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Master's Thesis

IMPACT OF COOPERATIVES AND FBOs ON COCOA FARMERS' PRODUCTIVITY AND ADOPTION OF ADDITIONAL LIVELIHOOD STRATEGIES IN GHANA

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Declaration

I, Emmanuel Dela Amegbe, hereby declare that this master thesis entitled; Impact of Cooperatives and FBOs on Cocoa Farmers' Productivity and Adoption of Additional Livelihood Strategies in Ghana, submitted to The Faculty of Tropical Agrisciences (FTA-CZU) for the master's degree in International Development and Agricultural Economics, is my original work and has not been submitted, either in part or in full, for any other degree or academic award. All sources of information used in this thesis, including but not limited to written, electronic, or personal communication, have been acknowledged and appropriately cited. Any assistance received in the research and writing of this thesis has been fully acknowledged as per FTA citation rules.

Emmanuel Dela Amegbe

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Abstract

Ahafo-Ano South West district of is one of the most densely populated cocoa growing areas in Ghana. Comprising of relatively small farms and a diverse combination of inhabitants, the district thrives in farming activities. Cocoa farming continues to be lucrative especially with the existing governmental and non-governmental organizations supporting cocoa cooperatives and other farmer-based organizations (FBOs) with inputs, extension and credit facilities. The EU, West African cocoa producers and other stakeholders have established policies to enhance the economic, social and environmental sustainability of the trade through cooperative activities. Support of the institutional capacity of producer groups seems to be one of the instruments for the empowerment of the farmers.

Evaluation of the impact of cooperatives, particularly on smallholder farmers, is crucial given the growing cooperative and FBO activities in cocoa sector of Ghana as a whole. Therefore, the study's primary goal was to examine how membership in a cooperative or farmer group affects additional livelihood adoption and productivity of cocoa farms. Through this, the contribution of cooperatives towards rural development and poverty reduction was clearly established.

219 cooperative/FBO members and 197 non-group members were sampled from the district for this study. The majority of farmers; 211 out of 219 (cooperative/FBO members) and 84 out of 197 (non-members) had adopted an additional livelihood strategy. The Inverse Probability Weighted Regression Adjusted and Propensity Score-Matching methods were used to estimate the treatment effect on the treated.

The results show that cooperative membership indeed had an influence on adoption of additional livelihood strategies. Further analysis into other factors that influence adoption proved that perception about ALS and knowledge about climate change had a positive influence. On the other hand, household size and access to information had a negative impact on adoption. Cooperative membership was also found to have a significant positive influence on the productivity of smallholder farmers in the region. Other factors that influenced productivity positively were; household size, farming experience, fertilizer application and extension services received by farmers. Age and farm size however had a negative impact on productivity. Findings from this study will inform policies in farmer intervention programs by stakeholders.

Keywords: Collective action, Social capital, Income diversification, Sustainable production, Poverty alleviation, Treatment effects, PSM, IPWRA

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1. INTRODUCTION

Cocoa provides a very important source of foreign exchange for developing countries and offers a good source of employment and livelihood for a large portion of the population (Huellen & Abubakar 2021). Cocoa production is largely dominated by poor rural producers (about 95% globally) and contributes significantly to the livelihoods of about 40 to 50 million people all around the world (Nelson et al. 2013). According to International Cocoa Organization (2021), small-scale farmers account for over 90% of global cocoa production, with the majority of these farmers located in West Africa.

The production and export of cocoa has traditionally dominated the Ghanaian economy (Kolavalli & Vigneri 2020). Today Ghana is one of the world's leading exporters of cocoa according to the World Bank (2022). According to the International Cocoa Organization (2021), Ghana produced over 900,000 metric tons of cocoa beans in the 2020/2021 crop year, making it the second-largest producer of cocoa in the world after their French neighbors (Cote d'Ivoire). Cocoa production accounts for a significant portion of Ghana's gross domestic products (GDP) and employs over 800,000 smallholder farmers and their families (Nkonya et al. 2021). In Ghana, a third of the population depends on cocoa as their main source of income (Bangmarigu 2019). Other natural resources like timber, gold, diamonds, bauxite, manganese and oil are also present in the country and puts Ghana in the top when considering wealthy nations in Africa (FAO 2014; Adabor et al. 2020).

In order to improve sustainable production, it is necessary to maintain the welfare and wellbeing of the primary producers given the significance of cocoa to Ghana's economy and the livelihoods of millions of Ghanaians (Asamoah et al. 2013). The ability of cocoa producers to generate high revenues is impacted by a number of factors. Most cocoa growers run modest plantations with 2 to 5 hectares of land (ICI 2017). Given the size of their small farms, yields are often low, averaging 0.42 tonnes per hectare (ICI 2017). According to Somarriba & Beer (2011), cocoa yield or productivity in Ghana is the least among all competitive cocoa producers in the world. For example, Southeast Asian cocoa yield is approximately 1000kg per hectare, Malaysian cocoa yield is 1800 kg/ha, and 800 kg/ha in Ivory Coast, whiles Ghana produces 300-400 kg/ha (Suh & Molua 2022). Besides the size of farms, other reasons for the low productivity includes poor farm maintenance practices, planting low-yielding varieties, and the incidence of pests and diseases according to Dormon et al. (2004) and Suh et al. (2022). Poor farm

maintenance practices could also be attributed to the lack of knowledge in new methods of smart farming and agriculture as a whole (Dormon et al. 2004; Nugussie 2010; Suh & Molua 2022). A significant challenge again is the aging cocoa trees, which reduces yield and makes trees more susceptible to diseases (Bateman 2015; Mahob et al. 2015; Wessel & Quist-Wessel 2015; Ma & Abdulai 2019). Lack of investment in infrastructure and farming methods that are more productive and efficient for cocoa production is another issue. Additionally, the production of cocoa in Ghana faces major difficulties due to climate change and shifting prices in the worldwide market (Ameyaw et al. 2014; Agyeman-Boaten & Fumey 2021). New emphasis is now on research into drought and disease resistant seeds and the use of agrochemicals. Though this has led to an increase in yield in recent years especially due to hybrid cocoa seedlings widely adopted by farmers, productivity is still generally low (Wessel & Quist-Wessel 2015; Amponsah-Doku et al. 2022).

Cocoa business for some decades now has attracted a lot of attention from various stakeholders (Mugendi et al. 2015; Iddrisu et al. 2020). Improvement in farmers' standard of living has been a hot topic in recent years following the inception of the 17 sustainable development goals (SDGs) by the United Nations in 2015. Giant chocolatiers worldwide; Mars, Toms, Hershey, Ferrero, Mondelez and Nestle have shown keen interest and commitment towards poverty alleviation and a sustainable cocoa sector considering climate change and its adverse effects (Iddrisu et al. 2020). This is reflected in the increased commitment towards support for smallholder farmers in cooperatives and other well-structured farmer associations. Efforts of support to enhance productivity take the form of extension, credit facilities and input supply for smallholder farmer associations and/or cooperatives.

The European Union in collaboration with West African producers have also initiated various strategies to enhance sustainable cocoa production (EU and West African producers, 2022). At the 'Cocoa Talks', stakeholders jointly endorsed the *Alliance on Sustainable Cocoa*; an ambitious roadmap to improve the economic, social and environmental sustainability of cocoa production and trade. The aim of the agreement is generally to stop deforestation, child labor and to improve the living standard of producers (smallholder farmers). The EU has made significant financial commitment towards these goals. For example, in Ghana, the cocoa sector has benefited up to €12 million and a program in support of green transition, agribusiness and cocoa production. These efforts are also targeted at enhancing the cocoa supply chain and ensuring that

especially smallholder farmers living below the poverty line get better prices. In order to support smallholder farmers, diversified sources of income are also encouraged in the joint endorsement for additional income generation.

A cooperative is a group of people who come together with a common interest to achieve a common goal. In the Ghanaian cocoa industry, cooperatives and other farmer-based organizations (FBOs) are a vibrant part of the cocoa business. Cooperatives and Farmer-based organizations (FBOs) are significant groups that create an avenue for various smallholder farmers to receive incentives and support from the government and other stakeholders. Cooperatives help to improve production, marketing and the overall livelihood of farmers (Bernard et al. 2010; Candemir et al. 2021). According to Fischer & Qaim (2012); Arias et al. (2013), with the changing technology and innovations in the global markets, cooperatives will be the only establishments with the ability to provide sustainable opportunities for smallholder farmers by serving as a stage for building capacity, exchanging information and innovation in rural areas. FBOs function similar to cooperatives but do not necessarily fulfill all the cooperative principles under the International Cooperative Alliance (ICA 2020). FBOs are less democratic and mostly controlled by NGOs and/or cocoa buying companies who usually set up these groups for easy transaction, identification of members and/or for certification purposes. For the purpose of this study, cooperatives and FBOs are considered the same as they both provide the same services and benefits for farmers. The only major differences however is that FBOs are not legally registered, members have no financial commitment and there is no budget and finance management by the group.

Research on the impact of agricultural cooperatives and/FBOs on farm productivity, price and household welfare (Ahmed & Mesfin 2017; Wassie et al. 2019; Zhang et al. 2020), farm inputs (Abate et al. 2013; Francesconi 2014; Candemir et al. 2021) and farmers' adoption of new technologies (Abebaw & Haile 2013; Ma & Abdulai 2016) in developing countries have been widely explored. In China, empirical results showed that cooperative membership have a positive impact not only on rice total factor productivity but also on total factor productivity change, technical change and technical efficiency change (Lin et al. 2022). In Astrid Fenger et al. (2017), RA/UTZ certified farmer groups (FBOs) significantly increased yield and incomes of members. This positive impact was because of credit support, delivery of information and knowledge, technical assistance and increased access to farm inputs. Generally, agricultural cooperatives and

farmer associations demonstrate potential to improvement in farmers' productivity and overall wellbeing. Zhang et al. (2020) also found that although cooperatives enhance productivity and general adoption of new technologies, it did not influence adoption of new technologies in China.

There is a lot of potential for the Ghanaian cocoa industry to be explored through organization and cooperation of smallholder farmers. The government, European Union and other companies and organizations have developed strategies to support farmers in the form of extension, credit and input supply to enhance production through cooperatives and farmer associations. However, not much research is done to determine the impact of these cooperatives on the productivity of cocoa farmers and how belonging to the group influences their adoption of additional livelihood strategies (ALS) as a diverse source of income. This study therefore seeks to bridge the knowledge gap and contribute to literature.

The rest of the chapters of this study has; literature review which describes in detail the history and present status of cocoa production in Ghana, the role of cooperatives in reducing transaction cost, principles and determinants of participation in cooperatives as well as benefits of cooperative or farmer group membership. Additional livelihood strategies as a means of improving living standards of smallholder farmers is also discussed in terms of determinants of adoption and benefits to be attained. The main objectives of the study, methodology, data collection approach, results, discussion, conclusion and recommendations follow accordingly in the next chapters.

2. LITERATURE REVIEW

2.1 History of cocoa production in Ghana

Successful introduction of cocoa (*Theobroma cacao*) to Ghana was around 1876, by Tetteh Quarshie from Fernando Pó (now Bioko in Equatorial Guinea) after a few attempts to cultivate cocoa in the country had failed (Leiter & Harding 2004). The first trees were planted in the southeastern part and progressively shifted to the western part of Ghana (Monastyrnaya et al. 2016).

In 1920, Ghana became one of the first cocoa producing countries and as at 1930 recorded around 40% of the global production (Aboagye & Bolt 2021). In 1947, the government of Ghana created Cocobod (Cocoa Marketing Board), a company that was solely in charge of the entire cocoa value chain. It enjoyed monopoly over all cocoa produced in the country as it reserved the sole right to buy cocoa beans from producers and sell on the world market. Between 1970 and 1980, production dipped when the government decided to increase taxations and expulse thousands of foreigners; who were for the majority employed in cocoa fields. Production then fell from 591,000 tons in 1964 to 159,000 in 1983 (Vigneri & Poku 2012). Due to aging trees, widespread disease, drought, low producer prices and the alleged smuggling of exportable beans into Côte d'Ivoire, Ghana saw its lowest level of production between 1983 and 1984 (Vigneri & Poku 2012; Kolavalli & Vigneri 2020).

In the 1990s, the country decided to semi-liberalize the cocoa sector. Although the reform partly meant to dissolve Cocobod, the government maintained it even against recommendations from International Monetary Fund (IMF) and World Bank to dissolve it (Ofosu-Asare 2018). The resulting system of partial liberalization, which is still in operation today however ensured that Cocobod lost its monopsony and private licensed buying companies (LBCs) could now buy cocoa alongside Cocobod from producers. Ghana's partial liberalization has contributed to the revitalization of its cocoa sector and cocoa producers benefit from competition put up by licensed buying companies (LBCs). LBCs have gained a significant market share so far due to credit services and instant cash payments for cocoa beans, which has come to replace the deferred payment system of Cocobod (Ofosu-Asare 2018).

In the past decade, Cocobod begun to put in place different programs to sustain farmers' productivity through crop protection programs and a fertilizer subsidies (Ofosu-Asare 2018). For some time, cocoa production was relatively profitable as productivity increased (Ingram et al. 2014). Other initiatives included extension services, cocoa rehabilitation programs, mass spraying programs and construction of cocoa roads in rural areas to ensure easy transportation of cocoa beans (Kolavalli & Vigneri 2020). With support from LBCs and other stakeholders, the government embarked on these activities to ensure good productivity and sustainable development of the cocoa industry. Cooperatives and FBOs were also encouraged for effective and efficient dissemination of these support services offered by stakeholders.

2.2 **Current cocoa industry in Ghana**

Second to Côte d'Ivoire in global cocoa production, Ghana is a very important industry player as it represents about 20% of global production (700 to 900 000 tonnes annually over the past decade) (Statista 2023). Cocoa makes up 20-25% of the total export receipt (coming second after mineral exports) in Ghana. Presently, cocoa is forecasted to contribute GH¢ 4.01 billion ($533 mill) to GDP in 2025 (Statista 2023). Cocoa is therefore very important to the Ghanaian economy in terms of foreign exchange earnings, employment, livelihoods.

Ghana's cocoa industry is not devoid of challenges. Illegal small-scale gold and/or diamond mining are some of the key challenges faced by the industry; putting pressure on the land use. Short-term with high remuneration land use in the favor of mining is always preferred over long-term with relatively low remuneration (cocoa production) (Boateng et al. 2014). Land degradation, deforestation, loss of biodiversity, weakness of relevant state institutions and apathy of some stakeholders, puts cocoa production in jeopardy and hence the livelihoods that depend on it (Enuoh & Bisong 2014). The industry is also heavily affected by climate change as was elaborated by Boateng et al. (2014). Sustainable development of the industry is dire especially considering the role of the industry in the provision of food, income, employment, raw materials, and foreign exchange for individuals and for the country. There is also the need for diverse sources of income for cocoa farmers because, as the number of cocoa farmers increase, the available land for production reduces in size and quality.

2.3 **Transaction cost economies**

In economics and other related disciplines, a transaction cost is a cost in making any economic trade when participating in a market. Coase (1993) argued that in order for a transaction to take place between a buyer and a seller, there are significant costs that needs to be considered. These costs could include the cost of searching and identifying where to get certain goods and services, cost of transportation, bargaining and decision-making costs, inspection, cost of drafting and enforcing a contract. Hither to Coase, transaction costs were underestimated or completely ignored (Carlton 2020).

Oliver E. Williamson (1995) also defines transaction costs as the costs of running an economic system of companies and unlike production costs, decision-makers determine strategies of companies by measuring transaction costs and production costs. Transaction costs are the total costs of making a transaction, including the cost of planning, deciding, changing plans, resolving disputes and after-sales (Williamson, O., & Masten 1999). Therefore, the transaction cost is one of the most significant factors in business operation and management. Williamson (1995) further analyses transaction costs in three main ways;

1. Bounded rationality: this is related to information collection and processing. It highlights the information asymmetry between buyers and sellers, agents and principal. It points out the fact that both parties to a trade rationally would keep information from the other if they know that the information could affect the value they hold in the trade. This also shows the lack of honesty in human behavior.
2. Opportunism with guile: this is also related to the tendency of humans to capitalize on any given opportunity. This means that, there is a possibility that, one party to in a trade would cheat on the other if an opportunity presented itself. This therefore gives rise to the need for clearly defining, monitoring to protect transactions and enforcing property rights and agreements. All these measures put in place to ensure a transparent transaction poses huge significant costs to the transaction.
3. Asset specificity: this cost also arises when investments are made in assets that can serve a specific function and without the particular function, the asset is rendered useless. This could also be related to specific skill acquisition that is rendered irrelevant if the task for which it is meant is not available anymore. Huge costs are incurred if such assets for some reason loses their relevance and cannot be used for any other function.

In the absence of honesty and goodwill and hence high transaction costs, firms would emerge if an "economizing" organization can reduce its production and transaction costs, making it less than the prevailing market prices (role of cooperatives). Cooperatives have proved to reduce transaction costs significantly through its collectivity. As an institution, cooperatives ensure that there is an access to market and prevailing market information in order to limited information asymmetry between producers and buyers. Cooperatives also have the chance to reduce transaction costs through forward and backward integration. Risk of asset specificity is also possible through shared risks and shared insurance. Various studies point to the fact that agricultural cooperatives as an organization helps to prevent low prices, reduce high cost of inputs, enhance negotiation power and influence better transactions.

Economies of scale is also an important strategy inspired by collective actions to reduce transaction cost (Fischer & Qaim 2012). Transaction cost theory, therefore presents motivation for collectivity and formation of cooperatives especially in the agricultural sector.

2.4 **Principles of cooperatives**

Cooperatives are governed by a set of principles, values and norms that govern the behavior of cooperative organizations. These principles were first established by the International Cooperative Alliance (ICA) in 1844 and have been revised several times since then. In Ghana the Cooperatives Act, 2008 (Act 680)[1] explains registration, duties and privileges, settlement of disputes and other miscellaneous topics that governs cooperatives. This Act is in accordance with the seven principles of the International Cooperative Alliance (ICA). According to the ICA in Manchester 1995, there are seven principles;

1. 1st - Voluntary and open membership.
2. 2nd - Democratic Member Control.
3. 3rd - Member Economic Participation
4. 4th - Autonomy and Independence

[1] The ACT talks mostly about cooperatives and only cautions the use of the name 'Cooperative" for groups that do not qualify as cooperatives. Rules and regulations governing other farmer-based organizations are same as rules for any other group in Ghana formed from common interest. The rules help to promote transparency, accountability and good governance in the organizations just as the purpose of cooperative principles.

5. 5th - Education, Training and Information
6. 6th - Cooperation among Cooperatives
7. 7th - Concern for Community

The International Co-operative Alliance defines a cooperative as "an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically controlled enterprise." In other words, cooperatives are created by people who have a specific need and who are willing to work together to meet that need.

Cooperative were introduced in Ghana in 1928 and has been very successful although has its own challenges (Whitaker et al. 1982). The emergence of agricultural cooperatives and FBOs is extensively viewed as a necessary institutional arrangement that can help farmers in developing countries overcome the constraints that impedes sustainable agricultural production. Cooperatives in Ghana are highly regulated by the government through the Department of Cooperatives (DOC) under Ministry of Employment and Labor Relation (MELR). The regulation of cooperatives was founded in the National Liberation Council Decree (NLCD) 252 of 1968, which was established during a military regime. In Ghana's cocoa industry, cooperatives and/or FBOs are key because the industry is smallholder dominated. According to Cocoa Health and Extension Division (CHED 2019) 512 out of 1,342 cooperatives identified have been fully registered with the Department of Cooperatives. However, numerous FBOs have morphed out of common interests but are not properly documented. A total number of 146,764 smallholder farmers made up of 101,796 cooperative members and 45,068 farmers in transition to cooperatives are recorded by Cocobod (CHED).

2.5 **Role of Cooperatives in cocoa production and rural development**

Frimpong-manso & Bakang (2022) in a study from Ghana identified that cooperatives enhance adoption of good agricultural practices (GAPs) that enhance sustainable production among small-scale farmers. Kehinde (2021) also pointed out that cooperative membership significantly influenced the probability and intensity of adoption of improved technologies in cocoa-based farming system, which were then newly introduced in southwestern Nigeria. These cooperatives and FBOs also make it possible for the smooth running of various certification programs that enhance sustainable production (Astrid Fenger et al. 2017; Astrid et al. 2020).

Agricultural cooperatives and farmer associations also help in alleviating poverty through higher profitability (Bijman & Iliopoulos 2014; Wossen et al. 2017; Ma & Abdulai 2019; Zhang et al. 2020). Zhang et al. (2020) revealed that cooperatives apart from the agronomic education they offer, ensures possibility for farmers to access to inputs, credit, extension services, and markets to boost their income, which cannot be acquired individually. Thus, agricultural cooperatives reduce transaction cost and boosts farmers income (Ma & Abdulai 2019).

Some cocoa farmers over the years have seen their lives impacted positively through cooperatives and farmer associations (Wossen et al. 2017; Iddrisu et al. 2020). In assessing the impact of cooperatives on wellbeing on farmers in Ivory Coast and Ghana by (Calkins & Ngo 2010), it was pointed out that farmers associations have a positive impact on the income, health, and well-being of producers, and these benefits also spread to the surrounding communities. However, the benefits remain unsatisfactory in Ghana as millions of people, especially small-holder farmers and local workers, continue to grapple with economic challenges that a well-organized cooperative sector could mitigate (Amani 2016; Dary & Grashuis 2021).

2.6 **FBOs and other collective actions**

In the late 1980s, state-controlled cooperatives begun to lose popularity, perhaps due to growing global pressure for structural reforms and market liberalization. Subsequent governments in Ghana therefore adopted a liberal approach to the development of cooperatives, allowing other types of rural farmers' self-help organizations to be formed. These groups were generally called farmer-based organizations (FBOs). Through FBOs, buying companies typically appoint purchasing clerks in communities and provide pre-financing for cocoa beans. Members of FBOs do not necessarily have any stake in the organization, as there is no financial commitment needed from members. FBOs provide training and capacity building or additional livelihood avenues for farmers just as cooperatives do. Members of FBOs receive credit, yearly premiums, planting materials. They also benefit from group activities such as mass spraying and other joint farm work activities that enhances their individual and overall productivity.

Collective farmer groups (FBOs) amongst cocoa producers are unique especially in the Ghanaian industry. There are different forms of groups that emerge out of common interests and do not necessarily have any legal identification. Generally, the FBOs are classified into three

main[2] groups based on their primary purposes. The groups are; certified farmer associations (CFAs), non-certified farmer associations (NCFAs) and village savings and loans associations (VSLAs).

Certified farmer associations are farmer groups that are created by licensed buying companies (LBCs) to procure certified cocoa beans from farmers. To create a farmers' association, LBCs undergo sensitization in a new community, introduces their company and explains what they offer besides the full price of cocoa beans. Interested farmers are then registered and a member is chosen from the group as a representative. A credible purchasing clerk and other executives are also elected or appointed from the group. LBCs then provide trainings, input, credit, extension services and other technical support to farmers in order to fulfill certification standards. These farmer associations benefit from trainings that cover good agricultural practices such as integrated pest and crop management and control, climate smart agricultural practices and fair trade that covers good agriculture, environmental and social topics. The main certification standards adopted by the LBCs and their respective farmer associations are the RA/UTZ and Fairtrade. Depending on which certification standard an LBC is compliant to, farmers in the association are audited to test their knowledge and adoption of various good agricultural practices (GAPs), good environmental practices (GEPs) and good social practices (GSPs). If a certified auditor identifies the overall farmer group as compliant, a certificate is then issued to the LBC to procure a given volume of cocoa beans for the next cocoa year, (usually between October and June). Passing through the audit also means that farmers are certified, their cocoa beans are certified and consequently these farmers receive an additional premium[3] for their compliance.

Non-certified farmer associations have a similar mode of establishment as in the case of CFAs but less attention is paid to trainings, input supply, credit etc. These groups exist solely to procure cocoa beans and are not interested in any other additional activities. There is no legal identity of the group just as in the CFAs. These groups exist in areas that are remote and often

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[2] The classification is done by author according to observations made prior to this study and inspired by contributions from key informants from Cocobod (CHED), Ecom (LBC) and MOFA

[3] These premiums are attained from customers abroad who procure cocoa beans for processing. Cocobod receives additional income on beans that are ethically labelled (RA/UTZ, Fairtrade). This income is then distributed to farmers at the end of the cocoa year.

beyond frequent reach of extension agents. Cocoa beans procured by these groups are called conventional cocoa beans. This means that they are not certified; they are not produced by any special standards unlike in the case of CFAs. Although NCFAs do not primarily have any interest in anything else apart from exchanging money for cocoa beans, farmers could come together to perform some tasks together as a group but not necessarily in the name of the association. In recent years, due to the increasing competition in cocoa trade, most non-certified farmer associations are being certified gradually in order to get the extra premium at the end of the year for farmers in order to keep members in the group.

Village savings and loans associations (VSLAs) are also groups formed primarily for savings and loans. Members are mostly cocoa farmers but do not exist in the group for any agronomic reasons.

According to the Cooperatives Act, 2008 (Act 680), the use of the name "cooperative" is not allowed if conditions under the act is not met. Therefore, not all farmer groups and/or associations qualify to be called cooperatives regardless of how similar their functions and roles might be as compared cooperatives. Cocoa cooperatives in Ghana are established in a similar way as CFAs and NCFAs and then registered as under the 1992 constitution. Most cocoa producer cooperatives are set up with the aid from the government through Cocobod. However, some cooperatives that are setup privately enjoy similar benefits as in the case of government cooperatives and CFAs. Similar to certified farmer associations, the government provide trainings, inputs, credit, technical support and other extension services to cooperative members and to certified farmer associations. Every year the government supplies fertilizers and other inputs, farm machinery (knapsacks, mist blowers etc.) and other tools primarily to cooperatives and CFAs. Every time there is a new development to enhance production, the government through extension officers deliver information and trainings to farmers in cooperatives and then train other field officers of various LBCs to deliver to their respective groups. Incentives from the government are not intentionally meant to exclude non-certified farmer associations and/or free ranging farmers. However, the strong platform needed to receive the incentives are just not available for farmers in these groups (NCFAs).

Farmers are free to join one or more groups if they wish (CFAs, NCFAs, VSLAs or Cooperatives). Many farmers who are members of CFAs usually double as members of government cooperatives. Farmers can additionally join VSLAs in order to save or acquire loans

from their groups depending on their needs. For the purpose of this study, cooperative members and CFA members were considered as one group (members) since members of these groups generally receive similar trainings, inputs, technical support and other benefits (treatment). All other cocoa farmers are classified as non-members.

2.7 **Challenges in cooperatives, social capital and commitment**

Cooperatives and farmers associations come with a number of challenges that if not properly managed defeats the purpose of formation. Mentality, trust, negative past experiences, lack of communication, preference for short time gains, lack of managerial and leadership skills, lack of government support and bureaucracy all contribute to the success or failure of any cooperative (Dary & Grashuis 2021; Mutale 2019; Asante-Addo et al. 2020; Nketia-Amponsah et al. 2019).

Cooperatives cannot stand alone in the quest to enhance farmers' livelihoods and ensure food security. The government has a mandate to provide motivation and incentives to cooperatives and farmer associations to ensure its survival. In order to correct the lack of competitiveness of smallholder farmers, various challenges to cooperative efficiency and sustainability must be mitigated.

For a long time, organizational commitment has had diverse definitions from Klein et al. (2019) and Meyer et al. (2006). Two of these definitions which are widely used are also used by Mowday et al. (1979) who defined organizational commitment as "the relative strength of an individual's identification with and involvement in a particular organization". One of the biggest challenges of cooperatives can be linked to the lack of commitment and the free riding (Fulton & Adamowicz 1993). Another popular definition is proposed by Meyer et al. (2006), who define organizational commitment as "a force that binds an individual to a target (social or nonsocial) and to a course of action of relevance to that target". For example, some members do not have the urge to attend cooperative meetings because they perceive trainings as a waste of time. Farmers would only want to be presents for meetings that end up with gifts or presents. During meetings that involve distribution of premiums at the end of the year or distribution of farm inputs and other materials, members come in their numbers. In order to inspire commitment, farmers who are present for the most group meetings could be awarded with farm inputs and other materials. In addition, trainings and other meetings can be made more interesting by

adopting advanced training materials and modules that will instill interest in participation and enhance adoption. In addition, trainers should be trained to deliver relevant subjects that are of interest at the right time for farmers.

2.8 **Factors that influence cooperative participation**

Cooperatives and farmer associations are governed by principles and rules that explains how members may participate. Voluntary membership is a key principle that enables farmers to participate freely or not in any cooperative. Participation is however influenced by a number of factors, some of which may render some farmers as non-members, partial members or full-time members of a cooperative. Factors that influence members of cooperative to participate in a cooperative could be demographic, socioeconomic, institutional or about general perception (Fischer & Qaim 2012).

Demographic factors such as age, gender, education, experience, household size, distance etc. contributes to the active participation of members in a group in a society (Ruiz Jiménez et al. 2010; Cechin et al. 2013; Muthyalu 2013; Fischer & Qaim 2014). Muthyalu (2013) identified that the older one is, the higher his or her chances of participation and vice versa. According to (Gyau et al. 2016) males have a higher chance of participation than females. Interestingly, (Fischer & Qaim 2014) also identified that women have a higher chance of participation than men in cooperatives as women are more dependent and tend to trust in groups more. Cechin et al. (2013), Muthyalu (2013), Fischer & Qaim (2014) and Gyau et al. (2016) all identified that education has a positive significant influence on cooperative active participation as more educated individuals joined cooperatives more than the less educated. This is individuals who are more educated tend to comprehend the impact and the benefits of groups especially for smallholders.

A wide range of studies note that personal and family characteristics have an influence on a farmer's likelihood to be a member of a cooperative or farmer association (Fischer & Qaim 2012;Sumelius 2014; Iddrisu et al. 2020). Farm ownership status and the size of land owned by a farmer also has a significant effect on the likelihood of a farmer in joining a cooperative or farmer group (Zeweld & Huylenbroeck 2013; Fischer & Qaim 2014; Muthyalu 2013). This is understandable because some farm operators are merely farm managers who share in the proceeds from harvest and are less motivated to join groups with these farms as they might switch

farms soon. This agreement is very popular in the cocoa farming communities and is commonly referred to as *abunu*[4] or *abusa*[5].

In addition to the personal characteristics, social capital also affect farmers' motivation positively (Nugussie 2010; Mojo D, Fischer Ch 2017). According to a study by (Verhees et al. 2015), members perception about social attributes existing in the cooperative such as trust, reciprocity of relationship, acceptance, voice, capacity building (information, training and education), leadership competence all influence whether or not an individual would participate in a cooperative or farmer group. Perception of farmers about incentives such as free agrochemicals other inputs or premiums in the case of certified group members also have a very important influence of one's decision to actively participate in a certified farmer associations in the case of Ghana.

According to Etim et al. (2021) experience and household size all have a positive impact of cooperative participation. This is because the more experience an individual had, the more the individual understood the benefit of teamwork and successful cooperation. This is very similar with results from studies by Cechin et al. (2013; Muthyalu (2013); Fischer & Qaim (2014) and Gyau et al. (2016) on the influence of education on cooperative participation. Result from (Etim et al. 2021) again implies that household heads with large members will be more willing to participate in cooperative organization. Martey et al. (2014) and Etim et al. (2021) demonstrated that agricultural production is labor intensive and heavily dependent on household labor. This means that smallholder farmers who have access to household labor could be more interested in cooperatives in order to capitalize on optimum productivity since they already have a fair amount of input (labor) required. It is also understandable that, large households already understand the benefit of being in a group hence, farmers from such backgrounds would have a positive perception towards cooperative activities. These finding are synonymous with Martey et al. (2014) who reported a positive effect of household size on farmers willingness to participate in cooperative organization.

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[4] *Abunu* literally means divided by two
[5] *Abusa* literally means divided by three
This system is explained more in the next sub-chapter (2.9.1)

Factors related to perception about social attributes existing in a cooperative or farmer groups also has an impact on participation. The perceptions are in the form of trust, reciprocity of relationship, acceptance, voice, capacity building (information, training and education), leadership competence and perception about incentives from government and other stakeholders as highlighted by Fischer & Qaim in (2014), Muthyalu in (2013) and Etim et al. in (2021).

2.9 **Factors influencing smallholder farmer productivity**

2.9.1 Cocoa production

Cultivation of cocoa in Ghana is widely dominated by small-scale farmers who use simple tools like cutlass, axe and sometimes hoes for the land preparation before planting (Bowers 2006). Smallholder farmers cultivate as owners, tenants, farm managers or sharecroppers and it could be for subsistence or commercialization. The type of farming system always in accordance with the needs of the farmer's family. Traditionally, low levels of technology and household labor are primarily used in production.

In land preparation, smaller and undesirable trees are cut-down and larger or stronger and desirable trees are left to provide permanent shade. Sometimes new trees are also planted to provide additionally required shade for the crops as part of land preparation. Plantain suckers, cocoyam and other temporary crops are also planted in the field as part of land preparation before cocoa seedlings are planted. The land is not fully prepared without enough trees (permanent shade), plantain and/or cocoyam (temporary shade). Cocoa seedlings are then planted on the field in a 3 meter by 3 meter (3m x 3m) or a 10 by 10 feet (10ft x 10ft) planting distance. The tree takes about 3-5years to develop and bear fruits, depending on the variety (Amoah et al. 2017). There are three main varieties of cocoa cultivated in Ghana: Amelonado, Amazonia and Hybrid (Adamafio et al. 2006; Amoah et al. 2017). The Amelonado and the Amazonia take about 5 years to bear fruit unlike the hybrid which requires only 3years of gestation (Adamafio et al. 2006; Amoah et al. 2017). In cocoa production just as is in many other cash crop productions, the right seedlings contribute a lot to the productivity of the farm.

The period between planting and the active production of cocoa trees is a very important stage of cultivation and ultimately influences productivity. Farmers usually depend on some food crops grown on the land as they wait for 3 to 5 years for the cocoa to mature and fruit. Although

at this time, farmers have no income from cocoa on the farm, farmers have to be committed to the application of the right chemicals and fertilizers, weeding, irrigation (during the dry season for some areas), pruning and overall maintenance. According to Quaye et al. (2015), due to the cost involved in the management of the farm (for farmers) and the amount of effort and technical knowledge involved in managing the farm (businessmen) an agreement is usually struck between the two parties; *abunu* and *abusa*. "A*bunu*" and "*abusa*" literally means "division 2" and "division 3" (respectively) and is an agreement between two parties to take care of a large piece of land and divide accordingly during the productive periods. This arrangement is typically between two parties; one that has the resources for the farming and another who can manage the farm but has limited resources for a farm. The caretaker (one party) takes the responsibility of maintaining the farm whilst the owner (other party) gives resources to the caretaker to ensure weeding, fertilizing, spraying and overall management of the farm. This agreement is usually important because both parties gain more by cooperating. Depending on the agreement between the two parties, harvest is divided into two or three and shared between parties every season. Alternatively, the caretaker would receive a share of the entire piece of land after a specific period depending on the agreement of both parties; this is usually agreed at the beginning of the agreement. Although *abunu* and *abusa* is very common, the legal structure[6] is very appalling and often times generate misunderstandings among families.

In order to enhance productivity of cocoa farms, farmers are educated on various agronomic practices and in smart agriculture. Changes in the climate and other adverse reasons cause for continuous research to improve production. Although farmers are experienced in what they do, a lot continue to change. There are now safer, smarter and more productive ways of farming, which needs to be adopted. The use of the right pesticides, fertilizers and other chemicals cuts down loss of cocoa beans by more than half although the abuse of chemicals could also be dangerous (Adu-Acheampong et al. 2015). Hand pollination is also a smart way of ensuring good productivity even over fertilizer application (Toledo-Hernández et al. 2020).

[6] Specifics of the agreement in *abunu* and *abusa* vary depending of location and interests of parties. Details on duration and time of service, how and when proceeds are divided, which proceeds are divided, what form rewards would be in (cash or in bags of cocoa) are all specified at the beginning of the service. However, there isn't any strong legal structure for the partnership to clearly define the terms of the agreement and this often results in conflict among families.

Proper harvest and post-harvest techniques enhances flavor, quality and weight of cocoa beans (Afoakwa et al. 2008; Rawel et al. 2019). Safe use and application of chemicals is also key in this regard. However, these reasons necessitate continuous training, education and extension on new discoveries from science and research to enhance good, safe and productive agriculture for farmers.

Pest and diseases are one of the most serious factors that reduces production on cocoa farms (Bateman 2015; Mahob et al. 2015; Wessel & Quist-Wessel 2015; Ma & Abdulai 2019). The impact of pest and diseases could be serious as losing a whole farm if not properly handled. One of the most serious cocoa disease is the Cocoa Swollen Shoot Virus Disease (CSSVD) which is not possible to control without losing a significant amount of trees depending of the spread (Ameyaw et al. 2015; Agyeman-Boaten & Fumey 2021). Other fungal diseases such as *Phytophthora megakarya* (black pod) and pest such as capsids, mirids, stem borers and cocoa moth all contribute immensely to loss of productive cocoa trees (Bateman 2015; Mahob et al. 2015; Denkyirah et al. 2016). The general preventive measures to this problem is good farm maintenance. Already infected trees also need to be treated with the appropriate chemicals and properly pruned to enhance sunlight penetration in the farm.

2.9.2 Access to credit

Smallholder farmers face numerous challenges and usually have very limited source of capital for operations (Azadi et al. 2021). This challenge limits farmers' ability to enhance production through investment into farm inputs ranging from simple tools; knapsack sprayers and manual pruners to slightly more complicated machinery; motorized sprayers, motorized pruners, motorized slashers and many others that makes work easy, fast and safe. The limitedness of farmers' capital base also means farmers do not have access to the quantity nor the quality of agrochemicals necessary for farming; even assuming they know exactly what chemicals to purchase and at what point in time.

In many businesses, assets are accumulated from capital and liabilities (loans) (Onumah et al. 2014). The risky nature of agriculture and cocoa farming specifically makes financial institutions reluctant to support farmers and for a good reason. In addition, the lack of appropriate collateral limits smallholder farmers from accessing loans from banks and other financial institutions.

When individual farmers fail to attain credit, cooperatives present a very important advantage for the members (Lin et al. 2022). Cooperatives sometimes provide loans to its members for farming and other purposes depending on the type of cooperative (Onumah et al. 2014). Farmers who are a part of cooperatives can have access to support from their group and then pay back usually at a relatively less interest rate. In addition, the government of Ghana established various financial schemes for smallholder farmers, especially for farmers in a group. The Agricultural Development Bank (ADB) was established to provide profitable financial intermediation and related services for a sustained and diversified agricultural and rural development (Akoto 1987). Also, rural banks to reach farmers, enhance agricultural activities and promote rural development (Afful et al. 2015). Although, through this initiative, the government aimed at supporting farmers with special priority for cooperatives, the reality is not as intended (Kwaning et al. 2014; Afful et al. 2015; Bentil Anthony Ewusi et al. 2021). These financial institutions favor farmers who have good credit standings regardless of their association with a group. However, between cooperative members and non-members of similar credit standing, members are favored more. This is because belonging to a cooperative means that farmers fit a certain criteria set and banks can have some trust in such farmers. For example, the fact that a farmer is a part of a cooperative could merely prove that the farmer even has a farm to begin with, has some sales records and can easily be traced through to a group. This saves the credit institution some time for background checks and generally reduces risk of default.

2.9.3 Access to farm inputs

Efficient production depends a lot on the kind of inputs invested in production (Norton & Nalley 2013; Kim 2021). Inputs ranging from raw materials to machinery and equipment used for production significantly defines the output received from operation. Cocoa productivity like any other farm business is dependent on the quality of seedlings, agro-chemicals applied, tools and equipment used (Monastyrnaya et al. 2016).

In recent times, hybrid cocoa seedlings have been promoted to replace the old variety of cocoa in Ghana (Wiredu & Mensah-bonsu 2011). This is because the seedlings have superior attributes to enhance productivity when compared to the older varieties that were formally found on most farms. Hybrid trees are high yielding, disease resistant, drought resistant and have more desirable traits depending on how seeds are modified (Wiredu & Mensah-bonsu 2011). These

seedlings are produced by CRIG[7] and distributed primarily by SPD[8] every year through cooperatives and farmers' associations. SPD receives a request from various cooperatives and farmer associations who arrange to take seedlings from SPD nursery sites or to receive these seedlings at a central location from the SPD. Besides cooperatives and farmer associations, individual farmers can request for seedlings from SPD but this is usually at a very high transport cost (transaction cost). According to Cocobod (2021), SPD produced 92 million hybrid seedling in the last cocoa season (2021/2022) and is set on producing 140 million seedlings in the 2022/2023 cocoa season. Various LBCs involved in the cocoa value chain, through support from the SPD also raise seedlings as top-up for government's efforts in cocoa rehabilitation. These seedlings are exclusively distributed by LBCs to their members. This effort is also a requirement in compliance with standards of certification. For example, in order to fulfil RA code of conduct or requirements in sections 4.1 and 4.2 (RA SAS Version 1.2), which covers pruning, renovation and planting, CFAs need to be provided with high quality cocoa seedlings by their respective LBCs. Every year, LBCs like Ecom, Olam, Nyonkopa and others raise millions of the seedlings for cocoa farmers (Astrid et al. 2020).

In addition, the government and other stakeholders also provides hybrid cocoa pods to various cooperatives and farmer associations who are equipped enough to establish their own nurseries and raise hybrid seedlings for their individual farms. This offer is only available to groups who show high seriousness; have a good site, show commitment and more importantly are a vibrant group.

Agro-chemicals have also become an important input in cocoa farming following the prevalence of pest and diseases. The use of various kinds of fertilizers have also been encouraged to enhance optimization of the hybrid seedlings' potential especially in areas where soils and other conditions do not favor proper growth. Cocobod in collaboration with MOFA provides some support for farmers in the form of free agro-chemicals to counter the most popular pests and diseases (eg. Black pod). Subsidized fertilizer is also provided yearly to farmers to support

[7] CRIG (Cocoa Research Institute of Ghana) is a subsidiary of Ghana Cocobod and deals primarily in all cocoa research (planting materials, agrochemicals, machinery etc.)

[8] SPD (Seed Production Division) is also a subsidiary of Cocobod and is solely in charge of raising in large quantities, enhanced seedlings that are provided by CRIG. These seedlings are then distributed to farmers for rehabilitation and/or for new farms.

cocoa production. Every year, various cooperatives and farmer groups receive spraying materials in the form of mechanized sprayers, mechanized pruners, appropriate working gear and agro-chemicals from government and other stakeholders to undertake mass spraying activities and/or pruning in order to prepare farms for new fruit formation. This is also only done through cooperatives and farmer associations and consequently farmers who do not belong to cooperatives nor any farmer association do not benefit from this.

In addition to the support, group members have the opportunity access quality/recommended agrochemicals. In most cases, smallholder cocoa farmers who are often isolated and far from agrochemical shops, have very limited chance to buy agro-chemicals even when they have their own money for purchase. Members of cooperatives and FBOs however have the opportunity to buy agro-chemicals and other farm inputs collectively through their groups. This reduces transportation cost and consequently cost per unit. During the weekly evacuation of cocoa beans from various cocoa communities, some LBCs also distribute inputs that farmers who are in their respective groups may have pre-ordered. This means that instead of travelling with an empty truck to pick up cocoa beans, farm inputs are delivered to communities in remote areas. Since the inputs are purchased through LBCs who work closely with Cocobod, quality is assured and farmers pay reasonably low prices for transport. This support is also only available for members who sell through the LBC.

2.9.4 Education, training and capacity building

Cooperatives and farmer associations guarantee that various smallholder farmers are educated and trained generally on good agronomic practices, good business practices to enhance safety, quality and productivity (Francesconi 2014; Wossen et al. 2017). Members are trained on proper agricultural practices; soil management, planting, shade management, pruning, weeding, pest and disease control and prevention, proper use of fertilizer, proper harvesting techniques and other related activities. All of these trainings significantly enhance productivity by informing farmers to make smarter decisions in their businesses. Most farmers make very common mistakes that have direct or indirect significance in their production. For example, if cocoa beans are harvested when fruit is fully ripe (which is mostly the case), cocoa beans lose a significant weight. The right time to harvest is when cocoa pods are mature and begin to yellow. On the other hand, if harvesting is done too early (when pods are not mature enough), beans are still

stuck to the pod and most beans are lost during pod breaking. Again, after harvest, if diseased pods are kept together with healthy pods (which is mostly the case), healthy pods are infected and lose weight. Hence, it is always important to keep diseased pods away from healthy pods especially when pod breaking will not be done within the first 2 days after harvest.

Regarding pest and disease, proper prevention and control activities are also disseminated to cocoa farmers through cooperatives (Agyeman-Boaten & Fumey 2021). Although pest and diseases like swollen shoot, black pod and other diseases affect productivity and destroy the farm in months (especially CSSVD), the prevention and control are as simple as proper farm sanitation. That is, pruning to allow sufficient air and sunlight through the farm, getting rid of stagnant water, cutting down diseased trees and other practices. However, due to the lack of training and education huge acres of farms are lost every year resulting from pest and diseases.

Members of groups are also typically trained on safety practices especially during agro-chemical application, proper use of various farm tools and equipment, the dire impacts of child labor and many others (Hamenoo et al. 2018; Oyekale 2018; Afriyie et al. 2019). This also enhances safety and posterity of the business.

In cocoa production, knowledge and information continues to increase due to extensive research. This means that education and training is always important even to farmers who might have been in the business for a significant number of years and hence have abundant experience. Knowledge and experience are both key and have a significant effect on cocoa productivity (Ayenor et al. 2007).

2.9.5 Access to extension services

Extension services provided by the government and other stakeholders is important especially when the information is new to farmers (Ma & Abdulai 2016). Education and training alone sometimes is not enough alone. Often times even after demonstrations with groups, a follow up extension support is significant to enhance adoption and compliance. For example, although farmers can appreciate a properly managed farm with good aeration, sunlight and no plastics around etc., the motivation to practice is lacking for diverse reasons. Sometimes it takes only a third party's comment or acknowledgement of good practices to nudge farmers to adopt additional good practices - although these practices actually benefits farmers by preventing investment made in pest and diseases control. Again, although farmers acknowledge availability

of shade trees protect cocoa trees and support cocoa trees to enhance productivity; it sometimes takes the involvement of a third party (extension agents) to nudge farmers into adoption.

Extension services however is not merely about motivating farmers but rather actively training farmers on good farm practices and actively monitoring and coaching farmers on how to implement various practices on their farms in order to benefit from optimum yield. Through extension, farmers are directed and monitored on their farms to enhance adoption.

Evidently, participation in a cooperative could significantly influence a farmer's access to information and other inputs and this could affect productivity. Other factors such as safety in production and quality of production are all significantly influenced through participation in a cooperative. The support cooperative members receive from the strength from one another, the access to credit, access to training and education amongst others pose an overall significant advantage to smallholder farmers who are cooperative members.

2.9.6 Additional Livelihood (AL) strategies for smallholder farmers

Additional livelihood is defined as any supplementary economic activity or combination of activities undertaken by smallholder farmers in order to achieve their livelihood goals (Shah et al. 2019; Alobo Loison 2015; Alinovi et al. 2010). A strategy to mitigate economic shocks in smallholder farmers' households are dependent generally on options available, capabilities (capital, assets, information, training, and even social assets). ALs have received much attention from researchers and policy-makers in the past decades, with high hopes that promoting it can offer a pathway for poverty reduction and economic growth in sub-Saharan Africa (SSA) (World Bank, 2007). The recent effects of climate change on agriculture have also necessitated the need for diverse non-farm economic activities to supplement farming. Some of these activities can be beekeeping, soap making, palm weevil production (akokono), snail farming, bead making and other livelihood strategies.

Non-farm AL are diverse economic activities that farmers practice for additional income besides farming or agriculture in general (Davis 2006; Asfaw et al. 2017; Alobo Loison 2015). Usually, these activities are not land based and do not require huge land ownership as in the case cocoa farms. They are usually local crafts adopted depending on the raw materials available in a certain area. For example, soap making, bead making and beekeeping are non-land AL that requires relatively small to no land ownership and serves as a good source of income for

smallholder farmers who are in the business. Alternatively, farm-based ALS refers to diverse livelihoods in other agricultural activity for income that requires relatively high land ownership (Murungweni et al. 2014; Asfaw et al. 2017). Sometimes smallholder cocoa farmers adopt farm-based ALS because they have the land for the activity. For example, a cocoa farmer with a portion of swampy land could venture into rice or sugarcane farming as an additional livelihood to supplement cocoa farming so that during cocoa off-season, income from the sugarcane or rice can be used to support the family and to some extent the cocoa business. For smallholder cocoa farmers, additional livelihood is important especially because cocoa is a seasonal cash crop. In the off-season when more investment is required to prepare the farm for the harvesting season, most smallholder farmers are unable to acquire the necessary inputs needed and on time due to the lack of capital. This reduces yield and productivity is affected. Examples of farm-based ALs is rice farming, sugar cane farming, fish farming, vegetable farming and fruit plantations.

2.9.6.1 Factors that influence adoption of additional livelihood

Climate change, food security and poverty are some of the major drivers of additional livelihood in rural communities in Ghana (Connolly-Boutin & Smit 2016). Climate change poses a threat to cocoa business but many scholarly works have not considered it as a potential factor that influences adoption of ALS (Asmah 2011). Although cocoa production is a profitable venture, income from the business is not always sufficient for typical smallholder farming households especially due to impact climate change (Wessel & Quist-Wessel 2015). The need for AL is therefore necessary for survival in most cases. The impact of climate change also poses a big threat to cocoa production and therefore the primary livelihood of these smallholder farmers (Amfo & Ali 2020). These households who depend solely on their cocoa farms as means of livelihood suffer low standards of living and produce most of the crops they consume either integrated on their cocoa plots or on separate lands.

Smallholder farmers who depend entirely on the yield from their farms also depend on the income generated from their farms in order to venture into other activities (Whitaker et al. 1982). The land size, productivity, yield or income generated from cocoa farming and access to credit influences adoption of additional livelihoods in diverse ways (Aneani et al. 2011; Amfo & Ali 2020). For example, some farmers will venture into an additional livelihood because they only have a small piece of cocoa farm, which consequently provides insufficient yield and

income. That will also mean that farmers do not need to spend so much time on their cocoa farms and hence can have some time for other diverse activities. Regardless, some farmers would also rather not venture into any AL because they do not have enough income from their farms to venture into other income generating activities especially those that will require some form of capital commitment. Such farmers usually settle for some kind of subsistence farming to supplement income generated from their farms to support their household daily food requirements. Other farmers who have relatively larger lands and/or who are more productive and consequently generate more income from their farms are more interested in investing into other diverse economic activities to enhance their living standards. Similarly, other smallholder farmers in the same condition would rather not diversify but continue to specialize in cocoa production and increase marginal production.

Additional livelihood adoption is again influenced by the kind of resources that are readily available to households (Murungweni et al. 2014). Some farmers venture into farm/land based agriculture as an AL because there are few diverse economic opportunities in the rural areas. Arable land however is abundant to these smallholder households and hence additional economic activities such as vegetable production, rice production and other short-term crops are preferred as a diverse source of income. Other farmers also venture into beekeeping, snail farming, livestock rearing and other forms of agricultural activities depending on which is more appropriate and conducive for the area. For example, some farmers would like to go into beekeeping or goat farming. However, if goat rearing is abolished in the area nor bees are not welcomed in the area, then the farmer will have to switch to some other diverse option more suitable for his location. Some households would similarly venture into some local kind of trade if training is assessable and startup is also readily available.

2.10 **Impact of cooperative membership on adoption of ALS**

Cooperatives and farmer associations also have influence on adoption of AL in the rural areas because members receive education and training on the need for diversification (Abate et al. 2013; Fischer & Qaim 2014). Members are educated on the changing environmental conditions that makes cocoa productivity inconsistent and hence the need for some kind of supporting economic activity. Training on which additional livelihoods are suitable for specific areas and how to get started are offered to smallholder farmers who belong to cooperatives. Also

cooperatives and farmer associations offer support in terms of credit to members and hence provides a capital platform for farmers who want to venture into AL but do not have the minimum capital required (Shah et al. 2019; Twumasi et al. 2021). Cooperatives as a group also enter into some kind of additional economic activities to support members and enhance the capital base of the group but this is not very common for smallholder cocoa cooperatives and farmer groups in Ghana.

By being a part of a cooperative, farmers have a higher chance of adopting an AL because, education and training on additional livelihood is available and capital is more accessible (Amfo & Ali 2020a).

3. MAIN AIM OF THE STUDY

The cocoa industry is vital to the economy and livelihood of millions of people in Ghana, with small-scale producers dominating the sector. However, there are several factors limiting cocoa productivity, including poor maintenance practices, low-yielding varieties, pests and diseases, aging cocoa trees and a lack of investment in infrastructure and farming methods. As a result, the government and other key stakeholders have developed measures to support farmers and enhance productivity. These innovative policies and interventions make use of farmer cooperatives and associations to effectively disseminate support in the form of credit, information and inputs. Despite the efforts of various stakeholders, including chocolatiers and the EU, to enhance sustainable cocoa production and improve the living standards of cocoa producers, productivity is still low and smallholder farmers are still the poorest in the society. It is therefore important to find out if the activities of cooperatives have the desired impact on productivity and adoption of income diversification activities for better livelihood of smallholder farmers. The results from the study will also be important for the government and other key stakeholders such as international chocolate makers, LBCs, NGOs and ethical labels (RA/UTZ, Fairtrade etc) in decision making regarding cocoa production and dissemination of innovations in the future.

The specific objectives are:

1. To identify the impact of cooperatives on adoption of additional livelihood strategies.
   - To assess other factors that influence adoption of additional livelihood strategies.
2. To examine the impact of cooperative membership on productivity of smallholder farmers.
   - To determine other factors that influence productivity of smallholder cocoa farmers.

3.1 **Conceptual Framework - Adoption of ALS**

Figure 1 depicts factors that potentially influence adoption of additional livelihood strategies such as socio-economic characteristics, access to resources, perception of ALS, cooperative membership and awareness of climate change (Aneani et al. 2011; Amfo & Ali 2020).

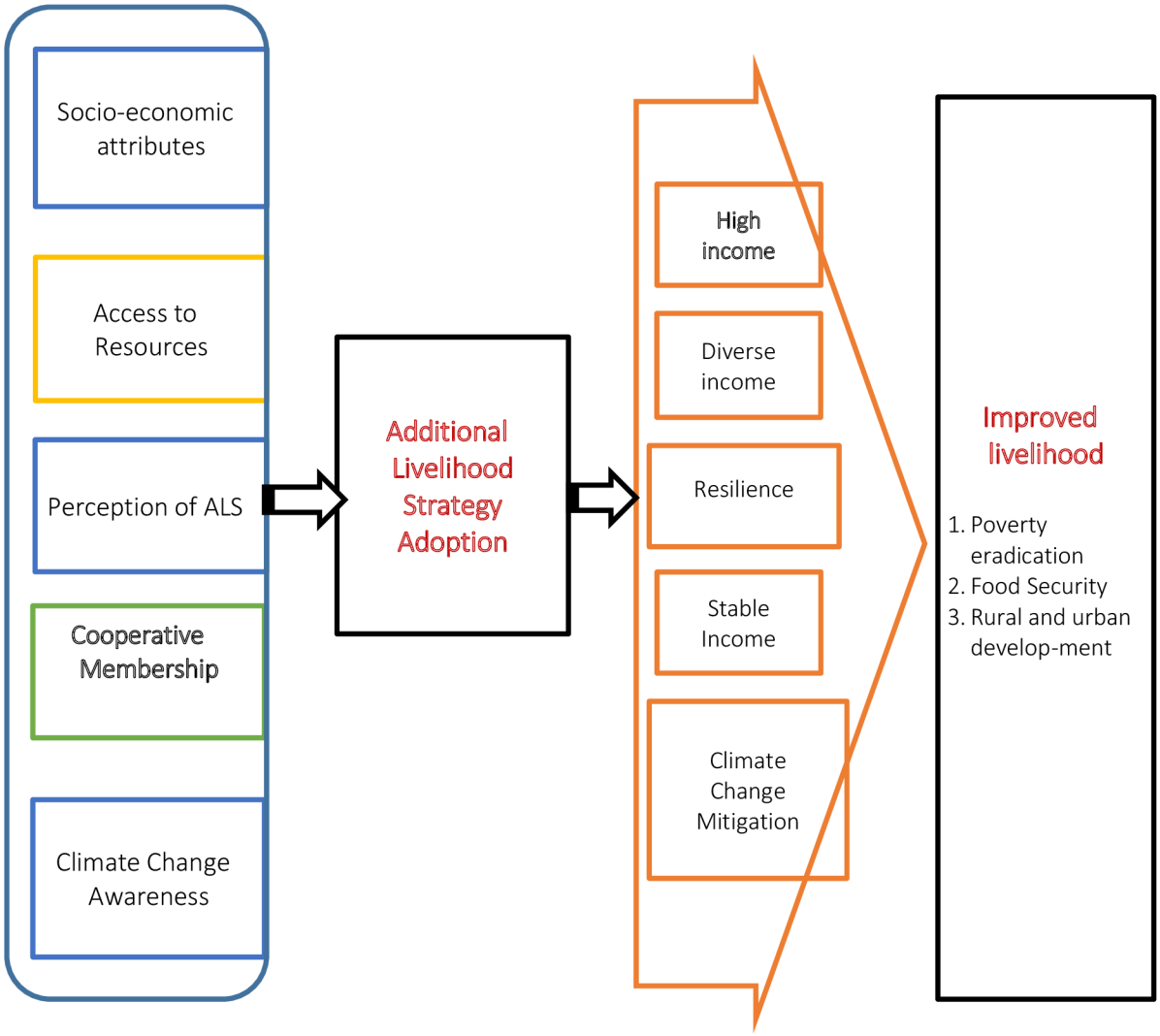

Figure 1 - Adoption of additional livelihood strategies

3.2 **Conceptual framework – Productivity**

Figure 2 also shows factors that influences cooperative participation and the impact of cooperatives on productivity. At the basic individual level, the decision to join a cooperative is influenced by *socio-economic factors*, *access to group*[9], *access to information*, *land ownership* and perception of individual farmers (*trust, acceptance, reciprocity, capacity building*) (Fischer & Qaim 2014; Zhang et al. 2020; Etim et al. 2021). On a broader level, the degree of feeling of togetherness (*social capital*) also plays an important role in the reception and participation in cooperatives (Etim et al. 2021).

Cooperative participation also has important benefits that differentiates members from non-members. Some of these benefits/attributes are in the form of *access to credit/capital*, *access education and training, adoption of ALS, access to information*, *access to extension* and *access farm inputs* (Abate et al. 2013; Bijman & Iliopoulos 2014; Ma & Abdulai 2019; Etim et al. 2021). All these factors ultimately enhance productivity of cooperative member.

Association with cooperatives also enhances farmers' knowledge on additional livelihood strategies and which could improve productivity. This is because farmers can channel income from additional livelihoods into their cocoa farms (Alobo Loison 2015; Amfo & Ali 2020b). This means that, with higher productivity and hence income, smallholders will be more interested in investing into other diverse businesses.

It is also important to note the potential relationship between higher income (productivity) and ALS. The relationship could be reciprocal. The higher income levels rise (from productivity of cocoa farms), the higher interest and adoption of ALS (Krantz 2001; Chand et al. 2011). Adoption of ALS also means that farmers will have additional income to support cocoa farming. Some scholarly works however prove that farmers engaged in ALS are less productive on their farms due to lack of specialization (Peprah 2015; Kerua 2019). Other reasons however could be; high demand for assets, lack of know-how, lack of marketing opportunities, lack of technology or ALS are just not profitable enough to support households and other businesses.

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[9] Pressure from the government also plays a role in nudging farmers into participation in cooperatives. However this is not considered as an individual variable because the strongest way the government can motivate farmers to participate into joining a cooperative is to make sure that the group is accessible.

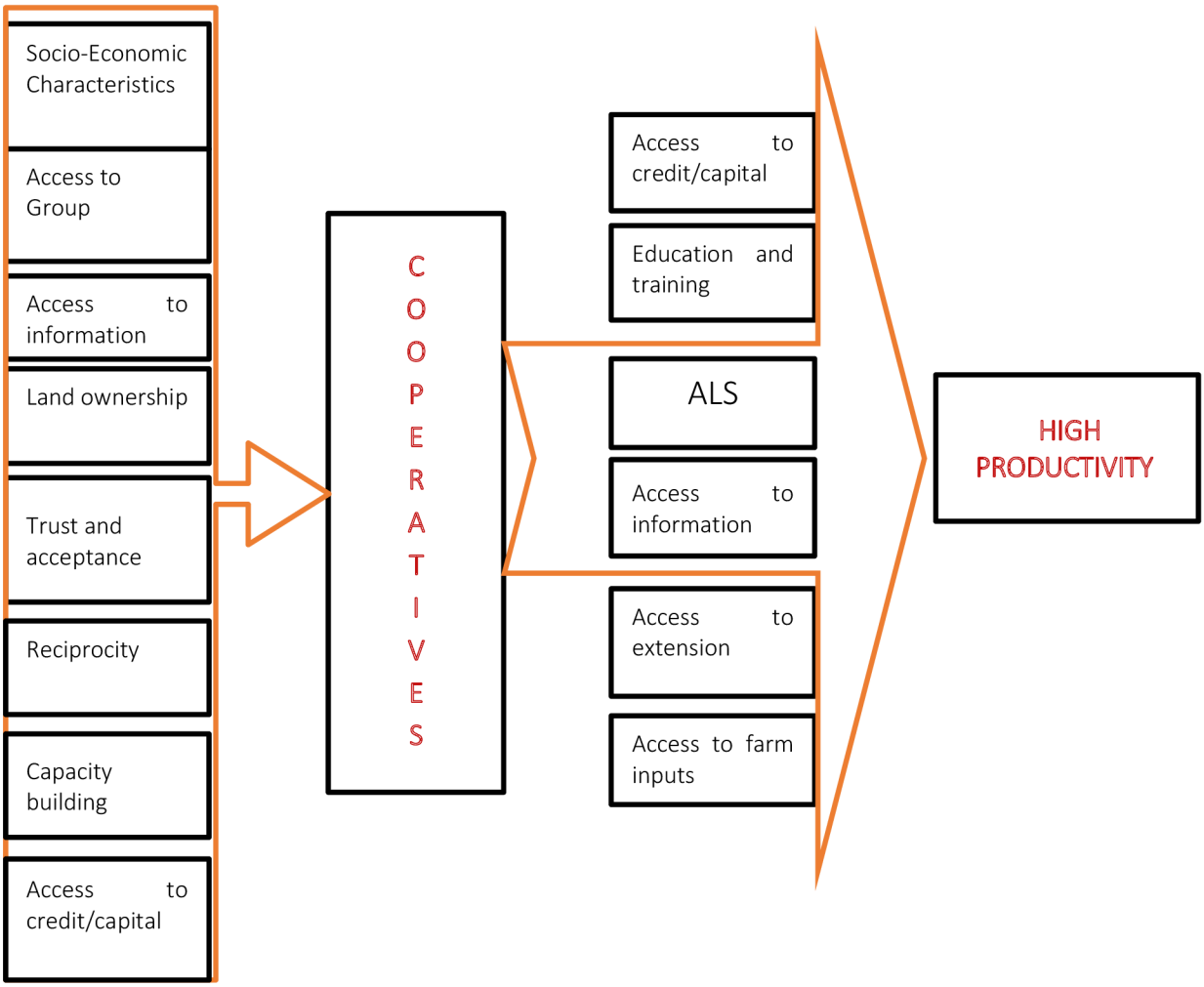

Figure 2 - Productivity of Smallholder farmers

4. METHODOLOGY

The study uses a quasi-experimental design. Like a true experiment, a quasi-experimental design aims to establish a cause-and-effect relationship between an independent and dependent variable (Gopalan et al. 2020). However, unlike a true experiment, a quasi-experiment does not rely on random assignment and manipulation. Instead, subjects are assigned to groups based on non-random criteria.

To find the cause-effect of the impact of cooperatives on productivity and adoption of ALS in this study, a comparative form of non-experimental design was used. The comparison was based on a treatment group (group members) and a control group (non-members). In order to enhance randomization and to some extent avoid selection bias, members and non-members were selected from various stratified communities of the study area. In addition, the propensity score matching technique was adopted to match the treatment against the control group.

4.1 **Study Area**

The study was conducted in Ghana's Ashanti region, in the Ahafo-Ano South-West area. The district is located on the North-Western edge of the area. The district is surrounded by significant cocoa-producing regions in the forest belt, including the Ashanti, Brong Ahafo, Central, and Eastern Regions. The distance between Mankranso, the district's administrative hub, and Kumasi, the Ashanti region's capital, is 34 kilometers.

The district was selected for the study because of how well it represents cocoa farmers in the area and nation at large. Cocoa cultivation is one of the district's main economic activities, with 76.8% of the population (50,494) living in rural regions. In order to sustainably enhance productivity through support services and credit facilities, the district is well-endowed with cocoa cooperatives and farmer groups that were established either by the government or private players.

In particular, for the aforementioned reasons, the government and the other private players provide cooperative farmers with cocoa and shade tree seedlings at the beginning of the rainy season. Other support takes the form of extension, climate smart education; good agronomic practices (GSPs), good environmental practices (GEPs) and good farm management practices (GFPs).

This region was also chosen for the fact that the government, NGOs and other stakeholders have trained cocoa farmers in a number of ALS, including beekeeping, soap making, palm weevil production (akokono), snail farming, bead making and other livelihood strategies. These trainings were delivered not only to group members but to all cocoa farmers in the district through extension agents.

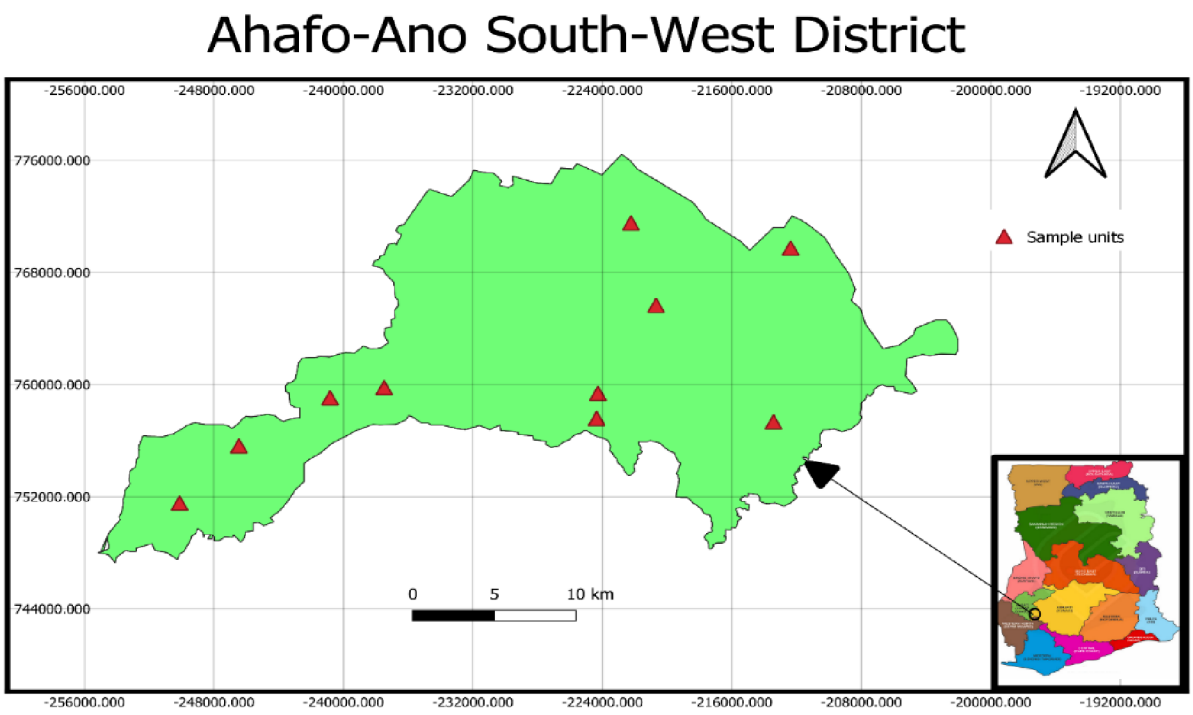

Figure 3 - Study Area

4.1.1 Target groups

The research uses two main groups; smallholder cocoa farmers who are members of a cooperatives or FBO (*Members*) and those who are not members of any group (*Non-members*). The term "members" refers to farmers who are officially recognized as belonging to a cooperative, FBO or farmer association and who gain benefits directly from those organizations. Members were chosen purposively within the study area and were relatively accessible because there were several groups in the region.

Farmers who are not a part of any farmer association, FBO or cooperative were considered as *non-members*. These farmers either do not have access to cooperatives or do not want to be a part of any group. These farmers typically reside in small towns, remote from

cooperative hubs and have restricted access to cooperatives. For the purposes of this study, neither non-members nor members were regarded to be farmers who are expelled from cooperatives or farmer groups for some reason. This is because their prior involvement and expertise gained from joining cooperatives may have an impact on how quickly they embrace ALS and how productive they are. Non-members of cooperatives were selected purposively from communities farther from the center of the communities in order to reach farmers who meet the intended criteria; limited cooperative access and spillover effects.

4.1.2 Sample Size

Data from Cocoa Health and Extension Division (CHED) of Cocobod shows that there is an estimate of 18,688 cocoa farmers in the selected cocoa district. This information was given by an extension officer (Mrs Esther Amponsah) and confirmed by the district manager of the Ministry of Food and Agriculture (MOFA). The sample size was thus calculated according to the formula;

$$(\boldsymbol{z2 * p * (1 - p)/e2)/ (1 + (z2 * p * (1 - p)/e2 * N)}).$$

Where *z* is the critical value of normal distribution at the required confidence level (1.96 for 5% confidence level), *e* is margin of error, *p* is sample proportion which is expressed as decimal and ***N*** is the population size (18,688 cocoa farmers). Considering $\boldsymbol{p}$ as 5% and $\boldsymbol{e}$ as 6%, the sample size would be 377. The sample size for this study was 416 respondents; 219 members and 197 non-members.

4.1.3 Data collection and sampling technique

The primary source of information for analysis in this study was field data. This information was gathered in 2021 between July and August. Together with the author, three additional interviewers used the *Nestforms* app on smartphones to gather the data. The enumerators lived in the district and were familiar with farmer associations and cooperatives' activities. Progress was accelerated by the interviewers' prior knowledge of digital farm data collection. In order to broaden coverage, motorbikes were also used to enhance mobility.

Ten (10) cocoa-growing societies were purposively selected for the study, including Afresini, Ango, Bonkwaso, Sabronum-Camp, Aponaponso, Mehame, Achiase, Betinko, Ntikrom, and Apatratom. These communities were picked from all over the district. The 10 communities are a mixture of cooperative hotspots or otherwise and were geographically well

dispersed. Once more, the selection of these communities was because there is a nice blend of members and non-members alongside a good rate of additional livelihood activities going on.

Farmers were asked a series of questions related to their socioeconomic characteristics, farm activities, yield or harvest, access to relevant support (credit, information, inputs), adoption of ALS and their perception about social capital, reciprocity and additional livelihood strategies (Annex 1: QUESTIONNAIRE). Before data collection began, key informants including government field officials were consulted to confirm and/or update enumerators on crucial information like the number of farmers in the selected areas and the ideal time to visit.

4.2 **Data Analysis**

4.2.1 Descriptive statistics

A t-test was used to summarize the means of all variables used for this study. The grouping variable used for the t-test was members and non-members. The result is shown in Table 1.

A radar chart was used to compare ALS adopted by members and non-members. The impact of cooperative membership on adoption of ALS was also tested using Pearson's test of correlation (chi-square). Adoption was measured as a binary; either yes (1)[10] or no (0). Enumerators probed further to ensure that farmers had indeed adopted ALS for more than a year and were still earning an income from them. Although almost all farmers did not keep accounting records on their ALS, enumerators could validate most of the adopted activities through observation[11]. For example, honey makers and soap makers had a sample of the products they sell at home to show. However not all activities could be observed[12]. For example, some farmers could not travel a long distance back to their farms to show what is been done and neither did they have a business certificate nor book of accounts to show.

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[10] Farmers' word can be trusted because they would always rather like to express how less fortunate they are instead of expressing how much they make from ALS. Hence, those who had adopted additional livelihoods were actually into a diversified income generating activity and were proud of it.

[11] However, other farmers would also lie about adopted ALS if they perceive to gain some benefits from enumerators or the study. Hence the need form probing and observation in some cases.

Productivity was also measured as yield (kg) per land size of farmers (hectares) as was done by Kongor et al. (2018). Stata (v17.0), SPSS (v26) and Microsoft Excel (Microsoft 365) were used to analyze and process the data.

4.3 **Prerequisite for IPWRA & PSM**

In order to analyze treatment effects and limit bias, IPWRA[13] and PSM[14] was used for objective one and two respectively. As a prerequisite, a probit regression was needed to assign propensity scores for respondents in order to allow for matching. The probit regression model is used when estimating the influence of independent variables on a binary dependent variable (membership or non-membership) (Fischer & Qaim 2014; Gyau et al. 2016). In this study, the regression model was used to analyze factors that influence cooperatives' participation as well as assignment of propensity scores for matching. The dependent variable for the probit regression model was cooperative membership. Membership was measured as a dummy variable with respondents answering between "yes" (1) or "no" (0) for members or non-members respectively. Members were farmers who belonged to a cooperative (or FBO) and received benefits from their groups due to their membership whiles non-members did not belong nor receive any support by virtue of their association with any group.

Independent variables employed factors influencing cooperative participation including socioeconomic variables such as (a) *gender* (b) *age and* (c) *education* were considered for the model (Fischer & Qaim 2012*;* Muthyalu 2013; Gyau et al. 2016). Other attributes considered to influence participation were (d) *distance* (e) *farm size* (f) *land ownership* (g) *access to extension* (h) *access to credit.* Respondents' perceptions were also included the model. These perception statements as included by other authors were also used in the model to clearly assess factors that influence participation; *perception about trust, perception about reciprocity, perception about capacity building, perception about acceptance, perception about access to information* (Ruiz Jiménez et al. 2010; Cechin et al. 2013; Muthyalu 2013; Fischer & Qaim 2014; Gyau et al. 2016).

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[13] IPWRA (Inverse Probability Weighted Regression Adjusted)
[14] PSM (Propensity Score-Matching)

The probit regression model was estimated as;

$$\boldsymbol{Y = \beta 0 + \beta 1 + X1 + \beta 2\, X2 + \cdots + \beta k\, Xk + u}$$

Where the outcome variable (Y) is membership (yes/no). β0 = constant term, β1….βk = estimated parameters, $X_1 \ldots X_K$ = independent variables and u = error term.

4.4 **Objective 1 – Adoption of ALS (IPWRA)**

The first objective of the study was to assess the impact of cooperative membership on adoption of ALS. For the purpose of this study, additional livelihood was measured as any activity in the past year that could generate additional income for farmers besides cocoa farms (apiculture[15], soap making, palm weevil production (akokono), heliciculture[16], bead making and other livelihood strategies). Trainings about these activities had been given to farmers by the government and other industry players in the previous years.

In order to estimate unbiased treatment effect (cooperative membership) on adoption, the inverse probability weighted regression adjusted (IPWRA) was used to assess how significant being a part of a cooperative influenced adoption. This method was used by (Wossen et al. 2017) to estimate the impacts of extension access and cooperative membership on technology adoption and household welfare. This approach helps in overcoming bias and estimating a more precise treatment effect through matching of control variables (Li & Donnell 2020). Just as for PSM, all observable characteristics are controlled for the treated and control groups and matched to ensure that there is a clear impact of a specific treatment. PSM was however not used to estimate adoption of ALS because the outcome variable in this case - adoption - is a binary variable.

Just like propensity score matching, IPWRA is used to estimate the treatment effect on a treated group. IPWRA however has a more robust ability to check for impact of a treatment on the treated (Kang & Schafer 2007).

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[15] Apiculture (Beekeeping)
[16] Heliciculture (Snail farming)

ATT in the IPWRA model is estimated as;

$$\boldsymbol{ATT = \frac{1}{N} + \sum_{i}^{Nw}[(\alpha 1 - \alpha 0) - (\varphi 1 - \varphi 0)]}$$

Where, (α1-α0) are estimated inverse probability weighted parameters for treated group (cooperative members), (φ1-φ0) are estimated inverse probability weighted parameters for untreated group (non-members) and Nw stands for the total number of treated households.

The second part of the first objective was to assess other factors that influenced adoption of ALS using the probit regression model. The dependent variable was adoption of additional livelihood strategies (1-adopted or 0-not adopted). Farmers who were considered as adopted were those engaged in any of the additional livelihood strategy taught by the government, cooperatives and even outside of these groups. These livelihood trainings included beekeeping, soap making, palm weevil production (akokono), snail farming, bead making and other livelihood strategies. Probit regression was used for the analysis because of the binary nature of the outcome variable - adoption.

The control variables that were considered for this model were socio-economic characteristics of farmers; (a) *age* (b) *gender* (c) *household size* (d) *education* (e) *experience* (f) *farm size* and (h) *landownership* (Aneani et al. 2011; Amfo & Ali 2020). Other independent variables that were of interest in this model were (i) *productivity* (j) *access to credit* (k) *access to information* (l) *perception* about ALS (m) *climate change awareness* (n) *access to extension* (o) *labor* and (p) *cooperative membership* (Aneani et al. 2011; Amfo & Ali 2020)

4.5 **Objective 2 – Impact of Cooperatives on Productivity (PSM)**

In the second objective, the impact of cooperatives on productivity of farmers was assessed using a propensity score matching method (PSM). The method has been used extensively by Schreinemachers et al. in 2016, Fischer and Qaim in 2012 and Mojo and Fischer in 2017 since its first use by Rosenbaum and Rubin in 1983 to estimate the average treatment effect on the treated (ATT).

Although the PSM is effective in minimizing bias, there is a limitation to the use as it cannot control unobserved characteristics directly just as IPWRA. Empirically, the average treatment effect on the treated (ATT) is estimated as;

$$\mathbf{ATT} = \mathbf{E}(\mathbf{P}(\mathbf{X})|\mathbf{C}=\mathbf{1})\{\mathbf{E}[\mathbf{Y}\,\mathbf{1}\,|\mathbf{C}=\mathbf{1},\mathbf{P}(\mathbf{X})]| - [\mathbf{E}\,\mathbf{Y}\,\mathbf{0}\,|\mathbf{C}=\mathbf{0},\mathbf{P}(\mathbf{X})]$$

Where *Y (1)* is the outcome variable (productivity) of the treated (members) and *Y(0)* is the outcome variable (productivity) for the control or not-treated group (non-members). *C=1* is for treated farmers and *C=0* control farmers. The average difference between the two outcomes refers to the treatment effect on the treated (ATT).

The second part of objective 2 employed a linear regression model to assess other factors influencing the productivity of members as was used by Bashir & Yuliana (2019). This method has been widely used to estimate factors influence an outcome variable that is continuous in nature; production, consumption, price and profit (Ofori-Bah & Asafu-Adjaye 2011; Akbar et al. 2021)

The dependent variable (productivity) was measured as yield of harvested cocoa beans in kilograms per hectare of land (kg/ha) for the previous cocoa season (October 2020-June 2021). This showed how much members and/or non-members could produce in kg/ha. Although other inputs such as number of trees could be considered in establishing productivity, in this study it is more appropriate to use land (input) against yield (output) to establish productivity. Due to the heterogeneous nature of the farms and cocoa trees in the district, it was impossible to consider productivity of individual trees as a measure of productivity of the farm. Also, based on our first pilot, it was found that the tree densities of members and non-members did not considerably differ from one another because both groups planted according to the advised planting distance ($3m^2$ x $3m^2$). Productivity is similarly measured by Kongor et al. (2018) and Aneani & Ofori-Frimpong (2013) as yield per farm size.

Respondents were asked how much cocoa they harvested and sold all year and if possible, to provided a passbook (receipt) to support. Although yield is not the sole productivity indicator, it is the most pertinent for this study and accurately depicts the disparity between the amount of input that went into production and the amount of output that resulted from it.

The independent variables considered for this model are socio-economic characteristics of all farmers; (a) age, (b) gender, (c) household size, (d) education, (e) experience (f) farm size (g) land ownership. Also other factors that influence productivity were included to demonstrate their impact in productivity as was done by (F. & K. 2013; Kehinde & Ogundeji 2022; Suh & Molua 2022). These factors were (h) labor, (i) fertilizer applied (j) access to extension (k) access

to credit (l) hybrid (m) age of trees (n) access to information (o) additional livelihood participation (p) cooperative membership. Linear regression is expressed as;

$$\boldsymbol{Yi = f\,(Xi, \beta) + e}$$

Where $\boldsymbol{Y_i}$ is the outcome variable (productivity), $\boldsymbol{X_i}$ represents the independent variables, $\boldsymbol{\beta}$ represents the estimated parameters and $\boldsymbol{e}$ represents the error term of the equation.

4.6 **Summary of variables**

Table 1 is a summary of all variables used in the study. The control variables or covariates are the variables that are repeated in multiple analysis in this study. Although they have the potential to influence the outcome variable, they are not the focus of this study. The total number of respondents sampled for this study was 416 (219 members and 197 non-members).

The t-test summary table below shows that, there is a significant difference between the times spent to get to meeting grounds (distance) in favor of members. Members are more educated and have higher experiences than non-members. Members who own their own farms are also significantly more than non-members.

Other independent variables of interest included in the table also describes the population in terms of members and non-members. According to the table, members of cooperatives apply more fertilizer and have access to extension services more than non-cooperative members and the difference was statistically significant. On the average, members received more credit than non-members at a significantly different rate (GHS632 against GHS65). Members also had significantly higher number of hybrid trees on their farms and younger trees which are all very important for good yield. According to the data, members were also more aware of climate change than non-members were. These variables generally show that the treatment group (members) are indeed different from the control group but similar enough to allow matching.

Variables that were included in the study to measure and assess perception also shows that members on the average have a significantly higher perception of reciprocity, trust, capacity building in groups, acceptance in the society and groups and benefits of adopting an additional livelihood strategy. The data shows that the difference between the two groups is statistically

significant. The data also shows that members of cooperatives have higher access to information regarding cocoa farming and other livelihood strategies that they may be interested in partaking.

In addition, the t-test also shows a significant difference in productivity for members and non-members possibly due to the treatment. However, the PSM through matching gives a more robust result below. Adoption of ALS was also significantly higher in members.

The t-test gives only a shallow summary as the normality of the data was not tested to inform the use of a parametric or non-parametric test.

Table 1 - Summary of variables

Control variables	Description	Measure-ment	Members (N=219)	Non-members (N=197)	Mean Diff
Age	Number of years	Years	50.06 (13.20)	48.06 (11.61)	-2.01
Gender	Male/Female	Y/N	0.63 (0.48)	0.66 (0.47)	0.03
Household size	No. of residents in the house	Number	4.93 (2.06)	5.00 (1.92)	0.07
Distance	Time spent to reach meeting group meeting grounds	Mins	8.47 (5.48)	9.92 (6.92)	1.46**
Education	Years of education	Years	2.86 (2.44)	2.05 (1.99)	-.82***
Experience	Years of cocoa farming	Years	20.53 (11.02)	17.13 (9.42)	-3.40***
Farm size	Farm size	ha	2.75 (1.74)	2.87 (1.79)	0.12
Land ownership	Owner or not	Y/N	0.79 (0.40)	0.56 (0.50)	-.24***
Independent and Dependent Variables					
Labor	Labor use for the past year	Y/N	0.58 (.50)	0.64 (.88)	0.06
Fertilizer	Amount of fertilizer applied	Scale of 1-5	3.77 (1.12)	2.39 (1.35)	-1.38***
Extension	Visits from extension agents in the past year	Number	4.16 (2.30)	1.18 (1.30)	-2.97***
Credit	Credit received	GHC	632.86 (1194.06)	65.94 (244.93)	-566.92***
Hybrid	>30% hybrid trees on farm	Y/N	0.82 (0.38)	0.45 (0.5)	-.37***
Age of tree	Age of tree	Years	11.62 (7.30)	15.68 (8.00)	4.06***
Climate Change Awareness	Climate Change awareness	Y/N	0.89 (.31)	0.94 (.24)	.05*
Reciprocity	Perception on reciprocity in groups/cooperatives	LS	3.80 (1.00)	3.46 (1.08)	-.34***
Trust	Perception of trust and trustworthiness of groups and their members	LS	4.48 (0.86)	4.31 (0.92)	-.17*
Capacity building	Perception of ease of capacity building through groups	LS	4.37 (.96)	3.54 (1.31)	-.83***
Information	Access to relevant information about farming and other ALS	LS	4.64 (0.64)	4.09 (1.16)	-.55***
Acceptance	Perception about acceptance in a group	LS	4.47 (.84)	3.85 (1.30)	-.62***
ALS benefit	Perception about the benefits of ALS	LS	4.52 (.68)	4.53 (.55)	.01
ALS adopted	Adopted ALS	Y/N	0.96 (0.19)	0.43 (0.5)	-.54***
Productivity	Yield per hectare of the past year	kg/ha	580.08	382.76	-197.31***

Note: ***, **, and * represents significance level at 1%, 5% and 10% respectively; LS=Likert scale (low-1, high-5)

4.7 **Limitations of the Study**

The study's lack of consideration of the cocoa varieties (amelonado and amazonica) (Kongor et al. 2018), the type of land utilized for cultivation, and other agronomic factors that could affect productivity might be a drawback. However, because the treatment and control groups originated from similar communities, the two will share similar soil types and other naturally occurring characteristics.

Contrary to Donkor and Hejkrlik (2021), the effect of members' commitment was not considered for the purposes of this study. Although information was gathered to differentiate between committed and non-committed members based on the number of trainings, activeness, and perception of belongingness of members, it is insufficient to use these factors as determinants of productivity. In the Ghanaian cocoa industry, cooperatives and farmer organizations may not always reward devoted farmers more favorably. Thus, increased production may not always be attributed to dedication to a group.

Members of multiple farmer groups were also not considered in this study either, despite the potential for considerable performance and adoption differences.

Another significant restriction is the issue of spill over. Non-members may passively benefit from important information because of the increased activity of cooperatives and farmer groups. Knowledge can spread quickly since radio and television are common even in the remote areas. In addition, information centres spread information rapidly in rural areas. However, the information for non-members was gathered from farmers who reside far from areas with high cooperative activity and had less chance of spill-over benefit.

Although through matching and the use of IPWRA and PSM, some amount of bias was eliminated, the approaches are known to fall short in eliminating unobserved bias.

The accuracy of some information from farmers regarding some variables of interest cannot be assured due to the lack of proper documentation and the nature of farmers in rural areas. Some farmers are unable to provide and extensive report on their activities in the past year. This limitation was however managed as much as possible through careful administration of questionnaires to make sure that farmers understood the questions in their local dialect and did not feel rushed into answering.

5. RESULTS

5.1 Description of Population and ALS adopted

Error! Reference source not found. below describes the various forms of additional l ivelihood strategies that were adopted by the sampled farmers. In all forms of ALS, adoption was higher for members than non-members. In terms of non-adoption, non-members of cooperatives were more (113 smallholder farmers) than members of cooperatives (8 smallholder famers).

As is shown in **Error! Reference source not found.**, ALS that were recorded were a piculture (beekeeping), soap making, palm weevil production, bead making, heliciculture (snail farming), poultry and livestock production. Vegetables, fruit, rice, yam and plantain intercropped in cocoa farms and all other crops cultivated by farmers for additional income were considered as "Other crops" as is shown in the figure. Other economic activities encountered in the survey including shoe making, palm oil making, fish farms and others were considered as "other".

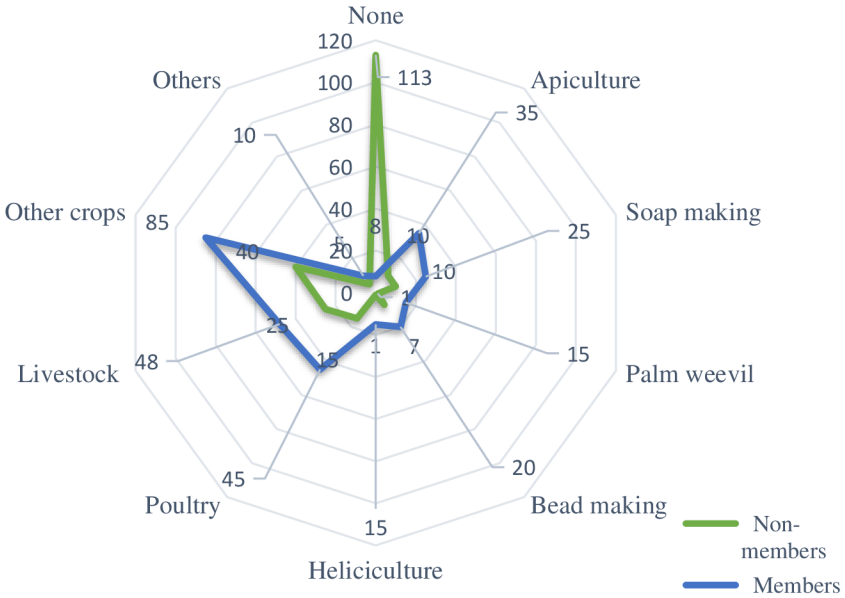

Figure 4 - Adopted ALS (number of farmers)

5.2 **Factors that influence cooperative participation**

Determinants of membership for IPWRA and PSM was analyzed in Stata. Number of observations analyzed were from all 416 respondents. The pseudo R^2 value (0.52) demonstrates a very good fit model. Table 2 is a summary of the results.

According to the results, distance and land ownership both had a significant influence on one's decision to join a cooperative. Distance had a negative significant influence; meaning that the longer the time spent to get to cooperative meeting grounds, the less likely individuals are to join groups. In addition, land ownership had a positive significant influence.

According to the table of results, extension, credit and information also had a significantly positive influence on membership. This implies that, the more access farmers had to extension, credit and information, the more willing they were to join a farmer group. Farmers' perception about reciprocity also had a positive significant influence on cooperative participation.

Table 2 - Determinants of cooperative participation

Participation	Coefficients	Z
Gender	-0.11	-0.61
Age	0.01	1.62
Distance	**-0.05**	**-3.40*****
Farm size	-0.08	-1.41
Land ownership	**0.44**	**2.16****
Extension	**0.57**	**8.29*****
Credit	**0.00**	**4.37*****
Trust	-0.19	-1.60
Reciprocity	**0.22**	**2.21****
Capacity building	0.03	0.28
Acceptance	0.05	0.44
Information	**0.57**	**3.53*****
_constant	**-4.48**	**-5.48*****
Probit regression	No. of observations	416
	LR chi2(12)	297.48
	Prob > chi2	0.0
Log likelihood = -139.02692	Pseudo R2	0.52

Note *** and ** represents 1% and 5% respectively; robust standard error reported

5.3 **Test of matching quality**

Figure 5 describes matching between the groups (members and non-members). According to graph, 70 respondents from the treated group (members) did not find an appropriate corresponding match in the control group (non-members) hence were omitted from the analysis (Off support). This off support group is indicated with the green bar in Figure 5. However, all remaining 346 respondents; 197 non-members and 149 members were appropriately matched according to their propensity scores and used for the purpose of this study in objective 1 (IPWRA) and objective 2 (PSM).

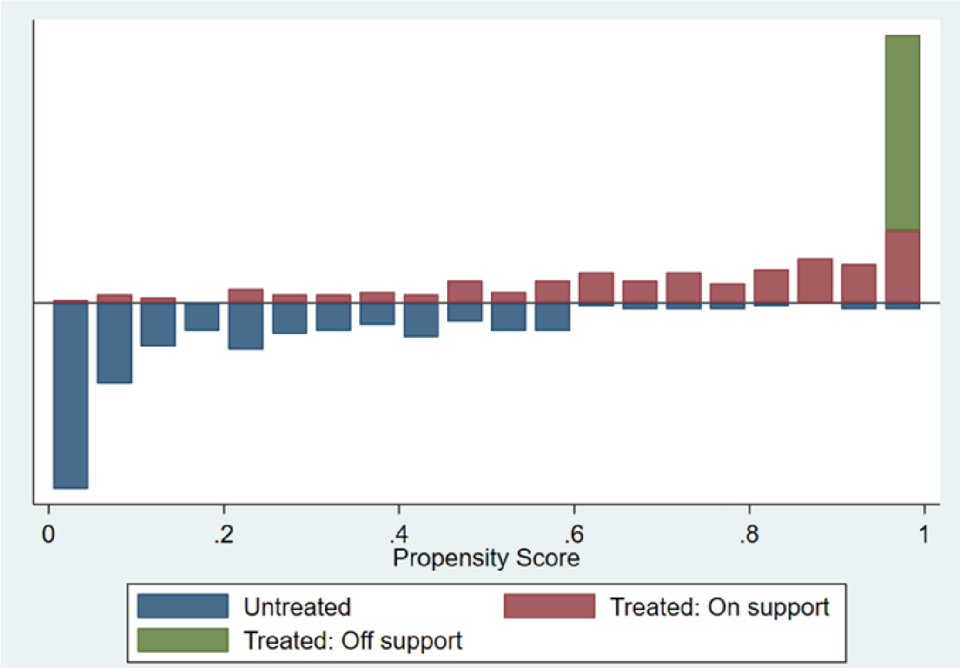

Figure 5 - PSM graph

5.4 **Results 1 – Adoption of ALS (IPWRA)**

In Table 3**,** the estimated potential outcomes shows the probability of adoption of ALS by members and non-members. According to the table, non-members have a 0.41 probability of adopting an ALS whiles members have a 0.98 probability of adoption.

The estimated average treatment effect in the population (ATE) was estimated at 0.41 (41%). ATE represents the average difference in adoption between members and non-members in the entire population that is being studied. In other words, it gives the average difference in adoption of members or non-members if both groups (entire population) were members of cooperatives and if both groups (entire population) were not members.

More importantly, the estimated average treatment effect on the treated (ATT) according to Table 3 was 0.39 (39%). This gives the average difference between adoption rate of members and adoption rate if the same members group were non-members. In other words, ATT estimates the causal effect of membership on the outcome of members. ATT clearly gives the results that we are looking for, as it explains exactly what effect membership had on members adoption.

ATE estimates the average treatment effect for the entire population, while ATT estimates the average treatment effect for the treated group only.

Table 3 - IPWRA results

	Adoption of ALS	Coef.	Std. Err.	z
Estimated potential-outcome means	Members	0.98	0.01	***118.02
	Non-members	0.41	0.04	***10.33
	(Members vs Non-members)	0.57	0.04	***14
Estimated average treatment effect in population (ATE)	(Non-members)	0.41	0.04	***10.33
Estimated average treatment effects on the treated (ATET)	**(Non-members)**	**0.39**	**0.05**	***7.55**

Note: ***,**, and * represents 1%, 5% and 10% significance levels respectively

Table 4 shows the results from a probit regression model to estimate other factors that influence adoption of ALS. According to the table, household size had a negative influence on adoption as well as access to information. Perception about benefits of ALS had a positive

influence on adoption. This means that respondents who knew of the benefits of adoption are more willing to venture into an ALS. Similarly, knowledge about climate change also positively enhanced ALS adoption as presented in the table. Cooperative membership also showed a strong positive impact on adoption of ALS as already established with IPWRA above in Table 3.

Table 4 - Factors that influence ALS adoption

Variable	Coefficient	z
Age	0.00	0.15
Gender	-0.15	-0.82
Household size	**-0.09**	**-1.95***
Education	0.06	1.42
Experience	0.01	0.51
Farm size	-0.08	-1.46
Land ownership	-0.18	-0.92
Productivity	0.00	0.31
Access to credit	0.00	0.16
Access to information	**-0.18**	**-2.07****
Perception about ALS	**0.35**	**2.12****
Climate change awareness	**0.83**	**2.61*****
Access to extension	0.06	0.96
Labor	0.03	0.27
Cooperative membership	**2.06**	**7.47*****
_cons	-1.42	-1.43

Probit regression	Number of obs	416
	LR chi2(15)	189.22
	Prob > chi2	0
	Pseudo R2	0.3772

Log likelihood = -156.20624

Note: ***,**, and * represents 1%, 5% and 10% significance levels respectively

5.5 **Results 2 - Impact of Cooperative Membership on Productivity**

According to Table 5, when the two groups - treated and control (members and non-members) were unmatched, the difference between the two groups was 197.31kg/ha. After using different PSM algorithms; nearest neighbor, radius caliper and kernel bandwidth to match, the average difference between the treated and control groups was 154kg/ha, 132kg/ha and 148kg/ha respectively as is shown in Table 5.

Table 5 - PSM match estimates of impact of cooperatives on productivity

	Match Algorithm	Observed Coef.	Treated	Control	Diff	Bootstrap Std. Err.	z
Product -ivity (kg/ha)	Unmatched	197.31	580.08	382.76	197.31	20.39	9.68***
	Nearest neighbor	154.96	581.45	426.48	154.96	48.58	3.19***
	Radius Caliper	132.72	581.45	448.72	132.72	42.29	3.14***
	Kernel bandwidth	148.83	580.08	431.25	148.83	55.05	2.68***

Note: ***,**, and * represents 1%, 5% and 10% significance levels respectively

5.5.1 Rosenbaum bounds sensitivity analysis

Table 6 is a test of sensitivity of PSM. This indicates the degree to which conclusions made about the impact of cooperatives on productivity would be altered by hidden biases of various magnitudes. According to the table, the impact analysis is not affected by hidden bias from gamma 1-2. However, at gamma 2.5 and more, there is effect of hidden bias in the impact analysis. This justifies the need to consider other factors that may influence productivity.

Table 6 - Rosenbaum sensitivity analysis

Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
1	4.50E-09	4.50E-09	151.255	151.255	101.93	195.425
1.5	0.000106	5.60E-16	97.26	199.825	47.41	250.205
2	0.009291	0	61.105	236.847	11.665	292.045
2.5	0.090021	0	33.52	264.125	-18.495	326.39
3	0.299533	0	13.825	289.71	(-40.22)	352.26

Drawing from the Rosenbaum sensitivity analysis, the impact of other variables on productivity is assessed using a linear regression model. Table 7 shows factors that influence productivity. Age and farm size had a negative significant influence on productivity whiles household size and experience had a positive significant influence on productivity. Likewise, the higher the experience of farmers the higher productivity was. Other variables such as fertilizer applied and extension services received also showed a positive significant influence on productivity as well as cooperative membership

Table 7 - Factors that influence productivity

Variables	Coefficient	t
Age	**-2.60**	**-2.33****
Gender	20.41	0.99
Household size	**17.35**	**3.66*****
Education	1.60	0.37
Experience	**3.95**	**2.76*****
Farm size	**-44.42**	**-7.54*****
Labor	7.27	0.54
Fertilizer	**28.27**	**3.72*****
Land ownership	28.25	1.26
Extension	**9.52**	**1.89***
Credit	0.00	-0.19
Hybrid	12.96	0.60
Age of tree	-1.79	-1.27
Information	14.86	1.38
Adoption of ALS	7.53	0.30
Cooperative Membership	**86.95**	**2.71*****
_cons	326.55	4.68
Linear regression	Number of obs =	416
	F(16, 399) =	14.41
	Prob > F =	0
	R-squared =	0.3663
	Adj R-squared =	0.3409
	Root MSE =	186.47

Note: ***,**, and * represents 1%, 5% and 10% significance levels respectively

6. DISCUSSION

The study looks into the benefits that cooperatives or farmer associations offer to its members by establishing the impact of membership on the adoption of additional livelihood strategies (ALS) and cocoa farm productivity. In order to control for other factors, we looked at other characteristics that are important for farmers' adoption of ALS or for their yield. Comparing members of cooperatives or farmer associations (members) to non-members, we established the effect of membership using two treatment effect method; IPWRA and PSM. These methods were chosen because of their ability to limit observable selection bias. To further understand how adoption of additional livelihood and productivity is influenced, regression models (probit and linear) were also used to include other explanatory variables that may influence our main outcome variables.

Owing to the vibrant activities of local government, non-governmental organizations (NGOs), cooperatives and other organizations, smallholder farmers in the study area often adopt ALS at a high rate. Via these stakeholders, farmers learn about new livelihood options that could provide a variety of revenue streams for themselves and their families. According to the study's findings, many farmers in the district engage in livestock, poultry and crop-based ALS. This is because farmers have easier access to the land and other resources necessary to start these additional income-generating ventures. Due to trainings from various organizations and the government, beekeeping, soap making, bead making, and palm weevil production are widely practiced in the region as well.

Comparatively, our results indicate that the cooperative members have a greater adoption rate than non-members. This was also identified by Amfo & Ali (2020) and Frimpong-Manso & Bakang (2022). Members' access to their respective groups' information and support services is likely reason behind this. It is less risky for members to adopt ALS since extension agents who instruct them on which ALS to adopt are easily accessible to provide support in the event that there are any difficulties. Non-members are forced to rely on any knowledge they can obtain from anywhere and they lack prompt assistance from extension agents. Members also benefit from farmer-to-farmer learning from other members who adopt a similar form of ALS in their respective groups. Although spillover effect within the neighborhood and even farmer-to-farmer learning could be beneficial for non-members, it is always easier for members to learn from one another in the same group hence the difference in adoption rates.

In considering other characteristics of membership that influences adoption, both members and non-members admit that merely being a part of a group inspires adoption. According to some respondents (members mostly), their willingness to adopt was greatly influenced by the fact that their group members were interested in the ALS that were taught by extension agents, and this inspired interest. Other respondents who had not adopted any ALS also admitted that it was out of fear of failure, lack of information and less motivation to start. Other factors identified from the probit regression model indicate that adoption was significantly influenced by household size, access to information, perceptions of ALS, and understanding of climate change.

The household size had a significant adverse effect on the adoption of ALS. Farmers with larger households were less interested in adopting an ALS and vice versa. It was determined from the study that the majority of households only had one primary bread winner for the family regardless of the size of the household. Smallholder farmers who therefore had larger households and hence more dependents were less inclined to adopt an ALS. This is understandable because those farmers had less money to set aside and invest in new and probably capital-intensive businesses. Some scholarly works that also found household size as negatively affecting adoption for similar reasons are: Croppenstedt et al. (2003), Kafle & Shah (2012) and Challa & Tilahun (2014).

The availability of information also affected the adoption of ALS. The regression results indicate that the adoption of ALS decreases with access to information. The negative results of the regression might indicate that though farmers have access to information, often times the information can be less motivational, irrelevant or communicated poorly. For instance, farmers in the outlying towns of *Ango, Desereagya and Sabronum Camp* expressed concerns about having to compete with other farmers who had adopted certain ALS (beekeeping and soap making) and were closer to the metropolitan centers. These remote farmers were less motivated as they believed that they would not survive in the market when it comes to selling their products. This suggests that their knowledge of ALS and even the success of other smallholder farmers in the trade prevented them from adoption because they believed they could not compete in price with other farmers in nearby areas. Similarly, Amfo & Ali (2020) pointed out that information from Ghana meteorological services geared towards enhancing adoption of diversification

strategies had a negative influence on adoption of farmers. They associated the outcome with insufficient and irrelevant information.

A considerable beneficial impact on adoption was also shown to be caused by smallholder farmers' perceptions of ALS. Farmers adopted ALS in greater numbers as they came to believe that it was good for themselves, their families, communities and their environment as was also noticed by Abdollahzadeh et al. (2015) and Ntshangase et al. (2018) in their study. This is because NGOs, the government, cooperatives and other groups educate smallholder farmers about the benefits of income diversification, including how it raises household income and fosters long-term rural development. From the field survey it was noticed that farmers who did not adopt any ALS for one or more reasons, did not believe that income diversification was essential. They rather claimed to be already preoccupied with their cocoa farms and perceived ALS as a distraction.

Another key factor that positively influenced adoption of ALS was awareness of climate change. Farmers who were knowledgeable about the persistent change in the climate were more inclined to venture into income diversification opportunities. This is consistent, for instance, with findings from Amfo & Ali (2020) who discovered that majority of cocoa farmers in Ghana diversify from cocoa farm income as a strategy to reduce impact felt from climate change on their crops (low productivity). According to Amfo & Ali (2020) these farmers usually diversified into livestock production, non-farm activities and other crops that they perceive more resistant to the adverse climatic change. Most farmers shared painful experiences in “failed” rain and extreme drought. This influenced many farmers to consider parting with portions of their lands in order to raise capital to launch additional and/or alternative businesses.

Deducing from our results, productivity is significantly higher for members than for non-members when both groups are either unmatched or matched using various PSM algorithms. The results reveal that members produce more yield per hectare of land when compared to non-members. According to Calkins & Ngo (2010), Foundjem-tita et al. (2016), Kehinde & Ogundeji (2022) and Frimpong-manso & Bakang (2022) strong agri-cooperatives do play an important role in helping resource-poor smallholder cocoa production. This is because members have access to information, extension and farm inputs, which play a key role in productivity. Cooperatives ensure that their members are trained on good productive farming practices and member farms are visited by extension officers frequently Frimpong-manso & Bakang (2022).

Members also have access to certified farm inputs at relatively reasonable prices through cooperatives.

Cooperation among cooperatives also induces horizontal learning among members. It was observed from the survey that due to the labor intensive and time sensitive nature of cocoa farming and its activities, cooperation was especially necessary for farmers with limited resources to hire labor at critical moments. For instance, during various periods of the year when labor is needed the most, cooperative members join together to perform time-sensitive activities such as pruning, harvesting, pod breaking and weeding from one farm to the other until every member's farm is visited and activities are completed at once. On the other hand, non-members waste more time to perform similar activities. However, if delayed, these activities drastically reduce overall yield and productivity.

Finding other factors that influence productivity was justified after the Rosenbaum sensitivity analysis was performed for the PSM. According to the linear regression, other factors besides cooperative membership that influenced productivity were age, farm size, household size, experience, fertilizer and extension as was also confirmed by (F. & K. 2013; Kehinde & Ogundeji 2022; Suh & Molua 2022).

Age and farm size had a negative impact on productivity. This implies that older respondents were less likely to be productive than their younger counterparts. This makes sense considering that smallholder cocoa growers typically have strength and any additional assistance from their households complements their efforts. However, older farmers find it challenging to maintain their cocoa farms. Adeniyi & Ogunsola (2014) agrees that aged farmers imply labor unavailability and younger farmers are more likely to be productive than the older ones. Aneani et al. (2012) also predicted that age would have a negative effect on adoption of new technologies, which in effect affected productivity in his study.

Farmer productivity decreased with the size of their farms. This finding contradicts the conventional production function that explains that output will rise as factors of production increase (Sheng & Chancellor 2019). Kongor et al. (2018) however found that larger farm sizes also reduce productivity due to inability to maintain these farms. In our study, due to the stigma Ghanaian agriculture still has, farmers are usually older; 50.06 years (members) and 48.06 years (non-members). Younger members of the cocoa communities usually migrate from rural areas immediately when they have the opportunity to do so. As a result, larger farm owners do not

have enough labor from at their immediate support group (family) (Kongor et al. 2018). As was previously established, cocoa farming requires intense labor, and productivity is greatly impacted by labor shortages.

Household size and experience also influenced productivity positively according to the linear regression model. The productivity increased with household size and with experience. This result is explained by the fact that larger households have higher labor force to support farming activities as was also discovered by other authors (Amos 2007; Kyei & Foli 2011; Wiredu & Mensah-bonsu 2011). Experience also influenced productivity positively as is in line with literature. Farmers with longer cocoa farming experience develop expertise and understanding in basic needs of the farm and how to take care of it. For instance, the mere ability to spot the right time to harvest and employ good post-harvest practices can improve the quality and quantity of harvest (yield) immensely (CRIG 2020). Experienced farmers also tend to reduce wastage in terms of both input used and harvested products.

With an increasing amount of fertilizer applied, productivity increased. This is in line with findings from others (Edwin & Masters 2005; Wiredu & Mensah-bonsu 2011; Nunoo et al. 2014; Kongor et al. 2018). The more farmers have access to fertilizer the more they were able to optimize productivity. Fertilizer use is very important, as it is associated with at least 19% higher cocoa yield (Edwin & Masters 2005). Extension also displayed a significant positive impact on productivity. This means that the training and education delivered to farmers enhanced productivity and the lack thereof implied less productivity. In the Ghanaian cocoa industry, majority of farmers are generally older as earlier established in previous paragraphs. As a result, farmers are accustomed to antiquated practices that must be modified to accommodate current agricultural advancements. Extension is therefore essential to coach and help improve productivity among farmers. Older farmers, for instance, who are not accustomed to appropriate agroforestry, do not effectively incorporate valuable shade trees on their farms. On such farms, the amount of shade trees were either excessive, insufficient, or trees were not desirable for shade management. Effective shade control in cocoa plantations yet shows a noticeably high potential in cocoa output improvement (FORIG 2021).

Our overall research question recognizes that productivity and adoption of ALS have a reciprocal relationship. This is the main reason for studying these two outcomes in parallel research design. The more productive famers are, the more they are expected to venture into

other businesses, which can generate additional income for themselves and their families. Similarly, with higher disposable income, farmers are expected to be more productive as they have more to spend on managing their cocoa farms to enhance productivity. However, in this study there was no significant relationship between the two variables of interest; productivity and ALS. This however could be because farmers are not profitable enough from either one of their business (cocoa or ALS) to support the other.

7. CONCLUSION AND RECOMMENDATION

The current attention that the sub-Saharan African cocoa sector has received is a significant step toward sustainable production and improvement in the standard of living for farmers. This calls for the establishment of sector that is coordinated, collaborative and profitable. In Ghana, cooperatives and other collective actions provide a platform for the sharing of knowledge, cooperation, training and a significant amount of community care. In order to comprehend the influence on smallholder farmers in terms of livelihoods and cocoa farm yield, the impact of cooperatives and organized farmer groups was examined in this study.

The probit regression model was employed to estimate propensity scores by determine the factors influencing cooperative membership. In order to evaluate the effect of membership on adoption of ALS of smallholder cocoa farmers, the inverse probability weighted regression method was used. This method checks observable bias through assignment of propensity scores and matching in order to create an experiment-like (true random) data set. Probit regression model was used to further assess other factors that could also affect adoption.

The results of IPWRA shows that membership was crucial to adoption of additional livelihood strategies. Other factors that enhanced adoption were: perception about additional livelihood strategies and awareness of climate change. Household size and access to information also affected adoption.

In assessing the impact of membership on productivity, three (3) propensity score-matching algorithms were used. All demonstrated that membership indeed enhanced productivity of smallholder farmers. Upon further analysis by considering other factors that influence productivity, it was confirmed that household size, fertilizer applied and extension services cause also enhances productivity, but age and farm size have a contrary effect.

Based on the study's findings, we advise the government and other interested parties to invest more in cooperatives and farmer groups to enhance profitability of cocoa farming and encourage involvement in ALS. This in our opinion, will guarantee increased economic, social and environmental sustainability of the cocoa sector. By financial support and technical assistance to the existing groups, smallholder farmers must be encouraged once more to join ALS. Markets for the skills trained under ALS should be developed to promote fair and healthy competition. Farmers will then tend to believe that they can survive in the market regardless of where they are or how much money they have to adopt and ALS.

Together with timely extension services, the government and other stakeholders should invest in providing smallholder farmers with high-quality agricultural supplies. Smallholder farmers should be encouraged to view farming as a profitable business and to encourage their children to pursue careers in the industry from a contemporary point of view. This will hasten cocoa and agricultural information technology development. The government should also establish easier and transparent farmland leasing policies to inspire farmers who are unable to maintain their cocoa fields to rent out their lands.

All these efforts have to be combined with policy initiatives from the EU, NGOs, Chocolate makers and other cocoa traders to improve the value and position of cocoa farmers in the international supply chains. Customers and/or consumers should also be informed about the challenges of the cocoa industry and be encouraged to support sustainably produced cocoa and its products (ethically labelled products) through their patronage.

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9. ANNEX

9.1 Annex 1: QUESTIONNAIRE

Dear sir/madam, this questionnaire will take only a few minutes. The process will take only a few minutes to talk to you about your cocoa business in general. I will be in charge of the process but you will be in charge of the content. Please be assured that this information will be strictly confidential and will only be used for academic purposes. Thank you.

Location and Biography

1. Name of Cocoa community…
2. Is there a cooperative in the community?
3. Do you have friends and/or family in your cooperative?
4. Distance from house to cooperative meeting grounds (minutes of walk)

Socio-economic characteristics

5. Age of respondent in years……
6. Gender …… [1] male [0] female
7. Where do you stay…….. [1] hamlet [2] community [3] other, specify
8. Household size……
9. Is there electricity in this community? ..... [1] yes [0] no
10. Do you own a TV/radio in your household…… [1] yes [0] no
11. Years of formal education (in years)…
12. How long have you been into cocoa farming (in years)…

Farm characteristics

13. What is your cocoa plot size (in acres)…
14. Are you the owner of your farm ? [1] yes [0] no
15. Do you have hybrid cocoa plants on your farm? [1] yes [0] no
16. What is the age of your farm?
17. How much cocoa beans did you harvest during the last cocoa season from your farm (in bags)

Cooperative Status

18. Are you a member of any cocoa cooperative or FBO?……..[1] yes [2] no
19. How would you rate your level of activeness in the cooperative's activities on a scale of 1-10? Highest is 10
20. How well do you feel recognized as an active member of your cooperative; on a scale of 1-10? Highest is 10

Additional livelihood

21. Are you aware of climate change? [1] yes [0] no
22. If yes, from where? [1] government [2] TV/radio [3] internet [4] cooperatives [5] friends and family
23. Are you aware of any additional livelihood practice? [1] yes [0] no
24. Have you adopted any form of additional livelihood to complement your cocoa farm – as taught by the government, cooperative or through any other medium? [1] yes [0] no
25. How did you learn these additional livelihood skills? [1] government [2] TV/radio [3] internet [4] cooperatives [5] friends and family

Please Indicate Your Level Of Agreement With The Statement Related To Trust In Your Community.

Trust Statements

26. Most people in my community, farmer association or cooperative can be trusted. [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree
27. Most people in my community, farmer association or cooperative have trust in me [ ] Strongly Disagree [ ] Partly Agree [ ] agree nor disagree [ ] Partly Agree [ ] Strongly Agree

Reciprocity Statements

28. If I work hard, I expect it will be repaid [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree
29. To help somebody is the best strategy to be certain that s/he will help you in the future [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree
30. If someone does a favor for me, I am ready to return it [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree

31. The way I treat others depends much on how they treat me. [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree

Education, Training and Information

32. Access to information about good agricultural practices has improved over the last 3 years. [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree
33. Service from extension agents have improve over the last 3 years [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree
34. Access to relevant market information have improved over the last 3 years [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree
35. Opportunity for further training has increased over the last 3 years [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree
36. You have better chance to mutually share experience with other farmers than 3 years [ ] Strongly Disagree [ ] Partly Agree [ ] Neither agree nor disagree [ ] Partly Agree [ ] Strongly Agree

9.1 **Annex 2 - Test of Multicollinearity**

Pearson square correlation matrix was performed to test multicollinearity between the variables used in the models in this study. In all tables (table 1 and table 2), none of the correlation matrix shows a value greater than or equal to 0.8 or less than or equal to -0.8 **($-0.8 \leq X \leq 0.8$).** This means that all variables used in the models are independent of each other enough to be used to estimate parameters for the model. Table 8 and Table 9 are for regression models used to assess other factors that influenced ALS (obj 1b) and productivity (obj 2b) respectively.

Table 8 - Pearson Test of correlation – probit regression model (obj 1b)

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
1-Distance	1.00												
2-Age	-0.18	1.00											
3-Gender	-0.05	0.01	1.00										
4-Education	0.06	-0.16	0.06	1.00									
5-Farm size	-0.09	0.16	0.26	-0.16	1.00								
6-Land ownership	0.04	0.17	-0.18	0.02	-0.06	1.00							
7-Access to extension	0.01	-0.01	0.02	0.13	-0.03	0.23	1.00						
8-Access to credit	-0.01	-0.01	-0.05	0.02	0.02	0.12	0.25	1.00					
9-Reciprocity	0.13	-0.06	0.00	0.02	-0.05	-0.08	0.03	0.07	1.00				
10-Trust	-0.04	0.04	-0.08	-0.08	0.13	0.15	0.12	0.15	0.17	1.00			
11-Capacity building	-0.02	0.06	0.04	0.01	0.08	0.00	0.31	0.21	0.20	0.33	1.00		
12-Access to Information	-0.13	0.08	0.10	0.05	0.06	-0.08	0.27	0.13	0.12	0.23	0.63	1.00	
13-Acceptance	-0.03	0.07	0.09	-0.01	0.05	-0.06	0.21	0.15	0.21	0.28	0.71	0.68	1.00

Table 9 - Pearson test of correlation - linear regression (obj 2b)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1Age	1.0															
2Gender	0.0	1.0														
3Household size	0.0	0.0	1.0													
4Education	-0.2	0.1	0.0	1.0												
5Experience	**0.7**	0.0	0.0	-0.2	1.0											
6Farmsize	0.2	0.3	0.1	-0.2	0.3	1.0										
7Landownership	0.2	-0.2	0.0	0.0	0.2	-0.1	1.0									
8Labour	0.1	0.0	0.0	0.0	0.1	0.1	0.0	1.0								
9Fertilizer application	0.0	-0.1	0.1	0.1	0.0	-0.1	0.1	0.0	1.0							
10Accesstoexension	0.0	0.0	0.1	0.1	0.1	0.0	0.2	-0.1	0.3	1.0						
11Accesstocredit	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.2	1.0					
12Hybrid	-0.1	0.1	0.0	0.2	-0.1	0.0	0.0	-0.1	0.3	0.2	0.1	1.0				
13Ageoftrees	0.3	0.2	0.1	-0.1	0.3	0.2	-0.2	0.1	-0.2	-0.3	-0.2	-0.1	1.0			
14Accesstoinformation	0.1	0.1	0.0	0.1	0.1	0.1	-0.1	-0.1	0.2	0.3	0.1	0.1	0.0	1.0		
15Als participation	0.0	-0.1	-0.1	0.2	0.1	-0.1	0.1	0.0	0.3	0.4	0.2	0.2	-0.2	0.1	1.0	
16Coop participation	0.1	0.0	0.0	0.2	0.2	0.0	0.3	0.0	0.5	0.6	0.3	0.4	-0.3	0.3	0.6	1.0