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International Cooperation in Agricultural and Rural Development

Determinants of off-farm livelihood diversification from cocoa farmers in Ghana

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DECLARATION

I do hereby declare that all text in this bachelor's thesis entitled "Determinants of off-farm livelihood diversification from cocoa farmers in Ghana" is original, and independently written. All sources have been cited and acknowledged using complete references, thus, according to the Citation Rules of the Faculty of Tropical AgriSciences.

In Prague, 14th April 2023

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Theophilus M. Larbi

Dedication

I dedicate this thesis to the most important people in my life: **Jana, Paul, Sally, Donald, and my siblings.**

Jana and Paul, thank you for always being my source of inspiration and motivation. Your unwavering support and encouragement have been instrumental in my academic journey. Your love and guidance have helped me overcome countless challenges and obstacles. Without you, I don't know how things would have been. Indeed, you are God sent.

Sally, thank you for being my confidant and friend throughout my years of study. Your listening ear and wise advice have been invaluable to me. I am grateful for your unwavering support and encouragement.

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To my siblings, thank you for always being there for me. Your love and support have been my anchor during the ups and downs of my academic journey. I am grateful for your unwavering support and encouragement. This thesis is as much yours as it is mine. Thank you for being a constant source of love and support.

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Abstract

This study examines the determinants of off-farm livelihood diversification from cocoa farmers in Ghana. The study's objective is to identify the factors that influence cocoa farmers' decisions to engage in off-farm activities and the impact of these activities on their household income. Diversification strategies included intercropping, crop and livestock diversification, and off-farm activities related to agriculture. Data were collected through interviews with 50 cocoa farmers in the Ahafo Ano District Council in Ghana, and the data were analysed using descriptive statistics, regression analysis, Mean Rank, Mann-Whitney U test, and the Wilcoxon test. The findings suggest that age, farming experience, and land ownership are significant factors that influence cocoa farmers' decision to engage in off-farm activities. The study also found that off-farm activities positively impact household income, which suggests that off-farm livelihood diversification can be an effective strategy for improving the economic well-being of cocoa farmers in Ghana. The study recommends the provision of financial credits, farm input subsidies, and farmers' training to enhance diversification strategies in Ghana's cocoa sector.

Keywords: Off-farm job, income, diversification, Cocoa, livelihoods, smallholder, Ghana.

Contents

1	Introduction.....	1
2	Literature Review.....	3
2.1	Agriculture in Ghana.....	3
2.2	Cocoa Cultivation and Harvesting	4
2.3	The cocoa sector in Ghana	5
2.4	Trade in cocoa and cocoa products	6
2.5	Government support and promotion of Cocoa production in Ghana	8
2.5.1	Extension services in Ghana	8
2.5.2	Cocoa marketing	9
2.5.3	Agricultural Farmers Groups	10
2.6	Livelihood Diversification Theory.....	11
2.7	Human Capital Theory	12
2.7.1	The socioeconomic features of cocoa farmers.....	12
2.7.2	Sources of income among cocoa farmers	13
2.7.3	Off-farm income livelihood diversification	14
2.7.4	The factors influencing off-farm livelihood diversification.	15
3	Aims of the Thesis	18
3.1	This study aims to investigate the factors that lead to off-farm livelihood diversification from cocoa farmers in the Ahafo Ano District.	18
3.2	The specific objectives	18
4	Methodology.....	19
4.1	Study area.....	19
4.1.1	Climate.....	20
4.2	Survey Sampling Process	20
4.3	Data Collection Procedure	20

4.4	Data analysis	21
5	Result and Discussion	22
5.1	Objective 1: To determine the socioeconomic factors affecting off farm among cocoa farmers.	24
5.2	Objective 2: To determine the influence of off farm jobs on income diversification and output.	25
5.3	The challenges in cocoa production	27
5.4	Limitations to the research	30
6	Conclusion and recommendation.....	31
7	Reference	32
8	Appendix.....	43
8.1	Questionnaire	43

List of figures

FIGURE 1. SHARE OF GHANA'S ECONOMIC SECTORS IN THE GROSS DOMESTIC PRODUCT (GDP) FROM 2011 TO 2021.....	4
FIGURE 2. GHANA'S COCOA INDUSTRY'S CONTRIBUTION TO THE COUNTRY'S GDP FROM 2014 TO 2025.....	6
FIGURE 3. QUANTITY OF COCOA BEANS EXPORTED FROM GHANA 2010-2020.	8
FIGURE 4. A MAP OF THE ASHANTI REGION, GHANA, SHOWING THE 27 ADMINISTRATIVE DISTRICTS. (FRIMPONG AND OFORI-KWAKYE 2016).....	19

List of tables

TABLE 1: DESCRIPTIVE STATISTICS OF VARIOUS VARIABLES (N = 50)	22
TABLE 2. DESCRIPTIVE STATISTICS OF CATEGORICAL VARIABLES (N = 50)	23
TABLE 3: CLASSIFICATION TABLE (N = 50)	24
TABLE 4: REGRESSION MODEL (N = 50)	25
TABLE 5: RANKS (N = 50)	26
TABLE 6: MANN-WHITNEY U AND WILCOXON TEST (N = 50)	27

Abbreviations

COCOBOD	Ghana Cocoa Board
CMC	Cocoa Marketing Company
CSSP	Cocoa Sector Support Program
FAO	Food and Agriculture Organization
GAP(s)	Good Agricultural Practice(s)
GDP	Gross Domestic Product
ICCO	International Cocoa Organization
LBC	Licensed Buying Companies
NGOs	Non-governmental Organizations
PBC	Produce Buying Company Limited
QCC	Quality Control Company
SAP(s)	Sustainable Agricultural Practice(s)
USD	United States Dollar

1 Introduction

Many risks (climate, pests and diseases, price volatility, policy changes) are involved with relying on farming as a source of income (Harvey et al. 2014). This issue is especially severe in countries in sub-Saharan Africa, like Ghana, where effective long-term mitigation measures have had average results. One of the more critical risk-mitigation measures available is income diversification, which refers to increasing the number of sources of income or balancing different sources of income (Wan et al. 2016). In an agricultural economy, income growth can come from various sources. In Africa, farm households—those whose primary source of income is the production of crops and/or livestock—have diversified their sources of income inside and beyond the agricultural sector to escape the adverse effects of poverty (Anang and Adomako 2019). Specifically, this aims to address their lack of financial security and access to food. Income diversification can be achieved by producing a diverse of crops and/or engaging in off-farm employment. Crop diversification refers to the cultivation of multiple crops simultaneously (Reckling and Ewert 2020). It also has concerns about the switch from agriculture for subsistence to agriculture for profit. Jinhong (2016) believes that farm households can increase their revenue through diversification to meet their immediate requirements, expand their operations, and engage in non-farm activities (food, shelter, health care, payment of school fees).

In 2021, more than 3.5 million Ghanaians lived in extreme poverty, with the daily poverty level at \$1.90 USD (Maja and Waarts 2021). As well as a high prevalence of poverty, most rural areas in Ghana specifically have poor infrastructure, low levels of urbanization, low population density, and a significant agricultural sector. In addition to rapid economic growth, any development plan for these areas must include a sustained and widespread increase in household income through diversification (Yuca and Giller 2021).

Most of the cocoa consumed worldwide is produced by smallholder farmers, whose livelihoods primarily rely on the sales of cocoa beans. While many factors impact its profitability, only some of which cocoa farmers and communities can control, cocoa is one of the most attractive livelihood possibilities in rural areas (Bashir and Ahmad 2017).

Some cocoa farmers also intercrop, growing other crops on different fields for their consumption and for sale, or work off-farm to boost their household incomes (Jiska and Slingerland 2021). Under the government's agricultural diversification policy, the Ghana Cocoa Board (COCOBOD) has emphasized the importance of cocoa farmers diversifying their household income sources (Ken 2021). The high price of agricultural inputs impacts on farmers' ability to make a living. Farmers are heavily burdened financially by the costs associated with buying fertilizer, farming supplies, pesticides, and labour, which further lowers the profit they can realize from cocoa production. Most cocoa-producing families earn less than the international poverty line (Molua 2022), so one of the biggest problems facing the cocoa industry is poverty. Other difficulties include using exploitative child labour, which results from poverty, destroying forest areas due to cocoa farming, and failing to uphold human rights along the supply chain (Nahanga 2016). According to Verter (2016), the lack of communication between COCOBOD and other parties in the supply chain is another issue facing the sector. Information is distorted as a result, and supply chain parties no longer have an equal connection.

The global cocoa economy is not sustainable due to a number of factors. The price that cocoa farmers get along the value chain is unsustainable because it prevents them from maintaining a reasonable standard of living for themselves and their families (Cilas 2020). Due to farmers not correctly supporting their farms and younger generations of farmers leaving the countryside to move to cities in search of employment, this has led to a problem on the production side. Several initiatives are being undertaken to figure out what the living wage for cocoa farmers should be, how to calculate it, and finally how to implement it within the cocoa value chain (Bastide 2020). Different players in the cocoa business are driving these initiatives. This paper aims to investigate the factors that lead to off-farm livelihood diversification from cocoa farmers in Ghana. The study analysed factors impacting income diversification among cocoa farmers, identified limits to cocoa production in the study area, and studied the socioeconomic features of cocoa farmers in the study area.

2 Literature Review

2.1 Agriculture in Ghana

According to FAO (2021), agriculture plays a vital role in the economy of Ghana, contributing to over 50% of the country's Gross Domestic Product (GDP) and providing employment for about 60% of the population. The main crops produced in Ghana include cocoa, cassava, yam, plantain, maize, rice, and palm oil (Alemayehu et al. 2022). The government of Ghana has made efforts to modernize and increase the productivity of the agricultural sector. This includes implementing policies to improve access to credit, inputs, and markets for small-scale farmers (Baffour 2011). The government has also invested in irrigation infrastructure and the promotion of agribusiness, as well as implementing programmes to increase food security (Pawlak et al. 2020).

However, the sector still faces numerous challenges, including low productivity, limited access to financing, inadequate infrastructure, and a lack of market access. Additionally, the sector is plagued by limited access to extension services, inadequate investment in research and development, and a shortage of skilled labour (Kwarteng and Doss 2017). Several initiatives have been undertaken by various stakeholders, including the government, non-governmental organizations (NGOs), and the private sector, to address these challenges and improve the agricultural sector in Ghana. For example, NGOs have been working to improve access to credit for small-scale farmers, while the private sector has been investing in agribusinesses and improving supply chain management (Yeboah 2018). The agricultural sector in Ghana continues to be an essential contributor to the economy and is critical to the livelihoods of many people in the country. Despite the efforts being made to modernize and increase the sector's productivity, significant challenges still need to be addressed. Ongoing initiatives aimed at improving access to finance, markets, and extension services, and increasing investment in research and development are critical to ensuring the sector's sustainable growth in the future (Amponsah 2021).

According to (**Figure 1**), from 2011 to 2021, Ghana's GDP was divided throughout its many economic sectors. Ghana's total domestic product in 2021 had an agriculture contribution of 19.71%, an industry contribution of roughly 28.26%, and a services sector contribution of about 45.93%.

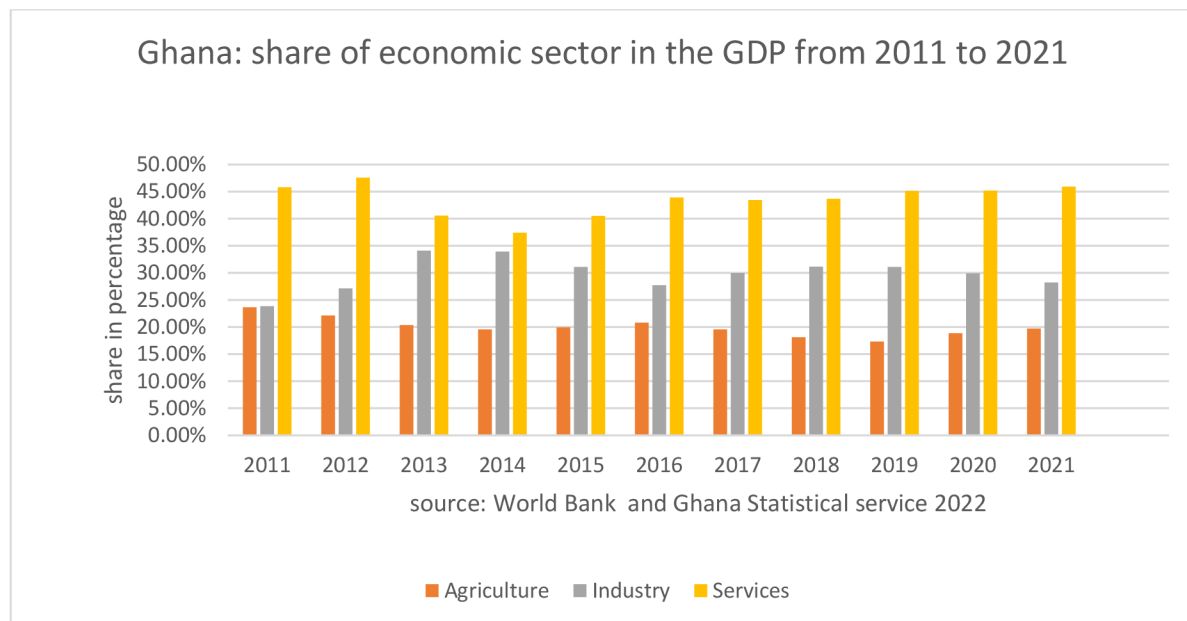


Figure 1. Share of Ghana's economic sectors in the gross domestic product (GDP) from 2011 to 2021.

2.2 Cocoa Cultivation and Harvesting

The first type of cocoa grown in Ghana is the Amelonado variety, which takes longer than five years to yield pods (Samuel 2022). Another variety introduced to Ghana is the Amazonian variety, which typically takes three to four years to produce pods. Later, a hybrid cocoa variety that yields more and matures earlier was also introduced. Cocoa is a crop that is grown permanently on trees with a life cycle of 25 to 30 years (Railton 2022). Depending on the cultivar, cocoa naturally takes three to six years from planting to bear its first pod, and ten years to achieve its full output potential from planting. Cocoa trees thrive in a shaded location with moderately higher temperatures (between 18 and 32 degrees Celsius) and regular rainfall. Rainfall patterns affect cocoa production as well; more important than annual rainfall totals is the average monthly rainfall over the year (Daniel and Julião 2022).

However, heavy rain over 2500 mm annually mainly increases the prevalence of the fungal disease (phytophthora pod rot) that produces the black pod illness and the cocoa swelling shoot disease. To grow cocoa, soils must be deep, well-drained, and sufficiently nutrient- and moisture-rich. The forest vegetation is initially removed from the area to make it suitable for cocoa farming, leaving only a few trees standing. In order to provide cover for the cocoa seedlings during the planting stage, foods like cocoyam and plantain are planted alongside cocoa seedlings. Occasional clearing is all that is needed on cocoa farms to keep weeds under control (Marçal 2022).

The harvesting of cocoa trees occurs twice a year, with the major crop season lasting from October to the end of March and the minor crop season often lasting from May to August (Gerald and Leuschner 2010).

2.3 The cocoa sector in Ghana

Ghana's cocoa sector is an essential contributor to the country's economy, accounting for approximately 5-6% of its Gross Domestic Product (GDP) and providing employment for over 800,000 people (Amaning 2017). Cocoa production is concentrated in the country's Western, Ashanti, and Brong-Ahafo regions, with an average farm size of 2 to 3 hectares. The sector has recently the sector has faced several challenges, including declining yields due to aging trees, pest and disease outbreaks, and poor farmer organization (Asante 2018). Efforts to address these challenges have been made, including implementing the Cocoa Sector Support Programme (CSSP), which aims to increase productivity, improve farmer livelihoods, and promote sustainable agriculture practices. The programme has successfully increased the availability of inputs, such as seedlings and agrochemicals, and provided training and extension services to farmers (Philip and Phil-Eze 2018).

Another important initiative is the establishment of COCOBOD, which has been instrumental in improving the marketing and trade of cocoa in the country (Kuusaana and Adu-Gyamfi 2021). The board has implemented measures to ensure the quality of cocoa beans, such as establishing of a grading system and introducing certification schemes (Hyacinth and Ogonnia 2018). Despite these efforts, the cocoa sector in Ghana continues to face challenges, particularly with regards to farmers' income. This is due to a combination of factors, including low cocoa prices, high production costs, and limited access to credit (Leroy and Darmastuti 2018).

To address this, there have been calls for the government to provide more support to the sector, such as tax incentives, subsidies, and improving infrastructure in cocoa-growing areas (Darmastuti 2018). The cocoa sector in Ghana plays a crucial role in the country's economy and efforts have been made to address the sector's challenges. However, more needs to be done to ensure the sector's sustainability and improve farmers' livelihoods.

In (Figure 2), cocoa was expected to contribute to be approximately 454 million US dollars, to GDP in 2022. In 2020, the value was estimated to be 375 million US dollars. Furthermore, agricultural products were expected to account for approximately 533 million US dollars of the country's GDP by 2025, the highest contribution observed during the period. Ghana produced 850 thousand metric tons of cocoa beans during the 2020/2021 crop season (Doris 2022).

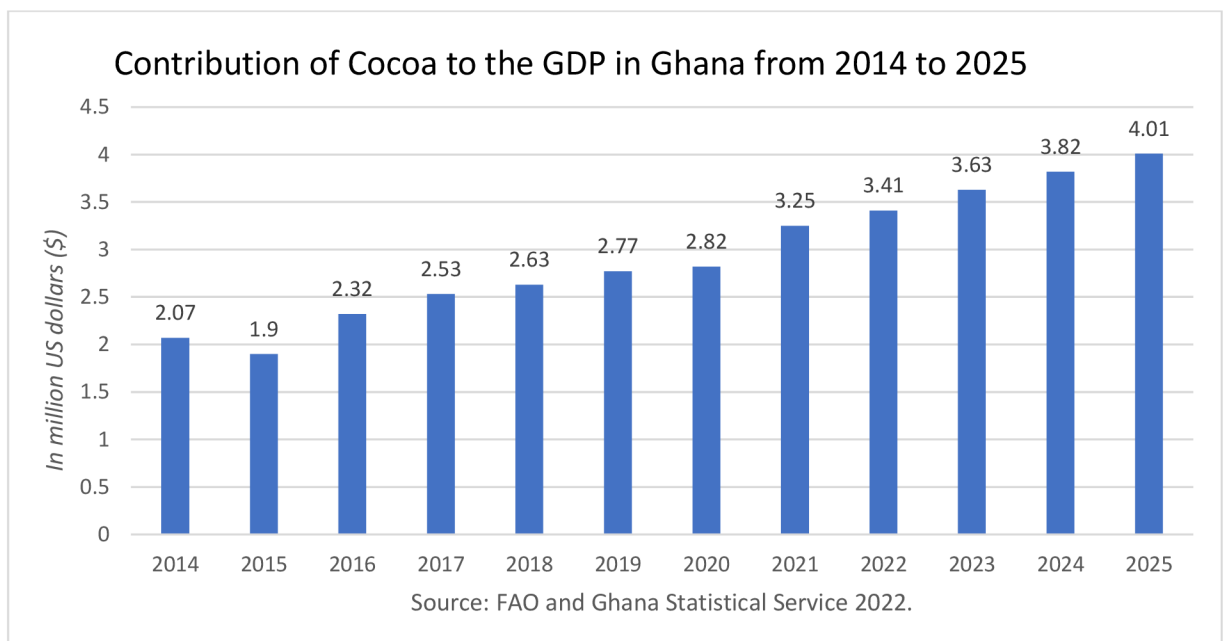


Figure 2. Ghana's cocoa industry's contribution to the country's GDP from 2014 to 2025.

2.4 Trade in cocoa and cocoa products

The trade in cocoa and cocoa products is a significant part of the economy in Ghana, with the country being one of the world's largest producers and exporters of cocoa beans. Cocoa is Ghana's largest foreign exchange earner, accounting for over 25% of the country's total exports.

The country's cocoa industry is dominated by the Cocoa Marketing Company (CMC), which is responsible for purchasing, marketing, and exporting of cocoa beans. The CMC is a subsidiary of the Ghana Cocoa Board, responsible for regulating the cocoa industry in the country (Kwarteng and Asamoah 2021).

The major export destinations for Ghana's cocoa beans are Europe and North America, with the Netherlands, Germany, and the United States being the largest importers. Ghana also exports chocolate and other items made from cocoa, including cocoa butter. A growing demand for organic and fair-trade cocoa products has led to the development of niche markets in Europe and North America.

However, Ghana's trade in cocoa and cocoa products faces several challenges. One major challenge is declining yields due to ageing trees, pest and disease outbreaks, and poor farmer organization. This has led to lower incomes for farmers and a decline in the competitiveness of Ghanaian cocoa in the global market (Kwaku and Monica 2019). To address these challenges, the government of Ghana has implemented several initiatives, such as the CSSP, which aims to increase productivity and improve farmer livelihoods through inputs, training, and extension services (Adom 2011). Another important initiative is the establishment of COCOBOD, which has been instrumental in improving the marketing and trade of cocoa in the country. Despite these efforts, the trade in cocoa and cocoa products in Ghana continues to face challenges, particularly with regard to the income of farmers (Amanor-Boadu 2005). This is due to a combination of factors, including low cocoa prices, high production costs, and limited access to credit. To address this, there have been calls for the government to provide more support to the sector, such as tax incentives, subsidies, and improving infrastructure in cocoa-growing areas (Adjase and Ayebeng 2016). The trade in cocoa and cocoa products is an important part of the economy in Ghana and efforts have been made to address the challenges facing the sector. However, more needs to be done to ensure the sector's sustainability and improve farmers' livelihoods.

As seen in **Figure 3**, the quantity of cocoa beans exported from Ghana has fluctuated over the years, with some years experiencing increases and others decreasing. Ghana exported over 520,000 metric tons of cocoa beans in 2020. Exports of this farm product totalled approximately 644,000 metric tons the previous year.

Furthermore, cocoa bean exports peaked at more than 843,000 metric tons during the period covered by the data. After the Republic of Côte d'Ivoire, Ghana exports the second-most cocoa in the world.

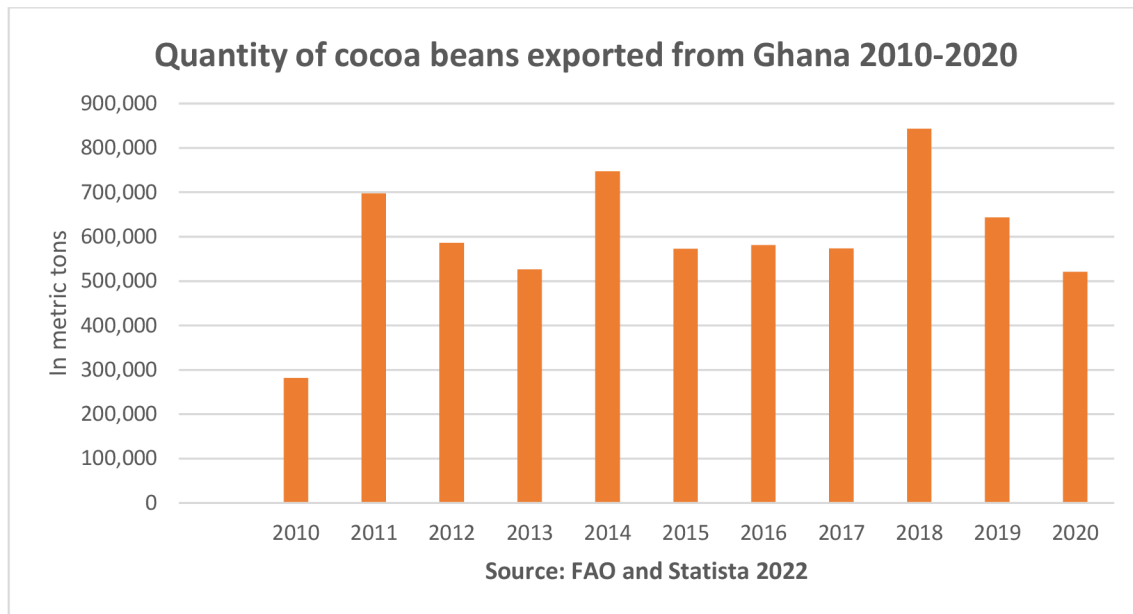


Figure 3. Quantity of cocoa beans exported from Ghana 2010-2020.

2.5 Government support and promotion of Cocoa production in Ghana

2.5.1 Extension services in Ghana

Cocoa extension services include training on best agricultural practices, pest and disease control, farm management, and access to finance and other resources. Such services play an essential role in supporting the development of the country's cocoa sector (Arko and Alhassan 2020). The main objective of these services is to provide farmers with the information and technical support they need to improve the productivity of their farms and increase their income. According to Odame (2019), Cocoa extension services in Ghana are typically provided by government agencies, such as COCOBOD, as well as non-government organizations, private sector companies, and research institutions.

There has been a growing recognition of extension services' role in supporting Ghana's cocoa sector's development (Bediako and Agyapong 2018).

According to Adom-Asamoah and Owusu (2017), efforts have been made to improve the quality and effectiveness of extension services, through providing training and support to extension agents, and using innovative approaches such as community-based extension and farmer field schools (Ocran 2020). Despite these efforts, the extension services provided to cocoa farmers in Ghana still face several challenges, including a shortage of trained extension agents, limited funding and resources, and weak linkages between research institutions and farmers. Nevertheless, extension services continue to play an important role in supporting the development of the cocoa sector in Ghana, and efforts are being made to overcome these challenges and improve the quality of the services provided to farmers (Adjei and Adjei 2016). COCOBOD's extension services are inconsistently delivered, which means that many Ghanaian cocoa farmers rely on a mixture of information and advice from various sources (Victor and Henry 2016).

2.5.2 Cocoa marketing

Ghana is well-recognized around the world for its commerce and production of cocoa. It has a minimum yearly output of 700,000 metric tons of cocoa beans as the second-largest producer of cocoa in the world since 2012. For instance, the production of cocoa beans was anticipated at 1.1 million metric tons during the harvest season of 2020–2021. COCOBOD has recognized threats to Ghana's cocoa output has recognized threats to Ghana's cocoa output, the government agency in charge of controlling cocoa procurement prices. Over 81 percent of the cocoa fields in the Eastern region were impacted by unlawful mining activities, the Board said in April 2022. However, the nation has continued to play a significant role in the global chocolate industry (Statista 2022). For the past few years, the government has encouraged the development of the non-traditional agricultural sector to expand the country's cocoa export. In Ghana, cocoa is mostly grown in six regions of the country including Eastern, Asante, Western, and some parts of the Brong-ahafo, Central, and Volta regions (Kuusaana and Adu-Gyamfi 2021). While the cocoa crop year begins in October, the smaller mid-crop cycle begins in July. All cocoa is sold at fixed prices, except that which is smuggled and sold abroad. Although most cocoa production is done by small farmers, the Ghanaian government controls the cocoa trade through COCOBOD (Gyawu 2015).

To ensure the cocoa sector is properly regulated, the government requires COCOBOD to grant licenses to private buying firms such as PBC, Armajaro, Akuapa, Cocoa Merchant, and Cocoa Abrabopa.

The various Licensed Buying Companies (LBC) employ District Managers, who in turn hire Commission Marketing Clerks. The LBCs pay Commission Marketing Clerks to purchase farmers' cocoa. Farmers sell their beans to cocoa marketing clerks, who bag and sort them thereafter. The QCC of COCOBOD grades the beans and rejects substandard beans as necessary. The Cocoa Marketing Company (CMC), a subsidiary of COCOBOD, receives the beans. Each bag is now marked with a station identification number. Before final export, the bagged beans are transferred to the port, where the CMC accepts them, and they are once again quality-checked by the QCC (Meshach and Brako 2015).

2.5.3 Agricultural Farmers Groups

Agriculture practices have the potential to alleviate poverty, increase income, and improve food security for 80% of the world's poor, who live in rural areas and primarily work in agriculture (World Bank 2022). The growth of rural and agricultural areas depends heavily on cooperation, which has long been a foundation of human society. Smallholder farmers in developing countries continue to face many challenges, including low crop yields, limited access to credit and extension services, and information irregularities that result in high transaction costs when participating in the input and output markets, despite increased research and development efforts aimed at addressing multiple productivity and market failures (Emelia 2015). Because of these constraints, governments, development organizations, and agribusiness companies are becoming increasingly interested in building farmer groups as one of the crucial steps in putting agriculture and value chain development programmes in place in underdeveloped countries.

Farmer organizations' facilitation of effective and efficient smallholder participation in agrifood value chains can benefit rural development, poverty reduction, productivity improvements, and food security. According to Hellin and Dohrn (2009), farmer groups' participation in these formalized chains can lower the transaction costs associated with acquiring cocoa production inputs and adopting productivity-enhancing innovations through increased access to private and public extension services, as well as simple access to credit.

This is due to the recent and rapid development of the agri-food value chains, the stricter food quality regulations and new procurement practices used by large agribusiness firms in developing countries. (Markelova et al. 2009; Bernard et al. 2010; Mojo et al. 2017).

2.6 Livelihood Diversification Theory

The concept of livelihood diversification has been around for centuries, as people have always engaged in a variety of activities to earn their livelihoods. However, the theory of livelihood diversification as a strategy for rural development and poverty reduction emerged in the 1980s and 1990s, in response to the limitations of traditional development approaches that focused on increasing agricultural productivity.

According to Davies (2020), livelihood diversification theory was first proposed by Robert Chambers in the early 1980s. Chambers argued that rural households must engage in multiple income-generating activities to mitigate the risks of relying solely on agriculture, which is vulnerable to weather, pests, and market fluctuations. He also emphasized the importance of understanding the complexity of rural livelihoods and the diverse strategies households use to manage their resources and cope with risk.

Over time, livelihood diversification theory has evolved and been refined by various scholars and practitioners. In the 1990s, for example, the sustainable livelihoods approach was developed, emphasising the importance of understanding households' assets and capabilities to generate income and improve their well-being (Ellis 2000). The sustainable livelihoods approach also highlighted the importance of addressing broader structural factors, such as access to markets and services, limiting households' ability to diversify their livelihoods (Christoplos et al. 2020).

Today, livelihood diversification remains a key strategy for rural development and poverty reduction and continues to be studied and refined by researchers and practitioners worldwide (de Haan 2019). Cocoa farmers in Ghana may engage in off-farm activities to supplement their income during periods of low cocoa prices, pest outbreaks, or other production-related challenges. For example, if cocoa prices fluctuate seasonally, farmers may need to engage in off-farm activities that provide more stable and consistent income streams to reduce their financial risk. This could involve engaging in petty trading, artisanal work, or livestock rearing, which can provide a steady income throughout the year and complement cocoa farming (Buah 2021).

Similarly, if household composition changes, such as the arrival of dependents or the departure of a family member, farmers may need to engage in off-farm activities to diversify their income and meet changing household needs (Asuming-Brempong 2017). This could involve engaging in activities requiring less labour or flexible schedules, such as artisanal work or petty trading.

Also, the theory suggests that promoting access to credit, education and training, and market information can create opportunities for farmers to engage in off-farm activities complementary to cocoa farming and help them diversify their livelihoods (Scoones 2015). For example, if farmers have access to credit, they can invest in off-farm activities that require upfront capital, such as artisanal work or the processing of cocoa products. Similarly, if farmers have access to education and training, they can acquire the necessary skills and knowledge to engage in more profitable and resilient off-farm activities (Amuakwa-Mensah and Marbuah 2018).

2.7 Human Capital Theory

Human Capital Theory emphasizes the importance of investing in education and training to build farmers' skills and knowledge and support their ability to engage in off-farm activities. Programs that provide training in areas such as business skills, crop diversification, and livestock production could be particularly effective in supporting off-farm livelihood diversification among cocoa farmers (Abu and Donkoh 2020). Institutional Theory highlights the importance of creating supportive institutional contexts that facilitate off-farm livelihood diversification. This could involve policies and regulations that support the development of alternative livelihood opportunities, and the involvement of key actors such as government agencies, NGOs, and private sector organizations in promoting and supporting diversification efforts (Asiedu and Sarpong 2021).

2.7.1 The socioeconomic features of cocoa farmers

The socioeconomic features of cocoa farmers in Ghana are diverse and complex, reflecting the heterogeneity of the country's rural population. Most cocoa farmers in Ghana are smallholder farmers who cultivate cocoa on small plots of land, usually less than 5 hectares (Emmanuel et al., 2018). They typically do not have access to capital, technology, or markets, limiting their ability to increase productivity and improve their livelihoods.

As previously noted, the income of cocoa farmers in Ghana is typically low and often insufficient to meet their basic needs (Anang and Asante 2020). The low prices of cocoa on the international market, combined with high production costs, can lead to low returns for farmers (Kongor et al., 2018).

Anyidoho (2012) believes that the average age of cocoa farmers in Ghana is relatively high, and there is a shortage of young people entering the sector. This presents a challenge to the future sustainability of the cocoa industry. A high percentage of cocoa farmers in Ghana have limited education, which can limit their ability to access information and technology that could improve their farming practices and livelihoods (Jennifer and Asenso-Okyere 2012). Cocoa is the source of income for many rural communities in Ghana, and a significant portion of the population depend on the sector for their livelihoods (Ole 2023). These socioeconomic features of cocoa farmers in Ghana underscore the importance of improving sector's competitiveness and enhancing the livelihoods of smallholder farmers. This includes investment in education, infrastructure, and support services, as well as programs aimed at increasing productivity and improving the sector's sustainability.

2.7.2 Sources of income among cocoa farmers

Ghana has a high intercropping and crop diversity prevalence, with different crops having various climatic requirements (Ayivor et al., 2015). Most cocoa growers grew other crops in addition to cocoa. Farmers, particularly those with new and old cocoa farms, intercrop their land with food crops including cocoyam, plantain, and cassava. These farmers have less dense cocoa plantations. Cocoa farmers can support their low cocoa earnings by selling other crops. Stefan (2018) believes that although climate change may negatively impact cocoa and other crops, the impact varies because different crops require different climatic conditions and planting and harvesting seasons throughout the year. Therefore, growing various crops protects against the variability of climatic conditions.

Farm animals (cattle, sheep, goats, and domestic fowls) are commonly raised to compensate for low cocoa yield because crops and animals require different climatic conditions (Peprah 2019). Furthermore, young, and energetic cocoa farmers support the incomes of other farmers by providing assistance in kind such as carrying farm produce for other farmers and weeding, fertilizer, and herbicide application.

Others participate in agriculturally related commercial off-farm operations such as agro-processing, small-scale farming for trade, and offering agricultural services like the sale of agrochemicals, farm tools and equipment, and veterinary medications (Bannor et al. 2022).

2.7.3 Off-farm income livelihood diversification

According to Samuel (2022), off-farm income and livelihood diversification refer to the sources of income and livelihood opportunities outside of agriculture and the farming sector. Off-farm income livelihood diversification is a strategy rural households employ to reduce their dependence on agriculture and improve their overall income and well-being. This can include non-farm activities such as trading, artisanal work, small-scale entrepreneurship, and wage labour (Wiggins 2012). For many smallholder farmers in Ghana, including cocoa farmers, off-farm income and livelihood diversification is vital for reducing their dependence on agriculture and improving their overall financial stability (Steve 2014). This can help farmers weather the ups and downs of the agricultural market and protect them from the impacts of shocks such as weather events and price fluctuations.

Off-farm income and livelihood diversification can also help increase smallholder farmers' income and improve their living standards. This can be particularly important for farmers who face constraints such as low productivity, low cocoa prices, and limited access to capital, technology, and markets (Gebru 2018). However, off-farm income and livelihood diversification can also present challenges for farmers, such as competition for jobs and limited opportunities for income generation.

Numerous studies have explored the factors influencing off-farm income diversification among rural households. These factors can be broadly grouped into three categories: socioeconomic, institutional, and farm and household characteristics (Gebru et al. 2018). Socioeconomic factors, such as education, household size, and access to credit, have been found to play a significant role in determining the likelihood of households engaging in off-farm activities. For example, households with higher levels of education tend to have a broader range of skills and knowledge that can be applied to off-farm activities, and as such, they are more likely to engage in off-farm diversification (Seng 2015). Similarly, access to credit provides households with the means to invest in off-farm activities and expand their sources of income.

FAO (2004) believes that institutional factors, such as government policies and extension services, can also play a critical role in influencing households' decisions to diversify their livelihoods (Leroy and Darmastuti 2018). Government policies that provide access to credit, training programmes, and information about profitable opportunities can help households invest in off-farm activities and increase their potential income. Extension services can provide households with valuable information and training on off-farm activities, (identify profitable opportunities and make informed decisions about diversification (Boer 2019).

According to Wirakusuma (2021), farm and household characteristics, such as the size of the farm, the type of crops grown, and the presence of other sources of income, can also influence households' decisions to diversify their livelihoods. For example, households with larger farms may have more resources to invest in off-farm activities, and as such, they may be more likely to diversify their livelihoods (Gilang and Irham 2021). Similarly, households that grow various crops may be more likely to diversify their livelihoods, as they have access to multiple sources of income. The presence of other sources of income, such as wage labour or non-farm businesses, can also influence households' decisions to diversify their livelihoods. Off-farm income livelihood diversification is a complex issue affected by socioeconomic, institutional, and farm and household factors (Wirakusuma et al. 2021). Understanding the influence of these factors on households' decisions to diversify their livelihoods is vital for developing effective strategies to support rural households and improve their well-being.

2.7.4 The factors influencing off-farm livelihood diversification.

Radhia (2020) argues that participation in off-farm labour is influenced by age, education, home structure, and agricultural features. The likelihood of a wife participating in the off-farm labour market declines with the number of children, raising her reservation wage. Young wives are also more likely to work outside the home than their older counterparts. The key predictors of off-farm involvement in rural Mexico include education, ethnic origin, and regional off-farm employment, according to off-farm activities there (Alain and Sadoulet 2001). Greater participation in money-generating activities and more lucrative off-farm occupations are made possible by higher levels of education, which decreases poverty and income inequality (Cervantes-Godoy and Dewbre 2010).

Cocoa farming is a source of income for many households in Ghana, but it is also subject to various challenges such as price fluctuations, prices, pests and diseases, and climate change (Amfo 2020). To mitigate these risks and improve their livelihoods, many cocoa farmers in Ghana have diversified their livelihoods by engaging in off-farm activities. Off-farm livelihood diversification refers to the participation in income-generating activities outside the primary agricultural sector (Bismark and Ali 2020). This can include non-farm businesses, wage labour, or other forms of self-employment. Off-farm livelihood diversification has been identified as a crucial strategy for rural households to reduce their dependence on agriculture and improve their overall income and well-being (Ernest 2020). However, the decision to diversify livelihoods is complex and influenced by various factors, including socioeconomic, institutional, and farm and household characteristics. According to Adongo and Bawah (2017), it is crucial to understand the factors that influence the diversification decisions of cocoa farmers in Ghana, as this knowledge can inform policies and programmes aimed at supporting farmers and improving their livelihoods.

Socioeconomic factors, such as education and household size, are significantly determinants of the likelihood of farmers engaging in off-farm activities (Efebo and Hinson 2010). For example, farmers with higher levels of education tend to have a wider range of skills and knowledge that can be applied to off-farm activities, and as such, they are more likely to engage in off-farm diversification. Similarly, larger households may require multiple sources of income to meet their basic needs, and as such, they may be more likely to engage in off-farm diversification (Mensah 2020). Access to credit is another important socioeconomic factor, as it provides farmers with the means to invest in off-farm activities and expand their sources of income (Asare and Adjei-Nsiah 2011).

Marfo (2015) believes that institutional factors also play a critical role in influencing farmers' decisions to diversify their livelihoods. Government policies and extension services can provide critical support for off-farm activities, such as access to credit, training programmes, and information about profitable opportunities. For example, government policies that provide access to credit for off-farm activities can help farmers invest in these activities and increase their potential income (Aidoo and Adomako 2015). Extension services can provide farmers with valuable information and training on off-farm activities, helping them to identify profitable opportunities and make informed decisions about diversification.

Farm and household characteristics, such as the size of the farm, the type of crops grown, and the presence of other sources of income, can also influence farmers' decisions to diversify their livelihoods (Boateng and Adjei-Nsiah 2013). For example, farmers with larger farms may have more resources to invest in off-farm activities, and as such, they may be more likely to diversify their livelihoods. Similarly, farmers who grow a various of crops may be more likely to diversify their livelihoods, as they have access to multiple sources of income. The local presence of other sources of income, such as wage labour or non-farm businesses, can also influence farmers' decisions to diversify their livelihoods (Maryo and Kassa 2022). Off-farm livelihood diversification among cocoa farmers in Ghana is influenced thus by a complex interplay of socioeconomic, institutional, and farm and household factors. Understanding the influence of these factors on farmers' decisions to diversify their livelihoods is vital for developing effective strategies to support farmers and improve their well-being (Owusu-Sekyere 2018).

This literature review highlights the various determinants of off-farm livelihood diversification among cocoa farmers in Ghana. The findings suggest that farm and household characteristics, as well as market access and agricultural policies, play a significant role in determining farm livelihood diversification among cocoa farmers. To support cocoa farmers in diversifying their livelihoods, it is important to address these determinants through policies and programmes that enhance market access, improve the agricultural environment, and support the development of off-farm activities.

3 Aims of the Thesis

3.1 This study aims to investigate the factors that lead to off-farm livelihood diversification from cocoa farmers in the Ahafo Ano District.

3.2 The specific objectives

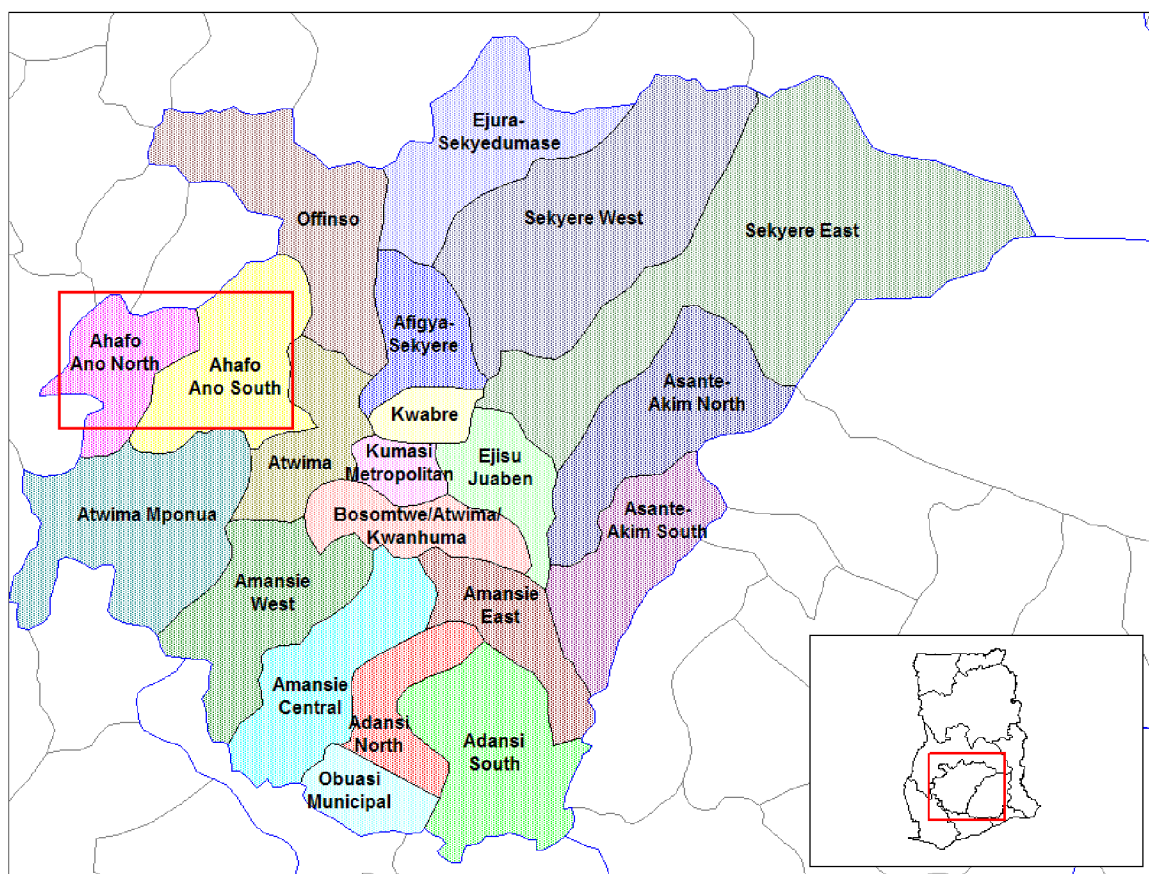
1. To determine the socioeconomic factors affecting off farm among cocoa farmers
2. To determine the influence of off farm jobs on income diversification and output
3. To investigate factors that limit cocoa production in the study area.

4 Methodology

4.1 Study area

The Ahafo Ano District Council is located in the Ashanti Region of Ghana. The Ahafo Ano District covers an area of approximately 1,493 square kilometres. According to the Ghana Statistical Service (2021), the Ahafo Ano District has an estimated population of 114,581. The population estimates, and projections are subject to change over time due to migration, birth rates, and mortality rates. The Ahafo Ano District Council is located in the area's north-western portion. (Oyekale 2020). The district has a rainy semi-arid climate. Around 26°C is the monthly average temperature. In March and April, just before the start of the rainy season, a maximum temperature of roughly 29°C is reported (MOFA 2020).

Figure 4. A map of the Ashanti Region, Ghana, showing the 27 administrative districts. (Frimpong and Ofori-Kwakye 2016)



4.1.1 Climate

The climate in the Ahafo Ano District Council is of the wet semi-equatorial type, with a mean monthly temperature of around 26°C. There are two distinct rainy seasons in the rainfall pattern. The main rainy season typically lasts from March through July, with June being the peak month. Between late September and November is the minor rainy season. The average yearly rainfall is between 150 and 170 cm. The amount and frequency of rain vary significantly from year to year. The average number of wet days per year is between 100 and 120, with the majority (75%) falling during the primary season. December through March are largely dry months (the harmattan period) (MOFA 2020).

4.1.1.1 Arable land

Abundant agricultural land is available in the district. Most of the land, or around 80% of it, is suitable for crop production, with cultivation taking place on about 60% of the arable land. The principal crops grown for food are maize, rice, cassava, yams, cocoyams, and plantains. The soil and rainfall regime support different agricultural products, including citrus, cocoa, oil palm, plantains, cassava, tomatoes, maize, and rice. A significant lack of agriculture affects some communities, like Wioso, Ahwerewam, and Sabronum, which are situated along forest reserves. These reserves are being encroached upon for both farming and hunting purposes (MOFA 2020).

4.2 Survey Sampling Process

Due to the size of the region, multiple stages of random sampling were employed. The Ahafo Ano District was selected due to its having rainfall patterns and soil conditions that are representative of Ghana's main cocoa-growing regions.

4.3 Data Collection Procedure

I got the dataset from Ebenezer Donkor, a PhD student at the Czech University of Life Science. Intensive data collection was conducted over a week (from 20th to 27th November 2022). The study used a multistage sampling procedure, with the first stage consisting of a purposeful selection of local government areas based on the presence of cocoa farmers in the area. In the second stage, two communities were randomly chosen from each local government area. In the third stage, simple random sampling was used to select 50 respondents from each community for a total sample size of 50 respondents. Interviews were done and recorded in Microsoft Excel over a period of three weeks and four days (from the 20th of November to the 15th of February 2022).

4.4 Data analysis

Fifty answers were used after data cleaning, of which 10 were outliers. Google Forms (<https://docs.google.com/forms/>) was used to create a Microsoft Excel file. The data was processed, coded, and sorted using Microsoft Excel file and Statistical Package for the Social Sciences (SPSS). While a sample of 50 respondents is relatively small, it can still provide valuable insights into the determinants of off-farm livelihood diversification among cocoa farmers in the Ahafo Ano District.

Descriptive statistics such as mean, median, and standard deviation were used to summarize the characteristics of the study. This involved calculating the averages for the variables of Age Years of education, Cocoa farming experience, and Cocoa farm size in hectares. The mean rank was used in situations where there were ties in the data, as it considered the frequency of each rank. Sum of Ranks was used in nonparametric tests, such as the Mann-Whitney U test. These measures can provide valuable insights into the distribution and central tendency of data. Regression analysis was used to test the relationships between one or more independent variables and a dependent variable. The goal was to determine how much the independent variables influence the dependent variable. Finally, The Mann-Whitney U test and the Wilcoxon test are nonparametric tests which are used to compare independent and dependent samples, respectively. The Mann-Whitney U test was used to compare the independent of Income and Output, while the Wilcoxon test was used to compare the dependent of Income and Output.

5 Result and Discussion

(Table 1) shows the descriptive statistics of household head characteristics and cocoa farming variables in Ahafo Ano District Council. The mean values for various characteristics of cocoa farmers are as follow: Age is around 50 years, while duration of education is around four years. On the other hand, cocoa farming experience is around 18 years, and the size of cocoa farm is 2.09 hectares. These statistics can be useful in understanding the typical profile of a cocoa farmer.

Table 1: Descriptive Statistics of Various Variables (n = 50)

Variable	Minimum	Maximum	Mean	Std. deviation
Age	28	80	50.28	11.093
Years of education	1	28	4.08	6.483
Cocoa farming experience	8	60	18.52	8.883
Cocoa farm size in hectares	0.50	5.00	2.09	1.20

(Table 2), the majority were male 68% of the total sample, while females made up 32% with 16 respondents. Regarding land ownership status, 39 male farmers (78%) and 11 female farmers (22%) were included in the sample. All 50 farmers (100%) had an off-farm job. Access to credit was reported by 82% of the sample. The farmers in get access to credit through Ghana Cocoa Board (COCOBOD), Rural and Community Banks (RCBs), Agricultural Development Bank (ADB), Microfinance Institutions (MFIs), and Non-Governmental Organizations (NGOs). The farmers are able to get access to credit because they are able to provide land ownership, farm size, repayment history, agricultural experience, and crop insurance. Similarly, 96% of the farmers had access to extension services. Cocoa farmers can access extension by joining a farmers' cooperative, contacting government agencies, participating in training programs, applying for loans and grants, and collaborating with private organizations.

When it came to training on Sustainable Agricultural Practices (SAP), 8% of respondents (4) reported having accessed training twice, 10% (5) three times, 32% (16) four times, and 50% (25) five times.

Table 2. Descriptive Statistics of Categorical Variables (n = 50)

Variable	Description	Frequency	Percentage
Household head characteristics			
Gender	Male	34	68.0
	Female	16	32.0
Membership		50	100.0
Institutional characteristics			
Off-farm job	Yes	46	92.0
Access to credit	Yes	41	82.0
Access to extension	Yes	48	96.0
Hybrid cocoa	Yes	41	82.0
Hybrid cocoa yielding	Yes	37	74.0
Training on SAP	Number of times		
	2	4	8.0
	3	5	10.0
	4	16	32.0
	5	25	50.0

Note: An ordinal or nominal collection of categories makes up a categorical variable, with a measurement scale (Sinharay 2010).

5.1 Objective 1: To determine the socioeconomic factors affecting off farm among cocoa farmers.

The classification (**Table 3**) shows the accuracy of a predictive model that is used to classify cocoa farmers in the Ahafo Ano District Council into two categories based on whether or not they have an off-farm job. The table shows how many people the model predicted to fall into each group and how accurate the predictions are. Specifically, the model predicted that 40 farmers do not have an off-farm job with 80% accuracy, and 44 have an off-farm job with 88% accuracy. The overall percentage of correct predictions is 84%, which is calculated by taking a weighted average of the two accuracies.

Table 3: Classification table (n = 50)

Classification table		Predicted			
		Off-farm job			
Step 1	Observed	0	1	Percentage corrected	
	Off-farm	0	40	10	80.0
	job	1	6	44	88.0
Overall percentage					84.0
a. The cut value is 0.500					

(**Table 4**) As the age increases, the older farmers with $\exp(B)$ 1.066 time are more likely to do off-farm jobs. This is because there are fewer young people in the cocoa sector. health concerns, limited access to credit are the things that can likely make older cocoa farmers work off-farm.

Similarly, as farming experience reduce, the farmers $\exp(B)$ times is more likely to do off-farm jobs. Farmers with less experience are scared to take risk and this push them to do off-farm jobs in other to secure any uncertainty such as diseases, pest, and other natural disasters that may occur.

Also, as the land ownership increases, the farmer's $\exp(B)$ 6.257 times more likely to do off-farm jobs. This is because larger farms require more capital and resources to operate, which can lead to higher debt and expenses. In order to offset these costs, some farmers may seek off-farm job. As farms grow in size, the workload may become too much for one person or family to handle alone. Hiring outside help can be expensive, so farmers may choose to supplement their income with off-farm jobs instead.

Table 4: Regression model (n = 50)

	B	S.E.	Wald	df	Sig.	Exp(B)
Age	0.064	0.035	3.384	1	0.066	1.066
Gender	-0.865	0.940	0.846	1	0.358	0.421
Years of education	0.012	0.054	0.046	1	0.830	1.012
Farming experience	-0.115	0.041	7.745	1	0.005	0.892
Farm size Ha	-0.199	0.175	1.303	1	0.254	0.819
Land ownership	1.834	0.715	6.583	1	0.010	6.257
Farming groups	23.197	7247.586	0.000	1	0.997	1.186E+10
Constant	-23.198	7247.586	0.000	1	0.997	0.000

5.2 Objective 2: To determine the influence of off farm jobs on income diversification and output.

The study finds that farmers in Ahafo District, farmers in the Ahafo District Council with an off-farm job have higher incomes and outputs than those without an off-farm job. Similarly, the sum of ranks for income is also higher for those with an off-farm job, at 3088.00, compared to 1962.00 for those without an off-farm job.

The same trend can be seen for output, with a mean rank of 38.96 for those without an off-farm job and 62.04 for those with an off-farm job, and a higher sum of ranks for those with an off-farm job (3102.00 compared to 1948.00). The study suggests that the effect of off-farm work on farm income depends on which effect is stronger, but in this case, having an off-farm job seems to positively impact farmers' income and output.

Table 5: Ranks (n = 50)

Ranks				
Off-farm job	N	Mean Rank	Sum of Ranks	
Income	0	39.24	1962.00	
	1	61.76	3088.00	
Total	100			
Output	0	38.96	1948.00	
	1	62.04	3102.00	
Total	100			

The Mann-Whitney U test and the Wilcoxon W test are non-parametric statistical tests used to compare two data groups (Han and Kim 2016). The Mann-Whitney U test shows that there is a significant difference between the income levels of people with and without an off-farm job ($U = 687.000$, $z = -3.885$, $p < 0.000$). The Mann-Whitney U test shows that there is a significant difference between the output levels of people with and without an off-farm job ($U = 673.000$, $z = -3.982$, $p < 0.000$). Similarly, the Wilcoxon W test indicates a significant difference in output levels for people with and without an off-farm job ($W = 1962.000$, $z = -3.982$, $p < .001$). The Mann-Whitney U test indicates a significant difference in income levels between those with and without an off-farm job, while the Wilcoxon W test shows a significant difference in output levels. The p-value of less than 0.000 indicates a very low probability that the differences in income and output levels could be due to chance alone.

Therefore, these tests (**Table 6**) suggest that having an off-farm job can significantly impact income and output levels. Additionally, off-farm jobs will lessen farmers' income limitation. In order to make up for output losses brought on by insufficient labour input, farmers may be encouraged to expand their purchases input and efficiency into farming operations.

Table 6: Mann–Whitney U and Wilcoxon test (n = 50)

	Income	Output
Mann-Whitney U	687.000	673.000
Wilcoxon W	1962.000	1948.000
Z	-3.885	-3.982
Asyp. Sig. (2-tailed)	0.000	0.000

Grouping Variable: Off-farm Job

5.3 The challenges in cocoa production

There are several difficulties facing the cocoa industry. Poverty affects many cocoa farmers. With cocoa production making up roughly two-thirds of their income, most cocoa farming households are living in poverty. Self-employed cocoa farmers in West Africa cultivate the crop on small pieces of land with an average yield of just 400 kilos per hectare and a size of fewer than five hectares. This results in vulnerability, especially given price fluctuations and restricted access to financial services. Living and working circumstances are frequently poor, and low salaries are frequently insufficient for subsistence (Christian and Philippe 2020).

Ghana's recent low cocoa yields are partially attributable to the aging farmers, fields, and cocoa trees (Laven 2010). The output of cocoa trees often diminishes after around 20 years and the fact that cocoa cultivation requires much labour just makes the issue worse. Because most farmers are elderly and weak, they decide against replanting because they believe it will cost more money to replace old plants with new ones than maintain existing trees (Cilas 2020).

On a large number of West African cocoa farms, child labour is a common occurrence. Since cocoa cultivation requires seasonal labour, most cocoa farming families cannot afford to recruit outside labour (Gregor, et al. 2018). As a result, cocoa farming households frequently rely on children and young people when there is a labour shortage. Around 1.6 million minors are thought to work on their families' cocoa farms in Côte d'Ivoire and Ghana, the two nations that produce the most cocoa worldwide. This translates to around 45% of the children residing in rural areas where cocoa is grown. Children who work in the cocoa industry frequently perform dangerous duties including spraying pesticides, lifting heavy objects, climbing cocoa trees to harvest, or cracking open cocoa pods with sharp implements like machetes. Development and education are hampered when children do not attend school. This can make it more difficult to end the cycle of poverty by entrenching the family's poverty for future generations (Atika, et al. 2018).

The country's land tenure laws are a major barrier to the growth of cocoa fields in Ghana. Most of the land in a traditional area is owned by the chiefs, and the majority of farmers are from different regions who sharecrop. The policies governing the ownership and use of land are typically unjust to the average farmer who works so hard to produce a crop. Policies like the "abunu," "abusa," or "abunan" systems, which indicate a ratio of 1:2, 1:3, or 1:4 in terms of the yield split between the landowner and cocoa farmer (s), respectively, demotivate farmers, who frequently feel abused considering their degree of involvement in the production (Adom-Asamoah 2015).

Cocoa production in many countries is threatened by aging plantations, poor farm management, soil degradation, pests, and other diseases (Laura 2020). Cocoa producers frequently rely on the clearing of additional forest land to increase production and meet demand. Deforestation causes biodiversity loss and contributes to climate change. Furthermore, the improper or excessive use of pesticides and chemical fertilizers on many cocoa farms degrades the quality of local water resources, contaminates soils, and reduces biodiversity (Leone 2020).

Climate change is endangering cocoa output more and more. Some locations become less favourable for cocoa farming as extreme weather occurrences increase frequency (Chris 2022). Both the quantity and quality of cocoa can be decreased by extended dry spells, a lack of rainfall, severe temperatures, and new pests and illnesses.

These changes result in decreased revenue and market volatility for which most farmers are unprepared (Victoria 2022). Thus, adapting to climate change to increase the resilience of livelihoods and farming systems is becoming a more urgent concern for all players in the cocoa sector.

It is challenging for farmers to escape poverty because of their low financial literacy and lack of access to financial institutions (Victoria 2022). They lack the wherewithal to purchase premium cocoa plants and input materials to reinvest in their farms because they lack access to savings systems, loans, or microcredits. Lack of funding hinders training, which reduces the likelihood of enhancing agricultural methods (Constance 2022). Additionally, poor road conditions increase the cost of harvest transportation and increase farmers' reliance on intermediary commerce, which lowers their income. Many areas that produce cocoa also have poor access to safe drinking water and sanitary facilities.

In conclusion, there are many factors that limit cocoa production. Ageing cocoa trees, poor farm management, soil degradation, pests, and other diseases, climate change, low financial literacy and lack of access to financial institutions, lack of wherewithal to purchase premium cocoa plants and input materials, and low cocoa yields are constraints to cocoa production.

5.4 Limitations to the research

Several constraints were faced during the research. Below are some of the limitations faced.

Sample size: The study's sample size was small, and sampling was not representative. Findings should be regarded as indicative.

External factors: External factors, such as changes in market conditions or government policies, may have impacted the determinants of off-farm livelihood diversification among cocoa farmers in the district during the study period, which may not have been captured in the analysis.

Generalizability: The findings may not be generalizable to other contexts or regions outside of the Ahafo Ano District Council, as local conditions and factors may differ significantly.

6 Conclusion and recommendation

The difficulties and opportunities faced by specific subsets of farmers must also be taken into account to successfully encourage off-farm livelihood diversification among cocoa farmers in Ghana. For instance, women farmers may encounter additional obstacles to obtaining credit and accessing markets, and so may need particular assistance to overcome these obstacles. Similarly, younger farmers may have different priorities and preferences than older farmers, necessitating the need for targeted programs and efforts to nudge them toward engaging in off-farm income-generating activities.

Policies and programs should promote sustainable livelihoods to support the overall development of rural communities and tackle the factors that affect the diversification of off-farm livelihoods. This can include initiatives to improve access to essential services such as healthcare and education as well as efforts to promote sustainable agriculture practices and protect natural resources.

Off-farm livelihood diversification is essential for Ghana's cocoa farmers to reduce the risks associated with over-reliance on cocoa production as their sole source of income. Various determinants influence the likelihood of farmers diversifying their income sources, including education, access to credit, land size, market access, age, gender, and location. Policies and programs promoting off-farm livelihood diversification should consider these determinants to develop effective strategies that encourage more farmers to pursue other income-generating activities beyond cocoa farming. By doing so, farmers can improve their economic well-being, reduce their vulnerability to risks associated with cocoa production, and contribute to the overall development of rural communities in Ghana.

7 Reference

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8 Appendix

8.1 Questionnaire

Part 1: Demographic Characteristics

1) What is your gender?

- Male
- Female

2) What is your age? _____

3) What is your highest level of schooling?

- Illiterate
- Secondary school
- Primary school
- College/University degree

4) How many years of schooling do you have? _____

Part 2: Input Support Program(S)

5) What is your cocoa Farm size in hectare? _____

6) Do you use hybrid cocoa?

- Yes
- No

7) Do you have hybrid cocoa yielding?

- Yes
- No

8) What is the average age of your cocoa trees? _____

9) Are you aware of climate change?

- Yes
- No

10) What is your household labour cost? _____

11) What is your cost per unit labour? _____

Part 3: Farming Practices

12) What is the number of labours you need every season? _____

13) Do you have training on SAP(s)?

- Yes
- No

14) Do have access to GAP(s)?

- Yes
- No

15) What is the frequency of extension access? _____

16) Do you have extension access?

- Yes
- No

17) What is the cost of agrochemicals? _____

18) What is your income from sales? _____

19) Do you have access to credit?

- Yes
- No

20) Do you off-farm job?

- Yes
- No

21) What is your income from off-farm job? _____

22) what was your output in 2019? _____

23) what was your output in output 2020? _____