essential components for plant nutrition management in living farming (Abubakar&Attanda, 2013).

Similarly, it uses natural pest management mechanisms such as predators and bloodsuckers that are abundant in nature, as well as botanical insecticides that are effective at controlling crop pests while posing no threat to the surrounding environment (Baiphethi& Jacobs, 2009). Crops with an intelligent selection of crop rotation practices, intercropping and associate cropping, stubble mulching, and the use of disease-resistant varieties are essential aspects that contribute to organic farming.

In addition to the typically applied farmyard manure (FYM), other forms of organic manure, such as compost made from urban and rural waste, crop residue, agro-industrial organic waste, and green manure, are included in the definition of organic manure in the broadest sense. The physical condition of the soil improves organic manure in its porosity and water-holding capability, as well as the microbial environment(Senjaliya, Vala & Ma, 2015). It also refills necessary micronutrients in the soil, boosts the resource use efficiency of applied fertilisers, and favours the plant's ability to access micronutrients. Organic manure is of greater significance for increasing crop yield and making agriculture sustainable as an environmentally friendly way of managing soil fitness(Salama, Baz, Gaafar & Zaki, 2015).Organic fertilisers are a means of managing soil health found in nature. In addition to its role in the production of NPK, it is common knowledge that FYM serves other essential roles. Unlike artificial fertilisers, which only give the critical plant nutrients, the storeroom of many plants nutritive is FYM and functions in the form of a good soil conditioner.

Farmyard manure contributes to the overall health of the soil. Recently, our farmers have been implementing a process known as green manuring, which has been around for decades. According to some estimates, old green manure crops of 40-50 days can provide nitrogen per hectare of 80-100 Kg(Khan, Iqbal & Islam, 2007). If only half of this nitrogen is absorbed by the crop, using an organic manure crop as a substitute for 50–60 kg nitrogen fertiliser per hectare is still possible. Some legumes that have the eventuality to be used as green ordure are Dhanicha, Sun hemp, Cowpea, Moong, bean, Guar, and Berseem, among others. It has been claimed that cultivated green manure crops Dhanicha, Sunhemp, Moong, and Guar contribute green matter(21 tons) and nitrogen (42 to 95 kg)per hectare during the Kharif season(Pratt & Castellanos, 1981).

Earthworms, found naturally in soil, are used in vermicomposting, an efficient method of composting organic waste that can be broken down. Vermicompost is a blend of worm casts,

macro and micronutrients (nitrogen, phosphorus, potassium, manganese, iron, cobalt, molybdenum, zinc, and copper), growth regulators (such as gibberellins and auxins), and beneficial microflora (such as Azospirillum, Actinomyces, and Phosphorobacillus, among others) (Shanthi, Bhoyar&Bhide, 1993). Vermicompost contains more nutrients than other types of compost, ranging from 1.2 to 1.5 percent nitrogen, 0.6 to 0.8 percent phosphorus, and 1.2 to 1.5 percent potassium.

According to available information, Earthworms can consume and convert all organic matter into readily available nutritional forms (Panday, Basnet, Bhatt &Tamrakar, 2014). Its organic nature makes it an excellent addition to an integrated strategy for managing plant nutrients in sustainable agriculture. By rotating and churning insects, vermin compost improves soil aeration and water-holding capacity, soil fertility, and pulverisation. The soil's physical and biological conditions also improve (Devi &Lourdhu, 2012). Soils containing earthworm species but not earthworm casts have five times the nitrogen, seven times the phosphate, eleven times the potassium, two times the magnesium, and seven to eight times the Actinomyces of soils that do not contain earthworm casts (Chatterjee, Bandyopadhyay& Jana, 2014).

Rotating crops is essential to organic farming and serves a significant purpose. A strategic choice of crops within the framework of crop rotation enables more effective extraction of plant nutrients from the various layers of soil(Wang, *et al.*, 2014). Intercropping is a method that helps reduce the danger of a crop failing owing to factors such as unpredictability in rainfall or the presence of a disease or insect infestation. Intercropping sorrel and red gram at a ratio of two rows to every one row of sorrel crop resulted in a yield 70 percent larger than that obtained by growing either crop individually (Mobasser, Vazirimehr & Rigi, 2014). In addition, it helped lower the incidence of diseases affecting red grams. The fact that the sorghum crop could use the nitrogen fixed by the red gram was yet another advantage. There was an increase in yield of about 14 percent in this intercropping compared to single cropping(Lithourgidis, Dordas, Damalas & Vlachostergios, 2011).

MATERIALS AND METHODOLOGY

The present research study is qualitative in nature as it collects qualitative data to achieve the study objectives. The researcher has conducted interviews to collect the data for the study. Structured interviews have been conducted for women farmers to know their perceptions of climate change, sustainable agriculture, organic farming and related aspects. The location of the study is the Himalayan state of Sikkim in India. Open-ended structured interviews were

conducted on a sample of 26 women farmers from April 2022 to July 2022 using the convenience sampling technique. The researcher used a qualitative data analysis tool to analyse the interview data. Firstly, the researcher used thematic analysis to generate first-order codes from the interview transcripts. Based on the first-order codes, the researcher has identified the sentiments of the women farmers. The researcher used an online tool (text2data) for sentiment *analysis, which further assisted in identifying the study's themes.*

To better understand how farmers think about climate change, sustainable agriculture, and related topics, we conducted structured, open-ended interviews with them. Twenty-six female farmers in the Himalayan state of Sikkim were chosen using convenience sampling. Qualitative data analysis tools were used to analyse the interview data. A web-based tool was used for sentiment analysis, which also contributed to identifying the themes. Crop selection based on seasons is vital for good yields. The thematic analysis also presented a positive response toward applying crop rotation, intercropping, and companion cropping. Compared to women with lower decision-making and inventive skills, women with these traits embraced more sustainable agricultural practises. Furthermore, for carry out the research some questions are designed that shown in the table 1. The interview is conducted and collecting the data based on this and analyze the results that shown in the next section i.e., results and discucussion.

Table 1: showing first-order codes of each interview question

Questions	First Order Code
Have you observed any abnormal weather patterns in the last 10 years?	The weather has changed enormously in the past ten years. Rainfall is heavy, scanty, and erratic, causing damage to the crops. The temperature has been rising, so the arrival of winter occurs late. Also, the summers have been much hotter for the last five years, and maximum temperatures reach 32- 33 degrees in May. Hot climate results in more pest infestation during the summers. Every year the temperature goes up. Climate change results from global warming, and the temperature in the Himalayas is increasing. Also, excess rainfall promotes soil erosion and landslides. Further, Winter is much colder than before. Temperatures in the winter have gone down by a few degrees.
How does it affect your farm?	Higher temperatures reduce the yield of desirable crops—the hot temperatures during maize cultivation cause pest infestation and plant diseases. Production and productivity are also severely affected. Hailstones during the harvesting season destroy crops. The positive of excess rainfall is the availability of cattle fodder. However, there is a loss of nutrients in the farms, and soil erosion occurs due to rainwater moving downhill. Also, there has been increasing in soil bacteria, fungus, and mould growth. Farmers have to face various hardships in cultivating crops.
How severe are these impacts?	The impact is very negative for a small farmer. It causes negative impacts on productivity and profits. Youngsters prefer to migrate to cities to work and are leaving farming as it has many hardships. Farmers are incurring many losses. They are losing their livelihoods to bad climate conditions. Farming is not profitable and causes huge losses due to changing weather conditions which are not conducive to productive farming. There is water scarcity in dry seasons, and rainfall is unpredictable. Untimely pre-monsoon rainfalls are leading to

	landslides and soil erosion. Impacts are found to be very negative and will become very serious in future.
Can you give an example of a year with high impact? (yield reduction, low/high selling price)	Due to COVID-19, the supply chain and demand became disruptive. Demand was low. Further, we had yield reduction due to the non-availability of farm labour and access to markets. Input costs are high. Though the selling price is higher than before, the transportation cost has also increased due to higher fuel prices. Smallholder farmers are finding it hard due to a lack of infrastructure. The poor yield of vegetables as extremely wet weather is not good for farming vegetables. The rising cost of farm inputs such as bio-fertilisers, biopesticides and increased pest attacks. The main crop failed last year due to worm infestation
Do you think that organic farming can be helpful in sustainable agriculture?	Organic farming appears good with the support of the government and other institutions. Nevertheless, the need for improved varieties of seeds is seen. Increased labour costs and input. Organic farming is good for human health as well as the environment. We need to be trained to tackle diseases and pests. We may not be able to sustain ourselves on our own. Significantly reduces the use of other fertilisers. Organic farming can be helpful in sustainable agriculture. It can help preserve the farm and the environment for a long time. It helps in reducing soil, water and air pollution
In your opinion, what is the role of vermicomposting in sustainable agriculture	Vermicomposting is a cheaper way of getting manure. Vermicomposting has helped. Improved soil quality, better quantity and quality of crops. Vermicomposting purchases through Subsidised rates regularly will help. It assisted in the process of replenishing the nutrients that were lost in the soil as a result of soil erosion. Vermicomposting helps balance the soil. Suitable for the overall ecological balance of the farm. It is eco-friendly. Furthermore, have a positive impact on plant growth and health. It has shown promising results in improving yield. It improves the microbial activity in the soil and improves water retention and aeration
Are you using organic manures?	We organically rear cattle and use the cattle dung to make organic manure for the farm. We are using cow dung manure and vermicomposting. Yes, I am using manure prepared from cow dung and vermin compost. Yes, we depend on cow dung manure and vermin compost, organic manures. Using green manures, compost from crop residues, vermin compost and oil cakes, we call Pinna. I am using cow dung manure and vermicomposting and composting from agricultural wastes. I use organic manures such as cow dung, urine, poultry jitters, droppings of sheep and goats and, of course, vermin compost
How does crop selection affect sustainable agriculture?	Climate-resilient cropping would be better now. Crop selection is important, and we do have seasonal crops. Crop selection and crop rotation are important for getting a good yield. We need to choose resilient varieties of crops which are hardy and can withstand weather fluctuations. Selecting suitable crops according to the season also helps improve yield and productivity. Sustainable agriculture demands better crop selection so that farming and yield are maintained. The wrong selection of crops would impact not only yield but also the fertility of the soil. Reduce the use of irrigated water. Nutrient management becomes easier, and pests can be controlled if the right crop selection is made
What is your opinion on crop rotation, intercropping and companion cropping?	Intercropping is good. Companion cropping helps to ward off many pests and pest management. We do mixed cropping and companion cropping to mitigate pest attacks as well as increase the fertility of the soil. We have experimented with mixed cropping, and the outcomes are satisfactory. These methods are good for the nutrient balance of the soils. For warding off pests and increasing productivity, intercropping and companion cropping are helpful. Crop rotation is good as diverse crops can be grown all year round. Companion cropping improves soil condition and prevents soil erosion
Please elaborate on the Pest management strategies used by you.	We use traditional pest management techniques such as spraying cow urine and using fly ash and limestones. We also use a mixture of traditional herbs. Use of quality seeds, Crop rotation, and Intercropping. Mulching is important at the right time, along with weeding. We are managing the dates of sowing, planting,

	and harvesting. Soil preparation. Water management. Minimal tillage, adequate use of manures and fertilisers, pruning, mulching, water management, and bio fertilisers. Techniques like cover cropping and crop rotation are used. Maintaining sanitation on the farm is important

*Source: Prepared by the authors (2022)

RESULTS AND DISCUSSION

Following is the evaluation of each interview question through thematic and sentiment analysis techniques-

Q1- Have you observed any abnormal weather patterns in the last ten years?

The researcher's thematic analysis provided nine distinct themes denoting that the abnormal weather pattern has been depicted through excess rainfall and rising temperatures. Further, it also denotes that the pest infestation has increased significantly due to abnormal weather patterns.

Table 2: Magnitude of the responses and detected entities for question one

This document is: negative (-1.00) Subjectivity: objective	Magnitude: 7.50	Score Range Negative -1.0 to 0.25	Neutral -0.25 to +0.25	Positive +0.25 to +1.0
Detected Entities	Type	Magnitude	Sentiment Score	
May	DAT	0.00	-0.249	
Himalayas	LOC	0.06	+0.234	

*Source: Prepared by the authors (2022)

Most detected keywords provide negative sentiments about the weather, like 'scanty', 'erratic', 'excess', and 'changed'. The sentiment analysis was conducted, which presented a negative score of -1.00, denoting the negative sentiments of the respondents about these abnormal weather patterns. The respondents felt that the changing weather conditions in the past years are negatively impacting farming.

Table3: Detected themes for questionone

Detected Themes	Magnitude	Sentiment Score
Pest infestation	0.99	-0.735
Much colder	0.95	-0.717
Very heavy	0.83	-0.663
Damages to the crops	0.72	-0.547
Excess rainfall	0.55	-0.524
Erosion and landslides	0.66	-0.506
Scanty and erratic causes	0.58	-0.479
Temperature is going up	0.80	+0.577
Changed enormously	0.56	+0.528

*Source: Prepared by the authors (2022)

Table4: Detected keywords for question one

Detected Keywords	Magnitude	Sentiment Score
Colder	0.988	-0.743
Erratic	0.516	-0.510
Excess	0.003	-0.249
Large	0.005	-0.249
Scanty	0.014	-0.247
Changed	0.001	+0.250
past	0.003	+0.249

*Source: Prepared by the authors (2022)

Table 5: Core sentences for question one

Core Sentences	Magnitude	Sentiment Score
The weather has changed enormously in the past ten years.	0.79	+0.574
Rainfall is very scanty and erratic, causing damage to the crops.	0.81	-0.467
The temperature has been rising, so the arrival of winter occurs late.	0.85	+0.603
Also, the summers have been much hotter for the last 5 to 6 years, and the maximum temperature reaches 32 to 33-degree centigrade in May.	0.49	0.128
Results in more pest infestation during the summers.	0.70	-0.543
Every year the temperature goes up.	0.85	+0.582
Global warming and the temperature in the Himalayas are increasing.	0.85	+0.603
Also, excess rainfall promotes soil erosion and landslides.	0.77	-0.496
Further, winter is much colder than before.	0.77	-0.523
Temperatures in the winter have gone down by a few degrees.	0.63	0.093

*Source: Prepared by the authors (2022)

Q2- How does it affect your farm?

The detected themes denoted by the thematic analysis are higher temperatures, badly affected soil erosion, and destroyed crops. The rising temperatures and excess rainfall are affecting the crops severely and destroying them. Further, it is also increasing soil erosion.

Table 6: Magnitude of the responses, detected entities and themes for question two

This document is: positive (+0.52) Subjectivity: subjective	Magnitude: 5.12	Score Range Negative -1.0 to 0.25	Neutral -0.25 to +0.25	Positive +0.25 to +1.0
Detected Themes		Magnitude	Sentiment Score	
Higher Temperatures		0.98	+0.730	
Desirable crops		0.76	+0.603	
Badly affected		0.87	-0.652	
Erosion of the soil		0.68	-0.556	
Destroy crops		0.95	-0.519	

*Source: Prepared by the authors (2022)

The sentiment analysis denoted a positive score of +0.52 which means that the respondents were positive regarding the higher impacts of changing weather conditions on their farms. The detected keywords like 'higher', 'affected', and 'destroy' also showed that the dynamic weather conditions led to higher impacts on the farms of the respondents negatively.

Further, many respondents also felt that the abnormal weather was the reason for their crop destruction.

Table 7: Detected keywords for question two

Detected Keywords	Magnitude	Sentiment Score
Desirable	0.988	+0.744
Higher	0.97	+0.735
Affected	0.007	-0.248
Destroy	0.99	-0.744

*Source: Prepared by the authors (2022)

Table 8: Core sentences for question two

Core Sentences	Magnitude	Sentiment Score
Higher temperatures reduce the yield of desirable crops.	0.89	+0.649
The hot temperature during maize cultivation causes pest infestation and plant diseases.	0.35	0.163
Production and productivity are also severely affected.	0.84	-0.535
Hailstones during the harvesting season destroy crops.	0.85	-0.560
The positive of the excess rainfall is the availability of cattle fodder.	0.77	+0.551
There is a loss of nutrients in the farms, and soil erosion occurs due to rainwater moving downhill.	0.77	-0.525
Also, there has been an increase in soil bacteria, fungus and mould growth.	0.30	0.174
Farmers have to face various hardships in cultivating crops.	0.35	0.162

*Source: Prepared by the authors (2022)

Q3-Can you give an example of a year with high impact? (Yield reduction, low/high selling price)

The thematic analysis denotes themes such as pest attacks, lack of infrastructure, and poor yield, among others. The respondents witnessed higher pest attacks and poor yields. Further, the lack of infrastructure has led to more disrupting results for the crops.

Table 9: Magnitude of the responses, detected entities and themes for question three

This document is: negative (-0.62)	Magnitude: 4.88	Score Range		
		Negative	Neutral	Positive
Subjectivity: subjective		-1.0 to 0.25	-0.25 to +0.25	+0.25 to +1.0
Detected Themes		Magnitude	Sentiment Score	
Pest attacks		0.99	-0.744	
Poor Yield		0.98	-0.731	
Lack of Infrastructure		0.93	-0.649	
Fertilisersbiopesticides		0.73	-0.545	
Became disruptive		1.00	+0.642	

*Source: Prepared by the authors (2022)

The sentiment analysis provided a negative score of -0.62, indicating the negative sentiments of the respondents on the high impacts on the field. The detected keywords like 'extreme', 'hard', and 'poor' denote that the previous years have beenhighly impacted by pest attacks, poor yield, and disruption.

Table 10: Detected keywords for question three

Detected Keywords	Magnitude	Sentiment Score
Poor	0.986	-0.741
last	0.005	-0.249
extreme	0.006	-0.249
hard	0.073	-0.232

*Source: Prepared by the authors (2022)

Table 11: Core sentences for question three

Core Sentences	Magnitude	Sentiment Score
Due to COVID-19, the supply chain and demand became disruptive.	0.66	+0.442
Demand was low; further, we had yield reduction due to the non-availability of farm labour and market access.	0.47	0.133
Input costs are high.	0.53	+0.117
Though the selling price is higher than before, the transportation cost has also increased due to higher fuel prices.	0.46	0.136
Smallholder farmers are finding it hard due to a lack of infrastructure.	0.60	-0.100
The poor yield of vegetables as extreme weather is not good for farming vegetables.	0.62	+0.095
The rising cost of farm inputs such as bio fertilisers, bio-pesticides and increased pest attacks.	0.83	-0.504
The maize crop failed last year due to worm infestation.	0.71	-0.474

*Source: Prepared by the authors (2022)

Q4- Do you think that organic farming can be helpful in sustainable agriculture?

The thematic analysis denotes key themes like good for human health and sustainable agriculture. It was found that most respondents found organic farming advantageous in bringing sustainable agriculture.

Table 12: Magnitude of the responses, detected entities and themes for question four

This document is: positive (+0.71) Subjectivity: subjective	Magnitude: 6.79	Score Range Negative -1.0 to 0.25	 Neutral -0.25 to +0.25	 Positive +0.25 to +1.0
Detected Themes		Magnitude	Sentiment Score	
Soil water		1.00	+0.738	
Good for human health		0.88	+0.600	
Sustainable agriculture		0.64	+0.570	
Organic farming		0.63	+0.565	
Increased labour costs		0.63	+0.550	

*Source: Prepared by the authors (2022)

The overall attitude of the farmers appears to be positive concerning organic farming. Further, the sentiment analysis denotes a positive sentiment score of +0.71. The respondents believed that using organic farming improved the sustainable farming practices of the farmers. Also, government support is identified as very important for deploying more use of organic farming among farmers.

Table 13: Detected keywords for question four

Detected Keywords	Magnitude	Sentiment Score
sustainable	0.994	+0.747
improved	0.99	+0.745
organic	0.989	+0.744
good	0.988	+0.743
helpful	0.986	+0.743
increased	0.978	+0.739
human	0.008	+0.248
help	0.034	+0.242

*Source: Prepared by the authors (2022)

Table 14: Core sentences for question four

Core Sentences	Magnitude	Sentiment Score
Organic farming appears good with the support of the government and other institutions	0.85	+0.603
But the need for improved varieties of seeds is seen	0.44	0.141
Increased labour costs and inputs	0.87	+0.584
Organic farming is good for human health as well as the environment.	0.94	+0.491
They need to be trained to tackle diseases and pests.	0.16	0.210
We may not be able to sustain on our own	0.72	-0.547
Significantly reduces the use of other fertilisers	0.67	+0.524
Organic farming can be helpful in sustainable agriculture.	0.81	+0.579
It can help pressure the farm and the environment for a long time.	0.49	0.128
It helps in reducing soil water and air pollution.	0.85	+0.628

*Source: Prepared by the authors (2022)

Q5- In your opinion, what is the role of vermicomposting in sustainable agriculture?

The thematic analysis detected themes of good results, positive impacts, and plant growth and health. Vermicompostingisfavourable for the farmers and the crop yields. Further, it also brings good health and growth to the plants.

Table 15: Magnitude of the responses, detected entities and themes for question five

This document is: positive (+0.63) Subjectivity: subjective	Magnitude: 6.44	Score Range Negative -1.0 to 0.25	 Neutral -0.25 to +0.25	 Positive +0.25 to +1.0
Detected Themes		Magnitude	Sentiment Score	
Good results		0.99	+0.736	
Positive impact		0.61	+0.555	
Plant growth and health		0.62	+0.510	

*Source: Prepared by the authors (2022)

The sentiment analysis saw a positive score of +0.63. Respondents' have a positive attitude toward using vermin composting within their sustainable agriculture. Further, most detected keywords suggest that vermicomposting is friendly and ecological, leading to better and positive results for the farmers.

Table 16: Detected keywords for question five

Detected Keywords	Magnitude	Sentiment Score
better	0.977	+0.992
Improved	0.99	+0.745
good	0.988	+0.743
friendly	0.987	+0.743
ecological	0.979	+0.743
positive	0.921	+0.739
useful	0.67	+0.711
assisted	0.001	+0.250
cheaper	0.21	0.198

*Source: Prepared by the authors (2022)

Table17: Core sentences for question five

Core Sentences	Magnitude	Sentiment Score
Vermicomposting is a cheaper way of getting manure.	0.81	+0.555
Vermicomposting has helped.	0.52	+0.121
Improved soil quality, better quality and quality of crops	0.39	0.152
Vermicomposting purchases through subsidised rates regularly will help.	0.82	+0.556
It has assisted in the process of replenishing the nutrients that were lost in the soil as a result of soil erosion.	0.37	0.158
Vermicomposting helps balance soil.	0.81	+0.555
Good for the overall ecological balance of the farm.	0.58	+0.490
It is ecofriendly	0.41	0.147
It has shown a positive impact on plant growth and health.	0.63	+0.509
It has shown good results in improving yield.	0.85	+0.628
It improves the soil's microbial activity and water retention and aeration.	0.61	+0.508

*Source: Prepared by the authors (2022)

Q6- How does crop selection affects sustainable agriculture

The thematic analysis detected good yield, climate resilience, right crops, and impact yield, among others. These denote that proper crop selection brings good yield results to the farmers. Further, resilient crop selection helps in withstanding weather fluctuations.

Table18: Magnitude of the responses, detected entities and themes for question six

This document is: negative (-0.62) Subjectivity: subjective	Magnitude: 4.88	Score Range Negative -1.0 to 0.25	 Neutral -0.25 to +0.25	 Positive +0.25 to +1.0
Detected Themes		Magnitude		Sentiment Score
Irrigated Water		0.99		+0.744
Better crop selection		0.96		+0.730
Right crop selection		0.94		+0.719
Good yield		0.91		+0.700
Climate resilient		0.98		+0.699
Seasonal crops		0.82		+0.655
Easier and pests		0.94		+0.642
Resilient varieties		0.64		+0.567
Right crops		0.53		+0.518
Wrong selection		0.92		-0.713
Impact yield but also		0.65		-0.546

*Source: Prepared by the authors (2022)

The sentiment analysis showed a positive score of +0.71. The detected keywords like 'important', 'seasonal', 'right', 'better', and 'choose', among others, depict that crop selection is based on seasons and choosing the right crop for each season is very important for good yields. The respondents have a positive attitude towards the impacts of crop selection on bringing sustainability to agriculture.

Table19: Detected keywords for question six

Detected Keywords	Magnitude	Sentiment Score
Better	0.977	+0.992
Sustainable	0.994	+0.747
Resilient	0.988	+0.746
good	0.973	+0.743
Right	0.791	+0.735
Hardly	0.72	+0.640
Choose	0.001	+0.250
Seasonal	0.001	+0.250
Important	0.063	+0.234
Easier	0.32	+0.170
wrong	0.986	-0.742

*Source: Prepared by the authors (2022)

Table 20: Core sentences for question six

Core Sentences	Magnitude	Sentiment Score
Climate resilient would be better now	0.86	+0.573
Crop selection is important, and we do have seasonal crops	0.90	+0.604
Crop selection and crop rotation are important for getting a good yield	0.58	0.104
We need to choose resilient varieties of crops which are hardy and can withstand weather fluctuations.	0.26	0.186
Selecting the right crop according to the season also helps improve yield and productivity.	0.73	+0.488
Sustainable agriculture demands better crop selection so that farming and yield are maintained	0.89	+0.585
The wrong selection of crops would impact not only yield but also the fertility of the soil.	0.85	-0.530
Reduce the use of irrigated water	0.50	0.125
Nutrient management becomes easier, and pests can be controlled with the right crop selection.	0.89	+0.565

*Source: Prepared by the authors (2022)

Q7- What is your opinion on crop rotation, intercropping and companion cropping?

The thematic analysis denoted key themes of outcomes are satisfactory, intercropping is good, prevents soil erosion, and pest management, among others. The themes depict that the respondents found satisfactory outcomes after applying crop rotation and intercropping. The farmers benefited from soil erosion prevention and pest management using cropping techniques.

Table 21: Magnitude of the responses, detected entities and themes for question seven

This document is: positive (+1.00) Subjectivity: subjective	Magnitude: 4.88	Score Range Negative -1.0 to 0.25	Neutral -0.25 to +0.25	Positive +0.25 to +1.0
Detected Themes		Magnitude	Sentiment Score	
Good as diverse crops		0.88	+0.617	
Outcomes are satisfactory		0.90	+0.572	
Intercropping is good		0.90	+0.572	
Pest attack		1.00	-0.747	
Prevents soil erosion		0.87	-0.627	
Mixed cropping		0.76	-0.627	
Pest management		0.61	-0.552	

*Source: Prepared by the authors (2022)

The sentiment analysis detected a positive score of +1.00. The respondents showed a positive attitude toward employing intercropping, crop rotation, and companion cropping. Further, the detected keywords include 'good', 'diverse', 'satisfactory', and 'pest', among others. This indicated that using all these techniques yielded satisfactory results regarding pest management and crop yields.

Table 22: Detected keywords for question seven

Detected Keywords	Magnitude	Sentiment Score
good	0.988	+0.743
diverse	0.975	+0.734
mixed	0.009	-0.248
mitigate	0.014	-0.247
satisfactory	0.229	+0.193
pest	0.993	-0.745

*Source: Prepared by the authors (2022)

Table 23: Core Sentences for question seven

Core Sentences	Magnitude	Sentiment Score
Intercropping is good	0.90	+0.572
Companion cropping helps to ward off pests and pest management	0.86	-0.545
We do mixed cropping and companion cropping to mitigate pest attacks as well as increase the fertility of the soil.	0.77	-0.525
We have experimented with mixed cropping, and the outcomes are satisfactory.	0.45	0.137
These methods are good for the nutrient balance of the soils.	0.89	+0.584
For warding off pests and increasing productivity, intercropping and companion cropping are helpful.	0.81	+0.600
Crop rotation is good as diverse crops can be grown all year round	0.72	+0.470
Companion cropping improves soil condition and prevents soil erosion	0.80	-0.580

*Source: Prepared by the authors (2022)

Q8- Please elaborate on the Pest management strategies used by you.

The thematic analysis for this question presented the key themes of management techniques, soil preparation, and mulching water management. Accordingly, it is depicted that

the respondents used a variety of strategies like soil preparation, mulching, and water management to combat the ill impacts of the pest attacks.

Table 24: Magnitude of the responses, detected entities and themes for question eight

This document is: Positive (+0.60) Subjectivity: subjective	Magnitude: 5.73	Score Range Negative -1.0 to 0.25	Neutral -0.25 to +0.25	Positive +0.25 to +1.0
Detected Themes		Magnitude	Sentiment Score	
Management techniques		0.93	+0.715	
Soil preparation		0.88	+0.656	
Mulching, water management		0.61	+0.538	

*Source: Prepared by the authors (2022)

The sentiment analysis detected a positive score of +0.60. The respondents had a positive attitude toward employing effective pest management strategies. Further, the detected keywords like 'important', 'adequate', and 'traditional' provide the respondents' ideologies towards employing traditional and new strategies against pest attacks and their ill effects.

Table 25: Detected keywords for question eight

Detected Keywords	Magnitude	Sentiment Score
traditional	0.989	+0.744
right	0.973	+0.735
such	0.001	+0.250
important	0.063	+0.234
adequate	0.255	+0.186

*Source: Prepared by the authors (2022)

Table 26: Core sentences for question eight

Core Sentences	Magnitude	Sentiment Score
We use traditional pest management techniques such as cow urine, fly ash and limestones. We also use a mixture of traditional herbs.	0.62	+0.508
Use of quality seeds crop rotation intercropping	0.57	-0.108
Mulching is important at the right time, along with weeding	0.85	+0.537
Managing the dates of sowing, planting and harvesting	0.67	+0.515
soil preparation	0.88	+0.656
Water management	0.12	0.220
Minimum tillage adequate use of manures and fertilisers pruning mulching water management and use of bio fertilisers	0.71	+0.461
Techniques like cover cropping and crop rotation are used	0.38	0.156
Maintaining sanitation on the farm is important	0.94	+0.519

*Source: Prepared by the authors (2022)

The respondents witnessed unusual weather patterns with excessive rainfall and increased temperatures. Additionally, anomalous weather has greatly increased the prevalence of pests. Farming suffered as a result. The rising temperatures are devastatingly affecting agricultural production. For many responders, bad weather was the main culprit for crop failure.

Most farmers interviewed about the effects of the COVID-19 pandemic said they saw increased pest infestation and lower harvests. Research to date also indicates that the haphazard or irrational application and exploitation of synthetic agricultural inputs like pesticides and fertilisers to increase production levels at lower costs severely disrupts the environmental balance (Montgomery, 2007).

Organic farmers were found to have favourable opinions about sustainable agriculture. Respondents were nearly unanimous in their belief that they required government assistance to implement large-scale organic farming. In contrast, prior research has emphasised the significance of several manageable, incremental steps made by the farmers at the individual and family levels to implement organic farming in their fields (Tilman, Balzer, Hill, &Befort, 2018). When considering what factors are most important to organic farming, the goals and financial stability of the farmer have emerged as the most critical factors. Farmers, farm labourers, lawmakers, scientists, businesses, and consumers all have a part to play in making sustainable agriculture possible (Eisler, et al., 2019).

In addition to these findings, interview participants appreciated the positive effects of Vermicomposting. Analysis showed that vermicomposting contributed to the health and growth of plants and crops. It also demonstrated that using vermicomposting is environmentally friendly and yields better results for farmers. Past studies like (Devi &Lourdhu, 2012) have shown that vermicomposting enhances aeration and water holding capacity, soil fertility, and pulverisation through the rotation and churning of insects. Furthermore, it also brings the necessary nutrients to the plants. The selection of crops has also been identified as a method that helps to withstand weather fluctuations. Seasonal plant selection is also essential to increase yields.

Thematic analyses also showed positive responses to the use of crop rotation, intercropping and companion cropping. Most respondents found that they could foresee benefits such as soil erosion control and pest control after using one or a combination of the three methods. The existing literature has also presented a selection of crop rotation practices, intercropping and associate cropping as among the top essential factors through which organic farming can be achieved (Baiphethi& Jacobs, 2009). In addition, increased yields were also seen as a result of using these methods. The reason behind the increasing yields after using such methods has been recognised by previous research. It was depicted that applying crop selection and rotation enables more effective extraction of plant nutrients from the various layers of soil (Wang, et al., 2014).

The interview analysis also showed that respondents used various techniques to manage pest infestations. For example, many respondents used soil preparation, mulching, and water management to control pest infestations in their fields. Furthermore, there is a use of organic farming, pest composting and other sustainable farming methods among the farmers. Both traditional and innovative strategies have been employed to combat pest infestations and other negative factors affecting crop yields.

CONCLUSION

A combination of thematic and sentiment analysis methods was used to evaluate each interview question in light of the responses obtained for this study's analysis. The respondents witnessed abnormal weather patterns through excess rainfall and rising temperatures. Furthermore, pest infestation has increased significantly due to abnormal weather patterns. All of these have negatively impacted farming activities. The rising temperatures with erratic rainfall patterns are severely damaging the crops. Soil erosion is also worsening because of this. Many responders attributed the loss of their crops to the abnormal weather. The negative impact on the crops during the COVID-19 pandemic has also been witnessed by most respondent farmers who have seen higher pest attacks and poor yields during this period. The thematic analysis also presented a positive response toward applying crop rotation, intercropping, and companion cropping. It was ascertained that most respondents could foresee the benefits of soil erosion prevention and pest management after using any of the three methods or a combination. Furthermore, increased crop yields were also found as the resultant outcome after using these methods. The study also presented that respondents used various techniques to manage the pest attacks and loss occurring due to the same. For instance, many respondents used soil preparation, mulching and water management to control pest attacks on their fields. Overall, it was assessed that the weather abnormalities have negatively impacted crop yields and farming activities. Also, organic farming, vermicomposting and other methods are applied for undertaking sustainable farming. Conventional and innovative strategies have been employed to control pest attacks and other negative factors affecting crop yield.

ACKNOWLEDGEMENTS

We want to thank our research colleagues for their valuable suggestions. Also, thank you to all the female farmers who participated in this study.

FUNDING

No funding was received for this work.

DISCLOSURE STATEMENT

The authors report that there are no competing interests to declare.

DATA AVAILABILITY STATEMENT

Interview data is available on reasonable request.

ETHICAL APPROVAL

The ethical clearance was received from the Institutional Ethical Committee of KH Manipal (MAHE) with approval number IEC-2021-494 for the whole PhD of which this project is a part. Informed consent was collected from participants. Due to ethical reasons, the identity of the participants has been hidden.

REFERENCES

Abubakar, M. S., & Attanda, M. L. (2013). *The Concept of Sustainable Agriculture: Challenges and Prospects*. OP Conference Series: Materials Science and Engineering, Volume 53, 5th International Conference on Mechatronics (ICOM'13) 2–4 July 2013, Kuala Lumpur, Malaysia. DOI:10.1088/1757-899X/53/1/012001

Baiphethi, M. N., & Jacobs, P. (2009). The contribution of subsistence farming to food security in South Africa. *Agrekon, 48*(4), 459-482. DOI: 10.10520/EJC18425

Bowman, M., & Zilberman, D. (2013). Economic Factors Affecting Diversified Farming Systems. *Ecology and Society, 18*(1), 33. Available at https://www.jstor.org/stable/26269286

Chatterjee, R., Bandyopadhyay, S., & Jana, J. C. (2014). Evaluation of vegetable wastes recycled for vermicomposting and its response on yield and quality of carrot (Daucus carota L.). *International Journal of Recycling of Organic Waste in Agriculture, 3*(2), 60. DOI:10.1007/s40093-014-0060-4

Devi, R., & Lourdhu M. A. (2012). Vermicomposting of poultry feather using Eisenia foetida and Indigenous earthworm: A comparative study. *International journal of scientific research, 2*(10), 45-48. DOI: 10.15373/22778179/OCT2013/12

Eisler, M. C., Lee, M. R., Lee, M. R., Tarlton, J. F., Martin, G., Beddington, J., . . . Saun, R. (2014). Agriculture: Steps to sustainable livestock. *Nature, 507*(7490), 32-34. DOI:10.1038/507032a

Giovannucci, D., Scherr, S. J., Nierenberg, D., Hebebrand, C., Shapiro, J., Milder, J. C., & Wheeler, K. (2012). *Food and Agriculture: The Future of Sustainability*. Retrieved 7 25, 2022, from https://sustainabledevelopment.un.org/content/documents/agriculture_and_food_the_future_of_sustainability_web.pdf

Hobbs, P. R., Sayre, K. D., & Gupta, R. (2008). The role of conservation agriculture in sustainable agriculture. *Philosophical Transactions of the Royal Society B, 363*(1491), 543-555. DOI:10.1098/rstb.2007.2169

Horrigan, L., Lawrence, R. S., & Walker, P. P. (2017). How sustainable agriculture can address the environmental and human health harms of industrial agriculture. *Environmental Health Perspectives, 110*(5), 445-456. DOI: 10.1289/ehp.02110445

Khan, A. u., Iqbal, M., & Islam, K. R. (2007). Dairy manure and tillage effects on soil fertility and corn yields. *Bioresource Technology, 98*(10), 1972-1979. DOI: 10.1016/j.biortech.2006.07.041

Kremen, C., Iles, A., & Bacon, C. M. (2012). Diversified Farming Systems: An Agroecological, Systems-based Alternative to Modern Industrial Agriculture. *Ecology and Society, 17*(4), 44.Available athttp://www.jstor.org/stable/26269193

Lithourgidis, A., Dordas, C., Damalas, C. A., & Vlachostergios, D. N. (2011). Annual intercrops: an alternative pathway for sustainable agriculture. *Australian Journal of Crop Science, 5*(4). DOI: 10.3316/informit.281409060336481

Mobasser, H. R., Vazirimehr, M. R., & Rigi, K. (2014). Effect of intercropping on resources use, weed management and forage quality. *The International Journal of Plant, Animal and Environmental Sciences, 2014*(2). Available at https://www.researchgate.net/profile/Hamidreza-Mobasser/publication/261986643_EFFECT_OF_INTERCROPPING_ON_RESOURCES_USE_WEED_MANAGEMENT_AND_FORAGE_QUALITY/links/0a85e536153aed4098000000/EFFECT-OF-INTERCROPPING-ON-RESOURCES-USE-WEED-MANAGEMENT-AND-FORAGE-QUALITY.pdf

Montgomery, D. R. (2007). Soil erosion and agricultural sustainability. *Proceedings of the National Academy of Sciences of the United States of America, 104*(33), 13268-13272. DOI: 10.1073/pnas.0611508104

Nicole, W. (2013). food from earth: sustainable farming in action. *Environmental Health Perspectives, 121*(7). DOI: 10.1289/ehp.121-a212

Panday, R., Basnet, B. B., Bhatt, P. S., & Tamrakar, A. S. (2014). Bioconcentration of heavy metals in vermicomposting earthworms (Eisenia fetida, Perionyx excavatus and Lampito mauritii) in Nepal. *The Journal of Microbiology, Biotechnology and Food Sciences, 3*(5), 416-418. Retrieved from https://office2.jmbfs.org/index.php/JMBFS/article/view/7007

Pratt, P., & Castellanos, J. (1981). Available nitrogen from animal manures. *California Agriculture, 35*(7), 24-24.

Ra, K., &Rb, S. (2022) A Study on the Promotional Methods Carried out by the Agro Retailers from Farmer's Perspective: Theni District, Tamil Nadu.*International Journal of Professional Business Review*.DOI: https://doi.org/10.26668/businessreview/2022.v7i3.e607

Reay, D. S. (2002). Intensive farming, US-style, is not sustainable worldwide. *Nature, 417*(6884), 15-15. DOI: 10.1038/417015c

Reddy, B. S. (2010). Organic Farming: Status, Issues and Prospects – A Review. *Agricultural Economics Research Review, 23*(2), 343-358. DOI: 10.22004/ag.econ.97015

Rigby, D., & Cáceres, D. (2016). Organic Farming and the Sustainability of Agricultural Systems. *Agricultural Systems, 68*(1), 21-40. DOI: 10.1016/S0308-521X(00)00060-3

Salama, Z. A., Baz, F. K., Gaafar, A. A., & Zaki, M. F. (2015). Antioxidant activities of phenolics, flavonoids and vitamin C in two cultivars of fennel (Foeniculum vulgare Mill.) in responses to organic and bio-organic fertilisers. *Journal of the Saudi Society of Agricultural Sciences, 14*(1), 91-99.DOI: 10.1016/j.jssas.2013.10.004

Sarjiman, Y., Lazim, H. M., &Lamsali, H. (2023). A Lean Management Approach of Rice Subsidy Distribution: Some Findings from a Study in Selangor. *International Journal of Professional Business Review*, *8*(1), e01257-e01257.DOI: https://doi.org/10.26668/businessreview/2023.v8i1.1257

SDG. (2018). *Proposal for Sustainable Development Goals .:. Sustainable Development Knowledge Platform*. Retrieved 7 25, 2022, from Sustainable Development Knowledge Platform: http://sustainabledevelopment.un.org/focussdgs.html

Senjaliya, H. J., Vala, G. S., & Ma, G. S. (2015). Nutrient management through organic and inorganic manures in coconut (Cocos nucifera L.) garden. *Asian Journal of Soil Science, 10*(1), 59-62. DOI: 10.15740/HAS/AJSS/10.1/59-62

Shanthi, N., Bhoyar, R., & Bhide, A. (1993). Vermicomposting of Vegetable Waste. *Compost Science & Utilization, 1*(4), 27-30. DOI: 10.1080/1065657X.1993.10757900

Smith, B. G. (2018). Developing sustainable food supply chains. *Philosophical Transactions of the Royal Society B, 363*(1492), 849-861.DOI: 10.1098/rstb.2007.2187

Tilman, D. (2017). Global environmental impacts of agricultural expansion: The need for sustainable and efficient practices. *Proceedings of the National Academy of Sciences of the United States of America, 96*(11), 5995-6000. DOI: 10.1073/pnas.96.11.5995

Tilman, D., Balzer, C., Hill, J. D., & Befort, B. L. (2018). Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(50), 20260-20264. DOI:10.1073/pnas.1116437108

United Nations Visitors Centre "Welcome to the United Nations — Tour the international UN Headquarters". (2017). Retrieved 7 25, 2022, from United Nations: http://visit.un.org/

Wang, Z.-G., Jin, X., Bao, X.-G., Li, X.-f., Zhao, J.-H., Sun, J.-H., . . . Li, L. (2014). Intercropping Enhances Productivity and Maintains the Most Soil Fertility Properties Relative to Sole Cropping. *PLOS ONE*, *9*(12). DOI: 10.1371/journal.pone.0113984