EFFECTS OF AGRICULTURAL PRACTISES ON SOCIO-ECONOMIC DEVELOPMENT IN COUNTY PROJECTS IN KENYA: A CASE STUDY OF NATIONAL AGRICULTURAL AND RURAL INCLUSIVE GROWTH PROJECT IN NANDI COUNTY

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A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF MANAGEMENT AND LEADERSHIP IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF BACHELOR OF ARTS IN DEVELOPMENT STUDIES OF THE MANAGEMENT UNIVERSITY OF AFRICA.

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DECLARATION.

This project is my original work and has not been presented for a degree in any other University

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This project has been submitted for examination with my approval as University Supervisor

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DEDICATION.

This research project is dedicated to my beloved parents, Esther Sitienei and Moses whose unfailing devotion, selflessness, and support have been my greatest source of strength. Their wisdom, hard work, and dedication to our family have inspired me to pursue knowledge and excellence.

Thank you for believing in me and for teaching me the principles of perseverance, integrity, and determination. This work is a reflection of your endless support and guidance.

With deep gratitude and love, I honor you both.

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ABSTRACT

Agriculture was a critical driver of socio-economic development in Kenya, particularly within rural areas such as Nandi County, where the majority of the population depended on farming for their livelihoods. This study examined the effect of agricultural practices—specifically agroforestry, organic farming, hydroponics and aeroponics, and irrigation farming—on socio-economic development in Nandi County, under the framework of the National Agricultural and Rural Inclusive Growth Project (NARIGP). The study adopted a descriptive research design employing both qualitative and quantitative approaches. Data were collected using structured questionnaires, interviews, and observations to ensure triangulation and enhance validity. The target population consisted of 400 individuals—including farmers, agricultural officers, local government officials, and community leaders—from which a sample of 120 respondents was selected through stratified random sampling. Quantitative data were analyzed using descriptive statistics and multiple regression analysis, with socio-economic development as the dependent variable and the four agricultural practices as independent variables. Instrument reliability was tested using Cronbach's Alpha, with a threshold of 0.7, and content validity was ensured through expert review. The study achieved a 100% response rate, with all 120 questionnaires successfully completed, reflecting strong engagement from the community. The findings showed that agroforestry was highly valued for improving soil fertility, crop yields, household income, and employment opportunities, with tree planting being the most widely adopted practice. Organic farming was positively perceived for improving produce quality, food security, and household incomes, despite challenges related to input access and labor. Hydroponics and aeroponics were acknowledged for their water-saving benefits and contribution to food security, although awareness and infrastructure gaps limited their adoption. Irrigation farming was widely recognized for enhancing productivity, stabilizing food availability, and improving incomes, though access challenges remained. Overall, agricultural practices significantly improved household income, food security, employment opportunities, and quality of life in Nandi County, though connections to affordable education and health services required further strengthening. The study recommended that county authorities and stakeholders intensify training, infrastructure investment, market linkages, and supportive policies to scale up sustainable agricultural practices. Additionally, it encouraged integrating agricultural gains with social services to promote inclusive and equitable socio-economic development. These findings contributed valuable insights for policymakers, development agencies, and future researchers interested in sustainable rural development in Kenya and similar contexts across sub-Saharan Africa.

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ACRONYMS AND ABBREVIATIONS

FAO: Food and Agriculture Organization

IAPM: International Association of Project Managers

M & E: Monitoring and Evaluation

MUA: Management University of Africa

NARIGP: National Agricultural and Rural Inclusive Growth Project

NGO: Non-governmental Organizations.

OPERATIONAL DEFINITION OF TERMS

Agroforestry: Incorporating trees and shrubs into agricultural landscapes alongside crops and/or livestock is known as agroforestry. This approach promotes climate resilience, decreases erosion, increases soil fertility, and boosts biodiversity.

Hydroponics and Aeroponics: Plants are grown in a nutrient-rich water solution in hydroponics, a soilless farming method, whereas aeroponics uses little to no growth media and grows plants in an air or mist environment. Both techniques make it possible to use resources like water and space efficiently and are especially well-suited for indoor and urban farming.

Irrigation Farming: The intentional application of water to crops or soil to augment natural rainfall and guarantee steady agricultural output is known as irrigation farming. This method makes it possible to cultivate in arid or semi-arid areas, increases crop yields, and lowers the chance of crop failure from dryness.

Organic Farming: Producing food without the use of artificial fertilizers, pesticides, genetically modified organisms (GMOs), or chemical additives is known as organic farming. Rather, it sustains soil fertility and ecological balance through natural processes, including crop rotation, composting, biological pest control, and organic inputs.

Socio-economic Development: The process of raising people's level of living and well-being through economic expansion, more job possibilities, better access to healthcare and education, and higher living standards is known as socio-economic development.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

An overview of the research on how agricultural practices affect Nandi County's socioeconomic development is given in this chapter, with particular attention on the National Agricultural and Rural Inclusive Growth Project (NARIGP). The problem statement, research objectives, research questions, study justification, scope, chapter summary, and study background are all covered.

1.1 Background

Agriculture remains a cornerstone of socioeconomic development across the globe, serving as both a source of livelihood and a driver of national growth. According to the Food and Agriculture Organization (FAO, 2018), the agricultural sector contributes approximately 4% to global GDP, though this figure varies significantly depending on a country's level of industrialization and technological advancement. In developed nations, innovations such as precision farming, hydroponics, and aeroponics have revolutionized agricultural productivity, bolstering food security and economic stability (Smith & Brown, 2019). Despite a global trend toward sustainable agricultural practices, many emerging economies, particularly in Africa and Asia, continue to depend on traditional farming methods (Gupta et al., 2020). Nevertheless, there is growing recognition of the importance of sustainable techniques—including agroforestry, organic farming, and irrigation systems—as well as newer technologies like hydroponics, in transforming rural economies and ensuring environmental resilience (Lee & Kim, 2021).

In various countries across different continents, agricultural practices such as agroforestry, organic farming, hydroponics, and irrigation play significant roles in shaping socioeconomic outcomes. In Brazil, for example, agroforestry systems are widely implemented in the Amazon and other regions, where integrating trees into agricultural landscapes has improved biodiversity, increased farmers' incomes, and strengthened resilience to climate variability (Cialdella, Jacobson, & Penot, 2023). Similarly, in India, organic farming has gained substantial ground,

particularly in states like Sikkim, which became the first fully organic state. This shift has enhanced soil health, improved long-term productivity, and reduced farmers' dependence on expensive chemical inputs, contributing to rural economic stability and food security. In the United States, hydroponic and aeroponic systems are widely used in urban farming, especially in cities such as New York and Chicago. These innovations allow for year-round food production, create employment opportunities, and help to urban food security by minimizing dependency on rural supply chains. In the Netherlands, a global leader in agricultural technology, hydroponics has been essential in maximizing yields while using minimal land and water resources, significantly bolstering the country's agri-export economy.

Meanwhile, in Egypt, irrigation is a central pillar of agricultural production due to the arid climate. The Nile River supports a complex irrigation network that underpins national food security and employment, although rising water scarcity and climate change pose serious threats to its sustainability (Giordano, Namara, & Bassini, 2023). In Australia, modern irrigation systems have enhanced productivity in water-scarce regions, contributing to the export-oriented agricultural economy while promoting efficient resource use. These examples across continents underscore the critical role that diversified and sustainable agricultural practices play in enhancing socioeconomic resilience, addressing climate change, and ensuring long-term food security (Harvey, 2024).

In Africa, agriculture continues to serve as the economic backbone for many nations. Agroforestry is widely used to address environmental degradation and promote food security and poverty reduction. Ghana and Uganda have made notable strides in organic farming, with community-based programs helping smallholder farmers transition to sustainable agriculture. Initiatives such as the Sustainable Organic Farming Development Initiative (SOFDI) have played a key role by providing training on composting, crop rotation, and natural pest control. These practices have improved soil health and productivity, resulting in better nutrition and increased incomes for rural households (Blockeel et al., 2023). Urban agriculture innovations are also on the rise in African cities like Nairobi and Lagos, where space constraints and growing populations have led to the adoption of hydroponic and aeroponic farming. Supported by organizations such as the African Association for Vertical Farming (AAVF), these technologies enable efficient, high-yield production of vegetables and herbs in urban and peri-urban

environments, enhancing food access and creating employment opportunities in informal settlements (Ahmed, 2020).

Irrigation continues to be a crucial focus area across many African countries, especially in Sudan, Morocco, and South Africa, where rainfall variability poses a significant threat to agricultural stability. Despite persistent challenges in water infrastructure and management, countries are investing in small-scale irrigation schemes and solar-powered systems to ensure a reliable water supply for farming. These improvements are vital for sustaining agricultural productivity, reducing poverty, and driving rural development (Zhang & Li, 2024).

In Kenya, agriculture employs more than 40% of the national workforce and over 70% of rural laborers, accounting for about 33% of GDP (KNBS, 2023). Despite this central role, the sector faces major obstacles, including restricted ability to get financing, low technology adoption, and vulnerability to climate change. In response, the Kenyan government, in collaboration with international partners, launched the National Agricultural and Rural Inclusive Growth Project (NARIGP) to modernize agriculture and support socio-economic development through improved practices (Ndungu, 2024). Agroforestry has significantly contributed to livelihoods, especially in arid and semi-arid regions of Kenya. Research indicates it enhances household income, improves food security, and helps preserve the environment. However, adoption depends on social and demographic factors such as education level, occupation, and age of the household head (Syano et al., 2016). Organic farming has deep roots in Kenya, with organized promotion beginning in the 1980s. The Kenya Organic Agriculture Network (KOAN) has been central in advancing organic practices through technical training, certification, and market development, leading to improved farmer income and sustainable development (KOAN, 2018). Kenya has also become a regional leader in hydroponics and aeroponics, with companies like Hydroponics Africa providing affordable systems to support food production and create employment. These technologies are especially popular among youth and urban residents, offering opportunities for climate-smart farming even in limited spaces (Ahmed, 2020). On the irrigation front, the National Irrigation Authority's 2023–2027 Strategic Plan underscores the importance of expanding efficient and sustainable irrigation systems to boost productivity and meet national food security goals (AIAP Secretariat, 2024).

In Nandi County, which boasts fertile soils and a favorable climate, agriculture is the cornerstone of the local economy. Major economic activities include tea, maize, and dairy farming, with emerging interest in hydroponics and agroforestry. However, small-scale farmers often lack the knowledge and financial means to adopt modern practices (Mureithi & Wachira, 2024). This research aims to assess the effects of agroforestry, organic farming, hydroponics, and irrigation on the socio-economic development of Nandi County under the NARIGP framework.

1.1.5 National Agricultural and Rural Inclusive Growth Project (NARIGP)

NARIGP is a World Bank-funded initiative launched in 2017 to enhance agricultural productivity, bolster food security, and support rural livelihoods in Kenya. The project aligns with Kenya's Vision 2030 and the Big Four Agenda, particularly the pillar on food security. It builds on previous agricultural projects such as the Kenya Agricultural Productivity Project (KAPP) and the Kenya Climate Smart Agriculture Project (KCSAP), aiming to address key challenges facing smallholder farmers, including low productivity, poor market access, and vulnerability to climate change. NARIGP is implemented in 21 counties, targeting smallholder farmers, agribusiness groups, and community-based organizations, especially in semi-arid and agriculturally underdeveloped areas. The project employs a Community-Driven Development (CDD) approach, where local communities identify and implement sub-projects tailored to their agricultural needs. Its key objectives include enhancing agricultural productivity through modern farming techniques, promoting market access by linking farmers to agribusinesses, empowering women and youth to participate in agricultural activities, and encouraging climate-smart agriculture for environmental sustainability. Funded with approximately USD 200 million from the World Bank, NARIGP implements several interventions, including farmer training and capacity building, provision of grants and farm inputs, development of rural infrastructure such as irrigation schemes and roads, and promotion of sustainable farming practices like agroforestry and water conservation. Since its inception, the project has contributed to increased agricultural yields, improved rural incomes, and strengthened farmer cooperatives.

1.2 Statement of the Problem

Agriculture plays a central role in Kenya's socio-economic structure, contributing about 33% to the national GDP and employing over 70% of rural laborers (KNBS, 2023). In Nandi County, agriculture serves as the foundation of the local economy, with the region's favorable agroecological conditions supporting key value chains such as tea, maize, and dairy farming. However, despite this potential, smallholder farmers continue to face persistent challenges, including low adoption of modern farming technologies, limited financial resources, and vulnerability to climate change. These issues undermine efforts to achieve sustainable rural development, food security, and poverty reduction.

Globally, sustainable agricultural practices—such as agroforestry, organic farming, hydroponics, and irrigation—have demonstrated considerable success in improving livelihoods, increasing productivity, and promoting environmental resilience in countries such as Brazil, India, and the Netherlands (Cialdella, Jacobson, & Penot, 2023; Blockeel et al., 2023; Harvey, 2024). Programmes such as the NARIGP) in Kenya have been introduced to promote these innovations at the grassroots level. However, there is limited localized empirical evidence evaluating the actual socio-economic impact of these practices within the context of Nandi County, especially under the NARIGP framework.

Furthermore, while studies have highlighted the individual benefits of agroforestry or hydroponics in isolated settings, few have assessed the integrated effect of multiple sustainable agricultural practices on rural socio-economic development in a high-potential area like Nandi County. This creates a knowledge gap on how these practices interact and help collectively to household incomes, employment, food security, and community resilience.

In addition, although modern technologies such as hydroponics and aeroponics are gaining traction in Kenyan urban areas, their applicability, uptake, and impact among rural populations—particularly in Nandi County—remain under-researched. Adoption barriers such as age, education, and occupation have been identified in national studies (Syano et al., 2016), but specific demographic and socio-economic determinants affecting adoption in Nandi County are yet to be comprehensively explored.

Moreover, the role of youth and women in embracing modern agricultural innovations in rural areas is not well-documented, despite the growing promotion of youth-driven agribusiness across Kenya. Understanding the inclusiveness of these practices and their potential to reduce inequalities in rural development constitutes another important research gap. While NARIGP is a flagship initiative aimed at inclusive rural transformation, localized evaluations of its effectiveness and outcomes remain scarce, particularly regarding how supported agricultural practices translate into measurable socio-economic improvements in target regions such as Nandi County.

This study, therefore, seeks to fill these gaps by empirically assessing the effects of agroforestry, organic farming, hydroponics, and irrigation on socio-economic development in Nandi County. The findings will provide policy-relevant insights for strengthening sustainable agricultural interventions and scaling inclusive development strategies in similar rural contexts.

1.3 Objectives of the Study

1.3.1 General Objective

To assess the effect of agricultural practices on socio-economic development in Nandi County, focusing on the National Agricultural and Rural Inclusive Growth Project (NARIGP).

1.3.2 Specific Objectives

i. To assess the effect of agroforestry on socio-economic development in Nandi County.
ii. To evaluate the role of organic farming in enhancing socio-economic development in Nandi County.
iii. To analyze the contribution of hydroponics and aeroponics to socio-economic development in Nandi County.
iv. To examine the effect of irrigation farming on socio-economic development in Nandi County.

1.4 Research Questions

i. What is the effect of agroforestry on socio-economic development in Nandi County?

ii. How does organic farming contribute to the enhancement of socio-economic development in Nandi County?
iii. In what ways do hydroponic and aeroponic farming systems contribute to socio-economic development in Nandi County?
iv. What is the effect of irrigation farming on socio-economic development in Nandi County?

1.5 Justification or Significance of Study

This study contributes to the theoretical understanding of sustainable agriculture and rural development by examining how practices such as agroforestry, organic farming, hydroponics, and irrigation influence socio-economic outcomes. It draws on and extends existing development theories, including Sustainable Livelihoods Theory and Agricultural Innovation Systems Theory, by contextualizing them within rural Kenyan settings, particularly Nandi County. By integrating localized data into these frameworks, the study enhances the theoretical models' applicability in analyzing agricultural transformation in low- and middle-income countries. This alignment allows for the validation and possible refinement of these theories, offering more grounded explanations of how agricultural innovation drives socio-economic resilience in diverse ecological and cultural contexts.

From a practical standpoint, the study provides critical insights for policymakers, development partners, and stakeholders involved in agricultural programs such as the National Agricultural and Rural Inclusive Growth Project (NARIGP). Identifying which agricultural practices have the most significant socio-economic impacts can help direct resources toward scalable, high-impact interventions. Furthermore, the research findings will inform county-level agricultural planning and the design of farmer support services, especially in areas facing land pressure, climate stress, and limited access to technology. Local farmers in Nandi County and similar contexts will benefit from recommendations on sustainable, climate-smart, and income-generating farming techniques, thereby supporting rural livelihoods and poverty reduction efforts.

This study fills a notable gap in the empirical literature by providing localized, data-driven evidence on the impact of integrated agricultural practices on rural development. While most existing studies have focused either on national-level analyses or single agricultural technologies,

this research offers a multi-dimensional view of how combined approaches influence community welfare, food security, and economic inclusion. It enriches academic discourse on rural agricultural modernization and contributes to a growing body of literature advocating for inclusive, sustainable development. The findings can be used as a reference for future research, particularly for scholars, students, and institutions investigating rural transformation, environmental sustainability, and agricultural policy in sub-Saharan Africa.

1.6 Scope

This study will be conducted in Nandi County, Kenya, focusing on NARIGP. The research will examine the period from May to August 2025, analyzing data on agroforestry, organic farming, hydroponics, and irrigation farming within this timeframe. The target population of 400 respondents will include smallholder farmers, agricultural extension officers, and key stakeholders in the agricultural sector.

1.7 Chapter Summary

Background data, the issue description, the research objectives, the research questions, the importance, and the scope of the study were all presented in this chapter. The study focuses on the effects of farming methods on socio-economic development in Nandi County under the NARIGP initiative. The next chapter will review relevant literature to provide theoretical and empirical insights into the study variables.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter delves into the theoretical and empirical underpinnings of the study while addressing key research gaps. It reviews existing theories and literature relevant to the research problem, linking them to the study objectives. The chapter includes the theoretical framework, empirical studies on the hypothesized variables, and a summary of identified research gaps. Additionally, the conceptual framework and operationalization of variables are outlined to guide the study analysis.

2.1 Theoretical Literature Review

Several theories establish a basis for comprehending the effects of agroforestry, organic farming, irrigation, and modern agricultural technologies like hydroponics and aeroponics on socio-economic development. This discussion focuses on three key theories: Sustainable Livelihoods Theory, Resource-Based View (RBV) Theory, and Innovation Diffusion Theory, which align with the research objectives.

2.1.1. Sustainable Livelihoods Theory

In 1992, Robert Chambers and Gordon Conway presented the Sustainable Livelihoods Theory (SLT), a paradigm for development that focuses on how people and communities make use of the resources at their disposal to create resilient and sustainable livelihood The theory was developed in response to the limitations of conventional development models that focused primarily on income and employment. SLT presents a holistic view by identifying five core types of capital necessary for achieving sustainable livelihoods: natural, human, financial, social, and physical capital. Environmental resources, including land, water, and biodiversity, are referred to as natural capital. Human capital includes education, health, and skills, while financial capital encompasses income, savings, and access to credit. Infrastructure and instruments that enable production are examples of physical capital, whereas networks,

connections, and organizations that promote collaboration and support are examples of social capital. The theory argues that sustainable development depends on how well individuals and communities mobilize and manage these forms of capital in the face of external shocks, institutional constraints, and environmental changes.

Despite its widespread use in development planning, the Sustainable Livelihoods Theory has been criticized for several reasons. One of the main critiques is that it is overly descriptive and lacks predictive capacity, making it challenging to measure impact or formulate clear policy interventions. Scholars such as De Haan (2012) argue that the theory underrepresents power dynamics, particularly structural issues like land inequality, gender discrimination, and political marginalization that shape access to livelihood resources. Others have noted that the framework often assumes equal opportunity to access capital, without adequately addressing how systemic barriers influence livelihood outcomes. SLT has also been criticized for having a bias toward rural areas and having little use in metropolitan and peri-urban settings. These criticisms highlight the need for adapting the theory to address the complexities of inequality, governance, and market systems.

In the context of agriculture in Nandi County, Kenya, SLT is particularly relevant in analyzing how agroforestry and organic farming contribute to sustainable livelihoods. Agroforestry is the practice of integrating trees with crops and animals. Supports natural capital by improving soil quality, enhancing biodiversity, and preventing erosion. It also boosts financial capital by diversifying income through the sale of timber, fruits, and fodder. According to Place and Garrity (2015), agroforestry systems enhance both ecological and economic resilience, especially in regions vulnerable to climate variability. Additionally, social capital is strengthened when farmers engage in group-based learning, resource sharing, and cooperative marketing. Organic farming, on the other hand, aligns with SLT by improving human capital through knowledge of eco-friendly farming methods and increasing financial capital through higher prices in niche markets. Research by Pretty et al. (2018) and IFOAM (2020) indicates that organic agriculture in Kenya not only enhances soil fertility and reduces input costs but also contributes to food safety and environmental sustainability.

These sustainable farming practices also support community development and collective action. When farmers form cooperatives or associations, they gain access to better extension services, financial training, and collective bargaining power. This enhances social capital, which is critical for resilience in rural economies. From an environmental perspective, both agroforestry and organic farming reduce reliance on synthetic inputs, mitigate climate change effects through carbon sequestration, and promote biodiversity conservation. For instance, agroforestry functions as a carbon sink, while organic farming avoids harmful agrochemicals that degrade soil and water. These practices, therefore, not only improve livelihoods but also support more general environmental objectives.

To maximize the potential of SLT in agricultural development, policymakers and development agencies should support farmers through training, subsidies, and market access. Education and capacity building are essential to ensure farmers can adopt and sustain agroecological practices. Governments should also integrate SLT principles into national agricultural and environmental strategies. Research and innovation in sustainable farming should be prioritized to ensure that smallholder farmers benefit from up-to-date knowledge and technologies. In doing so, communities in Nandi County and beyond can achieve improved food security, household income, and ecological stability.

In conclusion, understanding how various agricultural techniques, such as organic farming and agroforestry, may improve the sustainability and resilience of rural livelihoods is made easier with the help of the Sustainable Livelihoods Theory. By leveraging all five forms of natural, human, monetary, social, and physical capital, farmers in Nandi County can improve their socio-economic well-being while conserving their environment. Although SLT has its limitations, it remains a powerful tool for analyzing and guiding rural development strategies aimed at achieving long-term sustainability.

2.1.2. Resource-Based View (RBV) Theory.

In 1991, Jay Barney created the Resource-Based View (RBV) Theory, which provides a strategic framework for comprehending how businesses or people might gain and maintain a competitive edge. According to RBV, long-term success and strategic distinction sources and capabilities—

when they are valuable, rare, inimitable, and non-substitutable (often abbreviated as VRIN)—can become the foundation for long-term success and strategic differentiation. According to Barney (1991), these resources must not only be unique but also difficult for competitors to acquire or duplicate, thus forming the basis for sustained advantage in any sector, including agriculture. The theory emphasizes the internal strengths of an organization or individual rather than external market conditions, advocating that strategic management should focus on nurturing and leveraging distinctive capabilities.

While RBV has been widely adopted in strategic management and development planning, it has also received criticism from various scholars. One major critique is its inward-looking nature, which may cause organizations to overlook external factors such as market dynamics, competition, regulatory environments, or consumer preferences (Priem & Butler, 2001). Additionally, some argue that the theory lacks clarity in identifying what qualifies as a "resource" and how to measure or operationalize the VRIN characteristics (Newbert, 2007). RBV has also been challenged for its limited applicability to rapidly changing industries or environments, where competitive advantage may not necessarily stem from internal resources but from the ability to quickly adapt to change. These limitations suggest that while RBV is useful in certain contexts, it must be complemented by other frameworks that address environmental and systemic factors.

The RBV Theory provides a strong framework for comprehending how hydroponics and aeroponics may be strategic tools that improve sustainability and productivity in Nandi County's agricultural innovation. Aeroponics suspends plants in the air and mists then water enriched with nutrients, while aeroponics suspends plants in the air and mists their roots with nutrient solutions. These methods represent rare and valuable resources in the Kenyan context, where traditional soil-based farming often suffers from erratic weather patterns, soil degradation, and limited arable land. As argued by Savvas and Gruda (2018), these soilless farming techniques enhance agricultural efficiency by conserving water, accelerating growth cycles, and allowing year-round crop production. Farmers in Nandi County who adopt hydroponics and aeroponics can significantly outperform their peers in yield, crop quality, and market timing, achieving a competitive edge that aligns with RBV principles.

Moreover, the adoption of hydroponics and aeroponics in Nandi County aligns with the RBV requirement that strategic resources must be hard to imitate. These farming methods require not just capital investment, but also technical knowledge, infrastructure, and continuous innovation—factors that are not easily replicable by all farmers. As such, early adopters can secure a strategic lead in agricultural markets by providing consistent, high-quality produce with reduced environmental impact. This benefit is especially noticeable when climate change makes conventional farming practices less and less dependable. According to van Os et al. (2019), the long-term gains of soilless agriculture—such as decreased reliance on pesticides, lower input costs, and better water management—further enhance its value as a unique and sustainable resource.

The environmental benefits of these innovations further solidify their role as strategic resources within the RBV framework. Hydroponics and aeroponics reduce water usage by up to 90%, eliminate agricultural runoff, and significantly lower greenhouse gas emissions by minimizing soil disruption and chemical usage. These attributes support not only profitability but also ecological stewardship, making these systems attractive for sustainable development agendas. Successfully integrating these technologies into farming helps achieve more general environmental objectives like biodiversity preservation and climate change mitigation, while simultaneously increasing their economic returns and resilience.

To maximize the potential of these advanced agricultural systems, government agencies and development partners should prioritize investment in training, infrastructure, and financial support. The complexity of hydroponics and aeroponics means that without proper education and technical assistance, many farmers may struggle to implement these systems effectively. As such, partnerships with agricultural research institutions and NGOs can play a critical role in disseminating knowledge, building local capacity, and supporting smallholder inclusion. Financial incentives, such as subsidized equipment or low-interest loans, can also reduce entry barriers and encourage wider adoption of these transformative practices.

Finally, when examined alongside the Sustainable Livelihoods Theory (SLT), the RBV theory complements the broader development objective of creating resilient, sustainable, and inclusive farming systems. While SLT emphasizes the diverse forms of capital required for livelihood

sustainability, RBV sharpens the focus on strategic resource acquisition and exploitation for long-term competitiveness. By combining both frameworks, policy-makers and agricultural stakeholders in Nandi County can develop integrated strategies that foster innovation, strengthen food systems, and empower rural communities. The application of hydroponics and aeroponics thus represents not only a change in technology but also a tactical opportunity to reshape agriculture in line with modern sustainability and development goals.

2.1.3. Innovation Diffusion Theory (IDT)

The Innovation Diffusion Theory (IDT) was proposed by Everett Rogers in 1962, building on earlier work by rural sociologists and communication scholars. Rogers developed the theory to explain how innovations—whether technological, behavioral, or institutional—spread through populations over time. Knowledge, persuasion, decision-making, execution, and confirmation are all steps in the process of adopting an invention, according to IDT. Rogers divided adopters into five groups according to their quickness and readiness to accept new ideas: innovation laggards, based on their willingness and speed to embrace new ideas. Central to the theory are five perceived characteristics of innovations that influence adoption: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003; Mahajan & Peterson, 2020; Sahin, 2021). These attributes determine how quickly and broadly an innovation is adopted within a social system, making IDT a cornerstone in understanding technological transitions.

Despite its widespread use, IDT has received several critiques. One of the primary criticisms is its pro-innovation bias, assuming that all innovations are inherently beneficial and should be adopted (Greenhalgh et al., 2004; Atouba, 2022). Critics argue that the theory underplays contextual and structural barriers—such as poverty, illiteracy, or institutional failures—that may hinder adoption, regardless of an innovation's perceived benefits (Lyytinen & Damsgaard, 2001; de Groot et al., 2019). In addition, the model's emphasis on individual decision-making tends to overlook the broader socio-economic and policy environment influencing adoption (Gatimu et al., 2021). In agricultural settings, systemic factors such as land tenure insecurity, market inaccessibility, and credit constraints significantly influence whether farmers adopt new technologies, even when the innovation is deemed advantageous.

Nonetheless, IDT remains a valuable framework for analyzing the uptake of modern irrigation systems in Nandi County, including drip irrigation and sprinkler technologies. These innovations offer clear relative advantages over traditional rain-fed methods by providing better water-use efficiency, more reliable yields, and greater climate resilience (Ngigi et al., 2020; Oduor et al., 2021). They are also compatible with Kenya's Vision 2030 agenda and the broader African Union's push toward climate-smart agriculture (FAO, 2021; World Bank, 2022). However, the complexity associated with installing and maintaining these systems remains a barrier for smallholder farmers (Onyango & Owino, 2020). The role of trialability and observability is critical—exposure to functioning irrigation systems in neighboring farms increases the likelihood of adoption through social learning and peer influence (Kamau et al., 2019; Muriuki et al., 2022).

The diffusion of irrigation technology in Nandi County is heavily influenced by farmers' awareness, access to credit, and institutional support. Many smallholder farmers face information asymmetries, where they lack accurate or timely information on irrigation options and their benefits (Chege et al., 2020). Extension services, NGOs, and community-based organizations play a crucial role in bridging this gap (Mulwa et al., 2019; Akinyi et al., 2021). Demonstration plots, field days, and peer-to-peer learning improve observability and lower perceived risk, encouraging reluctant adopters to test the technology. Moreover, subsidies and microfinance options enhance trialability, making the technologies more accessible to resource-constrained farmers (Makau et al., 2023; Njeru & Mugambi, 2022).

When implemented successfully, modern irrigation can transform agricultural productivity in Nandi County. Farmers become less dependent on erratic rainfall and can grow crops year-round, resulting in increased yields, more stable incomes, and improved household food security (Muchiri et al., 2020; Wamalwa & Atieno, 2021). These impacts ripple outward, stimulating local market growth, supporting agribusiness ventures, and reducing rural poverty (Kipkoech & Ngeno, 2023; Koech et al., 2022). Furthermore, systems like drip irrigation are environmentally sustainable, conserving water while minimizing soil erosion and fertilizer runoff (Gichuki et al., 2021). As such, irrigation represents not only a productivity boost but a pathway toward resilient and climate-smart agriculture in Kenya's highland regions.

To fully realize the potential of IDT in advancing irrigation adoption in Nandi County, policy interventions must be strategically aligned with local realities. These include providing financial

incentives, expanding extension services, and establishing training programs to build technical capacity among farmers (Ndungu et al., 2024; Otieno & Mwangi, 2023). Government-led or NGO-supported community demonstration farms can increase observability and create social proof that motivates neighboring farmers to adopt the technology. Partnerships with research institutions can also promote local innovation and adaptation of irrigation technologies (Mwangi & Wekesa, 2021). Integrating IDT principles into national and county agricultural strategies ensures that the diffusion of innovation is inclusive, context-sensitive, and sustainable, leading to long-term transformation in the rural economy.

2.2 Empirical Literature Review

This section reviews empirical studies related to agroforestry, organic farming, hydroponics, aeroponics, and irrigation farming and their contributions to socio-economic development.

2.2.1. Impact of Agroforestry on Socio-Economic Development

With significant economic, environmental, and social advantages, agroforestry—the integration of trees, crops, and animals on the same piece of land—has become an essential agricultural technique. Various studies affirm its positive impact on income generation, food security, and environmental conservation, making it an essential strategy for sustainable socio-economic development.

Mbow et al. (2019) conducted an extensive study on agroforestry practices in Sub-Saharan Africa, concluding that they significantly improved household incomes by diversifying revenue sources, including timber and non-timber forest products. Their research emphasized that integrating trees within farming systems reduces farmers' vulnerability to climate change and enhances financial stability. Similarly, Foli et al. (2020) underscored that agroforestry plays a critical role in food security and climate change mitigation, thereby fostering socio-economic development.

On a global scale, agroforestry systems have been recognized for their multifaceted benefits. A comprehensive study spanning multiple countries across four continents highlighted that agroforestry practices not only enhance biodiversity but also provide economic advantages, such as diversified income sources and improved resilience against climate variability (Cialdella,

Jacobson, & Penot, 2023). These benefits contribute to the stability of rural economies by reducing reliance on single-income agricultural systems. Furthermore, agroforestry's ability to sequester carbon aligns with international climate change mitigation efforts, making it a sustainable agricultural strategy.

In the African context, agroforestry has played a pivotal role in addressing environmental challenges while fostering socio-economic growth. According to Mbow (2015), integrating trees into farming systems has led to improved soil fertility, increased crop yields, and additional income from tree products like fruits and timber. These benefits significantly contribute to food security and poverty alleviation across the continent. Studies have shown that agroforestry is particularly beneficial in arid and semi-arid regions where soil degradation and water scarcity are prevalent (Ajayi et al., 2017).

In Kenya, agroforestry has been a transformative force in enhancing livelihoods, particularly in dryland areas. Research indicates that agroforestry practices have resulted in improved household incomes, better food security, and environmental conservation. However, the adoption of these practices is influenced by various socio-economic factors, including education levels, occupation, and the age of the household head (Syano, Wasonga, Nyangito, Kironchi, & Egeru, 2016). Higher educated farmers are more likely to use agroforestry techniques due to their awareness of long-term benefits, while older farmers tend to rely on traditional farming methods.

According to Murthy (2016), agroforestry systems improve soil fertility, increase biodiversity, and provide additional income sources through the sale of timber and non-timber products. These benefits contribute to improved livelihoods and poverty reduction in rural African communities. In line with this, Place and Garrity (2015) examined agroforestry programs in Kenya and found that they significantly improved rural livelihoods by increasing farm productivity and reducing dependence on external inputs. Their study noted that smallholder farmers in regions such as Nandi County benefit from agroforestry due to improved crop yields, firewood availability, and carbon sequestration incentives. The presence of trees within agricultural systems enhances nutrient cycling, reduces soil erosion, and creates microclimatic conditions favorable for crop growth.

Nair et al. (2017) highlighted the role of agroforestry in climate change adaptation by improving soil structure and water retention, which are crucial for sustainable agricultural production. Trees can help farmers lessen the negative consequences of unpredictable rainfall and protracted droughts, which are prevalent problems in many African nations. Agroforestry also promotes ecological functions, including pollination and pest management, further enhancing agricultural productivity.

In addition to economic and environmental benefits, agroforestry contributes to social stability and rural development. According to Glover et al. (2019), communities practicing agroforestry experience enhanced social cohesion, as tree planting and land management often require collective efforts. This sense of community fosters knowledge exchange and collaboration among farmers, leading to improved agricultural techniques and higher yields. Furthermore, agroforestry initiatives supported by governmental and non-governmental organizations create employment opportunities, particularly for youth and women, thereby reducing rural-urban migration.

The role of policy and institutional support in promoting agroforestry cannot be overlooked. The necessity of incorporating agroforestry into national agriculture plans is becoming more widely acknowledged by governments and international organizations. According to FAO (2021), countries that have established clear regulatory frameworks and financial incentives for agroforestry adoption have witnessed higher implementation rates and improved agricultural sustainability. In Kenya, for example, policies promoting agroforestry have led to increased investment in tree nurseries, farmer training programs, and financial subsidies for agroforestry-related activities.

Agroforestry has many advantages, but there are a number of obstacles to its broad use. Key constraints include limited access to quality seedlings, lack of technical knowledge, and inadequate market linkages for agroforestry products (Sileshi et al., 2019). Development groups, scholars, and legislators must work together to remove these obstacles. Agroforestry investments should be supported by customized financing facilities created by financial institutions, and farmers should get hands-on training in agrns should develop tailored credit facilities to support agroforestry investments.

In conclusion, empirical evidence strongly supports the positive impact of agroforestry on socio-economic development. Agroforestry enhances household incomes, improves food security, promotes environmental sustainability, and fosters rural development. Studies from various regions confirm that agroforestry is a viable solution to multiple agricultural and economic challenges. However, more funding for agroforestry research, more policy backing, and more awareness among agricultural communities are all needed for it to reach its full potential. Global food security is still threatened by population expansion and climate change, al food security. agroforestry stands out as a resilient and sustainable agricultural practice that can contribute significantly to long-term socio-economic development.

2.2.2. Role of Organic Farming in Enhancing Socio-Economic Development

Organic farming is becoming more and more well-known around the world as a sustainable farming method with major advantages for the environment, economy, and health. Empirical research emphasizes its contribution to farmers' market development, job creation.

A study by Pretty et al. (2018) found that organic farming in developing countries leads to higher profit margins due to premium prices in local and international markets. Smallholder farmers who adopted organic farming in Kenya reported increased earnings due to reduced production costs and access to export markets. Organic farming has been recognized as a sustainable substitute for conventional farming on a global scale, tackling environmental issues including climate change and land degradation. By enhancing food security and lowering price volatility, it promotes reducing price volatility. The adoption of organic practices has been linked to increased resilience among farming communities, leading to more stable livelihoods.

In Africa, organic farming has been promoted to tackle interrelated environmental and socio-economic challenges. Initiatives across the continent have demonstrated that organic agriculture can enhance food security, improve nutrition, and boost incomes for small-scale farmers. For instance, the Sustainable Organic Farming Development Initiative (SOFDI) in Kenya focuses on empowering subsistence farmers with knowledge on sustainable agriculture, nutrition, and environmental conservation, leading to improved socio-economic conditions (Blockeel et al., 2023).

Research by Crowder and Reganold (2019) found that organic agriculture is 22–35% more profitable than conventional farming, primarily due to premium prices and lower input costs. In addition, a meta-analysis by Seufert and Ramankutty (2017) indicated that organic farming systems can enhance biodiversity and ecosystem services, which are vital for sustainable socio-economic development. However, they noted that organic farms might initially have lower yields, requiring government support to ensure economic sustainability.

A study by Rosati et al. (2020) discusses how organic agriculture addresses environmental challenges such as climate change and biodiversity loss while also enhancing food security and reducing dependence on fossil fuels. This approach aligns with the goals of sustainable socio-economic development in Africa. Additionally, Kassie et al. (2013) studied the impact of organic farming on household welfare in Ethiopia and found that households practicing organic farming had better food security, improved soil fertility, and higher income stability than those relying on chemical-intensive farming.

Furthermore, studies suggest that organic farming enhances rural employment by requiring more labor-intensive practices, such as composting and manual weeding, compared to conventional farming. This increase in employment opportunities supports socio-economic development by reducing rural unemployment and migration to urban areas (Scialabba & Müller-Lindenlauf, 2018). In Uganda, a study by Kledal et al. (2020) found that organic farming increased farmer resilience to climate shocks while improving household nutrition and overall economic stability.

Despite these benefits, organic farming faces challenges, including limited access to organic certification, lack of government incentives, and knowledge gaps among farmers. However, policy interventions and training programs can address these barriers, ensuring that organic farming continues to are essential to sustaining socio-economic development. By supporting research and investment in organic agriculture, governments and stakeholders can further strengthen their contribution to environmental sustainability, food security, and rural livelihoods.

2.2.3. Contribution of Hydroponics and Aeroponics to Socio-Economic Development

Hydroponics and aeroponics are innovative soilless farming methods that offer solutions for food security and economic growth, particularly in land-scarce and water-limited regions. These technologies provide sustainable agricultural alternatives by enhancing resource efficiency and increasing food production.

A study by Savvas and Gruda (2018) found that hydroponics increases crop productivity by 30–50% compared to soil-based farming. In Kenya, urban farmers adopting hydroponics reported higher yields of vegetables like lettuce, tomatoes, and strawberries, improving income levels and employment opportunities. A 2021 study by Benke and Tomkins revealed that hydroponic systems yield up to 30% more produce compared to traditional soil-based methods, making them economically viable in urban settings. Furthermore, research by AlShrouf (2017) demonstrated that aeroponics reduces water usage by up to 95%, offering a sustainable solution for regions facing water scarcity. A recent study by Salma, Shubham, and Kaushal (2024) explores how these technologies can increase crop yields and resource efficiency, making them viable options for sustainable agriculture. Additionally, aeroponics is emerging as a promising method for food production, offering advantages such as reduced water usage and faster plant growth.

Globally, hydroponic and aeroponic systems are known to have the capacity to optimize resource use, particularly water and space, leading to increased crop yields and reduced environmental footprints. These methods facilitate year-round production, independent of soil quality and climatic conditions, thereby enhancing food security and creating employment opportunities in urban and peri-urban areas. The controlled environments of these systems also minimize the need for chemical inputs, promoting sustainable agricultural practices.

In Africa, the adoption of hydroponic and aeroponic technologies is emerging as a viable solution to deal with issues like limited arable land, water scarcity, and rapid urbanization. These methods enable efficient food production in areas unsuitable for traditional agriculture, thereby improving food availability and nutrition. For instance, the African Association for Vertical Farming (AAVF) has been instrumental in promoting these technologies across the continent, aiming to achieve Sustainable Development Goals related to ending poverty and hunger. The AAVF emphasizes that vertical farming can be implemented in diverse settings, including urban rooftops and slum areas, making it accessible to various communities (Ahmed, 2020).

Kenya has been at the forefront of adopting hydroponic and aeroponic farming techniques to bolster its agricultural sector. Companies like Hydroponics Africa have been pivotal in providing affordable and straightforward hydroponic solutions, aiming to enhance food production, nutrition, household incomes, and community empowerment. Their mission aligns with

combating climate change and promoting sustainable agriculture. Additionally, the establishment of the African Association for Vertical Farming (AAVF) in Kenya underscores the country's commitment to innovative farming practices. The AAVF advocates for soilless farming methods, which are particularly appealing to the youth, as they are less labor-intensive and can be practiced in limited spaces, including urban areas. These initiatives have not only improved food security but have also created employment opportunities, contributing to the socio-economic development of Kenyan communities (Ahmed, 2020).

Similarly, Dresbøll et al. (2019) examined aeroponics in commercial potato farming and found that it improves water and nutrient use efficiency while maintaining high productivity. This technology has been particularly useful in arid regions where traditional agriculture is unviable. Hydroponic and aeroponic farming has gained momentum in various regions of Africa, driven by increasing urbanization and the need for innovative food production methods. Countries such as South Africa and Nigeria have also begun implementing these farming techniques, particularly in urban areas, to address food security challenges (Rahmann et al., 2021). The ability of hydroponics and aeroponics to provide high-quality produce without reliance on arable land is particularly valuable in mitigating food shortages and promoting economic resilience.

In Kenya, Wanjiru et al. (2021) reported that hydroponics is gaining traction in urban areas such as Nairobi and Kisumu, where land scarcity is a challenge. Farmers engaged in hydroponic farming earn stable incomes through fresh vegetable sales to supermarkets and hotels. The economic benefits extend beyond direct employment; hydroponic farms have created business opportunities in the supply of hydroponic materials, nutrient solutions, and consulting services. These innovations are transforming the agricultural landscape, providing opportunities for small-scale entrepreneurs and youth-led agribusiness initiatives.

Despite the numerous benefits, challenges such as high initial investment costs, technical expertise requirements, and market access constraints hinder the widespread adoption of hydroponics and aeroponics. Studies suggest that financial incentives, training programs, and policy support from governments and development organizations could facilitate broader implementation of these farming methods (Sharma et al., 2022). Addressing these challenges

would unlock the full potential of hydroponic and aeroponic farming in achieving food security and socio-economic development in Africa.

As the global agricultural sector continues to evolve, hydroponics and aeroponics represent promising solutions for sustainable farming. With advancements in technology and increasing awareness of resource-efficient agriculture, these farming methods are poised to play a crucial role in future food production systems. Their adoption in developing regions, including Kenya, underscores their potential in enhancing socio-economic development by creating employment opportunities, ensuring food security, and promoting environmental

2.2.4. Effect of Irrigation Farming on Socio-Economic Development

In order to improve agricultural production, food security, and rural development, irrigation farming is essential. Its economic importance is highlighted by a number of empirical studies. Farmers can grow crops all year round thanks to irrigation, which lessens their reliance on erratic rainfall patterns. Additionally, it improves food production, raises household incomes, and generates jobs, all of which support socioeconomic development.

Mango et al. (2018) discovered that small-scale irrigated farming considerably raised household incomes and decreased poverty levels in the Chinyanja Triangle in Southern Africa. According to the study, farmers were able to grow high-value products like fruits and vegetables thanks to irrigation, which increased market opportunities and raised living standards. Similar to this, smallholder farmers in Kenya have been able to improve their livelihoods by increasing crop yields and reducing costs via the use of solar-powered irrigation systems (BizTalk, 2025). In arid and semi-arid areas, where water shortage is a significant problem, solar irrigation has proven very helpful. Farmers have been able to lower operating costs and improve sustainability by using renewable energy sources for irrigation.

In their analysis of international irrigation projects, Hussain and Hanjra (2004) discovered that irrigated farming lowers poverty, boosts rural employment, and doubles agricultural yield. According to their findings, irrigation helps boost agricultural output, which in turn promotes economic expansion. Irrigation initiatives like the Galana-Kulalu Irrigation Scheme have greatly increased maize output in Kenya, guaranteeing food security for the country. Despite obstacles

including poor management and insufficient money, the Galana-Kulalu project has shown how extensive irrigation may improve food production and economic stability.

Irrigation is closely linked to a reduction in poverty on a global scale, especially for urban consumers and direct recipients. Research has shown that the effects of irrigation go beyond the farm level and affect the environmental, health, and nutrition sectors (Giordano, Namara, & Bassini, 2023). Better irrigation results in more food being available, which keeps prices stable and makes food more affordable for those living in cities. Furthermore, because irrigated agriculture improves nutrition and nutritional diversity, it has been associated with better health results.

However, issues like climate change and water shortages pose serious risks to the world's food supply. According to a research by the Global Commission on the Economics of Water, increasing water crises might jeopardize over half of the world's food output over the next 25 years, requiring immediate changes in water management (Harvey, 2024). Adopting water-efficient irrigation methods like drip and spray irrigation is essential since current irrigation infrastructure is being strained by climate change-induced droughts and unpredictable rainfall patterns.

In Africa, irrigation has been linked to improved food security and socio-economic development. Efficient irrigation and sustainable water management are crucial for stable food production, especially considering that agriculture accounts for 70% of global water consumption (Zhang & Li, 2024). However, the continent faces challenges such as inadequate infrastructure, water scarcity, and socio-economic inequities related to irrigation development. Addressing these issues is essential for maximizing the benefits of irrigation in Africa. Investments in irrigation infrastructure, coupled with training programs for farmers, can enhance water-use efficiency and improve agricultural output.

Irrigation farming has made a substantial contribution to socioeconomic development in Kenya. In order to ensure food security and foster socioeconomic progress, the National Irrigation Authority's Strategic Plan 2023–2027 seeks to create effective and sustainable irrigation systems (AIAP SECRETARIAT, 2024). In areas that have historically been vulnerable to food insecurity, including as Turkana, Baringo, and Tana River counties, the strategy calls for expanding

irrigation systems. The government hopes to lessen the effects of climate change and lessen dependency on rain-fed agriculture by expanding access to irrigation.

Similarly, Fan et al. (2013) studied the impact of irrigation on economic growth in developing countries and found that areas with well-developed irrigation systems experience higher agricultural productivity and GDP growth. The study emphasized that improved irrigation reduces reliance on rainfall, making farming more resilient to climate variability. Countries that have invested in irrigation infrastructure, such as Egypt and Sudan, have recorded significant improvements in agricultural productivity and rural incomes.

Mutunga and Mbatia (2020) examined the economic benefits of small-scale irrigation projects in Kenya's Rift Valley region, including Nandi County. They found that irrigation farming increases farmers' incomes, enhances food availability, and reduces seasonal unemployment by enabling year-round crop production. The study highlighted that smallholder irrigation schemes, such as those supported by community-based organizations, have had a transformative impact on rural livelihoods by ensuring steady incomes and reducing vulnerability to droughts.

Notwithstanding these advantages, obstacles including poor water source accessibility, hefty startup costs, and a lack of technical expertise prevent irrigated farming from spreading over most of Africa. Interventions from the public and commercial sectors, such as funding for water-saving technology, farmer training initiatives, and subsidies for irrigation equipment, can assist in removing these obstacles.

To sum up, irrigated farming is a major force behind socioeconomic growth, especially in areas that are vulnerable to unpredictable rainfall and water scarcity. The beneficial effects of irrigation on agricultural production, revenue generation, food security, and job creation are supported by empirical data. However, maintaining the sustainability of irrigated farming would require tackling issues including water scarcity, infrastructural deficiencies, and the effects of climate change. Irrigation farming has the potential to greatly boost economic growth and reduce poverty in Africa and beyond by using contemporary irrigation technology, strengthening farmer support initiatives, and improving water management regulations.

2.3 Summary of the Literature Reviewed and Research Gaps

Table 1: Summary of the Literature Reviewed and Research Gaps

Author	Focus of the Study	Findings	Research gap	Focus of the current study
Mbow et al. (2019)	Impact of agroforestry on income generation and climate change resilience in Sub-Saharan Africa	Agroforestry improves household incomes by diversifying revenue sources and reducing vulnerability to climate change.	Limited studies on agroforestry's socio-economic impact at the county level in Kenya, specifically in Nandi County	To assess the impact of agroforestry on socio-economic development in Nandi County
Crowder & Reganold (2019)	Profitability of organic vs. conventional farming	Organic farming is 22–35% more profitable than conventional farming	Few studies assessing organic farming's direct impact on local communities in Kenya	To evaluate the role of organic farming in enhancing socio-economic development in Nandi County
Kassie et al. (2013)	Impact of organic farming on household welfare in Ethiopia	Organic farming improves food security, soil fertility, and income stability	Insufficient studies on how organic farming affects rural livelihoods in Nandi County	To evaluate the role of organic farming in enhancing socio-economic development in Nandi County
Mango et al. (2018)	Small-scale irrigation farming and	Irrigation increases household	Few county-specific studies on the socio-	To examine the effect of irrigation

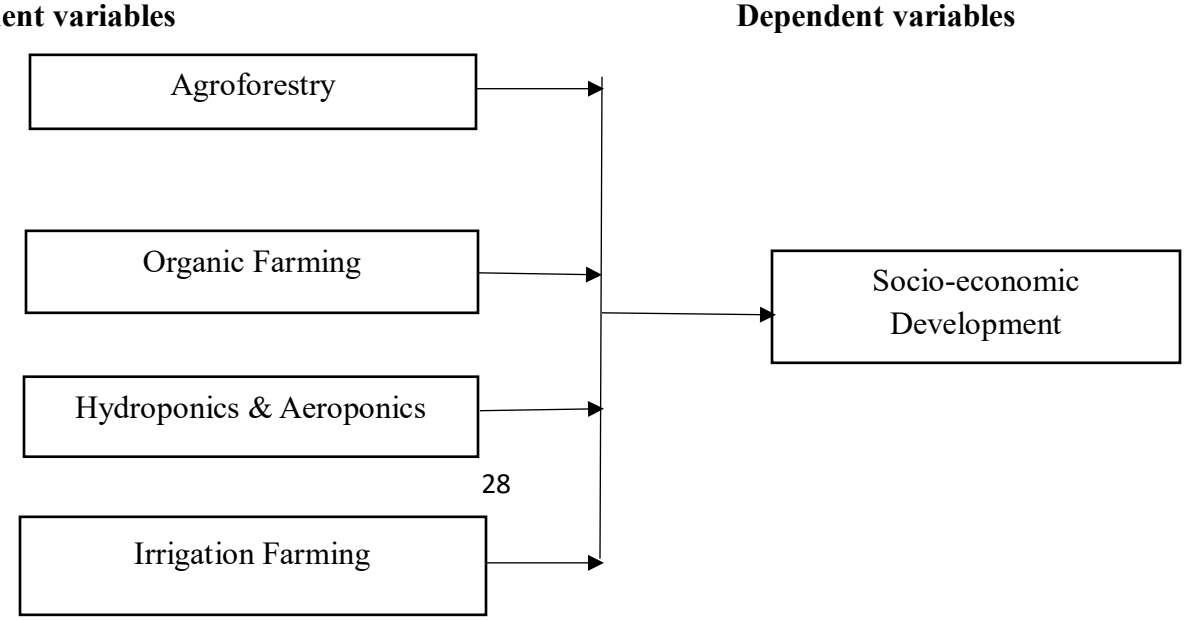
Author	Focus of the Study	Findings	Research gap	Focus of the current study
	poverty reduction in Southern Africa	incomes and food security	economic impact of irrigation in Kenya	farming on socio-economic development in Nandi County
Hussain & Hanjra (2004)	Role of irrigation in increasing agricultural productivity	Irrigation doubles farm output and reduces poverty levels	Limited focus on irrigation farming on local economies in Kenya	To examine the effect of irrigation farming on socio-economic development in Nandi County
Foli et al. (2020)	Role of agroforestry in food security and climate change mitigation	Agroforestry fosters food security and climate change adaptation, contributing to socio-economic development	Lack of localized studies focusing on Nandi County's unique agroforestry challenges and opportunities	To assess the impact of agroforestry on socio-economic development in Nandi County
Pretty et al. (2018)	Economic benefits of organic farming in developing countries	Organic farming leads to higher profit margins due to premium pricing and reduced production costs	Limited research on organic farming's socio-economic contributions in specific counties of Kenya	To evaluate the role of organic farming in enhancing socio-economic development in Nandi County
Syano et al. (2016)	Socio-economic factors influencing	Education level and occupation significantly	Need for region-specific analysis of adoption	To assess the impact of agroforestry on

Author	Focus of the Study	Findings	Research gap	Focus of the current study
	agroforestry adoption in Kenya	influence agroforestry adoption	barriers and benefits	socio-economic development in Nandi County
Mutunga & Mbatia (2020)	Economic benefits of small-scale irrigation in Kenya	Smallholder irrigation improves incomes and food security	Lack of studies analyzing irrigation farming in Nandi County	To examine the effect of irrigation farming on socio-economic development in Nandi County

Contribute to understanding socio-economic development in Nandi County through agroforestry, organic farming, and irrigation farming.

2.4 Conceptual Framework

Figure 1 Conceptual Framework



2.5. Operationalization of Variables

Table 2. Operationalization of Variables

Variables	Indicator	Measure	Scale	Tools of analysis
	Independent variables			
Agroforestry	Tree planting, intercropping, and soil fertility	Number of trees planted, crop yield changes	Ratio Scale	Descriptive Statistics, Regression Analysis
Organic Farming	Use of organic fertilizers, pest control	Percentage of land under organic farming	Ratio Scale	Descriptive statistics, Correlation Analysis
Hydroponics & Aeroponics	Water usage efficiency, crop yield	Crop yield per unit of water used	Ratio Scale	Regression Analysis, ANOVA
Irrigation Farming	Access to irrigation, yield per acre	Hectares under irrigation, income changes	Ratio Scale	Correlation Analysis, Descriptive Statistics
	Dependent variable			
Socio-economic Development	Income levels, employment, and food security	Household income, employment rate, and food	Ordinal Scale	Descriptive Statistics, Inferential

Variables	Indicator	Measure	Scale	Tools of analysis
		availability		Analysis

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

The methodology section, an essential part of any research, outlines the research design, target population, sampling techniques, data collection instruments, and procedures used to ensure the validity and reliability of the study. This chapter also discusses ethical considerations adhered to in conducting the research.

3.1 Research Design

A descriptive research design was adopted for this study. This design is suitable for studies that seek to provide an accurate representation of characteristics, behaviors, and other aspects of a given population. The study employed both qualitative and quantitative approaches to assess the impact of various agricultural practices on socio-economic development in Nandi County. Data was collected using structured questionnaires, interviews, and observations to obtain reliable and valid findings.

3.2 Target Population

Farmers taking part in Nandi County's National Agricultural and Rural Inclusive Growth Project (NARIGP) were among the study's target group. Agricultural officers, local government representatives, and community leaders engaged in agricultural projects were also the focus of the study.

Table 3: Target Population

Category	**Target Population**	**Percentage**
Farmers	300	75%
Agricultural Officers	50	12.5%
Local Government Officials	30	7.5%
Total	**400**	**100%**

3.3 Sample and Sampling Technique

3.3.1 Sampling Procedure

A sample is a subset of a population selected for a study to represent the whole population (Kothari & Garg, 2019). The study used stratified random sampling to ensure representation across different categories of respondents. As recommended by Kombo & Tromp (2009), a study should employ between 10% and 30% of the target population. Given the size of the target population, a 30% sampling rate was used.

3.3.2 Sample Size

The study sampled 120 respondents from the target population.

Table 4: Sample Size

Category	**Target Population**	**Percentage**
Farmers	300	90
Agricultural Officers	50	15
Local Government Officials	30	9
Community Leaders	20	6
Total	**400**	**120**

3.4 Data Collection Instruments

The study used structured questionnaires and interviews to collect data. The questionnaire had both closed-ended and open-ended questions, designed to gather relevant data on agroforestry, organic farming, hydroponics, aeroponics, and irrigation farming. A 5-point Likert scale was used for quantitative responses.

3.5 Pilot Study

A pilot study was conducted to pre-test and validate the data collection instruments before the commencement of the main study. Pre-testing is essential in identifying ambiguities, testing the effectiveness of questions, and refining data collection procedures to enhance the reliability and validity of the research (Kothari & Garg, 2019; Mugenda & Mugenda, 2003). The pilot involved 10 respondents from Nandi County participating in the National Agricultural and Rural Inclusive Growth Project (NARIGP) who shared similar characteristics with the target population but were excluded from the main study.

3.5.1 Validity

Validity refers to the accuracy and ability of a research instrument to measure what it is intended to measure (Jaspersen, 2018). Content validity was ensured through expert review and guidance from the research supervisor.

3.5.2 Reliability

Reliability refers to the consistency of research instruments in measuring the intended variables. The study used Cronbach's Alpha to test reliability, with an acceptable threshold set at 0.7 (Kothari, 2014).

3.6 Data Collection Procedure

The researcher visited Nandi County and distributed questionnaires to selected respondents. Interviews were conducted with key stakeholders to obtain in-depth insights. The collected data will be checked for completeness before analysis.

3.7 Data Analysis and Presentation

The data was cleaned, coded, and analyzed using descriptive statistics. Data was presented in tables, charts, and graphs to provide clear insights. The study employed multiple regression analysis using the following model:

$$Y = \beta_0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \varepsilon$$

Where:

Y= Socio-economic development

X1= Agroforestry

X2= Organic farming

X3 Hydroponics and aeroponics

X4= Irrigation farming

$\beta 0, \beta 1, \beta 2, \beta 3, \beta 4$ =Regression coefficients

$\boldsymbol{\varepsilon}$ = Error term

3.8 Ethical Considerations

3.8.1 Informed Consent

Participants were given informed consent forms explaining the purpose, procedures, and voluntary nature of the study.

3.8.2 Voluntary Participation

Participants were informed that their participation was voluntary and that they could withdraw at any stage without any consequences.

3.8.3 Confidentiality

The collected data was stored securely, and respondents' identities remained confidential.

3.8.4 Privacy

Data was anonymized, and no personal identifiers were collected.

3.8.5 Anonymity

Questionnaires did not collect personal details, ensuring participants' responses remained anonymous.

3.9 Chapter Summary

This chapter outlined the research design, target population, sampling techniques, data collection methods, pilot study, validity and reliability tests, data analysis, and ethical considerations. The next chapter presents the research findings and analysis.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.0 Introduction

This chapter presents the analysis and interpretation of data collected on the impact of agricultural practices on socio-economic development in Nandi County. A total of 120 respondents participated in the study, drawn from farmers, agricultural officers, local government officials, and community leaders. The analysis is organized based on the four key agricultural practices: agroforestry, organic farming, hydroponics and aeroponics, and irrigation farming. Descriptive statistics such as means and standard deviations were used alongside multiple regression analysis to determine the strength of relationships between the independent variables and socio-economic development.

4.1 Presentation of Research Findings

4.1.1 Response rate

All 120 of the questionnaires that were given to the chosen respondents were properly filled out and returned, giving the study a 100% response rate. The target demographic, which included farmers, agricultural officers, local government representatives, and community leaders in Nandi County, had a high degree of participation and engagement, as seen by the high response rate. This kind of response rate reduces the possibility of non-response bias, which improves the validity and dependability of the study results. Additionally, it shows that the data gathered is representative of the target sample, offering a strong basis for precise analysis and extrapolation of the study's findings.

4.1.2 Background Information of Respondents

Table 5: Gender of Respondents

Gender	Frequency	Percentage
Male	65	54.2%

Gender	Frequency	Percentage
Female	55	45.8%

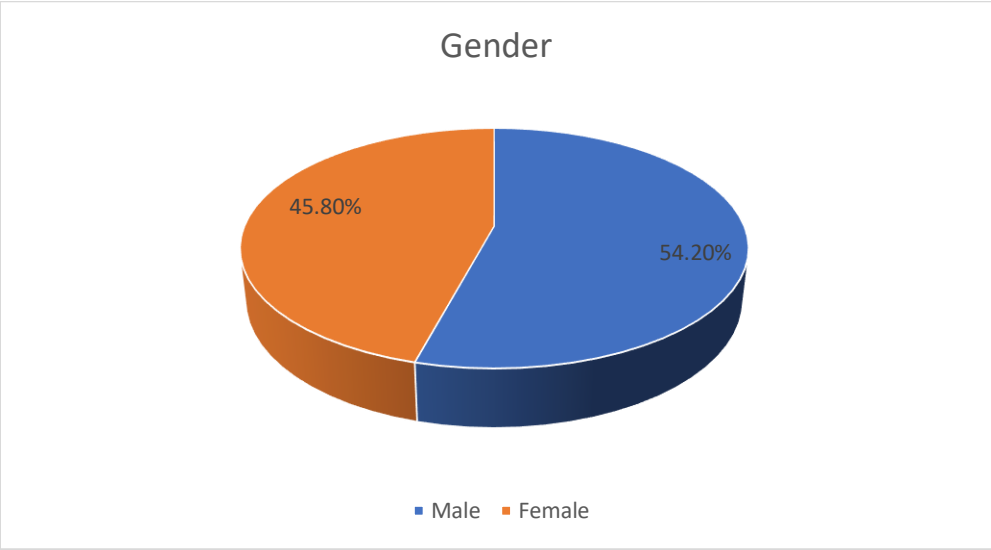


Figure 2: Gender of Respondents

Table 5 presents the gender distribution of the respondents involved in the study. Males made up 65 (54.2%) and females made up 55 (45.8%) of the 120 participants. With a small male preponderance, this suggests that both genders were fairly represented in the survey. According to the close balance, both men and women participate significantly in Nandi County's agricultural and socioeconomic activities. Because of this representation, the study's conclusions are certain to encompass a wide variety of viewpoints, experiences, and contributions from people of both genders.

Table 6: Age Distribution of Respondents

Age Bracket	Frequency	Percentage
18–25	20	16.7%
26–35	45	37.5%
36–45	35	29.2%

Age Bracket	Frequency	Percentage
46 and above	20	16.7%

The study participants' age distribution is shown in Table 6. The bulk of participants, 45 (37.5%), were in the 26–35 age range, with 35 responses (29.2%) falling into the 36–45 age range. Each group had 20 responders (16.7%), with equal representation in the 18–25 and 46+ age groups. This distribution shows that the majority of people in Nandi County who work in agriculture and other socioeconomic fields are between the ages of 26 and 45, which is considered to be an economically active age group. Long-term sustainability in the industry and the adoption of agricultural methods may be impacted by the generational variety in involvement demonstrated by the presence of both younger and older responders.

Table 7: Primary Occupation of Respondents

Occupation	Frequency	Percentage
Farmer	90	75.0%
Trader	10	8.3%
Extension officer	15	12.5%
Other	5	4.2%

The principal occupations of the respondents are shown in Table 7. 90 respondents, or 75.0%, identified as farmers, indicating that the studied population in Nandi County was mostly focused on agriculture. Twelve percent of the respondents were extension officials, and eight percent were traders. Just 4.2% of respondents said they worked in other jobs. Farmers make up the majority of the sample, which guarantees that the data gathered accurately represents the viewpoints and experiences of people most active in agricultural activities and validates the research's applicability to the target demographic. By including traders and extension agents, important information about the larger agricultural ecosystem and support systems is added.

Table 8: Years Engaged in Agriculture

Years in Agriculture	Frequency	Percentage
Less than 1 year	10	8.3%
1–3 years	40	33.3%
4–6 years	45	37.5%
Over 6 years	25	20.8%

The distribution of responses by number of years of agricultural experience is displayed in Table 8. Forty respondents (33.3%) had one to three years of experience in agriculture, whereas the biggest group, 45 respondents (37.5%), had four to six years of experience. Ten respondents (8.3%) had less than a year of experience, while 25 respondents (20.8%) had worked in the agricultural industry for more than six years. Given that a sizable majority of participants (91.6%) had worked in agriculture for at least a year, it is likely that the majority of respondents were qualified to offer insightful commentary on farming methods. A vibrant agriculture sector with both seasoned and up-and-coming players contributing to socioeconomic development in Nandi County is reflected in the mix of more recent and experienced participants.

Table 9: Participation in NARIGP

Participation	Frequency	Percentage
Yes	75	62.5%
No	45	37.5%

Information on respondents' involvement in the National Agricultural and Rural Inclusive Growth Project (NARIGP) is included in Table 9. Forty-five (37.5%) of the respondents said they did not participate in the NARIGP, whereas 75 (62.5%) said they did. This implies that a significant number of Nandi County's agricultural stakeholders have been reached and engaged by the NARIGP effort. Given the high level of engagement, it is possible that many respondents

benefited from resources, training, or assistance linked to the project. This improves the study's capacity to assess how organized agricultural activities affect the socioeconomic advancement of the area.

4.1.3 Descriptive Analysis of Agricultural Practices

4.1.3.1 Agroforestry

Table 10: Agroforestry Practices

Statement	Mean	SD
I have adopted tree planting	4.12	0.81
Improved soil fertility	4.01	0.84
Increased crop yields	3.98	0.90
Improved household income	3.85	0.93
Created job opportunities	3.72	1.00

The opinions of the respondents on agroforestry methods and their impact on Nandi County's socioeconomic results are shown in Table 10. The data shows generally positive attitudes toward agroforestry, with all mean scores above 3.70 on a 5-point Likert scale. The highest-rated statement, “I have adopted tree planting” (mean = 4.12, SD = 0.81), indicates that tree planting is widely practiced among respondents, reflecting high adoption of agroforestry techniques. Respondents also recognized that agroforestry has improved soil fertility (mean = 4.01) and increased crop yields (mean = 3.98), confirming that the integration of trees into farming systems contributes to environmental sustainability and agricultural productivity. Furthermore, the practice is seen to have enhanced household income (mean = 3.85) and created job opportunities (mean = 3.72), suggesting its broader economic benefits, although these aspects scored slightly lower, possibly due to varying levels of economic returns across households. The standard deviations range from 0.81 to 1.00, indicating moderate agreement among respondents. Overall, the results demonstrate that agroforestry is both widely adopted and positively perceived in Nandi County, with notable benefits for the environment, crop output, and livelihoods. These

findings underscore the importance of promoting agroforestry as a sustainable agricultural practice with significant socio-economic advantages.

4.1.3.2 Organic Farming

Table 11: Organic Farming Practices

Statement	Mean	SD
Use of organic fertilizers	3.95	0.85
Improved production via organic pest control	3.88	0.90
Reduced farming costs	3.75	0.92
Improved produce quality	3.90	0.80
Improved income & food security	3.92	0.83

Table 11 presents an analysis of respondents' perceptions regarding the application and impact of organic farming practices in Nandi County. The findings reveal a generally positive outlook, with all five statements receiving mean scores above 3.70 on the 5-point Likert scale. The highest rated statement, "Use of organic fertilizers" with a mean of 3.95, indicates that many farmers are actively shifting toward environmentally friendly and sustainable soil enhancement methods. This aligns with global trends advocating for reduced chemical dependency in agriculture. Respondents also acknowledged the role of organic pest control methods in improving production (mean = 3.88), which shows confidence in natural alternatives to synthetic pesticides. This is further supported by a mean score of 3.90 for the improvement in produce quality, suggesting that organic methods are not only environmentally sound but also contribute to healthier and more marketable outputs. While the reduction in farming costs had a slightly lower mean of 3.75, it still reflects a favorable perception, possibly due to long-term savings despite higher initial labor or input investments. Importantly, the statement that organic farming improves household income and food security scored 3.92, indicating that respondents see clear socio-economic advantages tied to organic practices. This also demonstrates that organic farming may serve as a viable pathway to achieving broader development goals such as poverty

reduction, improved nutrition, and sustainable livelihoods. The overall mean score of 3.88 points to a strong level of awareness and appreciation of organic farming among agricultural stakeholders in Nandi County. These results highlight the need for continued training, policy support, and market linkages to further mainstream organic agriculture as a pillar of rural development. Additionally, extension services and agricultural programs can build on this positive perception to scale up adoption and maximize the economic, environmental, and health benefits of organic farming.

4.1.3.3 Hydroponics and Aeroponics

Table 12: Hydroponics and Aeroponics

Statement	Mean	SD
Knowledge of hydroponics/aeroponics	3.45	1.02
Improved crop yields	3.61	0.94
Saves water	3.75	0.88
Created jobs	3.42	0.97
Improved food security	3.70	0.86

Table 12 examines respondents' perceptions and knowledge of hydroponics and aeroponics systems. The overall average mean score of 3.59 reflects a moderate level of awareness and appreciation for these modern, soilless farming methods. The statement with the highest mean, "Saves water" (3.75), indicates that respondents recognize water efficiency as a key advantage of hydroponics and aeroponics—an especially valuable benefit in areas facing water scarcity or erratic rainfall patterns. The next highest score was 3.70 for "Improved food security", suggesting that respondents acknowledge the potential of these systems to stabilize food production, particularly when traditional farming is affected by climate variability. The

perception that hydroponics and aeroponics contribute to improved crop yields was also relatively high (3.61), reinforcing their value in increasing agricultural productivity. However, the lowest mean scores were for knowledge of hydroponics/aeroponics (3.45) and job creation (3.42). These findings highlight a gap in exposure and technical capacity, with many respondents likely lacking direct experience or access to the necessary infrastructure. The relatively low familiarity with hydroponic and aeroponic systems may limit broader adoption unless addressed through awareness campaigns, training workshops, and investment in demonstration projects. Overall, while perceptions of the benefits of hydroponics and aeroponics are positive, the limited awareness and technical understanding suggest a need for increased support from extension services, agricultural officers, and policymakers. Encouraging innovation and providing access to information and resources will be essential to unlock the full potential of these advanced agricultural techniques in enhancing productivity and food security in Nandi County.

4.1.3.4 Irrigation Farming

Table 13: Irrigation Farming

Statement	Mean	SD
Access to irrigation	3.85	0.89
Increased productivity	3.95	0.82
Improved household income	3.90	0.88
Created employment	3.88	0.90
Stabilized food availability	3.97	0.85

Table 13 presents respondents' views on the role of irrigation farming in enhancing agricultural and socio-economic outcomes. The overall average mean score of 3.91 indicates a strongly positive perception of irrigation farming among respondents in Nandi County. This suggests that irrigation is widely recognized as a valuable strategy for boosting agricultural resilience and year-round productivity. The highest-rated item, "Stabilized food availability" (3.97), emphasizes

the critical role of irrigation in mitigating the effects of seasonal rainfall and ensuring a consistent food supply. Similarly, the statement "Increased productivity" received a mean score of 3.95, reflecting that farmers and stakeholders view irrigation as a key driver of enhanced output per unit of land or labor. Respondents also agreed that irrigation contributes to improved household income (3.90) and employment creation (3.88), which underscores its importance not only for food security but also for local economic development and livelihoods. Access to irrigation scored slightly lower at 3.85, suggesting that while the benefits are well-recognized, access may still be limited for some farmers, potentially due to infrastructural or financial constraints. Overall, the findings affirm that irrigation farming is regarded as a reliable and impactful practice, with wide-ranging benefits for farm productivity, income generation, employment, and food stability. To maximize its potential, there is a need to expand irrigation infrastructure and provide support services that make this technology more accessible to smallholder farmers across Nandi County.

4.1.3.5 Socio-Economic Development Indicators

Table 14: Socio-Economic Development

Statement	Mean	SD
Increased household income	4.02	0.76
Improved employment	3.88	0.84
Improved food security	3.95	0.79
Affordability of education and health	3.82	0.92
Improved quality of life	3.90	0.88

Table 14 highlights respondents' perceptions of the contribution of agricultural practices to socio-economic development in Nandi County. The overall mean score of 3.91 indicates a strong agreement that agricultural interventions have led to meaningful improvements in key areas of well-being. The highest-rated item, "Increased household income" (4.02), demonstrates that many respondents have experienced direct financial benefits from their engagement in agriculture. This is closely followed by "Improved food security" (3.95) and "Improved quality

of life" (3.90), which show that agriculture is not only a source of income but also a vital pillar for sustenance and overall well-being. Respondents also acknowledged improvements in employment opportunities (3.88), reflecting the capacity of agricultural projects to stimulate local labor markets and reduce rural unemployment. The lowest-rated yet still positive statement was "Affordability of education and health" (3.82), suggesting that while agricultural gains are improving livelihoods, further support may be needed to translate these benefits into full access to social services. Collectively, the data affirms that agricultural practices—especially when supported by programs like NARIGP—have had a positive and transformative effect on the socio-economic status of the people in Nandi County. Continued investment in agriculture, alongside efforts to improve access to markets, credit, and infrastructure, will be crucial in sustaining and amplifying these development gains.

4.1.4 Regression Analysis

4.1.4.1 Model Summary

Table 15: Model Summary

Model	R	R^2	Adjusted R^2	Std. Error
1	0.781	0.610	0.598	0.402

Table 15 presents the model summary of the multiple regression analysis conducted to assess the influence of four agricultural practices—agroforestry, organic farming, hydroponics and aeroponics, and irrigation farming—on socio-economic development in Nandi County. The R value of 0.781 indicates a strong positive correlation between the combined agricultural practices and socio-economic development. The R^2 value of 0.610 means that approximately 61% of the variability in socio-economic development can be explained by the four predictor variables. This suggests that the model is a good fit and that agricultural practices play a substantial role in influencing socio-economic outcomes such as income, employment, food security, and quality of life. The Adjusted R^2 value of 0.598 adjusts for the number of predictors in the model and confirms the strength of the relationship, accounting for potential overfitting. The standard error of 0.402 is relatively low, implying that the model's predictions are fairly accurate and consistent. The results from this model summary indicate that the agricultural practices under

investigation are significant and reliable predictors of socio-economic development in Nandi County. This provides strong statistical backing for initiatives that aim to enhance rural livelihoods through investment in diversified, sustainable farming systems.

4.1.4.2 ANOVA

Table 16: ANOVA Summary

Source	SS	df	MS	F	Sig.
Regression	52.63	4	13.16	32.45	0.000
Residual	33.45	115	0.29		
Total	86.08	119			

The ANOVA (Analysis of Variance) findings for the regression model evaluating the influence of four agricultural methods on Nandi County's socioeconomic growth are shown in Table 16. The regression model as a whole is statistically significant, as evidenced by the p-value (Sig.) of 0.000, which is far lower than the traditional cutoff of 0.05. This indicates that the observed correlation between the dependent variable (socio-economic development) and the independent variables (agroforestry, organic farming, hydroponics & aeroponics, and irrigated farming) is unlikely to be the result of chance. Given the notably high F-statistic of 32.45, it is further supported that the regression model fits the data well. This strong F-value shows that the combined effect of the four predictor variables significantly improves the ability to explain variance in socio-economic outcomes.

4.1.4.3 Regression Coefficients

Table 17: Regression Coefficients

Variable	B	Std. Error	Beta	t	Sig.
Constant	0.652	0.278	—	2.35	0.021

Variable	B	Std. Error	Beta	t	Sig.
Agroforestry (X1)	0.285	0.074	0.301	3.85	0.000
Organic Farming (X2)	0.260	0.080	0.274	3.25	0.002
Hydroponics & Aeroponics (X3)	0.195	0.072	0.208	2.71	0.008
Irrigation Farming (X4)	0.275	0.078	0.290	3.52	0.001

The regression results in Table 17 indicate that all four agricultural practices—agroforestry, organic farming, hydroponics and aeroponics, and irrigation farming—are statistically significant predictors of socio-economic development in Nandi County. The constant term (B = 0.652, p = 0.021) is significant, representing the starting point of socio-economic development when all predictors are held constant. Among the independent variables, agroforestry has the strongest influence with a coefficient of B = 0.285 and a standardized Beta = 0.301 (p = 0.000), suggesting that increased use of agroforestry practices contributes most significantly to improvements in household income, food security, and employment. Irrigation farming also shows a strong impact (B = 0.275, Beta = 0.290, p = 0.001), underscoring its role in boosting productivity and ensuring year-round agricultural output. Organic farming follows closely with B = 0.260 (Beta = 0.274, p = 0.002), indicating its effectiveness in enhancing sustainable production and economic gains. Hydroponics and aeroponics, though with the smallest coefficient (B = 0.195, Beta = 0.208, p = 0.008), still contribute positively and significantly to socio-economic development, particularly through water conservation and improved yields. Overall, the findings confirm that all four practices have a meaningful and statistically significant effect, with agroforestry and irrigation farming emerging as the most impactful strategies for promoting socio-economic growth in the county.

4.1.5 Findings

The study revealed that agroforestry and irrigation farming are the most widely adopted and have the greatest impact on socio-economic development in Nandi County. These practices were strongly associated with improvements in household income, food security, and employment.

Organic farming was also positively received, especially for its sustainability and cost-effectiveness, as many respondents reported benefits such as improved produce quality and reduced input costs. In contrast, hydroponics and aeroponics, while less familiar to many respondents, demonstrated clear potential in enhancing productivity and conserving resources, particularly water. Overall, the findings confirm that modern and diverse agricultural practices are essential to driving socio-economic development, with strong evidence that innovations in farming can transform livelihoods and promote sustainable growth in the region.

4.2 Limitations of the Study

Despite the insightful observations generated, this study faced several limitations that should be acknowledged:

i. **Limited Awareness of Modern Techniques**: A significant number of respondents had limited exposure to hydroponics and aeroponics. This may have affected the depth and accuracy of responses related to these practices, potentially underestimating their true impact.
ii. **Geographical Scope**: The research was conducted exclusively within Nandi County. Therefore, results might not apply to other regions with different climatic, economic, or infrastructural conditions.
iii. **Sample Size Constraints**: Although 120 respondents were sampled, this may not have been sufficient to represent the complete range of agricultural experiences and socio-economic conditions across the entire county population.
iv. **Access and Infrastructure Variations**: Variations in access to infrastructure, such as irrigation systems, extension services, and markets, may have influenced responses, yet these contextual factors were not fully controlled for.

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS, AND CONCLUSION

5.0 Introduction

This part of the study includes a summary, suggestions, and a conclusion based on the factors and study findings. The goal of the study was to examine the effect of agricultural practices on socio-economic development in Nandi County, focusing on the National Agricultural and Rural Inclusive Growth Project (NARIGP).

5.1 Summary of the Findings

All 120 surveys were successfully completed and returned, yielding a 100% response rate for the study. This indicates that the target demographic in Nandi County was highly engaged and interested. The results are more reliable, and there is less chance of non-response bias because of this complete engagement. According to the respondents' background data, there is a reasonably balanced gender representation, with men making up 54.2% and women 45.8%. This suggests that both sexes actively participate in activities linked to agriculture. In terms of age, the majority (66.7%) fell within the 26–45 age range, which represents the economically active population, while younger and older participants provided generational diversity. Regarding primary occupation, a significant 75% of respondents were farmers, validating the agricultural focus of the study. Traders and extension officers made up smaller proportions, contributing complementary perspectives on the farming ecosystem. Most participants (91.6%) had more than one year of farming experience, with the largest group having 4–6 years, suggesting that respondents were knowledgeable about agricultural practices. Finally, 62.5% reported participation in the National Agricultural and Rural Inclusive Growth Project (NARIGP), demonstrating the initiative's strong local reach and influence, and providing a relevant context for evaluating the impact of agricultural interventions on socio-economic development.

5.1.1 Agroforestry Practices

Table 10 illustrates respondents' views on agroforestry practices and their socio-economic impact in Nandi County. The results reflect broadly positive perceptions, with mean scores above 3.70 across all statements. Tree planting emerged as the most widely adopted practice (mean = 4.12), indicating high levels of engagement in agroforestry. Respondents agreed that agroforestry had improved soil fertility (mean = 4.01) and increased crop yields (mean = 3.98), highlighting its contribution to sustainable farming and environmental health. Additionally, agroforestry was perceived to boost household incomes (mean = 3.85) and create job opportunities (mean = 3.72), demonstrating wider socio-economic benefits. The standard deviations, ranging between 0.81 and 1.00, suggest moderate consensus among participants. Overall, the data confirms the positive and significant role agroforestry plays in promoting sustainable agricultural practices and socio-economic development in the area.

5.1.2 Organic Farming

The analysis of Table 11 reveals a generally positive perception of organic farming practices among respondents in Nandi County. The highest rated practice was the use of organic fertilizers (mean = 3.95), highlighting a strong shift toward sustainable soil management. Other aspects, such as improved produce quality (mean = 3.90), enhanced income and food security (mean = 3.92), and increased productivity through organic pest control (mean = 3.88), further underscore the perceived benefits of organic farming. Even the relatively lower mean score for reduced farming costs (3.75) reflects a favorable attitude, likely due to the recognition of long-term economic advantages. Overall, the mean score of 3.88 indicates a high level of awareness and appreciation for organic farming among the local farming population.

5.1.3 Hydroponics and Aeroponics

Table 12 provides insights into the perceptions of respondents regarding hydroponics and aeroponics in Nandi County. The overall average mean of 3.59 suggests a moderate level of familiarity and appreciation for these modern, soilless farming techniques. Respondents most strongly acknowledged water-saving benefits (mean = 3.75), emphasizing the relevance of hydroponics and aeroponics in areas experiencing water constraints. The systems were also

credited for improving food security (mean = 3.70) and crop yields (mean = 3.61), demonstrating recognition of their potential to enhance agricultural output and stability. However, knowledge of these systems (mean = 3.45) and their impact on job creation (mean = 3.42) were rated comparatively lower, reflecting gaps in awareness, training, and infrastructure availability.

5.1.4 Irrigation Farming

Table 13 provides a comprehensive view of respondents' perceptions regarding irrigation farming in Nandi County. The overall mean score of 3.91 reflects a strong and positive consensus on the significance of irrigation as a transformative agricultural practice. The highest-rated statement, "Stabilized food availability" (mean = 3.97), underscores the value of irrigation in promoting year-round food production and mitigating seasonal variations in rainfall. Similarly, high scores for "Increased productivity" (3.95) and "Improved household income" (3.90) illustrate that respondents associate irrigation with enhanced agricultural output and better livelihoods. The perceived ability of irrigation to create employment (mean = 3.88) further reinforces its socio-economic relevance. However, the slightly lower score for "Access to irrigation" (3.85) highlights that while the benefits are clear, availability remains an issue for many farmers.

5.1.5 Socio-Economic Development Indicators

Table 14 presents the respondents' views on the effects of agricultural practices on socio-economic development in Nandi County. The overall mean score of 3.91 reveals a strong consensus that agriculture has significantly contributed to household and community well-being. The highest-rated statement, "Increased household income" (mean = 4.02), suggests that many participants have realized tangible financial benefits from their agricultural activities. Close behind are "Improved food security" (3.95) and "Improved quality of life" (3.90), indicating that agriculture plays a central role in ensuring nutrition, stability, and overall livelihood improvement. "Improved employment" (3.88) reflects the sector's role in job creation, while the slightly lower score for "Affordability of education and health" (3.82) points to a need for more direct linkages between agricultural success and access to essential services.

5.2 Conclusion

In conclusion, agroforestry has been positively embraced by the farming community in Nandi County, particularly through tree planting, which supports soil health, crop productivity, and environmental sustainability. Beyond environmental benefits, agroforestry has also improved household incomes and created employment opportunities, though economic gains may differ among households. The consistency in the respondents' views highlights that agroforestry is not only feasible but also effective in advancing sustainable agricultural systems and supporting local livelihoods.

According to the majority of responders, organic farming is a good agricultural method that promotes socioeconomic growth and environmental sustainability. The findings suggest that stakeholders in Nandi County recognize the value of organic inputs in improving production, reducing chemical use, enhancing product quality, and contributing to food security and household income. Despite initial implementation challenges such as labor intensity or access to organic inputs, the long-term benefits appear to outweigh the drawbacks. This signals a readiness among farmers to embrace organic farming on a broader scale.

While respondents appreciate the environmental and productivity-related benefits of hydroponics and aeroponics, the data reveal a significant knowledge gap that could hinder widespread adoption. The lower scores for awareness and job creation suggest that most farmers have limited exposure to or experience with these systems. Nonetheless, the relatively high scores in areas such as water conservation and food security point to strong potential for these technologies to support sustainable agriculture in the region, especially in the context of climate change and resource scarcity. There is a clear interest and perceived value, but practical limitations remain.

The findings demonstrate that irrigation farming is widely appreciated as a crucial tool for boosting productivity, improving income, generating employment, and ensuring food security. Respondents clearly view irrigation as a dependable means of achieving agricultural sustainability and economic resilience in Nandi County. However, limited access suggests that many farmers may not be fully benefiting from this technology due to barriers such as high

installation costs, inadequate water infrastructure, or lack of technical support. Thus, while irrigation holds significant promise, broader access remains a key challenge.

The findings confirm that agricultural development has had a transformative impact on the socio-economic landscape of Nandi County. Through increased income, food availability, and job opportunities, agriculture is proving to be a key driver of rural development. However, while the benefits are evident, the relatively lower rating for education and health affordability suggests that more work is needed to ensure that economic gains are equitably channeled toward improving access to critical social services. The data supports the conclusion that agriculture, when properly supported, can be a foundation for inclusive and sustainable socio-economic progress.

5.3 Recommendations

Based on these findings, it is recommended that county authorities and agricultural stakeholders further promote and support agroforestry initiatives through targeted training, technical assistance, and access to tree seedlings. Extension services should focus on educating farmers about maximizing the economic benefits of agroforestry while ensuring environmental sustainability. Additionally, programs that link agroforestry with local markets and value chains could help farmers realize higher and more consistent economic returns, further reinforcing agroforestry as a viable pathway to socio-economic development in Nandi County.

To build on these positive perceptions, it is recommended that stakeholders—including government agencies, NGOs, and agricultural extension services—intensify training and awareness programs on organic farming techniques. Policies should be developed or strengthened to support organic certification, provide incentives for adoption, and promote research into cost-effective organic inputs. Additionally, improving access to organic markets and linking farmers with buyers who value organic produce can boost income and motivation. Investment in extension services will be crucial in helping farmers scale up adoption while ensuring practices remain consistent with organic principles. Ultimately, organic farming should be integrated into rural development strategies as a sustainable pathway to economic growth, environmental protection, and improved public health.

To bridge the knowledge and adoption gap, it is recommended that targeted training and awareness programs on hydroponics and aeroponics be introduced through agricultural extension services, local institutions, and community-based demonstrations. Government and private sector stakeholders should invest in pilot projects and model farms to provide hands-on learning opportunities and build local capacity. Subsidies or financial incentives could also be introduced to support initial infrastructure costs for early adopters. In addition, curriculum updates in agricultural training institutions should incorporate soilless farming technologies to prepare future farmers and agribusiness professionals. By integrating hydroponics and aeroponics into broader agricultural development strategies, Nandi County can enhance food security, create new employment opportunities, and promote climate-resilient farming systems.

To fully harness the benefits of irrigation farming, it is recommended that government bodies, NGOs, and private stakeholders invest in expanding and modernizing irrigation infrastructure across Nandi County. Subsidized schemes or low-interest loans could help smallholder farmers afford irrigation systems. Moreover, capacity-building programs should be implemented to train farmers on efficient water management and irrigation technologies. Community-based irrigation projects, supported by local cooperatives and agricultural extension services, can also enhance reach and effectiveness. Integrating irrigation into broader rural development strategies will be vital for promoting inclusive growth, ensuring food security, and strengthening economic resilience in the face of climate variability.

To build on these positive outcomes, stakeholders should intensify support for agricultural programs that directly enhance income, employment, and food security. Investments in market access, value addition, rural infrastructure, and agricultural financing can further raise household incomes and create more economic opportunities. Additionally, efforts should be made to integrate agriculture with broader social development initiatives—such as subsidized education, health insurance schemes, and community savings programs—to ensure that the benefits of agricultural progress extend to all aspects of life. Finally, policies should prioritize inclusivity, ensuring that women, youth, and vulnerable populations also benefit fully from agricultural-led development in Nandi County.

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APPENDICES

APPENDIX I: LETTER OF INTRODUCTION

Dear respondent

I am LyanCherotich, a student at The Management University of Africa, with Admission Number BDSK/5/00127/1/22. As required, my study focuses on the effect of agricultural practices on socio-economic development in Nandi County, focusing on the National Agricultural and Rural Inclusive Growth Project (NARIGP). Given this context, your participation in completing the attached questionnaire is very appreciated. The information you submit will only be utilized for this research. I'm grateful in advance.

Regards

Lyan Cherotich

BDSK/5/00127/1/22

The Management University of Africa

APPENDIX II: QUESTIONNAIRE ON AGRICULTURAL PRACTICES AND SOCIO-ECONOMIC DEVELOPMENT IN NANDI COUNTY

SECTION A: BACKGROUND INFORMATION

1.What is your gender?

a) Male [ ]
b) Female [ ]

2.What is your age bracket?

a) 18–25 [ ]
b) 26–35 [ ]
c) 36–45 [ ]
d) 46 and above [ ]

3.What is your primary occupation?

a) Farmer [ ]
b) Trader [ ]
c) Extension officer [ ]
d) Other (specify) _____

4.How many years have you been engaged in agricultural activities?

a) Less than 1 year [ ]
b) 1–3 years [ ]
c) 4–6 years [ ]
d) Over 6 years [ ]

5.Are you a participant in the National Agricultural and Rural Inclusive Growth Project (NARIGP)?

a) Yes [ ]
b) No [ ]

SECTION B: AGROFORESTRY

Please rate your level of agreement with the following statements using a scale of 1 to 5: (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

Statement	1	2	3	4	5
I have adopted tree planting on my farm.					
Agroforestry has improved my farm's soil fertility.					
Agroforestry has increased my crop yields.					
Agroforestry practices have improved my household income.					
Agroforestry activities have created job opportunities in my community.					

SECTION C: ORGANIC FARMING

Please rate your level of agreement with the following statements using a scale of 1 to 5:

Statement	1	2	3	4	5
I regularly use organic fertilizers on my farm.					
Organic pest control methods have improved my production.					
Organic farming has helped me reduce					

farming costs.					
Organic farming has improved the quality of my produce.					
Organic farming contributes to improved household income and food security.					

SECTION D: HYDROPONICS AND AEROPONICS

Please rate your level of agreement with the following statements using a scale of 1 to 5:

Statement	**1**	**2**	**3**	**4**	**5**
I have knowledge of hydroponics or aeroponics farming.					
Hydroponics/aeroponics have improved crop yields in my area.					
Hydroponics/aeroponics help in saving water during production.					
Hydroponics/aeroponics systems have created new job opportunities in my area.					
Hydroponics/aeroponics have contributed to improved food security in my area.					

SECTION E: IRRIGATION FARMING

Please rate your level of agreement with the following statements using a scale of 1 to 5:

Statement	**1**	**2**	**3**	**4**	**5**
I have access to irrigation water on my farm.					
Irrigation has helped me increase my farm productivity.					
Irrigation has improved my household income.					
Irrigation has created employment opportunities in my community.					
Irrigation has helped to stabilize food availability throughout the year.					

SECTION F: SOCIO-ECONOMIC DEVELOPMENT

Please rate your level of agreement with the following statements using a scale of 1 to 5:

Statement	**1**	**2**	**3**	**4**	**5**
Agricultural practices have increased my household income.					
Agricultural practices have improved employment opportunities in my area.					
Agricultural practices have improved my household's food security.					
I can now afford to pay for education and health services due to improved farming practices.					
Agricultural projects have increased my overall quality of life.					

The Management University of Africa

Sponsored by The Kenya Institute of Management

Date: 24th June 2025

TO WHOM IT MAY CONCERN

LYAN CHEROTICH– BDSK/S/00127/1/22

This letter serves to introduce the above named who is a **Bachelors of Arts in Development Studies (BDS)** student and is interested in carrying out research on **Effect of Agricultural Practices on Socio-Economic Development in County Project in Kenya: A Case Study of National Agricultural and Rural Inclusive Growth Project in Nandi County**

Any assistance accorded to her in pursuit of this study will be greatly appreciated.

Yours Sincerely,

Dr. Juster Nyaga

Dean, School of Management and Leadership

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Summary