A Community Knowledge-Based Assessment of Smallholder Farmers' Perception of Cluster Farming and its Potential Role in Sustainable Accessibility to Farmer-Centric Support in Nigeria.

by

HAMZAT Azeez Adewale

A thesis presented to the

School of Collective Intelligence,

Mohammed VI Polytechnic University,

in fulfillment of the

Thesis requirement for the degree of

Master in Collective Intelligence.

Supervised by:

Professor Mark Klein

Reviewed by:

Professor Cathal O'Madagain

September 2022

AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. I understand that my thesis may be made electronically available to the public

ABSTRACT

This study aimed to understand the views of smallholder farmers in Oyo State, Nigeria, towards cluster farming as a means of promoting sustainable farmer-centric support. Cluster farming is an economic approach for small, limited resource, and socially disadvantaged farmers to increase productivity, reduce risk, and improve community growth by organizing smallholder farmers into a collective unit through a participatory approach.

Data was collected from 300 smallholder farmers through a combination of structured questionnaires and deliberative surveys. The study evaluated the farmers' views on cluster farming using five key frameworks: productivity, knowledge, collaboration, efficiency, and support. The closed-ended questions were analyzed using descriptive statistics, while the open-ended questions were analyzed through natural language processing.

The results showed that only 9% of the farmers had participated in cluster farming, despite 85% of them being aware of its existence. 79% believed that cluster farming can be an efficient solution for crop farmers, but 83% thought that the lack of investors could limit its effectiveness. Additionally, 25% of the farmers felt that legal documentation between cluster members and stakeholders may be necessary in case of conflicts of interest or to ensure uniformity and genuine support.

The results also revealed that access to cluster markets, finance, yield improvement, participation in extension training/services, and engagement were factors significantly impacting the farmers' positive perception of cluster farming. This information can be used by policymakers to understand the challenges faced by smallholder farmers, predict their actions and demands, and provide high-impact support programs through cluster farming.

Keywords: Cluster Farming, Smallholder Farmers, Farmer-centric Support, Deliberative Surveys, Collaboration, Extension Services, Efficiency, Productivity, Knowledge.

ACKNOWLEDGEMENTS

I would like to extend my deepest gratitude to the School of Collective Intelligence at the Mohammed VI Polytechnic University for its unwavering support throughout my degree program. My heartfelt thanks go out to each of my professors at SCI, who provided me with insightful teachings and invaluable support both mentally and materially. I am especially grateful to my supervisor, Professor Mark Klein, for his guidance and support, which was instrumental in my academic journey.

I would also like to express my appreciation to Professors Lex Paulson, Cathal O'madagain, James Winters, Emile Servan-Schreiber, Jose Segovia-Martins, Florencia Devoto, and Mauricio Dias Martins, who provided me with support and guidance in various aspects of my program.

I would also like to extend my sincere gratitude to the UM6P community, particularly the top management, for providing me with the opportunity to be a part of this esteemed institution. A special mention goes to the OCP Foundation for providing me with a scholarship, without which this dream would not have been possible. I would also like to thank all those who participated in this study and took an interest, especially the farmers who voluntarily shared their experiences and insights.

Finally, I would like to acknowledge my family and friends for their unwavering moral and financial support throughout my academic journey. I am particularly grateful to my brothers and sisters, my wife's parents, and my friends Gafari Lukumon, Abdullahi Babatunde, and AbdoulKafid Toko, who stood by me through thick and thin. Their support means the world to me.

DEDICATION

I dedicate this work to the Divine Providence, Almighty Allah, for blessing me with life, good health, and success. Furthermore, I extend my heartfelt dedication to my beloved wife, the Queen of my life, and our two precious daughters. Your unwavering love, support, and encouragement have been my driving force, and I could not have accomplished this without you. Your sacrifices, big and small, are greatly appreciated and will not be forgotten. I am forever in your debt and blessed to have you by my side.

TABLE OF CONTENTS

LIST OF TABLE AND FIGURES

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Agriculture is a vital sector for the sustained growth not only for developed countries but more importantly for developing countries, especially agriculture-based countries such as those in Sub-Saharan Africa. In Africa, 73% of the rural population consists of smallholder farmers, and they make up about 80% of total farmers (Arias et al., 2013; Rapsomanikis, 2015; Kienzle, 2015). Most of the farm holdings in Africa are farms with fewer than two hectares operated by rural smallholder farmers who are dependent on agriculture for their economic livelihoods (Kamara et al., 2019).

Nigeria is one of the most densely populated countries in the world with about 95% of the farmers being smallholders (Mgbenka et al., 2016). Despite their contribution to the economies and household food security, Nigeria's smallholder farmers are among the most vulnerable people working in agriculture (Dorward et al., 2005, World Bank, 2002). They are constrained by lack of capital assets, infrastructure, and a lack of market institutions that would enable them to increase agricultural productivity. This results in high transaction costs, ineffective coordination, pervasive market defects (Moustier, 2013; Rola-Rubzen et al, 2012). These are formidable problems the resolution of which will take much time, effort, and resources. However, Nigeria among most other African countries, have failed to meet the requirements for a successful agricultural revolution, and lags far behind the rest of the world (Diao et al., 2010).

Although farmer-centric support is available in some forms, many smallholder farmers do not have easy access to it. In fact, they are often forced to sell their crops at a lower price due to the limited

availability of services that would link them to good industries that need farmers' produce as raw materials (Olushola & Oladimeji, 2020). Despite the implementation of poverty reduction strategies and economic liberalization intended to open fresh market-driven opportunities for economic growth, the results in many sub-Saharan countries have been mixed (Winter-Nelson & Temu, 2002; Fafchamps, 2004).

According to Mgbeka et al (2016), governments in Nigeria and a few foreign organizations have made conscious attempts throughout the years to increase agricultural productivity, but these efforts have not produced the desired outcomes. Many smallholders still practice subsistence farming and are unable to earn enough money to afford basic necessities such as clothing, housing, and food (Adewumi & Ilori, 2014).

Smallholder farmers need assistance in overcoming market imperfections and other barriers to sustainable agriculture (Batt et al., 2010). Otherwise, managing the scale differences between actions taken at the farm level and repercussions at greater ecosystem scales will be a significant problem (Sabo et al., 2017). Lack of support forces many farmers into competing for limited resources such as plots of land, which can lead to conflicts and human rights abuses.

For example, farmers in some parts of northern Nigeria have been accused of illegally occupying land and farms belonging to Fulani herders, leading to violence and confrontation between the two groups. Hence, they often cannot meet stringent food safety and quality control requirements, seldom able to provide standardized products on a continuous basis, and often lack market information (Gulati et al. 2007).

Even though farmers can collaborate in groups to tackle most of these problems, poor coordination between agricultural providers limits the exploitation of potential synergies amongst actors (Chowa

et al., 2013). This leaves smallholder farmers without the resources they need to be successful in sustainable agriculture (Teresa and Poli, 2015). The government and other organizations need to provide more support for small-scale producers, especially in terms of access to markets and affordable credit (Watson, B., 2008; Shiferaw et al., 2009; Oyeyinka et al., 2012).

To increase the reach and impact of a farmer-centric support program, development organizations frequently group smallholder farmers into agricultural clusters for collective action (Oakeshott, 2016). Cluster farming is an economically viable practice to sustain small, limited resource, and socially disadvantaged farmers. According to researchers (e.g., Inan, 1984; Srinath et al., 2000; Uy, 2005; Marilou O. Montiflor, 2012; Olatunji & Letsoalo, 2013; Shukla et al., 2019), cluster farming involves the organization of many smallholder farmers (usually facilitated by government and/or private organizations) into a collective unit through participatory approach to share resources and expertise, to accomplish common goals, increase productivity, reduce risk, and for community growth. Although we may argue that there are some tiny conceptual differences between group farming, cooperative farming, and cluster farming, we would like, for simplicity, agree here that they can be used interchangeably.

Often than not, when collective intelligence in agriculture is being discussed or browsed on the internet, what usually comes up is about the application of digital infrastructures in agriculture. However, this is very limiting to the conceptual values of collective intelligence. Unarguably, collective intelligence involves the use of multiple minds to solve problems in such a way that, a group of average people produces better results than any one member of the group (Leimeister, 2010; Landemore, 2012; Woolley et al., 2015).

Similarly, Cluster farming is a form of farming that differs from traditional farming in the way that it is operated. It has been demonstrated that farming in clusters is an economically viable practice to sustain small, limited resource, and socially disadvantaged farmers and forestland owners with their agricultural operations (Uy, 2005; Mendoza, 2006; Marilou O. Montiflor, 2012; Karki et al., 2021). Therefore, it should be known as the collective intelligence agriculture because it brings multiple farmers together, pooling their knowledge and creativity to solve their problems, generate ideas, solutions, and markets. Therefore, individual producers who choose to cooperate, e.g., for marketing, work together to make decision and share information are referred to as cluster farmers (Uy, 2005; Gualberto, 2007).

Some African nations have implemented a policy of group farming (clusters) to increase their low agricultural productivity (Okuneye, P.A., 1984). However, the Farm Settlement Scheme and other group farming programs' history demonstrates that they have had mixed fortunes. This is primarily the result of an inadequate strategy, particularly given that these programs are implemented by a bureaucratic organization with little to no input from the farmers. For instance, Successful collective action in marketing necessitates better coordination of various activities for the delivery of desirable high quality and standardized products (Bekele et al. 2009). Farmers must be adequately involved in the development and management of strategies that concern them, and must be implemented methodically. Smallholders possess many workable ideas that can assist in putting agriculture on a more sustainable and fair footing because of their immense collective experience and deep knowledge of local conditions (Hassanein and Kloppenburg, 1995; Barahona and Levy, 2003; Knickel et al., 2008).

Cluster farming has the potential to bring about significant changes in the lives of rural farmers, however, some researchers claim that group projects are typically plagued with issues as a result

of low farmer participation for a variety of reasons. Some of the cited reasons are the lack of adequate institutional and extension support, including expanded beneficiary access to inputs, credits, extension services, transport, market, and government programs (Bembridge, 2000; Mayende, 2004). Naik et al., (2010) found that cluster development has been extremely effective at changing the economies of many nations and fostering the growth of multinational corporations (MNCs).

According to Montiflor (2007), four major elements were found to be influencing the operations of cluster farming groups in Mindanao: different cluster farming strategies, the need for additional farmer leaders, fostering and maintaining farmer engagement, and the existence of powerful institutional support organizations. However, information about the Nigerian farmers' perception of cluster farming is insufficient and not well documented. Hence, this study assessed the smallholder farmers' perception of cluster farming; whether it would be receptive to them, and whether they would think it would break the barriers between them (their communities) and accessibility to farmer-centric support programs.

1.2 Aims and Objectives of the Study

The general objective of the study was to investigate the perception of smallholder farmers to clustering and the factors that make cluster farming a viable approach to gaining farmer-centric support for smallholder farmers in Oyo State, Nigeria.

The specific objectives were to examine:

i. How do farmers (individually and/or in groups) differ in their understanding that cluster farming would lead to either positive or negative outcomes?

ii. What are the perceived barriers to cluster farming for farmers and farmers' support managers.

1.3 Hypothesis

i. The null hypothesis: There is no association/correlation between cluster farming and accessibility to farmer-centric support.

ii. The alternate Hypothesis: There is a significant positive correlation between cluster farming and farmer-centric support.

1.4 The Significance of the Study

It is hoped that the findings of this study will contribute to developing a better understanding of smallholder farmers' needs and that it will be a useful resource for policy makers in designing cluster farming approaches and any other agricultural development program. We believe that this information can help governments and non-government organizations with their advocacy, research, and outreach projects. The findings of this study may also serve as a starting point for future research for academics and professionals.

CHAPTER TWO

2.0 LITERATURE REVIEW

To allow for deeper understanding of the literature revolving around the usefulness of cluster farming approach, we will use this chapter to explore some concepts regarding farmer-centric support, community knowledge, and collaboration as they relate to smallholder farmers.

2.1 Smallholder Farmers' Barriers and Accessibility to Farmer-centric Support

Smallholder farmers are a critical part of the global food system and play an important role in sustainable agricultural production (Sabo et al., 2017). These farmers generally have limited opportunities for livelihood improvement because of limited farm size, poor knowledge of production, marketing, and difficulties accessing finance.

Overall, there is no doubt that smallholder farmers form the backbone of the Nigerian agricultural sector, and smallholder farms are Nigeria's current reality, holding the key to agriculture's comeback (Mgbenka et al., 2016; Ezekiel, O, 2017). The Nigerian agricultural sector is the largest employer in the country and is an important source of income for more than 70% of Nigerians. Nigeria alone possesses 98.3 million hectares of land, of which 74 million are suitable for farming. However, only 50% of this land has been used to grow crops and raise cattle, putting the country's ability to combat hunger and poverty at risk (Opara, S., 2011). Given its vast natural resource wealth, the Nigerian economy is capable of ensuring food security (Sabo et al., 2017).

Smallholder farmers, particularly those in Africa and other developing countries, are at risk of going out of business due to the competitive pressure brought on by globalization and large-scale commercial farmers. It is anticipated that smallholders in Africa will either completely transition

to subsistence farming or disappear altogether (Mudhara 2010). The FAO estimates that 500 million smallholder families produce over 50% of the food to feed the world's population and it is they who will have to bear the brunt of the need to increase food production by over 60% by 2050 (FAO, 2011b).

The International Fund for Agricultural Development (IFAD, 2009) lists several factors that hinder high production in Nigerian small-scale farming. These include: a sizable portion of small-scale agriculture that lacks both sustainability and profitability; a vicious cycle of poor productivity and income, severe financial constraints, and constrained investments or input availability/use; the absence of market access and of reliable processing and distribution; and the lack of market access and of credible processing and distribution. To increase the productivity of small farms, sophisticated farm inputs are required. These inputs include fertilizers, a wider selection of seeds and seedlings, feeds, plant-protection agents, agricultural machinery, equipment, and water (Mgbenka et al., 2016).

Fragmentation, which happens when individual farmers are unable to establish ties with other farmers and are uninformed of what each other is doing, is also one of the obstacles keeping smallholder farmers from receiving agricultural support (Adela et al., 2022). A recent survey found that only 38% of smallholder farmers in Nigeria have regular access to information about new farming techniques, weather predictions and other developments that can help them improve their productivity (FAO, 2018). Accessing training and other sorts of information that can assist them advance their farming techniques is particularly troublesome in this regard. Many developing countries do not offer adequate extension services to their farmers, and even when they do offer them, they often do not adequately meet the needs of their intended beneficiaries (Brown et al. 2005). This means that smallholders in these countries are often left without the support they need

to be successful agricultural producers. Given the significance of information access, it is perhaps not surprising that the majority of Nigerian smallholder farmers think that the government ought to take a more active role in boosting the nation's agricultural sector.

The Nigerian farming system as it stands does not fully utilize contemporary farming methods, financial resources, advice services, and market data. Frequently, they lack access to the resources needed to finance the crucial agricultural projects (Komicha and Ohlmer, 2006). Smallholder farmers' productivity and profitability are hampered by their inability to optimize their operations and increase yields due to limited access to resources. This is in part because the majority of farmer-centric support programs are managed by governments or international organizations that are difficult for smallholder farmers to access when they live in remote areas.

In addition, agricultural development agencies are unlikely to invest in rural areas that are not seen as viable investment opportunities (Oni, 2008), which means that they are less likely to offer much-needed technical assistance and marketing support to local farmers. When these agro-industries in both rural and urban centers are unable to sustain production and there is a steep drop in food production, hunger and poverty will rise.

2.2 Impacts of community knowledge on smallholder farmers' performance.

As agriculture systems become more complex, farmers' access to reliable, timely, and relevant information sources becomes more critical to their competitiveness (Kabelele et al., 2015). Agricultural knowledge is a critical resource for farmers (Lwoga, 2011; Mtega et al., 2016), and it can be easily transferred between generations, contributing a valuable advantage to be derived from cluster members which provide opportunities for rural farmers to improve their livelihoods.

Farmers constantly share information about things that are important to them. These exchanges have been particularly well documented for seeds of different crops and varieties (Cromwell 1990).

To compensate for the lack of formal sources, farmers often relied on informal sources of knowledge within their farming community (Boahene et al 1999; Lyon 2000; Llones & Suwanmaneepong, 2021). The knowledge producers and users make up the agricultural knowledge value chain. As knowledge is developed with the intention of assisting farmers in boosting productivity, farmers play a key role in agricultural knowledge management. They do transfer this agricultural knowledge through social interactions (Nonaka et al., 2000; Conley and Udry 2010), and communities play an important role in reinforcing smallholder farmers' success (Hellin et al., 2009).

In rural areas of developing countries, it is often difficult for members of the older generation to share their knowledge of local agricultural practices with younger members of the community, as the older generation is losing touch with the skills and knowledge of their forebears.

The elders often have limited access to education and experience, which makes it difficult for them to impart knowledge in a way that is comprehensible to the younger generation. This gap has significant implications for the future of sustainable agriculture, as it becomes increasingly difficult to acquire and/or transfer this vital knowledge from older generations to younger generations. This problem, however, can be adequately managed through effective knowledge flow/transfer among cluster members (Karki et al., 2021).

By exchanging information and expertise, we can draw on one another's experiences. This encourages innovation and progress in the best-case scenario on the technical, social, and economic fronts (Rutz and Zingerli; 2009). All published and unpublished knowledge on the broad topics of

agriculture is included in the category of "agricultural information," which also includes inventions, concepts, and technologies of agricultural policy (Aina, 1990). The goals of agricultural information, however, are seldom ever achieved if farmers lack access to it. Agricultural companies are often unable to access relevant information regarding the knowledge base of farmers. This makes it nearly impossible for them to effectively develop products, strategies, and services that meet the needs of the market. Knowledge can be of different types - traditional knowledge which is transmitted orally or through demonstrations and local knowledge which is based on personal experience and informal education (Kotani & Nakatsuji, 2012).

In traditional knowledge, community members pass on information informally through informal networks, but this is usually less reliable than formal knowledge transfer methods such as extension services or educational programs. Local knowledge is another type of knowledge that can be useful for farmers because it provides them with practical solutions that are tailored to their local environment.

Overall, local knowledge and traditional knowledge can provide significant benefits to smallholder farmers but neither of them may replace formal knowledge transfer methods (Diekmann et al, 2009. Datta et al. (2013) found that farmer knowledge programs focused mainly on imparting technical knowledge were less effective than traditional programs that provided more training on how to utilize local resources. This indicates that the approach that a development agency takes when designing a knowledge transfer program can have a substantial impact on its outcomes.

Summarily, this section demonstrates the importance of providing both traditional knowledge and technical knowledge to smallholder farmers to help them improve their productivity and food security. Our understanding is that even though local knowledge and traditional knowledge are

beneficial, they may not replace formal knowledge and vice versa, unless. This combination of knowledge facets is what is usually missing in adoption training programs leading to farmers sticking to their old and tested methods. However, if cluster farming is well managed, it would bring individuals farmers of various levels and kinds of experience, with qualified extension agents testing out the different combinations of these methods and in different areas.

2.3 Collaboration among smallholder farmers

Collaboration in food systems is important, as many academics have noted (e.g., Che, Veeck & Veeck, 2005). The successful management and growth of sustainable agriculture is increasingly recognized as requiring collaboration among farmers (Prager, 2015). To deal with complex sustainability requirements in agri-food supply chains, collaboration among heterogeneous stakeholders is essential to collectively achieve a competitive advantage for better environmental, business, and societal outcomes (Schiller et al., 2014; and Vitunskienė et al., 2014).

Due to collaboration, many innovations have spread from farmer to farmer without the intervention of any formal agricultural extension services, such as the diffusion of the moldboard plow in many parts of Africa. The most immediate benefit to the individual farmer is increased production. Andersson et al. (2005) assert that when farms collaborate, they use their resources more effectively, improve accessibility to farmer-centric support and can coordinate their efforts better.

Che et al. (2005) found that because they are typically geographically isolated and often lack certain marketing skills, farmers who interact directly with consumers have a greater need to participate in collaborative marketing initiatives, compared to those who grow commodity crops. Farmers can collaborate to share resources and lower handling costs during harvesting, claim Dania et al. (2018). This will assist farmers and agricultural enterprises that have limited access to resources,

technology, information, and skills in maintaining their operations and enhancing the quality and accessibility of their food by putting it on the market.

The majority of scientists stress that only active collaboration between farmers, agricultural suppliers, food processors, consumers, academic communities, and policy officials can assure the growth of sustainable agriculture. According to Jarrett et al. (2015), coordinated and collaborative initiatives can help address local land management issues, enhance social cohesion and knowledge exchange within the farming community, and positively engage the general public in landscape scale conservation. Collaboration has also been deemed crucial for preserving the social and economic sustainability of farming (Sutherland et al., 2015; Sulewski et al., 2018).

Business-to-business collaborations in the food industry have also led to improving economic, environmental, and social standards through effective communication among farmers and traders (Hamprecht et al., 2005). Farmer organizations have the potential to mitigate the effects of imperfect markets by enabling contractual links to input and output markets, leveraging market functions for smallholder farmers. One such example is the establishment of a network for rice growers in the Mekong Delta in Vietnam (Le Coq et al., 2004; Vo et al., 2013; Berg et al, 2017).

However, for the parties that do engage in collaborative efforts, activities are often limited due to issues such as reliability, convenience, seasonal constraints, and price (Starr et al., 2003). Vogt and Kaiser (2008) identified the lack of infrastructure, financial support, and institutional support as barriers that inhibit collaborative efforts even if local food system stakeholders are willing to collaborate.

Stakeholders have opportunities to enhance market share, market growth, and margins within a collaborative system. Cooperatives provide small-scale farmers with an opportunity to sell their

crops to a larger market (Dania et al., 2018). Farmers can also share their knowledge and expertise regarding different agricultural practices and the quality of their products. Ultimately, greater cooperation between smallholder farmers can result in the empowerment of rural communities and promote sustainable agriculture practices. Collaboration is essential for empowering farmers, especially those in communities with poor socioeconomic status, when it comes to gaining access to funding and other resources that are essential to running a farming business (Lorencowicz et al., 2013).

In this section, we have tried to establish the importance of collaboration among smallholder farmers. This is crucial because collaboration is one of the four key components identified by Montiflor (2007) as factors influencing the operations of cluster farming organizations in Mindanao. The author asserted that some cluster members were unable to participate in regular meetings and events because they were too busy with their farms and related businesses, while some have had negative interactions that led to mistrust and lack of confidence. Therefore, for sustainable cluster farming, effective and high-quality collaboration can make it easier for farmers to access resources, opportunities, and rewards.

2.4 Overview of Cluster Farming

Cluster farming refers to the organization of many smallholder farmers into a collective unit through participatory approach to accomplish common goals, share resources and expertise to increase productivity, efficiency and yield (Inan, 1984; Srinath et al., 2000; Uy, 2005; Marilou O. Montiflor, 2012; Olatunji & Letsoalo, 2013; Shukla et al., 2019). According to Axalan et al., (2011), cluster farming is said to have been developed by the corn industry as a strategy to access governmental funding.

Two clustering approaches have been identified in Southern and Northern Mindanao: an area-based approach, where neighboring farmers group together, and a commodity-based approach, where farmers plant the same vegetable and combine their produce to achieve a higher volume (Montiflor et al., 2009). Galeski (1987) distinguished between four types of cluster farms. These included group farms established by adherents of an ideology; landless families who were able to purchase the land; collective farms organized by the government; and collective farms organized by farmers.

Farmers are unable to meet the expected volume and the quality demands of the rising institutional market because most farms are small and operate independently. Part of the reasons for creating cooperatives are to make loans more accessible and to engage in collaborative marketing of farm products to increase income (Digby and Gretton, 1955; Republic of the Philippines, 1992). The major goals of cluster farming are to plant similar crops, grade to a similar standard, combine the harvest to get a higher volume, deliver in bulk to cutdown on transportation expenses, and thereby boosting net income (Uy, 2005; Mendoza, 2006). Smallholder farmers must come together and adapt to the new environment in order to participate in these growing marketplaces, or they risk further marginalization (Boselie et al., 2003).

The clustering technique, in which a small group or cluster is organized and guided to enter the market in order to enhance their incomes and quality of life, is one way to facilitate the delivery of a more consistent volume of high-quality vegetables (CRS-Philippines, 2007). This kind of collaborative marketing systems gives farmers greater market information, greater negotiation strength, and a higher price, and may have a considerable positive impact on the farmers' income.

According to Brasier et al. (2007), cluster farming is a technique to foster community growth. This is because members of the cluster are the first to enjoy the benefits of being in clusters. These

benefits to the members may vary according to the individual interest but some of the initial benefits may include being engaged with fellow cluster member, sharing knowledge, collaborating on solutions, or at least informing one another about opportunities that may only be tapped as clusters e.g., group cluster marketing (Uy 2005; Mendoza 2006). Part of the initial benefits that clusters benefit prior to companies/investors is that being in clusters could produce a public good, which might therefore justify government actions like providing subsidies (farmer-centric support). The individual companies that facilitate the clusters (e.g., to gain ample access to the raw materials being produced by the clusters) and their clients come second.

For groups of farmers in a specific region, cluster farming serves as a tool for production and financial planning (Gualberto 2007). Farmer access to institutional markets, institutional relationships, funding, and free or discounted inputs has been made possible through clusters (Real et al., 2013). It has been demonstrated that the cluster farming strategy streamlined the marketing channel, enhanced productivity, produced superior raw materials, and increased prices (Montiflor et al., 2008; Ebarle et al., 2014; Rola-Rubzen et al., 2013; Washim et al., 2015). This technique has significantly raised the standard of living for smallholder vegetable producers in the Philippines (Lamban et al., 2013).

To increase the reach and impact of a farmer-centric support program, development organizations frequently group smallholder farmers into agricultural clusters for collective action (Oakeshott, 2016). For example, in the southern Philippines, agricultural clusters have increased profits of smallholder farmers (Rola-Rubzen et al, 2012) by improving their economies of scale, sharing knowledge and risks, and innovations encouraged (Reardon and Berdegue, 2006; Brown and Sander, 2007; Murray-Prior, 2008; Proctor and Vorley, 2008; Shepherd and Cadilhon, 2008).

Clusters increase efficiency and profitability because they share similar inputs, such as labor with specialized skills, according to Goetz et al. (2004). In a "big-box" environment, clusters give small farmers countervailing market power. They are particularly useful to agribusinesses and small-scale farmers alike. They both gain from creating new, site-specific tacit knowledge and cooperating to address new needs, such as environmental, social, and economic objectives.

According to Goetz et al., clusters foster innovation and competition, and agricultural activities always perform better in clusters. In Montiflor et al. (2015), a comparative study of clustered farmers using a before and after approach revealed that the income of the farmers in the Philippines increased by 42% after joining the cluster. The survey showed that over 82% of farmers made more money from cluster farming than from individual farming. They mentioned high or higher market pricing, better market chances, marketing aid, financial support, and access to production inputs. Compared to the rates they obtained from traders, farmers benefited from cluster farming by receiving higher and more consistent prices.

The application of cluster approach to scale up tilapia fish production in the Fiji Islands was evaluated by Varawa et al. (2014). The cluster technique increased the farms' capacity from a 47% level of operation to an 80% level of production, which resulted in a significant increase in income. According to Axalan et al. (2011), farmers in a cluster improved their agricultural and marketing methods, gained more technical and marketing expertise, had better access to capital, and earned more money. The strategy helped to develop relationships of trust, assurance, dedication, and collectiveness among cluster members. Clusters promote the expansion of local networks that might lead to changes in management practices (Hassanein and Kloppenburg, 1995).

Czerniawski (1986) coined the phrase "cluster marketing," describing it as a focused, local market strategy to marketing planning and implementation based on the concepts of "economy of force" and "mass." To concentrate attention on locations with the highest potential for business expansion and greater sales, geographically separate consumer groups are developed. According to research by Bernat (1999) on rural labor markets and industry clusters, the researcher noticed lower transportation costs for local enterprises as a result of input and output market agglomeration, as well as higher worker productivity and skill levels, knowledge spillovers, and a quicker dissemination of innovation.

The aim of cluster (group) farming is to use more efficiently the scarce resources which might be land (Bamiduro et al., 2011), labors and capital, etc. Another instance shows how cluster (cooperative) farming has raised annual income by 24% in the Indian state of Jind (Joginder et al., 1989). Group farming in Taiwan has increased farmers' revenue, reduced marketing expenses, and increased their opportunity for progress (Chen, 1992). Cooperative production is typically viewed as a way to increase smallholders' ability to increase product quality, as well as their capacity for capital expenditures, managemkaent abilities, and bargaining strength (Sims et al., 1993; Coles and Mitchell, 2011).

In general, cluster farming is a practical and effective way to communicate risks and risk management to farmers to reduce risks and maximize returns (Mahida et al., 2014). It employs practical economic concepts, such as economies of scale, effectiveness, least-cost methods, and profit maximization, that are necessary to give the target groups more power (Karki et al., 2021). However, group projects are generally beset by problems resulting from low participation by farmers due to lack of adequate institutional and extension support including expanded beneficiary access to inputs, credits, extension services, transport, market, and government programs, etc.,

(Bembridge, 2000; Mayende, 2004). Without the assistance of a public or private organization, it can be challenging to handle the logistics of such a huge undertaking.

Getting groups of farmers to cooperate and coordinate their efforts can be challenging in the absence of focused, farmer-centric support. Due to the frequent absence of infrastructure, this might be particularly difficult in rural locations. A lack of empirical data on alternative forms of collective action, participation factors, the effectiveness of marketing groups, and how supportive institutions and policy support can strengthen the role of collective marketing groups persists despite the growing interest in innovative farmer organization and market institutions (Dorward et al., 2005).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter presents the research design, sample and sampling techniques, Data and Data Collection Methods, and the Method of Data Analysis.

3.1 Study Area

Oyo State is made up of 33 Local Governments and is situated in the South-West geopolitical region of Nigeria. It has a surface mass of 28,454 km and a population of 7,840,900, which has an equatorial climate with dry and wet seasons and a high relative humidity. Oyo State has guinea savannah in the north and rain forest in the south for its vegetation. In the north, there is grassland with scattered trees where the south has dense forest. Plants including maize, yams, cassava, millet, rice, plantains, cocoa trees, palm trees, and cashews can grow well in the state's environment.

3.2 Sample and Sampling Techniques

Five local government areas of Oyo State, Nigeria were purposely selected for this research. This is because these areas are popular for their involvement in the state’s agriculture. From each local government, two farming communities were randomly selected. From each farming community, 30 farmers were interviewed physically (n = 300). After receiving their consent to participate, the participants were told of the study's goals and the data was gathered from May 2022 to July 2022.

Table 1: List of the selected farming communities

Local Governments	Selected Farming Communities
1. Iseyin	i. Ipapo ii. Kona-Odo Ogba
2. Iwajowa	i. Itasa ii. Idiko Ago
3. Itesiwaju	i. Okaka ii. Alaga
4. Afijio	i. Akinmorin ii. Ojutaye
5. Oyo West	i. Fashola ii. Aba Oyo

3.3 Data and Data Collection Methods

Prior to the study, ethical approval for this study was obtained from the Oyo State Minister of Agriculture. Additionally, community leaders gave their consent for entry into their areas, and respondents provided their informed consent. The selected farming communities were visited, and questionnaires administered in person in the form of interviews. Because ethical concern is crucial to our research, participants could respond anonymously to the questions if they so desired. Participants were free to choose not to answer some personal questions at their discretion and to fully opt out if they so desired.

For this study, sampled farm households provided information on socioeconomic, demographic, group membership, and cluster farming (perceptions)-related aspects. Questions were asked about the respondents' willingness to pay for extension service, their satisfaction with market availability, selling price, problems facing them as crop farmers, why they would join a support program etc. Questions were also asked to test awareness of the farmers about the existence of cluster farming and their perception of its challenges and various advantages. Some of the questions regarding

cluster farming were measured through statements rated on a Likert scale. Open-ended question was asked on why the farmers would support a cluster farming approach.

The close-ended questions were administered using structured questionnaires. Even though smallholder farmers have a lot of problems they can collectively solve and discuss about, they are geographically dispersed and have little or no internet access. Hence, the tool used for the in-depth open-ended data collection in this research was the offline version of the deliberative survey; a new kind of collaborative brainstorming tool, developed by the MIT Professor Mark Klein. Group discussion and individual interviews were held to have reactions of the farmers concerning their detailed experiences and their perceptions of cluster farming.

Extensively, some farmers' groups were asked to highlight their most important problems in agriculture. About 22 problem headings were listed. They were then asked to rank the list in order of priority or problem intensity during meetings. They were able to do this through weighing the pros and cons of whether one problem should take precedence over the other. Participant groups include members officially belonging to some of the farmers groups such as: *AFAN, Fashola Farmers Association, Ipapo/Iseyin Farm Settlement group, Odooto community farmers, and NPFS*.

Going through the literature about cluster farming, we were able to gather that cluster farming is reported to have had some 5 benefits separately reported. We have attempted to combine these benefits and made them into a 5-key framework for evaluating cluster farming systems. This framework would lay a good understanding of the concept for future studies.

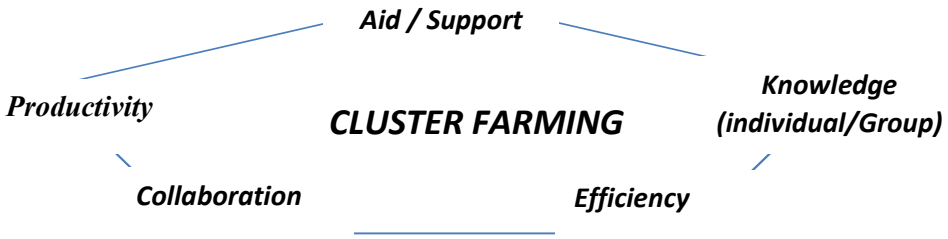

Figure 1: 5-key framework for cluster farming

3.4 Method of Data Analysis

The data from the Likert scale questions were number coded in excel such that "Strongly agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly disagree = 1". The data was then analyzed in Jupyter Notebook (Python IDE) for graphical (descriptive) and correlation analysis. Using the IDE, data from the open-ended questions were analyzed using Natural Language Processing techniques comprising the visual representation of the sentiment analysis, word cloud, and topic modeling.

CHAPTER FOUR

4.0 (a) RESULTS AND DISCUSSION

This chapter presents the results of the analysis, followed by the discussion on the subject. The result is presented in three subsections: demographic characteristics, correlation analysis, and sentiment analysis.

4.1 Demographic characteristics

This section describes the dynamics in the respondents' population for this research. It includes the language, gender, age, education, reasons for farming, years in farming, annual income change (2020 – 2021), etc.

4.1.1 Language distribution of the sampled population

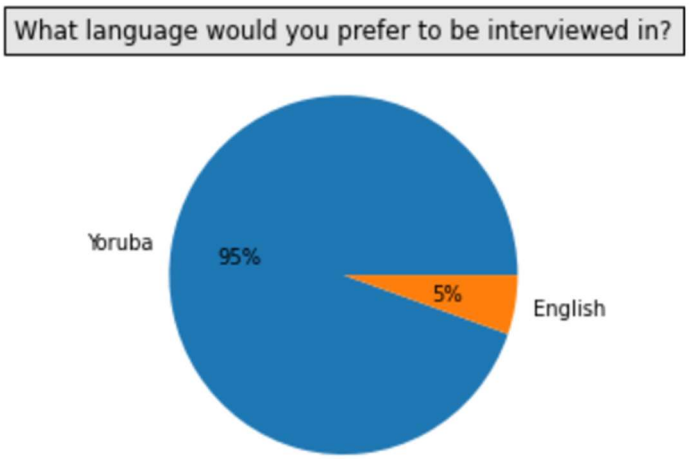

Figure 2: Barplot of language preference of the respondents

Figure 2 depicts the fact that the majority (95%) of the respondents were comfortable using Yoruba language. The few 5% that preferred English as the language of communication included the non-Yoruba speakers (e.g., Igbo, Togolese, Ghanian) and the educated ones among the farmers.

4.1.2 Gender distribution of the sampled population

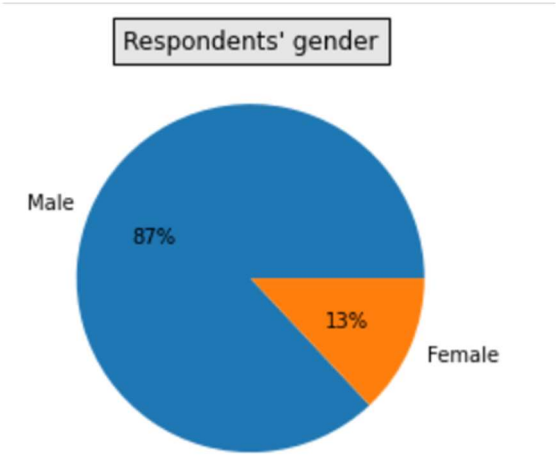

Figure 3: Gender distribution of the farmers

The figure 3 shows that 87% of the respondents were men while the rest were women.

4.1.3 Age distribution of the sampled population

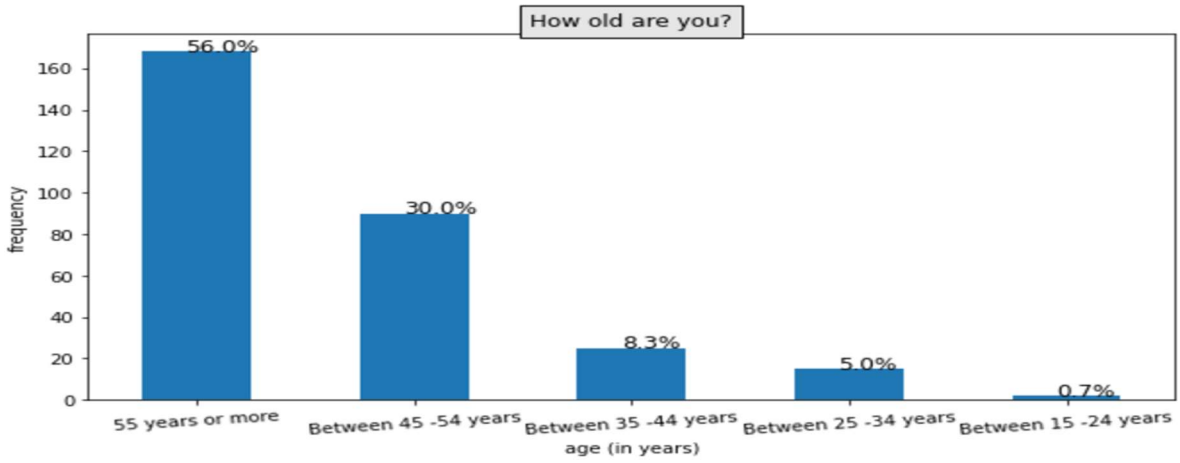

Figure 4: Age distribution of the farmers

Only a few smallholder farmers in the sampled communities were below the age 35. The majority of the farmers were between the ages of 45 to 55 and more. It could be seen that only a few (0.7%) of the sampled population were between the ages of 15 – 24 years.

4.1.4 Educational levels of the sampled population

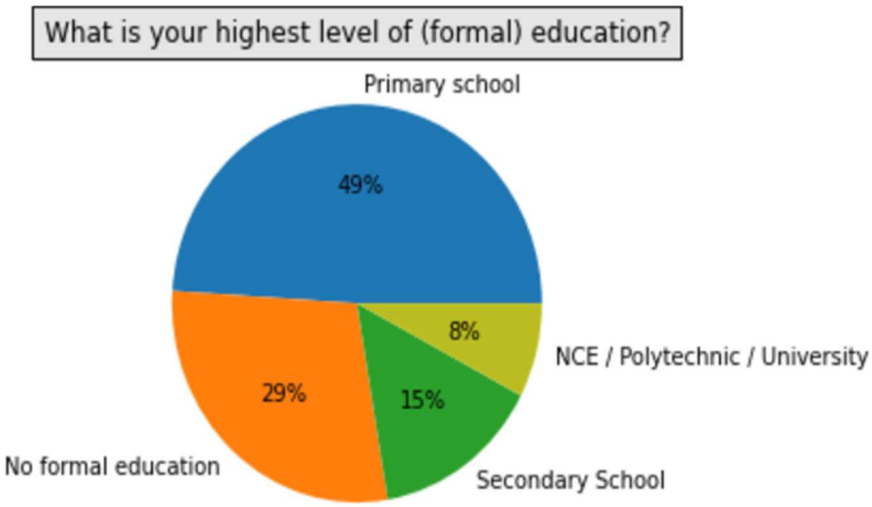

Figure 5: Education level of the farmers

Almost half (49%) of the sampled population had a primary school education, 29% -not formally educated, 15% - had a secondary school education, and 8% - have been privileged to attend a tertiary education.

4.1.5 Farming experience of the sampled population

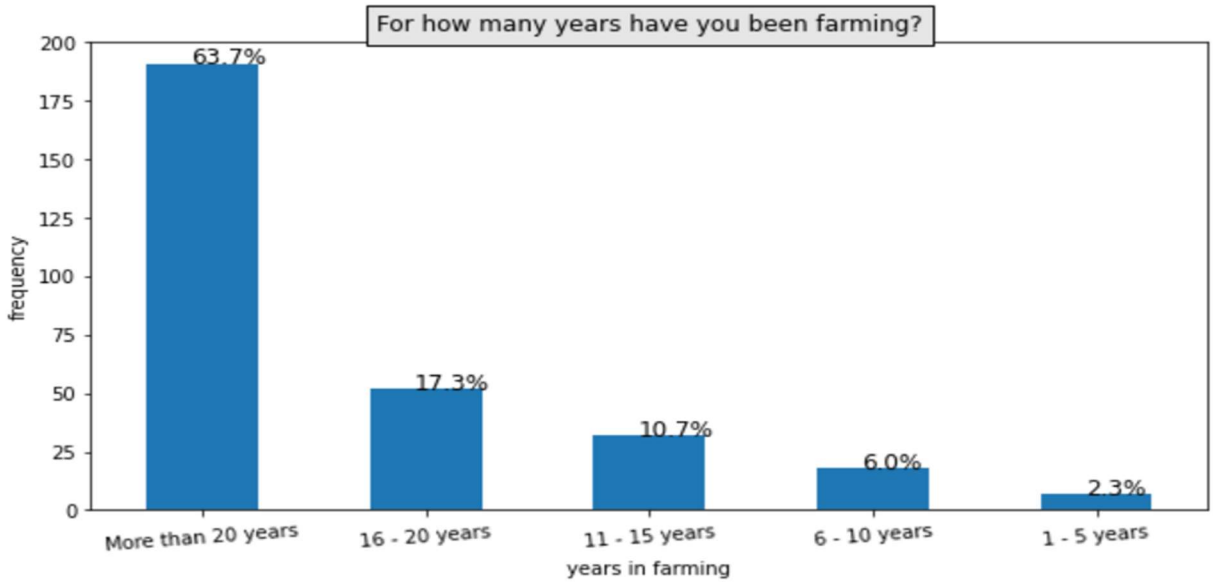

Figure 6: Respondents' years in farming

In all the communities, the majority (63%) of the farmers present have a farming experience of more than 20 years, 17.3% have been farming for 16 – 20 years, while only 2.3% are new to farming.

4.1.6 Respondents' motivation for choosing crop farming

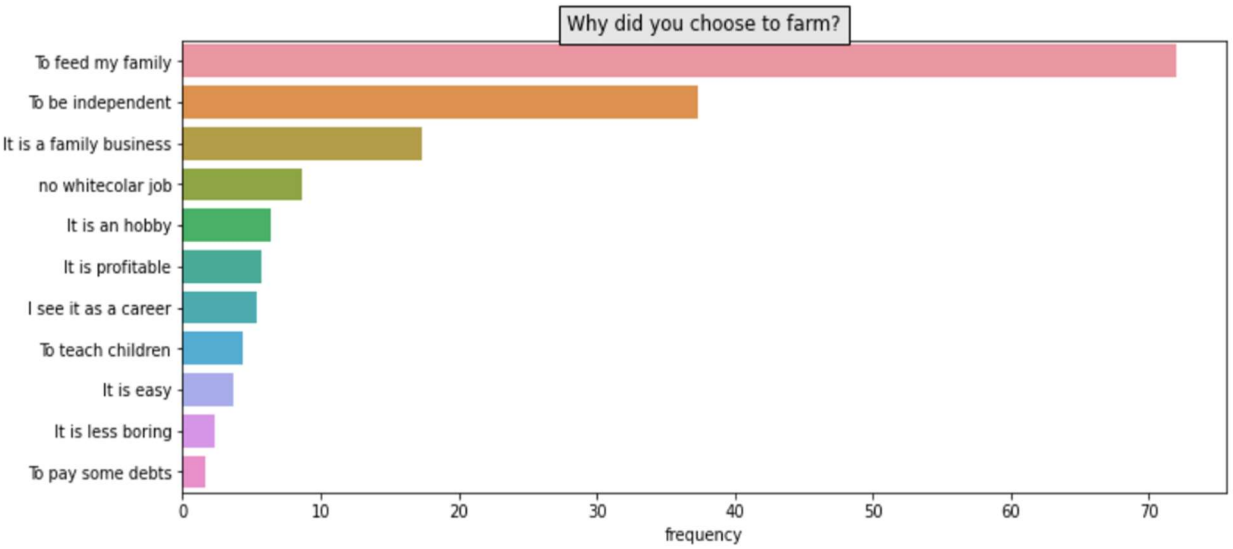

Figure 7: Respondents' reasons for farming

Looking at the responses above, we can confidently summarize the respondents' various motivations to just one thing; to generate income (money).

4.1.7 Respondents' annual change in income (positive or negative)

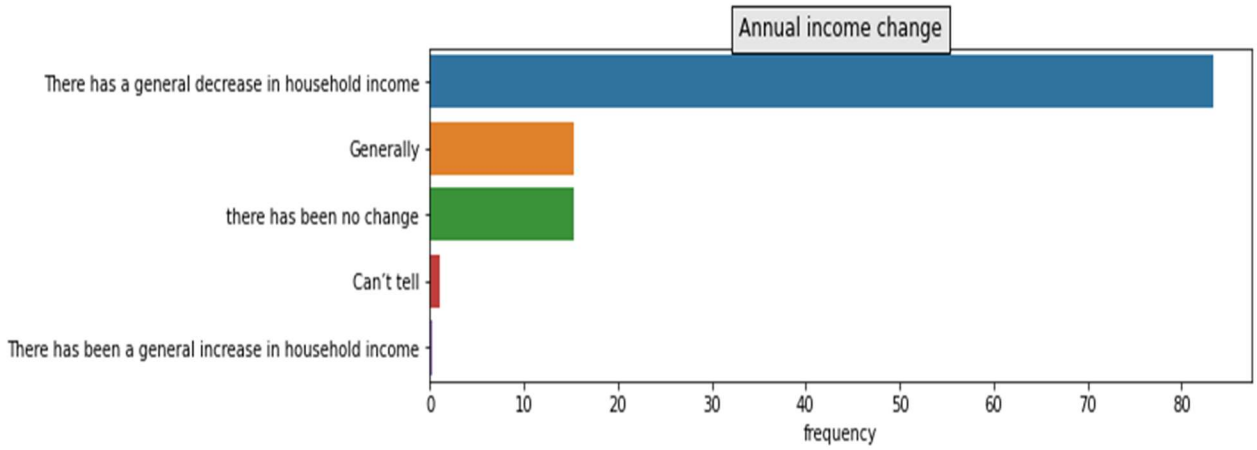

Figure 8: Respondents' annual income change

Only 0.3% of farmers feel their household income has increased generally, compared to 83.3% who claimed that it has decreased generally, 15.3% didn't think there has been a general change in their household income, 1% couldn't tell, and 0.3% said they did not know.

4.1.8 Comparing the respondents' years in farming (i.e., consistency and expertise) in farming with the amount of annual (2020 - 2021) income change

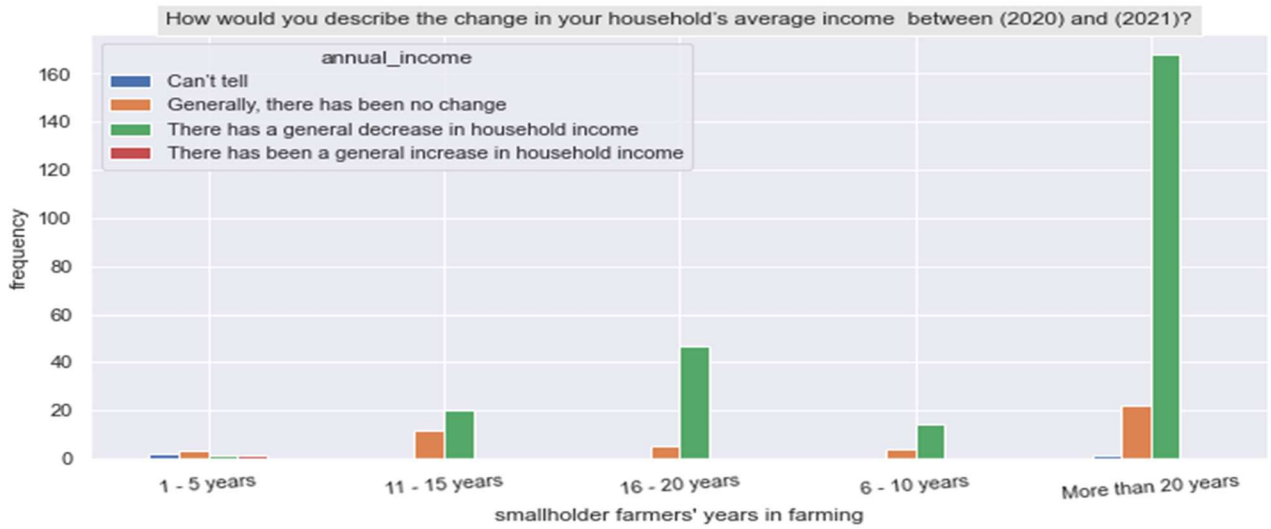

Figure 9: Change in respondents' household income compared to years in farming

Most of the farmers very experienced in crop production believed they have accomplished less between 2020 and 2021.

4.1.9 How much do the smallholder farmers think they need extension services

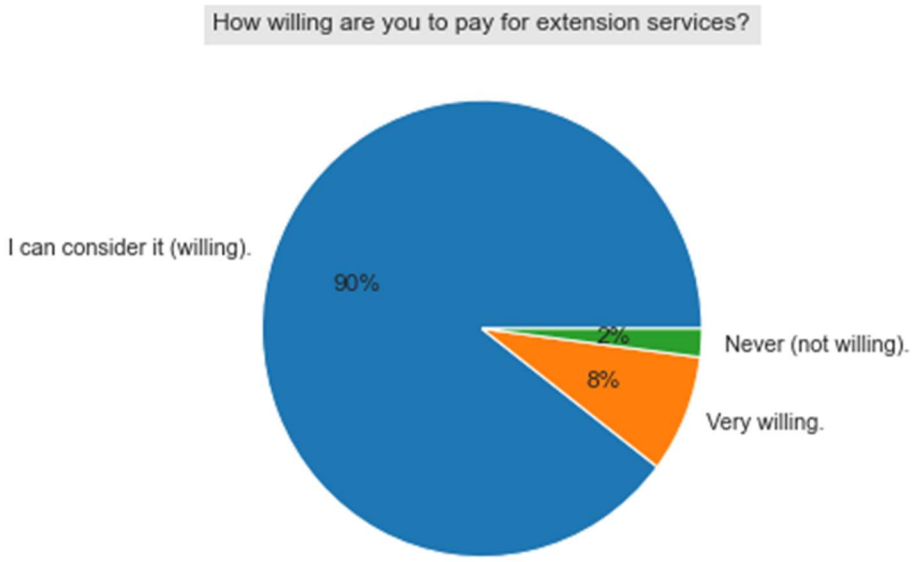

Figure 10: Respondents' willingness to pay for extension services

We gauged the extent of availability—or lack thereof—of extension services using the respondents' willingness to pay. More than 90% of the respondents said they would be prepared to pay for extension services in exchange for easier access to support programs.

4.1.10 Major problems facing the smallholder farmers

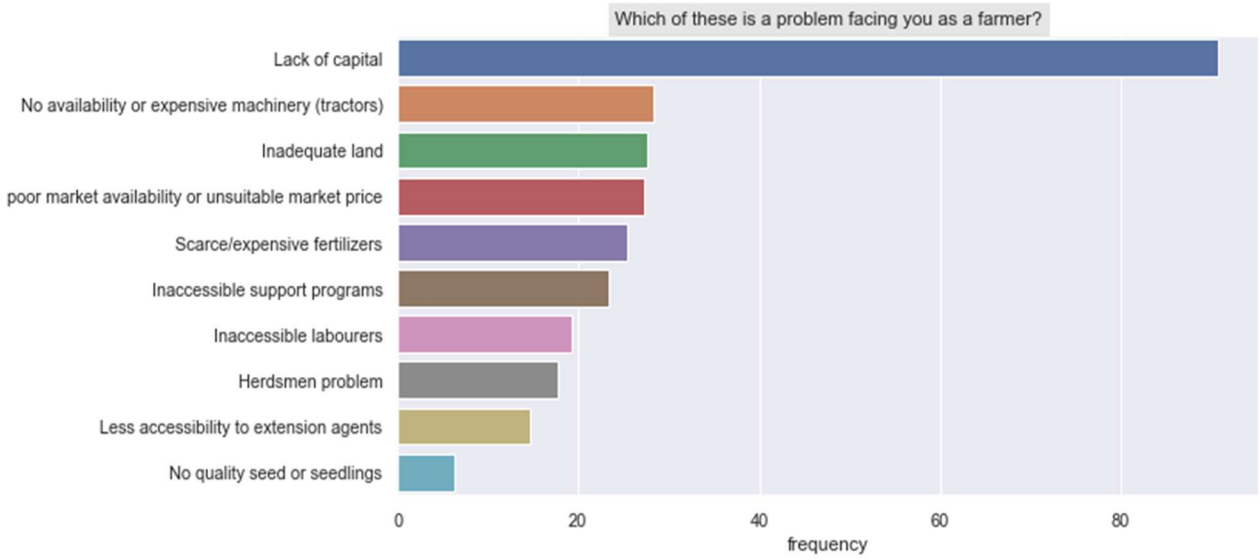

Figure 11: Respondents' list of problems in order of intensity

Lack of capital happened to be the greatest limiting factor for the smallholder farmers in the sampled communities. Other major issues include lack of access to machinery, land tenure, suitable market, lack of inputs like fertilizers, inaccessible support programs, herdsmen attacking farms with cattle, poor extension services, and poor supply of improved seeds or modified seedlings.

4.1.11 Farmers' satisfaction with the current market availability

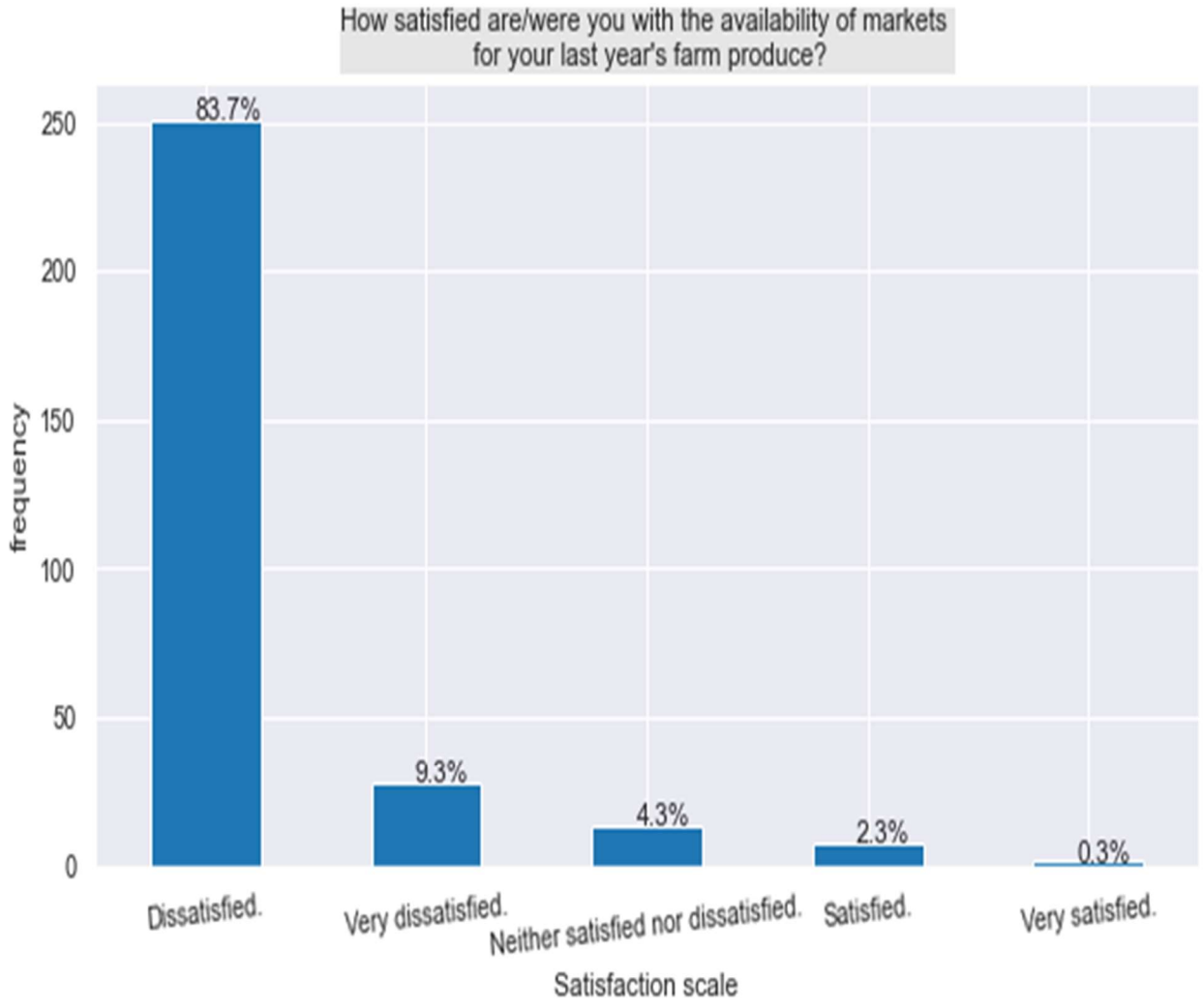

Figure 12: Respondents' satisfaction with their current marketing opportunity

The number of good markets that are within the reach of the farmers does not satisfy them. Only a small percentage of them expressed some level of satisfaction.

4.1.12 Farmers' satisfaction with the current selling price

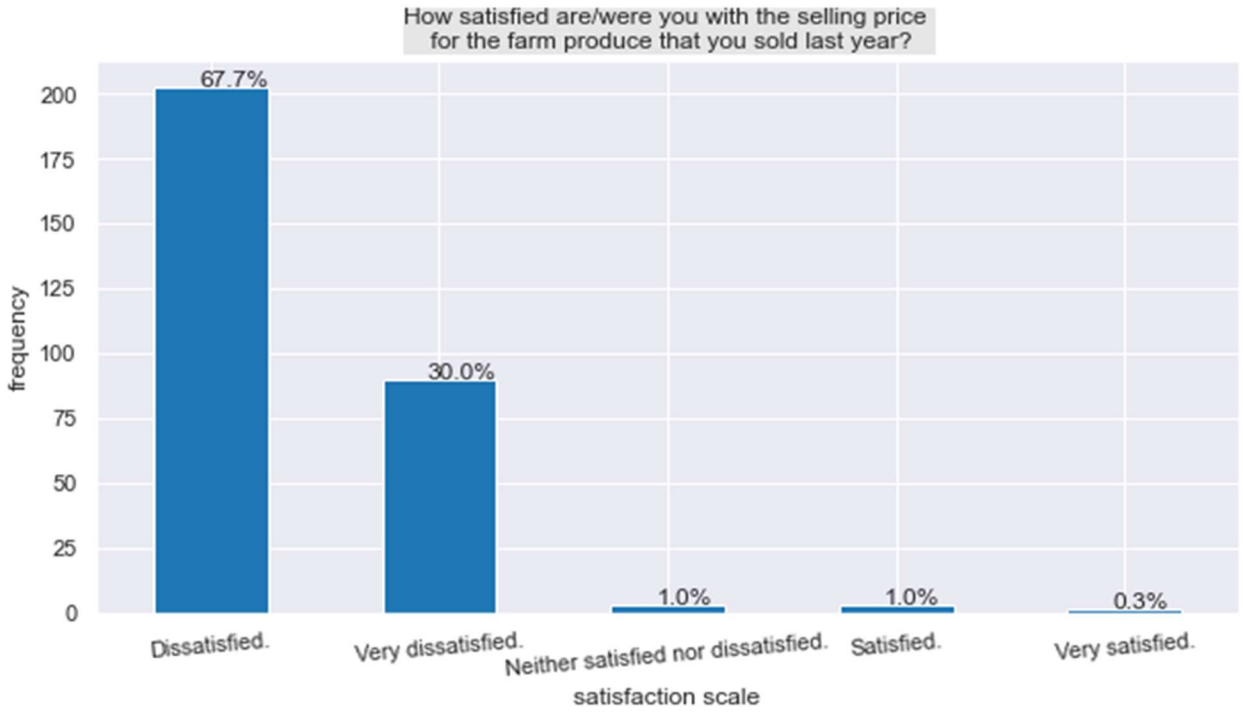

Figure 13: Respondents' satisfaction with the selling price

Farmers generally express dissatisfaction with the prices being offered for their produce at the end of crop season, which is similar to their response regarding marketing availability.

4.2.0 Exploration of the Cluster Farming Results

This subsection reports on the finding of the exploration of smallholder farmers' perception on cluster farming. As shown in Figure 1, we evaluate the cluster farming system using five criteria: productivity, group knowledge, collaboration, effectiveness, and farmer-centric support.

4.2.1 Respondents group membership

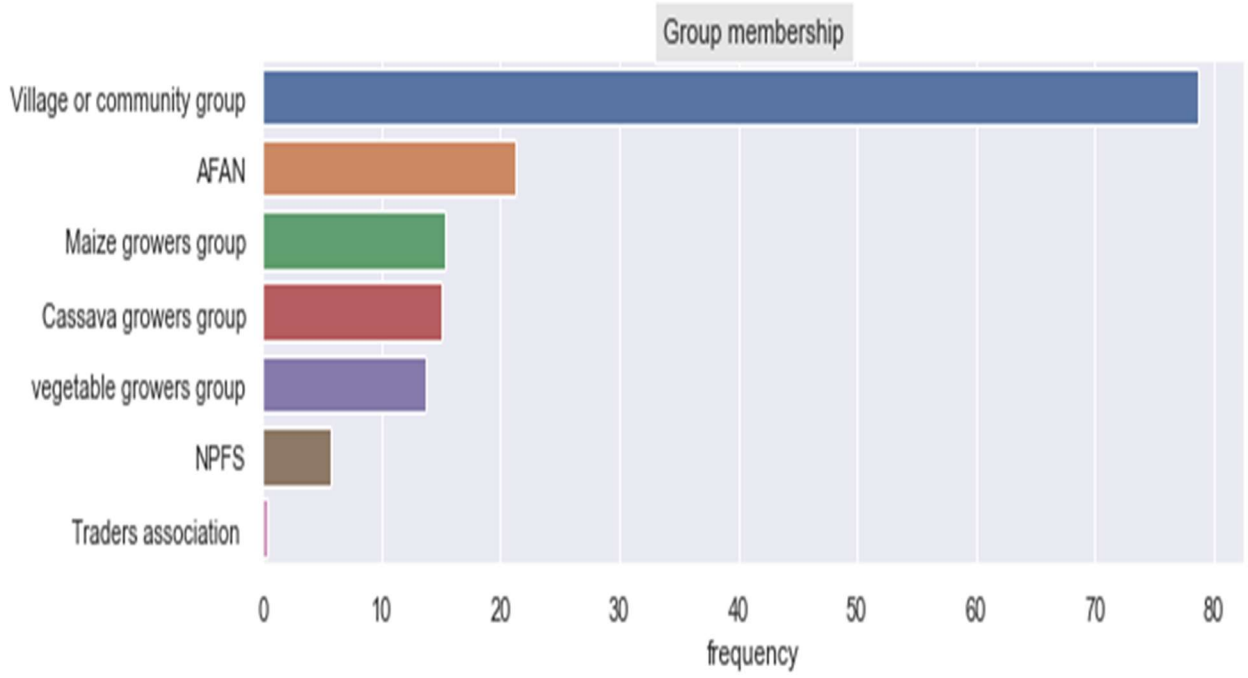

Figure 14: Respondents' group membership

The study shows about 78% of the farming officially (communally) belongs to at least a village or community group. About 21% of them belongs to the "*All Farmers' Association of Nigeria* (AFAN), while a few others also belong to commodity groups like *maize growers' groups*, *vegetable growers' group*, *cassava growers' group*, and *National Programme on Food* Security¸(NPFS), and *traders' groups*.

4.2.2 Awareness about cluster farming

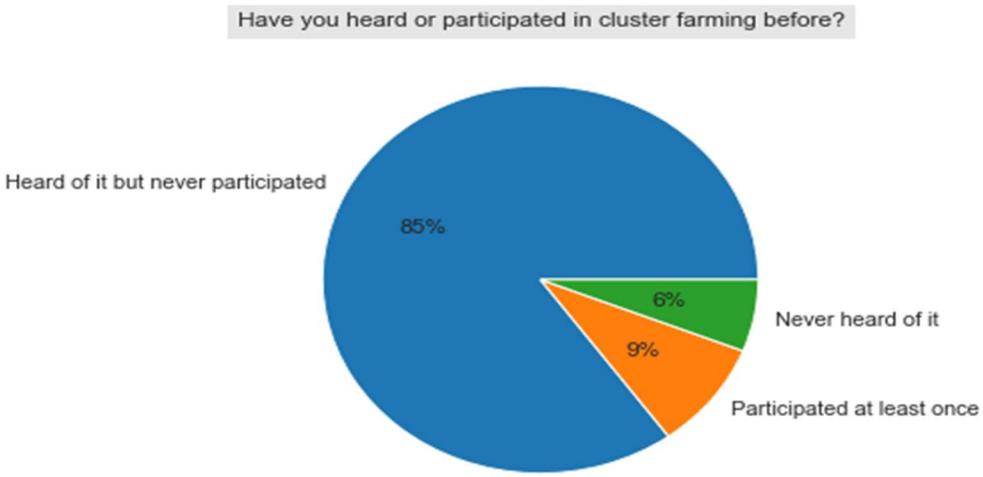

Figure 15: Measuring farmers' awareness level about cluster farming

According to the survey, more than 90% of smallholder farmers are already aware of cluster farming, but only approximately 9% of them have ever engaged in it.

4.2.3 Farmers' motivation for joining a support program

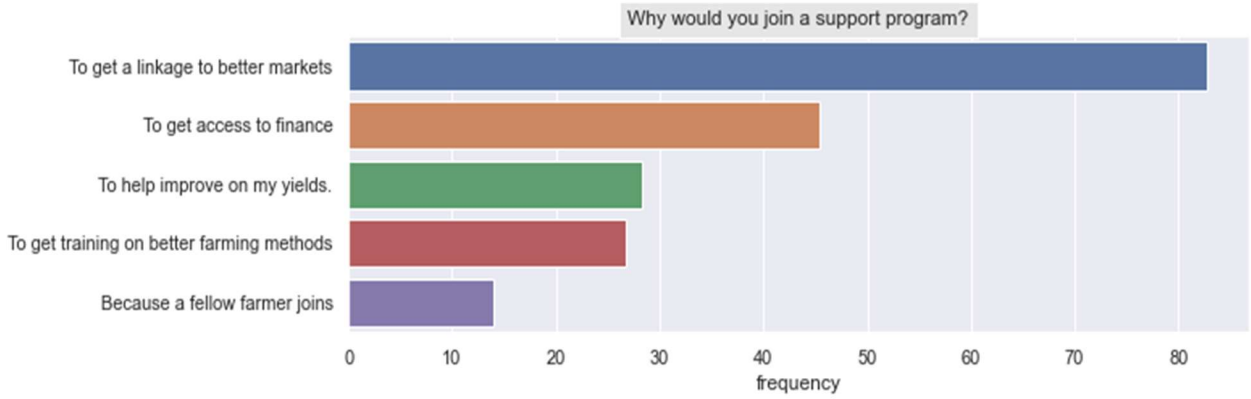

Figure 16: Respondents' reasons for joining a support program

82% of the smallholder farmers said they would enroll in a support program to gain access to better marketing channels, 45% said it would help them get financing, 28% said it would increase their

yields, 26% said it would help them learn better farming techniques, and 14% said it would be because a fellow farmer was enrolling.

4.2.4 Productivity

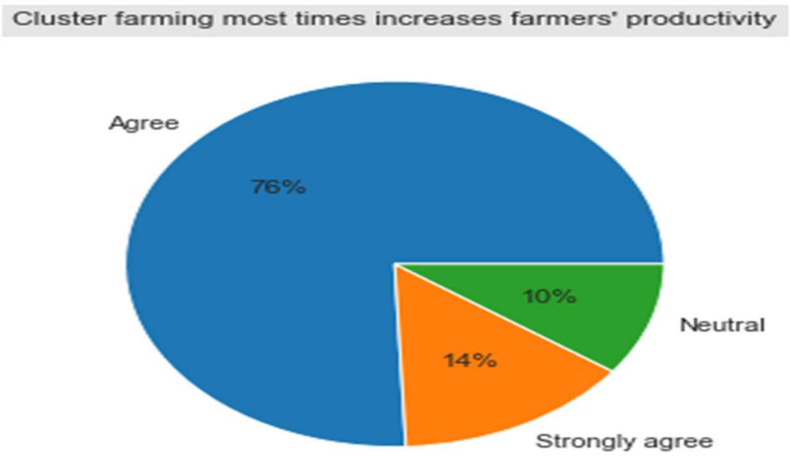

Figure 17: Cluster farming increases productivity

76% agreed that cluster farming most times increases farmers' productivity, 14% strongly agreed, and 10% were neutral.

4.2.5 Group knowledge

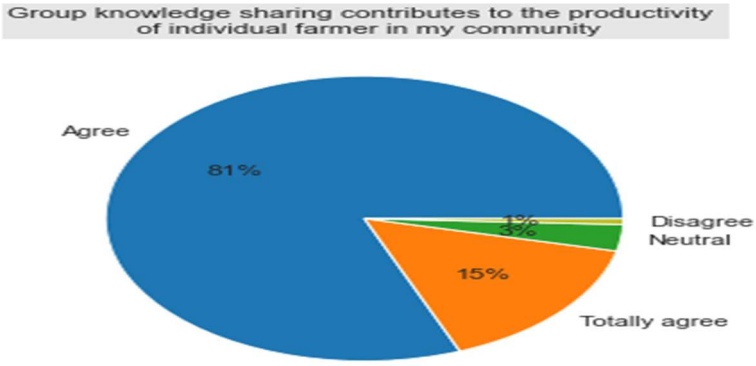

Figure 18: Group knowledge enhances productivity

81% of farmers agreed that having access to collective information (group knowledge) increases each farmer's productivity; 15% strongly agreed; 3% were indifferent; and 1% disagreed.

4.2.6 Collaboration (a)

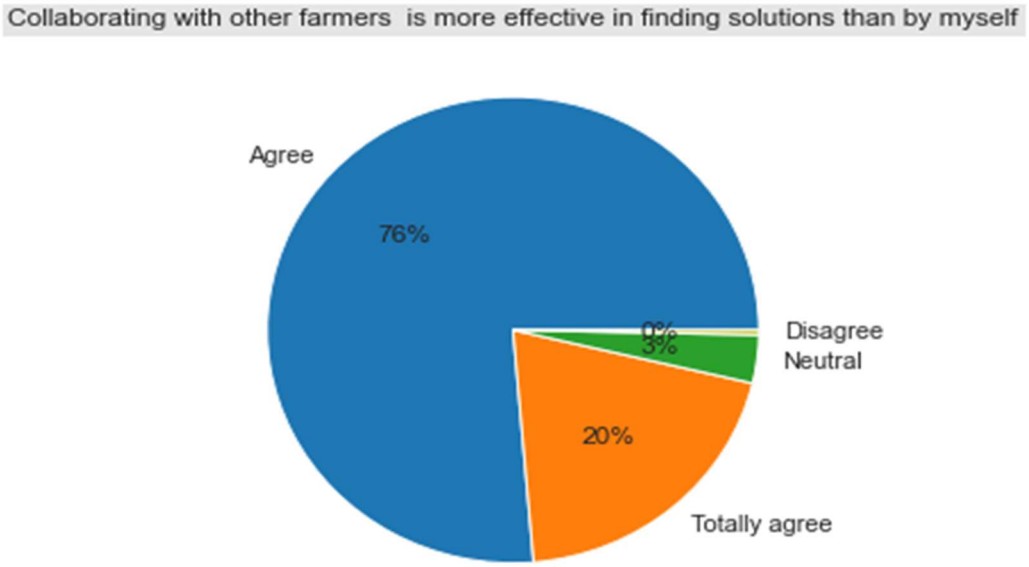

Figure 19: collaborating with other farmers is more effective in finding solutions

76% of the farmers agreed that collaborating with other farmers is more effective in finding solutions than individually; 20% strongly agreed; 3% were indifferent; and 0% disagreed.

4.2.7 Collaboration (b)

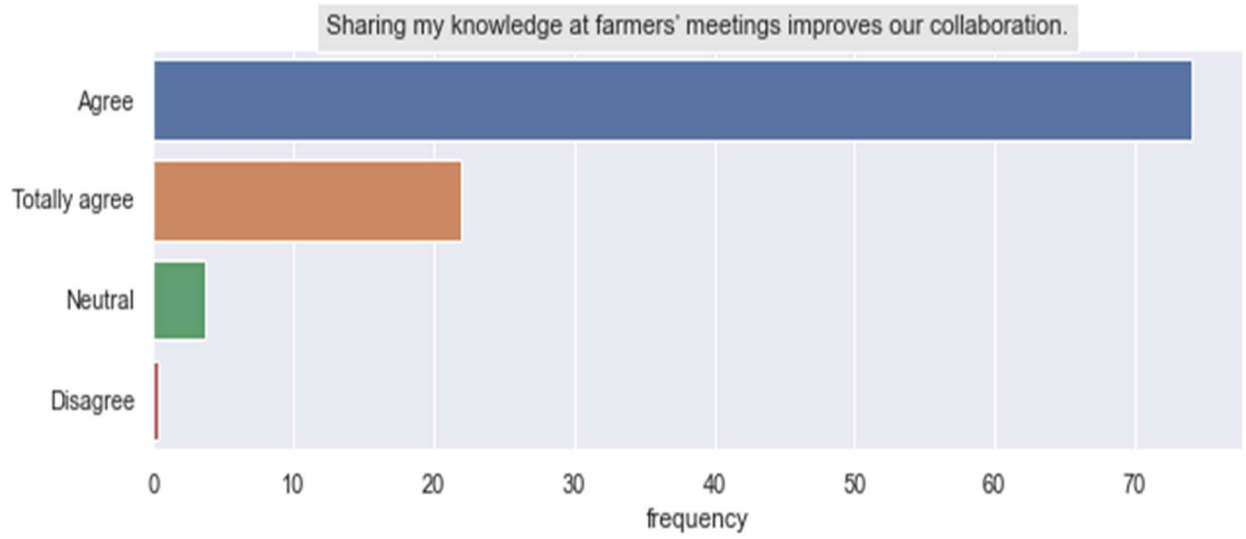

Figure 20: sharing my knowledge at farmers' meetings improves collaboration

Similar to the results in figure 18, 74% of the farmers stated that sharing their knowledge in the presence of other farmers increases collaboration (and/or collaborative problem-solving); 22% strongly agreed; 3.7% were neutral, and 0.3% disagreed.

4.2.8 Efficiency

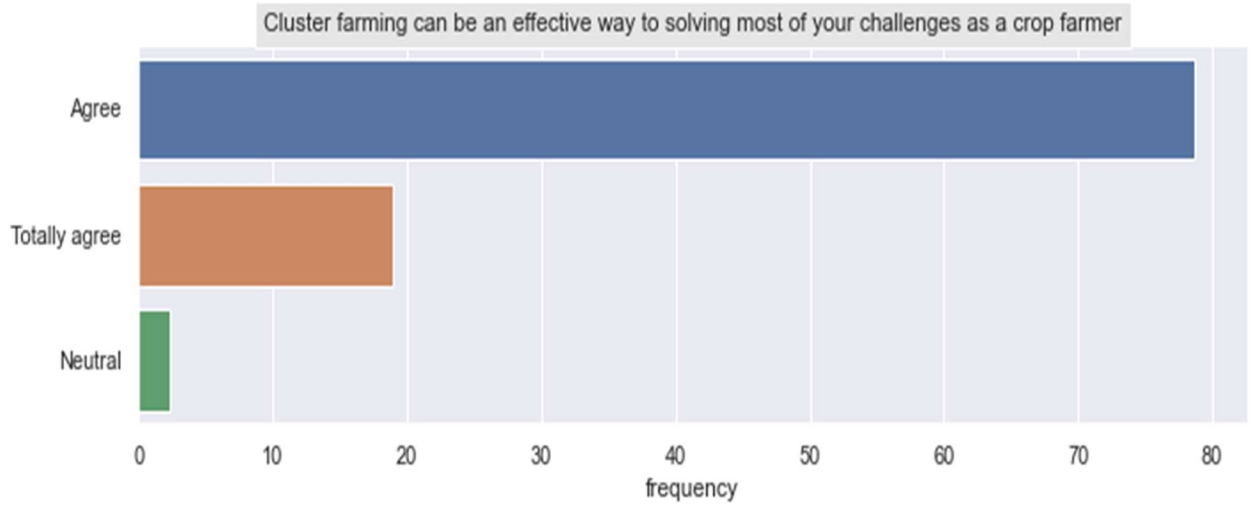

Figure 21: Bar plot for cluster farming being an effective way

79% of the farmers stated that sharing their knowledge in the presence of other farmers increases collaboration (and/or collaborative problem-solving); 19% strongly agreed; 2% were neutral.

4.2.9 Support

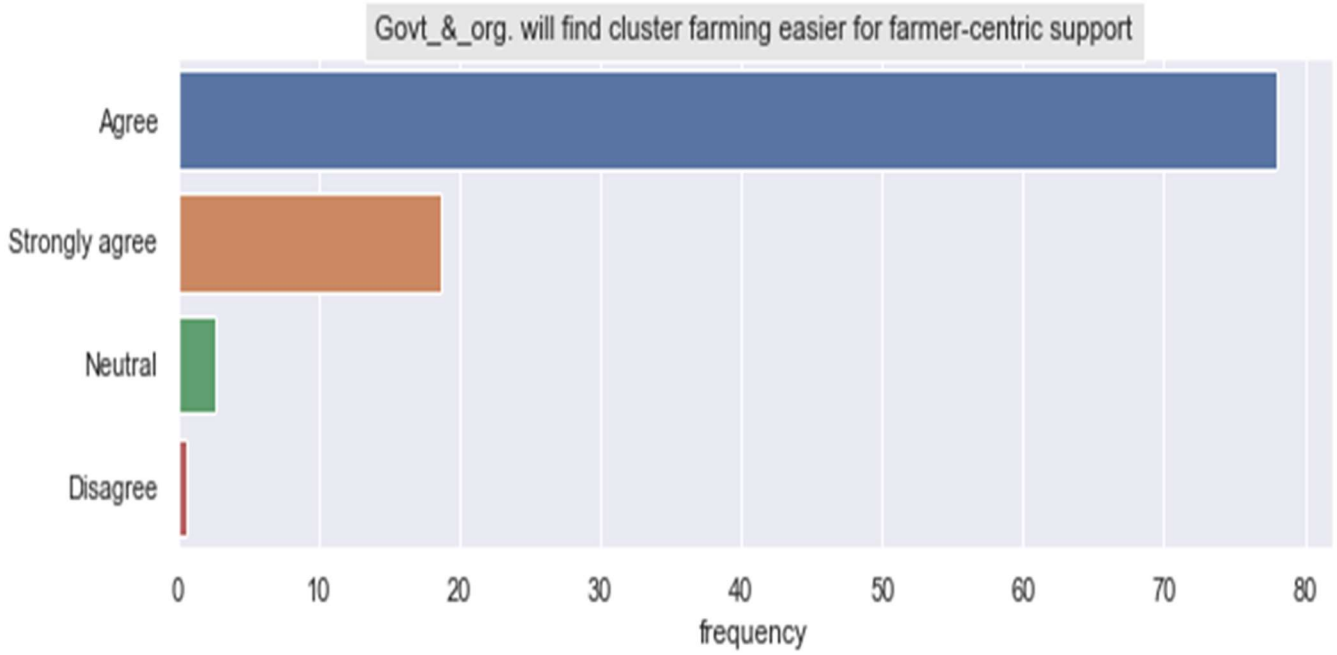

Figure 22: Govt & organizations will find cluster farming an easier strategy

In order to reach smallholder farmers, cluster farming can be a viable method for policymakers to use, according to 78% of the respondents. 18.7% of respondents strongly agreed, 2.7% were indifferent, and 0.7% actually disagreed regarding this.

4.2.10 Factors that can limit cluster farming

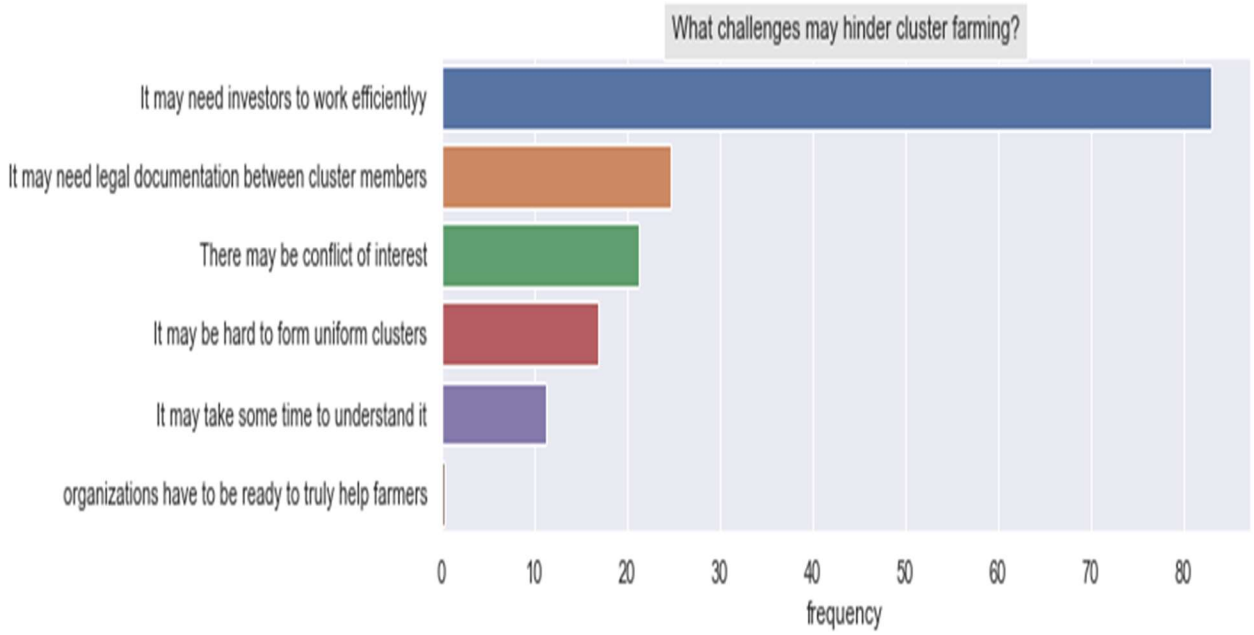

Figure 23: Challenges that may hinder cluster farming

The majority (83%) of respondents agreed that cluster farming might require investors to operate well. 24.7% of the respondents thought there might eventually be a need to legally document the cluster members and their activities; 17% thought it might be subject to conflicts of interest (e.g., with investors); 21.3% thought it might be difficult to form uniform clusters; 11.3% thought it would take some time for them to understand how cluster farming could be beneficial; and 0.3% thought it requires organizations to genuinely want to assist smallholder farmers.

4.3.0 Correlation and Regression Analysis

4.3.1 Correlation between cluster farming variables

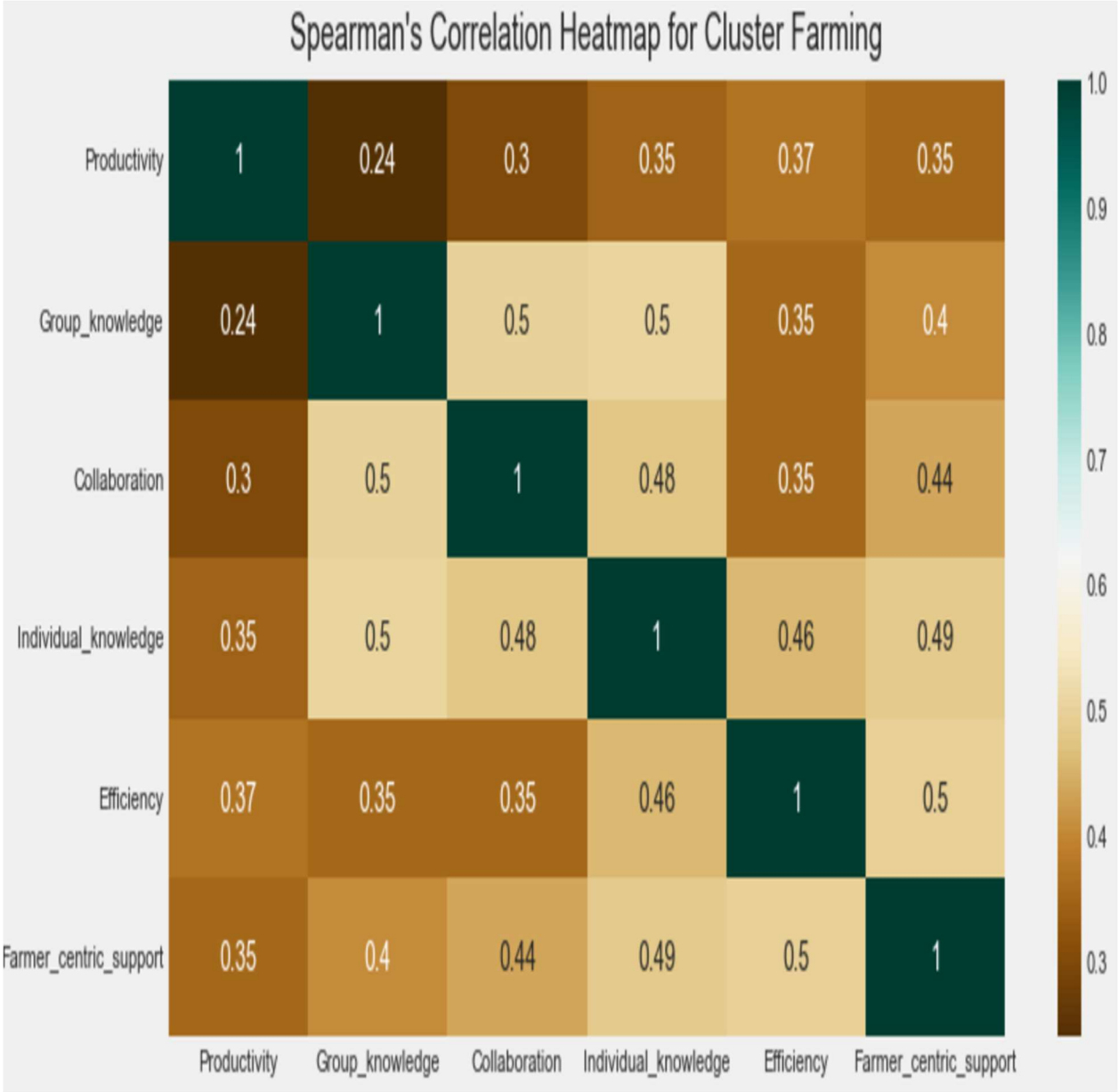

Figure 24: Spearman correlation plot between selected variables.

4.3.2 Simple Linear Regression Analysis

OLS Regression Results

Dep. Variable:	Farmer_centric_support	R-squared:	0.326
Model:	OLS	Adj. R-squared:	0.310
Method:	Least Squares	F-statistic:	19.75
Date:	Wed, 28 Sep 2022	Prob (F-statistic):	4.94e-16
Time:	08:14:02	Log-Likelihood:	-81.661
No. Observations:	210	AIC:	175.3
Df Residuals:	204	BIC:	195.4
Df Model:	5		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.9539	0.324	2.943	0.004	0.315	1.593
Productivity	0.1310	0.060	2.195	0.029	0.013	0.249
Group_knowledge	0.1097	0.076	1.444	0.150	-0.040	0.259
Collaboration	0.1367	0.067	2.033	0.043	0.004	0.269
Individual_knowledge	0.1556	0.069	2.258	0.025	0.020	0.291
Efficiency	0.2395	0.069	3.476	0.001	0.104	0.375

Omnibus:	44.043	Durbin-Watson:	2.163
Prob(Omnibus):	0.000	Jarque-Bera (JB):	435.762
Skew:	-0.360	Prob(JB):	2.37e-95
Kurtosis:	10.020	Cond. No.	121.

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 25: OLS model summary

4.4 Natural Language Processing

4.4.1 Sentiment Analysis

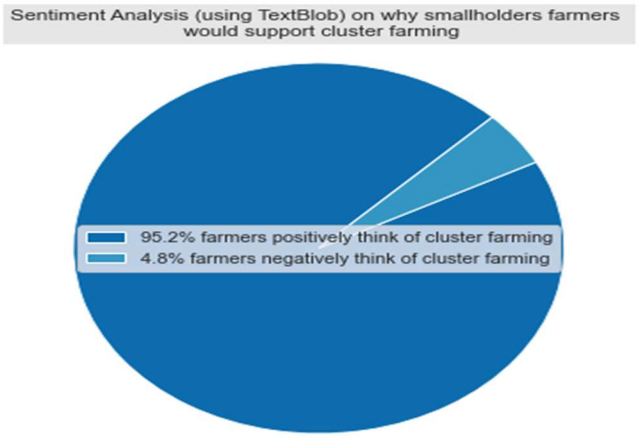

Figure 26: Sentiment analysis pie plot

4.4.2 WordCloud

Figure 27: Wordcloud of the respondents' motivation for supporting cluster farming

This was an open-ended question which allowed the respondents to fully express their perception towards cluster farming and its potential to gaining access to farmer-centric support. In this plot, the bigger and bolder a word appears, the more often it was mentioned and the more important it is to farmers. This can be used to understand the smallholder farmers' pain points, sentiment, recommendation, and opportunities for policy makers to harness.

4.4.3 Topic modeling on why farmers would support cluster farming

A topic model is a type of statistical model that is used to discover the underlying themes or topics that are present in the data. In the context of cluster farming, we used topic model to understand why farmers would support this approach to farming.

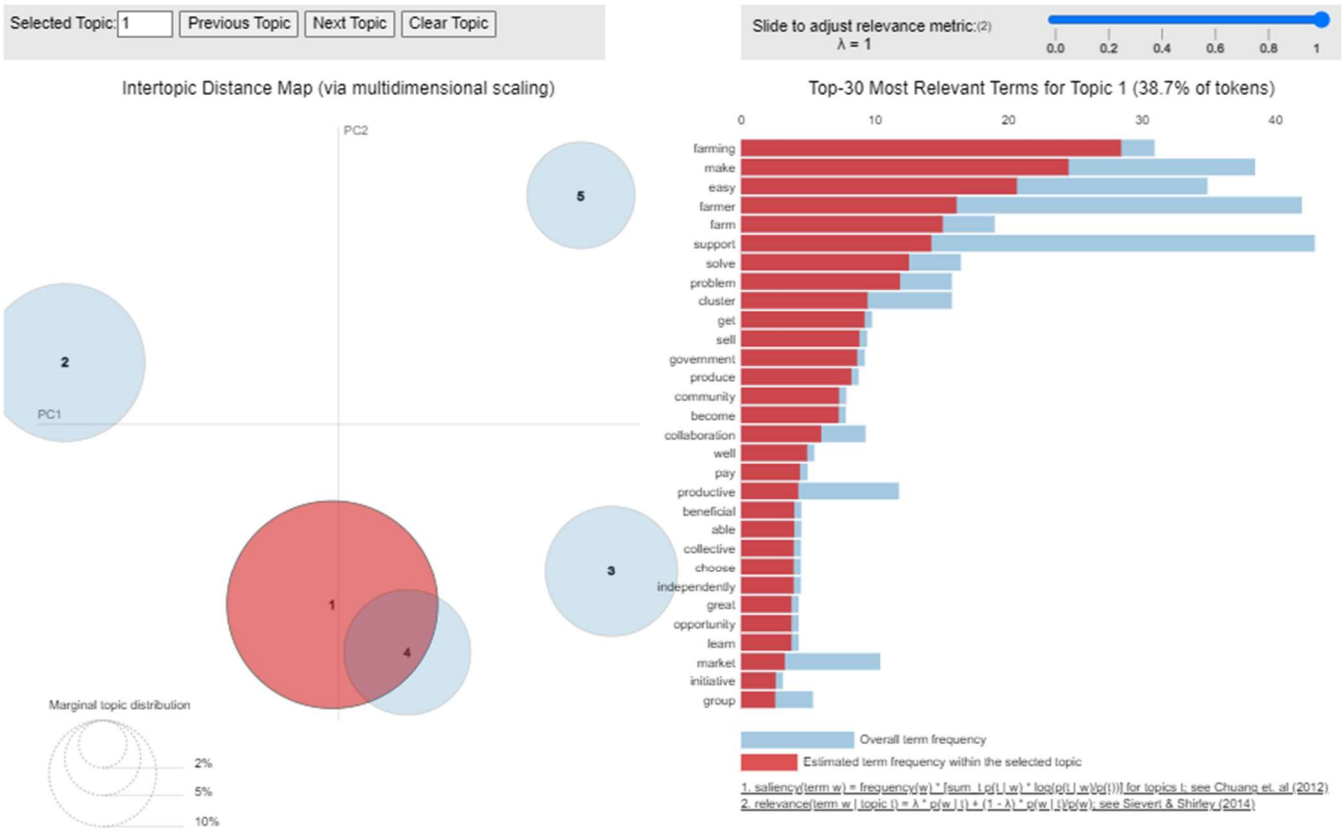

Figure 28: Topic 1 model

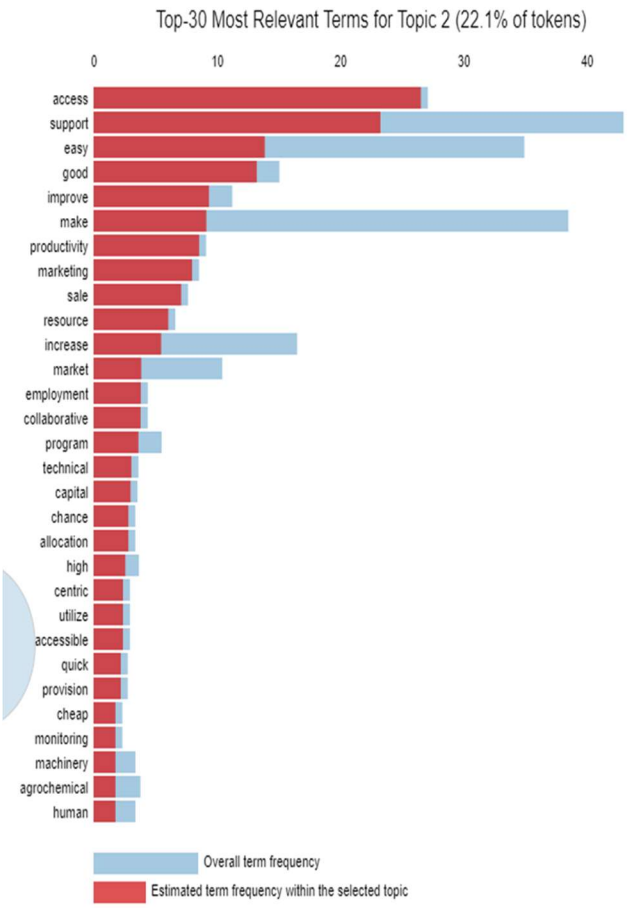

Figure 29: Topic 2 model

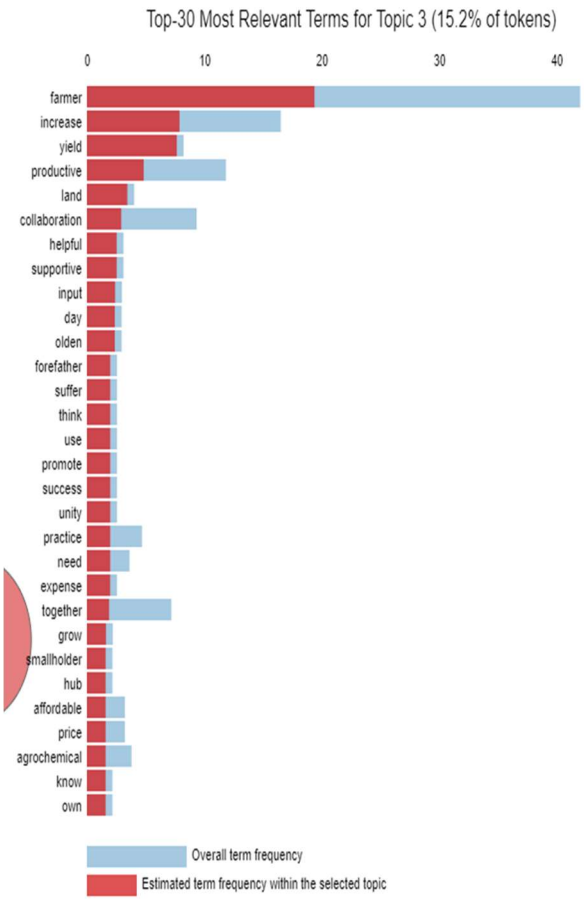

Figure 30: Topic 3 model

The efficiency topic is represented by the large red circle near the center of the visualization, while the accessibility and productivity topics are represented by smaller circles positioned farther away from the center. This visual representation makes it easy to see at a glance the main themes that are present in the responses, and to understand the relationship between the different topics as related to cluster farming through our *5-key framework*.

4.0 (b) DISCUSSION

As mentioned under methodology, this study was a community knowledge-based assessment because it sought to evaluate the farmers' opinion on cluster farming based on their lived

experience, knowledge, practice, and their observed environment. According to a farmer, the majority of the rural residents are the elderly farmers. He explained that this is because most of their youths are migrating away to urban areas to engage in some casual operations in local agricultural processing companies (e.g., garri production, starch industries), or artisan work (e.g., vulcanizing, auto mechanic, etc.). He explained that the few ones coming back to farming are mostly the ones that are making some money in the urban areas and bringing it back to villages to invest in agriculture. Most of the sampled households were men. However, the gender gap was not caused by a flaw with the sampling, but rather with the fact that males are mostly in charge of managing most farming activities in the communities. Women mostly do not have big separate farms but rather assist and contribute to the success of their household farms.

Respondents were prompted to list a few of their most important problems. The difficulties were compiled into a list, and groups of farmers were asked to rank them in order of priority or problem intensity during meetings. They were able to understand this approach through weighing the pros and cons of whether one problem should take precedence over the other. It came out that their major problems were as a result of lack of capital. This corresponds with the findings of Komicha and Ohlmer, (2006). It also agrees with the findings of Mgbenka and Agwu, (2011) that limited access to financing facilities hinders small-scale farmers' productivity and growth. This points out to one of the reasons why cluster farming is essential to these groups of farmers as demonstrated in Inan, 1984; Galeski 1987; Naik et al., 2010; Axalan et al., 2011; and Varawa et al., 2014.

Majority of the respondents were officially engaged in some form of group membership; most people of them relying on agriculture with the purpose of providing for their families. Even though, this study was done in 2022, we think the year has not yet ended and the farmers may not have yet determined their revenue. Therefore, we assessed their revenue between 2020 and 2021. Our

expectation was that household income would increase with crop production experience and consistency. However, respondents stated the opposite (Figures 8 & 9). About 83% of respondents claimed that their household's income had generally decreased. They attributed the decline to a lack of capital, inaccessible machinery, insufficient cropland, which has been described in Bamiduro et al., (2011) as the scarce resources. They also attributed their failure to improper market prices or availability, scarce or expensive inputs like fertilizers and agrochemicals, inaccessible laborers, and other factors.

Farmers were asked why they would join a support program, and the top reasons given were to obtain access to a better market, financial resources, increased yields, access to training, and for successful engagement with other farmers (Figure 16). The majority of them even agreed that they can consider paying for extension service if it would give them accessibility to support programs (Figure 10). When asked if they were aware of cluster farming or had ever engaged in it (presumably in the past), 85% of them stated they had heard of it but had never engaged in it, while 9% claimed they had done so at least once. 79% felt that cluster farming can be an effective solution to address the majority of their issues as crop farmers, and 19% absolutely agreed. However, 83% of the farmers (figure 23) claimed that the lack of investors might reduce the effectiveness of cluster farming (private and public).

About 25% of the farmers also thought that cluster farming may need legal documentation between cluster members and stakeholders. They thought that this might be required in the event of a conflict of interest, uniformity of clusters or a lack thereof, and the willingness of stakeholders to genuinely assist the farmers. Policymakers can use this finding to fully understand the problems faced by smallholder farmers, forecast their upcoming actions and demands, and ultimately make informed choices.

The farmers said they are not able to benefit from cluster marketing because they mostly cannot meet up with the quantities fitted to be sold to companies. This is because they are fragmented and usually sell their produce individually. A group of the respondents (AFAN) bemoaned the fact that a specific organization had previously asked them to grow cassava in large quantities but refused to buy it from them since there was an oversupply of the commodity during the harvest year. Therefore, they consider having investors and documents to be a crucial factor.

In the visualized topic model, we denoted that there are three main topics present in response data: efficiency (i.e. makes farming easy), accessibility (i.e. access support), and productivity (i.e. increase yield). Overall, the topic model showed that farmers support cluster farming for a variety of reasons, including increased efficiency and productivity, the creation of stronger communities, problem-solving, and the adoption of sustainable farming practices, etc. As one of the advantages of cluster farming (Galeski, 1987; Sherief, 1991; Apo, 1994; Coles and Mitchell, 2011; Shukla et al., 2019; Olatunji and Letsoalo, 2013, etc.), most of the respondents thought working with other farmers to find solutions was more effective than doing so alone and that sharing community knowledge (e.g., at farmers' meetings) improves collaboration. By working together, farmers can improve their efficiency, reduce their costs, gain better access to markets, and support sustainable farming practices. These factors make cluster farming a viable and attractive option for many farmers.

Overall, the correlation matrix indicates that correlation matrix (values range from 0.24 to 0.5) between the five variables shows that there is a moderate level of interdependence, hence, we reject the NULL hypothesis and accept that there is a positive correlation between cluster farming and farmer-centric support. We can infer the following from the correlation plot:

- The respondents thought that cluster farming adequately supports community knowledge (with the correlation of 0.5 between individual and group knowledge), and that this knowledge sharing supports collaboration (r =0.48 and r = 0.5) among stakeholders. This supports the discovery of Karki et al (2021) that the problem of increasing difficulty to transfer vital knowledge from older generations to younger generations can be adequately managed through effective knowledge flow among cluster members (Karki et al., 2021).

- The findings agrees that farmers believe that cluster farming may be an efficient solution for them to collaborate. This follows the literature that cluster farming have been developed by as a strategy to access governmental funding, institutional markets, and free or discounted inputs (Boselie et al., 2003; Axalan et al., 2011; Lorencowicz et al., 2013; Real et al., 2013; Prager, 2015).

- The result also shows that productivity have a positive linear relation with farmer-centric support. This goes well with Gualberto (2007) that groups of farmers in a specific region, serves as a tool for production, financial planning, and improved standard of living (Gualberto 2007; Lamban et al., 2013).

- The respondents thought that focused "farmer-centric support" results in an "efficient cluster farming system" (r = 0.5). This corroborates the idea put forth by Brasier et al. (2007) that cluster farming can help communities grow.

Even though we are aware that correlation does not imply causation, we are implying it nonetheless because we have a strong theoretical justification (Umesh et al., 2010; African Harvesters, 2020; Karki et al., 2021) for why these variables might correlate with farmer-centric support in cluster farming. For example, an increase in collaboration may lead to an increase in knowledge and

farmer-centric support, which in turn leads to an increase in efficiency and productivity. This suggests that investing in these areas can lead to overall improvement in the cluster farming system.

In figure 25, the OLS model summary result shows that the model explains approximately 32% of the variance in the data (R-squared), with an adjusted R-squared of approximately 0.31. This indicates that there is still a significant amount of variance in the data that is not explained by the model. The P-value of the F-statistic is very low (4.94e-16), indicating that the model is statistically significant. The F-statistic itself is 19.75, further indicating that the model is a good fit for the data. The t-test scores for the individual variables in the model are all below 0.05, indicating that these variables are statistically significant and contribute to the overall fit of the model. This mean that *productivity, collaboration, individual knowledge, and efficiency* are related to cluster farming being a good strategy to apportioning *farmer-centric support* to smallholder farmers.

The sentiment analysis of cluster farming shows a positive overall sentiment of 95%. This indicates that the majority of individuals and groups who have discussed or commented on cluster farming have a favorable view of the practice. With the help of this sentiment analysis and the previous response (79% of smallholder farmers approved, and 19% absolutely agreed, to cluster farming), it is possible to forecast how these farmers will feel about the practice. The wordcloud suggests that the focus of the topic is on improving support, ease, access, improvement in productivity, and market, through increased collaboration, problem-solving, and knowledge, etc.

CHAPTER FIVE

5.0 CONCLUSION, RECOMMENDATION, AND LIMITATION

5.1 Conclusion

This study provided insights into the factors that impact the motivation for cluster farming. These results can help agricultural stakeholders to implement cluster farming initiatives. This study also showed that by using deliberative surveys (based on Klein M., 2017), it is possible to identify variations in motivation among the different members in clusters, a concept that has not yet been addressed in the agriculture literature. Cluster farming can also create social connections between farmers and provide opportunities for them to support one another.

With cluster farming, barriers that can be overcome include improving pathways to access and increasing the number of programs available in a community. This can be done by creating programs that provide financial support, and extension services so that farmers can access information, learn, share knowledge, and build engagements with one another. Increasing awareness about resources available to members of the community can help eradicate food insecurity and provide improved access to farmer-centric support.

Providing information about these programs can also help build a sense of community and increase engagement with the local community. Collaboration among farmers has been demonstrated to be beneficial for the individual farmer and can lead to increased production, decreased input costs, and improved food security. This can be effectively facilitated with a carefully planned cluster farming system.

5.2 Recommendation

Governmental organizations should work to remove any barriers to the development of clusters and small farmer agricultural cooperatives, such as high loan interest rates, information asymmetry, challenging and indirect access to credit, and expensive technologies, as recommended by Karki et al. (2021). In order for smallholder farmers to advance collectively, they need assistance organizing themselves into strong associations or groupings so they can respond to market needs (Mgbenka, et al., 2016).

According to Mgbenka et al., (2016), smallholder farmers should be helped to organize themselves into viable associations that would enable them to respond to market demands. To ensure that each member of the cluster can operate together, it is crucial to take into account the logistical challenges that must be resolved. For instance, it could be necessary to give the cluster's participants access to shared resources like storage spaces and transportation networks. If the farmer has access to skilled labor, resources, and a temperate environment, cluster farming can be profitable. Governments and organizations can support the expansion of cluster farming by offering financial and technical support and making sure that producers receive a fair price for their goods. And according to Mgbeka et al., 2016, and Zuberu et al., 2019, the government must guarantee that all social classes have equitable access to the advantages of cluster farming.

In order to better meet the requirements of smallholder farmers, organizations must guarantee that extension services are responsive. Private organizations can also assist smallholder farmers in a number of ways, including by buying their crops at a predetermined price from them and holding them until a buyer is found, by setting up "buyers' clubs" where many people can buy a specific

crop in bulk at a discounted price, by expanding access to credit and markets, or by working directly with retailers to create regional markets for locally produced goods.

For traceability, each cluster member must also be properly registered and documented under clusters. Farmer-centered organizations must make sure that smallholder farmers can obtain the information and inputs they require from agricultural aid programs in order to make better decisions. Such farmer-focused assistance may need to include at least five primary elements: 1) technical support and training; 2) marketing and promotion; 3) market access; 4) capacity building and business development; and 5) environmental preservation.

With the aid of "digitally enabled" agri-technologies, communities all over the world are making the transition to digital agriculture. It might be challenging for extension workers to obtain data or get in touch with recipients in rural areas of Nigeria and other developing nations because there is sometimes little or no internet connection there. In order to best inform a better policy, we believe that deliberate survey can be a potent tool for extension workers in rural areas since they can gather crucial feedback about beneficiary requirements, pinpoint areas where extension services can be improved, and assess impact.

They can also encourage stakeholder involvement in interventions, policies, programs, and investments, which may result in better decisions. They can be used to assess the impacts of extension services, by measuring program outcomes or changes in the beneficiary's knowledge, attitudes, and behaviors, and to address the gaps in the knowledge and skills of extension workers. Extension workers can use the information gathered through deliberative surveys to conduct periodic assessments of their programs and adjust as needed.

5.3 Limitation of the Research

The number of respondents from each farming community was predetermined (n=30), which is one of the drawbacks of this study. This is due to the difficulty in estimating the number of persistent farmers who actually live in each village and how comparable their population is to that of other areas. There were no cluster farms accessible, according to the researchers' inquiries, to conduct a cluster farming effect assessment using observation, interviews, or any other method that might be feasible. The lack of experimental cluster farms or even cluster markets may make the concept appear very dated, abstract, and unattainable to some readers. Another important limitation is that we could not easily gain access to the main policy makers in the state in order for them to participate and respond to the question about cluster farming being a good strategy for government and organizations to apportion resources to smallholder farmers. Instead, we relied on the same smallholder farmers to respond based on their experience in various support programs that they might have missed or participated in.

5.4 Suggestions for Further Research

It is advised that future study on cluster farming utilize a randomized controlled trial experiment. This would enable a thorough assessment of the concept's influence and the measurement of the variations in outcome in each community, local government, and state government area across the nation. Researchers should prioritize adopting the deliberative survey approach instead of the traditional survey method, which is primarily employed by agricultural extension agents and enumerators, to obtain more structured and focused responses. Through deliberative survey, insights into what works best for which farmers and how to enhance the system using a knowledge-based approach would also be provided.

References

1. Adela, A., Nekir, B., & AA, E. (2022). Assessments of the current agricultural extension systems and recommended for interventions in gurage zone ethiopia.
2. African Harvesters. (2020, November 2). The role of cluster farming for sustainable food security in Africa. Retrieved September 5, 2022, from https://africanharvesters.com/2020/11/02/the-role-of-cluster-farming-for-sustainable food-security-in-africa/
3. Aina, L. O. (1990). Information Africa Farmers; some obstacles to information flow. Information Development. *6*(4) 201 – 205.
4. Andersson, H., Larsén, K., Lagerkvist, C.J., Andersson, C., Blad, F. and Samuelson, J. (2005). Farm Cooperation to Improve Sustainability. Ambio, *34*(4/5), 383-387.
5. Arias, P., Hallam, D., Krivonos, E., & Morrison, J. (2013). Smallholder integration in changing food markets. FAO: Rome, Italy.
6. Axalan, J. T., F. T. Israel, S. B. Concepcion, P. J. Batt, R. Murray-Prior, and L. Loma (2011). "Socio-Economic Impact of Cluster Marketing: The Case of Ned Land Care Association Sweet Pepper Cluster." Acta Hort (ISHS) 895:37-44. http://www.actahort.org/books/895/895_4.htm.
7. Bamiduro, J.A. and A.G. Rotimi, 2011. Small scale farming and agricultural product marketing for sustainable poverty alleviation in Nigeria. Open Journal System. Home, vol. 7(3).
8. Barahona, C., Levy, S., 2003. How to Generate Statistics and Influence Policy Using Participatory Methods in Research: Reflections on Work in Malawi, 1999-2002. IDS Working Paper 212. IDS, Brighton.

9. Batt, P. J., Concepcion, S. B., Murray-Prior, R. B., & Israel, F. T. (2010, August). Experiences in linking smallholder vegetable farmers to the emerging institutional market in the Philippines. In *XXVIII International Horticultural Congress on Science and Horticulture for People (IHC2010): International Symposium on 921* (pp. 57-63).

10. Bembridge, T. M. 2000. Guidelines for rehabilitation of small-scale farmer irrigation schemes in South Africa. WRC report No 891/1/00. Pretoria: sWater Research Commission.

11. Berg, H., Ekman Söderholm, A., Söderström, AS. *et al.* Recognizing wetland ecosystem services for sustainable rice farming in the Mekong Delta, Vietnam. *Sustain Sci* **12**, 137–154 (2017). https://doi.org/10.1007/s11625-016-0409-x.

12. Bernat, G. A., Jr. (1999). Industry clusters and rural labor markets. Southern Rural Sociology, 15(1): 170-187.

13. Boahene K, Snijders TA, Folmer H (1999) An integrated socioeconomic analysis of innovation adoption: the case of hybrid cocoa in Ghana. J Policy Model 21:167–184

14. Brasier, K. J., Goetz, S., Smith, L. A., Ames, M., Green, J., Kelsey, T., ... & Whitmer, W. (2007). Small farm clusters and pathways to rural community sustainability. *Community Development*, *38*(3), 8-22.

15. Brown, O., and Sander, C. (2007). Supermarket Buying Power: Global Supply Chains and Smallholder Farmers (International Institute for Sustainable Development).

16. Che, D., Veeck, A., & Veeck, G. (2005). Sustaining production and strengthening the agritourism product: Linkages among Michigan agritourism destinations. Agriculture and Human Values, 22(2), 225–234. http://dx.doi.org/10.1007/s10460-004-8282-0

17. Chen, H. H. (1992): Small-Farm Problems and Group Farming in Taiwan. Industry of Free China 77(5), 33–42.

18. Chowa, C., Garforth, C., & Cardey, S. (2013). Farmer Experience of Pluralistic Agricultural Extension, Malawi. Journal of Agricultural Education and Extension, 19(2), 147–166. https://doi.org/10.1080/1389224X.2012.735620.

19. Coles, C., Mitchell, J. 2011. Working together horizontal coordination as an upgrading strategy. In: Mitchell, J., Coles, C. (Eds.), Markets and Rural Poverty: Upgrading in Value Chains. Earth scan, Washington DC, pp. 1–20.

20. Conley TG, Udry CR (2010) Learning about a new technology: pineapple in Ghana. Am Econ Rev 100(1):35–69.

21. Cromwell, E. 1990. Seed diffusion mechanisms in small farmer communities: Lessons from Asia, Africa, and Latin America. Network Paper 21, Agricultural Administration (Research and Extension) Network. London, UK: Overseas Development Institute (ODI).

22. CRS-Philippines. 2007. The Clustering Approach to Agroenterprise Development for Small Farmers: The CRS- Philippines Experience. A Guidebook for Facilitators. Davao City, Philippines.

23. Czerniawski, R.D. (1986). Cluster Marketing: An Alternative Approach to Marketing Planning and Implementation. Journal of Consumer Marketing, 3 (Spring), 81-86.

24. Dania, W. A. P., Xing, K., & Amer, Y. (2018). Collaboration behavioural factors for sustainable agri-food supply chains: A systematic review. Journal of Cleaner Production, 186, 851–864. doi:10.1016/j.jclepro.2018.03.148.

25. Diao, X., Hazell, P., & Thurlow, J. (2010). The role of agriculture in African development. *World development*, *38*(10), 1375-1383.

26. Diekmann, F., C. Loibl, and M. T. Batte. (2009). "The Economics of Agricultural Information: Factors Affecting Commercial Farmers' Information Strategies in Ohio." *Review of Agricultural Economics* 31 (4): 853–872.

27. Dorward, A, Kydd, J, Morrison, J & Poulton, C, 2005. Institutions, markets and economic development: Linking development policy to theory and praxis. Development and Change 36(1), 1–25.

28. Ebarle, E. J. N., Sarmiento, J. M. P., Aguinaldo, R. T., Concepcion, S. B., Montiflor, M. O., Real, R. R., & Bacus, R. H. (2014, August). Analysing the factors affecting the profitability of vegetable farmer clusters in Southern Philippines. In *XXIX International Horticultural Congress on Horticulture: Sustaining Lives, Livelihoods and Landscapes (IHC2014): XVII 1103* (pp. 115-120).

29. Ezekiel, O (2017). Mechanization for smallholder farming: an indispensable tool for economic diversification.

30. FAO, 2011b. *The State of Food and Agriculture 2010-2011: Women in Agriculture – Closing the Gender Gap for Development*. Food and Agriculture Organization of the United Nations. Rome, Italy. Available at: http://www.fao.org/docrep/013/i2050e/i2050e.pdf.

31. Galeski, B. 1987. The models of collective farming. In: Dorner, P. (Ed.). Cooperative and commune: group farming in the economic development of agriculture: 1987. New York: University of Wisconsin Press: 17-42.

32. Goetz, S. J., M. Shields, and Q. (Cindy) Wang. (2004). Agricultural and Food Industry Clusters in the Northeast U.S.: Technical Report. Regional Rural Development Paper No. 26. The Northeast Regional Center for Rural Development, College of Agricultural Sciences. The Pennsylvania State University, University Park, PA.

33. Gulati A., N. Minot, C. Delgado, and S. Bora. 2007. Growth in high-value agriculture in Asia and the emergence of vertical links with farmers. In (Global Supply chains, standards and the poor: how the globalization of food systems and standards affects rural development and poverty, ed. Swinnen, J.F.M pp. 91-108. Oxford, England: CABI.

34. Hamprecht, J., Corsten, D., Noll, M., & Meier, E. (2005). Controlling the sustainability of food supply chains. Supply Chain Management, 10(1), 7–10. https://doi.org/10.1108/13598540510578315/FULL/XML.

35. Hassanein, N., and J. R. Kloppenburg, Jr. (1995). "Where the Grass Grows Again: Knowledge.

36. Hellin, J., Lundy, M., & Meijer, M. (2009). Farmer organization, collective action and market access in Meso-America. *Food policy*, *34*(1), 16-22.

37. International Fund for Agricultural Development (IFAD), 2009. Key elements for supporting the renewed focus on agricultural productivity and small-scale agricultural development in Nigeria. Insight No. 10, September.

38. Inan, I. H. (1984): Corlu Ilcesi Seymen Köy Kalkinma Kooperatifinde Grup Tariminin Ekonomik Analizi. Türk Kooperatifcilik Kurumu Yayin No. 52, Ankara.

39. Jayne, TS, Govereh, J, Mwavumo, A, Nyoro, JK & Chapoto, A, 2002. False promise or false premise? The experience of food and input market reform in Eastern and Southern Africa. World Development 30(11), 1967–85.

40. Jarrett, J., Morris, C., Wheeler, R. & Winter, M. (2015). Literature review on farming collaboration [research report]. London: DEFRA.

41. Joginder, S., D. K. Grover and S. Prem (1989): Scope of Cooperative Farming in Haryana: a Village Plan Approach. Indian Cooperative Review 26 (3), 319–328.

42. Kabelele, M. M., & Akakandelwa, A. (2015). An Investigation into the Information Needs and Information Seeking Behaviour of Small-Scale Cattle Farmers: A Case of Selected Villages of Katima Mulilo Rural Constituency of Zambezi Region, Namibia. *Journal of Library and Information Science*, 1.

43. Kamara, A., Conteh, A., Rhodes, E. R., & Cooke, R. A. (2019). The relevance of smallholder farming to African agricultural growth and development. *African Journal of Food, Agriculture, Nutrition and Development*, *19*(1), 14043-14065.

44. Karki, L., Shange, R., Hill, W. A., Bonsi, C., English, H., Agbodjan, E., ... & Idassi, J. (2021). Assessing The Impact of Cluster Farming Initiatives on Small and Socially Disadvantaged Farmers, Ranchers, and Forestland Owners: A Case of The Southeastern Region of The United States. *Professional Agricultural Workers Journal*, *7*(2), 26.

45. Kienzle J 2015. Sustainable Intensification of Agriculture-The FAO Save & Grow Approach –Focus Smallholders in Africa. Hanover: 13 November, 2015. Food and Agricultural Organisation of the united Nations (FAO). From (Retrieved on 8 March 2021).

46. Klein, M. (2017). Towards crowd-scale deliberation. *Available at SSRN 2987624*.

47. Komicha, H.H. and Ohlmer, B. (2006), "Effect of credit constraint on production efficiency of farm households in southeastern Ethiopia", Ethiopian Journal of Economics, Vol. 15 No. 19, pp. 1-33.

48. Landemore, H. (2012). Collective wisdom: Old and new. *Collective wisdom: Principles and mechanisms*, 1-20.

49. Lamban, R.J.G., Montiflor, M.O., Real, R.R., Axalan, J.T., Concepcion, S.B., Bacus, R.H., Apara, D.I., Israel, F.T., Batt, P.J., Murray-Prior, R.B., and Rola-Rubzen, M.F. (2013). Marketing benefits derived from

clustering: the case of vegetable clusters in Mindanao. Acta Hortic. 1006, 203–208 http://dx.doi.org/10.17660/ ActaHortic.2013.1006.24.

50. Le Coq, J. F., Trébuil, G., & Dufumier, M. (2004). History of rice production in the Mekong Delta. In *Smallholders and Stockbreeders* (pp. 163-185). Brill.
51. Llones, C. A., & Suwanmaneepong, S. (2021, November). The role of engagement among farmers in developing farming knowledge: evidence from northern Thailand. In *IOP Conference Series: Earth and Environmental Science* (Vol. 892, No. 1, p. 012043). IOP Publishing.
52. Leimeister, J. M. (2010). Collective intelligence. *Business & Information Systems Engineering*, *2*(4), 245-248.
53. Lorencowicz, E., Uziak, J. (2013). Farmers Collaboration – a Factor in the Development ff Sustainable Agriculture. In Lorencowicz, E., Uziak, J. & Huygheboert, B., eds., Farm Machinery and Processes Management in Sustainable Agriculture (pp. 139–142). Lublin: University of Life Sciences.
54. Lwoga, E.T., 2010, 'Bridging the agricultural knowledge and information divide: The case of selected telecenters and rural radio in Tanzania', Electronic Journal on Information Systems in Developing Countries 43(6), 1–14.
55. Lyon F (2000) Trust, networks and norms: the creation of social capital in agricultural economies in Ghana. World Dev 28:663–681
56. Mahida, P. J., Lende, S. R., Shrivastava, V., Jha, A. K., & Yusufzai, S. I. 2014. Cooperative and Cluster Farming. *INDIAN FARMER*, 134.

57. Mayende, G. 2004. The challenge of land tenure reform in South Africa. In: ROTH et al. (Ed.). Finding solution and securing rights: 2004 National Land Tenure Conference organised by the Department of Land Affairs, Pretoria. Durban: Butterworths: 46-63.

58. Mendoza, L. (2006). The Experiences of CRS in Clustering, Presented during the 3rd Mindanao Vegetable Congress, Cagayan de Oro City, Philippines 25-26, 2006.

59. Meyer, C. A. (1990): A Hierarchy Model of Associative Farming. Journal of Development Economics 34 (1/2), 371–383.

60. Mgbenka, R.N. and A.E. Agwu, 2011. Communication platforms existing among research, extension and farmers in Abia and Enugu States of Nigeria. A pre-Ph. D research seminar, Department of Agricultural Extension, University of Nigeria, Nsukka.

61. Mgbenka, R. N., Mbah, E. N., & Ezeano, C. I. (2016). A review of smallholder farming in Nigeria: Need for transformation. *International Journal of Agricultural Extension and Rur*al Development Studies, 3(2), 43-54.

62. Mgbenka, Regina & Igbokwe, Edwin & Mbah, Evangeline & Ike, Ezeano & Onah, O. (2016). Strength of Linkages among Local Governments, Farmers and Agricultural Development Agencies. 34. 1090-1102. 10.5829/idosi.wasj.2016.34.8.15686.

63. Montiflor, M. O., P. J. Batt and R. Murray-Prior (2015). Socio-Economic Impact of Cluster Farming for Smallholder Farmers in Southern Philippines. Curtin University of Technology, GPO Box U1987, Perth WA 6845, Australia. https://www.researchgate.net/publication/47639663_Socioeconomic_impact_of_cluster_farming_for_smallholder_farmers_in_Southern_Philippines.

64. Montiflor, M.O., Batt, P.J., and Murray-Prior, R. (2008). Cluster farms in Mindanao: are smallholder farmers' expectations being fulfilled? Banwa 8, 39–54.

65. Montiflor, M. O. (2007, September). Cluster farming as a vegetable marketing strategy: the case of smallholder farmers in southern and northern Mindanao. In *II International Symposium on Improving the Performance of Supply Chains in the Transitional Economies 794* (pp. 229-238).

66. Mtega, W. P., Ngoepe, M., & Dube, L. (2016). Factors influencing access to agricultural knowledge: The case of smallholder rice farmers in the Kilombero district of Tanzania. *South African Journal of Information Management*, *18*(1), 1-8.

67. Mudhara M 2010. Agrarian Transformation In Smallholder Agriculture In South Africa: A Diagnosis Of Bottlenecks And Public Policy Options. In: Conference Paper Presented at Overcoming Structural Poverty And Inequality In South Africa: Towards Inclusive Growth And Development, Johannesburg, 20-22 September 2010, P. 20.

68. Murray-Prior, R. (2008). Are farmers in the transitional economies likely to benefit from forming collaborative marketing groups? Banwa - The Academic Journal of the University of the Philippines Mindanao *5* (*2*), 10–21.

69. Naik, G. and V. Nagadevara (2010). Spatial Clusters in Organic Farming–A Case Study of Pulses Cultivation in Karnataka (Working Paper No. 316). https://www.researchgate.net/publication/256029842_Spatial_Clusters_in_Organic_Farming_-_A_Case_Study_of_Pulses_Cultivation_in_Karnataka.

70. Nonaka, I., Toyama, R. & Konno, N. 2000, 'SECI, ba and leadership: A unified model of dynamic knowledge creation', Long Range Planning 33, 5–34.

71. Oakeshott, J. A. (2016, November). Sustainable smallholder farming clusters in the Philippines. In *International Symposia on Tropical and Temperate Horticulture-ISTTH2016 1205* (pp. 109-116).

72. Okuneye, P. A. (1984). A critique of the Group Farming Policy in Nigeria. *Agricultural Administration*, *16*(2), 67-75.

73. Olatunji, O. A., & Letsoalo, S. S. (2013). Value congruence, the success of group farming in agricultural extension. *South African Journal of Agricultural Extension*, *41*, 26-33.

74. Olushola, F., & Oladimeji, A. (2020). Effects of the psaltry cassava out-grower scheme in enhancing smallholder productivity in Oke-Ogun Area of Oyo State, Nigeria. *Journal of Agricultural Extension*, *24*(4), 137-150.

75. Oni, K.C. (2008). Transforming Agricultural Potentials to Wealth in Northern Nigeria. Invited Paper Presented at the Northern Nigerian Economic and Investment Summit (NEIS), Abuja, October 2008.

76. Opara, S., 2011. Exploring lifeline in small-scale farming. NBF Topics.

77. Oyeyinka, R. A., Ayansina, S., & Adamu, C. (2012). Effect of farmers organization on agricultural technologies development in Afijio local Government areas of Oyo State, Nigeria. *OIDA International Journal of Sustainable Development*, *5*(11), 43-50.

78. Ozowa, V. N. (1995): information Needs of Small-Scale Farmers in Africa; The Nigeria Example, Quarterly Bulletin of the Association of Agricultural Information Specialists. 40(1): 1 – 3.

79. Prager, K. (2015). Agri-environmental collaboratives for landscape management in Europe. Current Opinion in Environmental Sustainability, 12, 59–66. DOI: 10.1016/j.cosust.2014.10.009.

80. Proctor, F.J., and Vorley, B. (2008). Innovation in business models and chainwide learning for market inclusion of smallholder producers. Banwa - The Academic Journal of the University of the Philippines Mindanao *5* (*2*), 22–38.

81. Rapsomanikis, G. (2015). The economic lives of smallholder farmers: An analysis based on household data from nine countries. Food and Agriculture Organization of the United Nations, Rome.

82. Real, R.R., Concepcion, S.B., Montiflor, M.O., Axalan, J.T., Lamban R.J.G., Apara, D.I., Israel, F.T., Bacus, R.H., Batt, P.J., Murray-Prior, R.B., and Rola-Rubzen, M.F. (2013). Impact of collaborative marketing on vegetable production systems: the case of clustering in the Southern Philippines. Acta Hortic. 1006, 303–308 http://dx.doi.org/10.17660/ActaHortic.2013.1006.38.

83. Reardon, T., and Berdegue, J.A. (2008). The Retail-Led Transformation of Agrifood Systems and its Implications for Development Policies. Washington D.C.: World Bank. https://openknowledge.worldbank.org/handle/ 10986/9233

84. Rola-Rubzen, M.F., Murray-Prior, R.P.J.B., Concepcion, S.B., Real, R.R., Lamban, J.G., and Bacus, R.H. (2012). Impacts of clustering of vegetable farmers in The Philippines. Paper presented at: Smallholder HOPES - Horticulture, People and Soil (Cebu, The Philippines).

85. Rutz, D., & Zingerli, C. (2009). Interrelating knowledge processes with institutional and cultural contexts in organic rice farming: insights from integrated rice and duck farming in the Hongdong community of South Korea. *Rural Development News*, (1/2009), 23-29.

86. Sabo, B. B., Isah, S. D., Chamo, A. M., & Rabiu, M. A. (2017). Role of smallholder farmers in Nigeria's food security. *Scholarly Journal of Agricultural Science*, *7*(1), 1-5.

87. Schiller, S. R., Gonzalez, C., & Flanigan, S. (2014). More than just a factor in transition processes? The role of collaboration in agriculture. Transition Pathways towards Sustainability in European Agriculture; CABI International: Oxfordshire, UK, 83-96.

88. Shepherd, A.W., and Cadilhon, J.J. (2008). Commodity associations and their potential role in supply chain development. Banwa - The Academic Journal of the University of the Philippines Mindanao *5* (*2*), 90–114.

89. Shiferaw, B., Obare, G., Muricho, G., & Silim, S. (2009). Leveraging institutions for collective action to improve markets for smallholder producers in less-favored areas. *African Journal of Agricultural and Resource Economics*, *3*(1), 1-18.

90. Shukla, R., Parmar, G., Sharma, S., Leua, A., & Chaudhari, B. (2019). Cluster Farming Strategy for Market Access: Smallholder Vegetable Farmers' Perception and Constraints. *Emerging Issues in Agribusiness Management in India*, 49.

91. Sims, B. G., R. Ventot and A. Rivera (1993): Cooperatives as a Solution to Small Farm Mechanization Problems in Cuba. Agricultural Mechanization in Asia, Africa and Latin America, 24 (4), 63–68.

92. Srinath, K., Sridhar, M., Kartha, P. N. R. & Mohanan, A. N. 2000. Group farming for sustainable aquaculture. Ocean and Coastal Management, 43: 557-571.

93. Starr, A., Card, A., Benepe, C., Auld, G., Lamm, D., Smith, K., & Wilken, K. (2003). Sustaining local agriculture: Barriers and opportunities to direct marketing between farms and restaurants in Colorado. Agriculture and Human Values, 20(3), 301–321. http://dx.doi.org/10.1023/A:1026169122326

94. Sutherland, L. A., Darnhofer, I., Wilson, G. & Zagata, L. (2015). Transition Pathways Towards sustainability in Agriculture: Case Studies From Europe. Wallingford: CABI. DOI: 10.1079/9781780642192.0000.

95. Sulewski, P., Kłoczko-Gajewska, A. & Sroka, W. (2018). Relations between Agri-Environmental, Economic and Social Dimensions of Farms' Sustainability. Sustainability, 10, 4629. DOI: 10.3390/su10124629.

96. Teresa Serra, Elena Poli, Shadow prices of social capital in rural India, a nonparametric approach, European Journal of Operational Research, Volume 240, Issue 3, 2015, Pages 892-903, ISSN 0377-2217, https://doi.org/10.1016/j.ejor.2014.08.019.

97. Umesh, N.R. *et al.* (2010). Shrimp Farmers in India: Empowering Small-Scale Farmers through a Cluster-Based Approach. In: De Silva, S.S., Davy, F.B. (eds) Success Stories in Asian Aquaculture. Springer, Dordrecht. https://doi.org/10.1007/978-90-481-3087-0_3

98. Uy, J.C. (2005). Cluster Farming: The NorMin Veggies Experience, presented during the 2nd Mindanao Vegetable Congress, Davao City, Philippines 17-19 August 2005.

99. Varawa, J, T. Pickering, A. Singh and S. Singh (2014). Small Farmer Groups (Farm Clusters) as a Strategy to Up-Scale Tilapia Fish Farm Production in Fiji Islands. Secretariat of the Pacific Community, Fiji and Fiji Ministry of Fisheries and Forests. file:///C:/Users/Tuskegee%20University/Desktop/MYTU/DeanHill/Impact_Cluster/Manscript/WA2014_0811_fish.pdf.

100. Vo, H. V., Dang, N. K., Le, T. N., & Tran, B. T. (2013). Assessment of a farmer base network in promoting an integrated farming system at the Mekong delta in Vietnam. *Asian Journal of Agriculture and Development*, *10*(1362-2016-107719), 39-58.

101. Vogt, R. A., & Kaiser, L. L. (2008). Still a time to act: A review of institutional marketing of regionally grown food. Agriculture and Human Values, 25(2), 241–255. http://dx.doi.org/10.1007/s10460-007-9106-9.

102. Washim, M. R., Kamal, M., Hoque, M. A., & Yasmin, R. (2015). The impact of cluster farming approach in simplification of shrimp (Penaeus monodon) marketing channel of Paikgachha Upazila. European Journal of Business and Management, 2(8), 3953-3956.

103. Watson, B. (2008). How to Assist the Small-Scale Farmer. *International Assessment of Agriculture Science and Technology for*.

104. Winter-Nelson, A & Temu, A, 2002. Institutional adjustment and transaction costs: Product and input markets in the Tanzania coffee system. World Development 30(4), 561– 74.

105. Woolley, A. W., Aggarwal, I., & Malone, T. W. (2015). Collective intelligence and group performance. *Current Directions in Psychological Science*, *24*(6), 420-424.

106. World Bank, 2002. World development report 2002: Building institutions for markets. Oxford University Press, New York.

107. Zuberu, E., Ari, M. A., & Iliya, B. (2019). Effect of agriculture financing on agriculture productivity in Nigeria. *International Journal for Innovative Research in Multidisciplinary Field*, *5*(7), 104-15.