UNIVERSITY OF CAPE COAST

FACTORS INFLUENCING EXTENSION DELIVERY IN THE VOLTA COCOA REGION OF GHANA

BERNARD ARCHIBALD SENYO AGYEMAN

2022

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BY

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Thesis submitted to Department of Agricultural Economics and Extension, School of Agriculture, College of Agriculture and Natural Sciences, University of Cape Coast, in partial fulfillment of the requirements for the award of Doctor of Philosophy in Agricultural Extension.

APRIL 2022

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature………………………………… Date: ………………...

Name: Bernard Archibald Senyo Agyeman

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature…………………………Date…………….

Name: Prof. Festus Annor-Frempong

Co-Supervisor's Signature……………………….……… Date……………….

Name: Dr. Albert Obeng Mensah

ABSTRACT

Effective extension delivery improves farmers' competencies, adoption, yield, and income levels. Following a mixed-method research approach, this study examines the factors influencing extension delivery in the Volta Cocoa Region of Ghana. The quantitative data was collected using an interview schedule from 420 sampled cocoa farmers whilst Focus Group Discussion, In-depth interview, and observation guides were used to gather the qualitative data. The SPSS 25 and NVivo 12 software were used to analyse the data. The results indicate the prevalence of CHED extension activities and 19.8 percent of the cocoa farmers involved in pluralistic extension. Cocoa farmers perceived the quality of CHED and private extension delivery respectively as acceptable and good. Cocoa farmers used own land, sharecropping, hired labour usually from Togo, and *Fidodo* (nnoboa) in cocoa farming. Access to credit, price incentives, and low activities of cocoa farmer associations and extension organisations were most pressing challenges cocoa farmers faced. The extension delivery effects: high competency, and adoption levels; yield (Mean:793.5kg/ha and SD: 987.1kg/ha), and income (Mean:GH¢5707.5 and SD:GH¢8270.4) from cocoa were significantly different between CHED and pluralistic extension receivers. Age, experience in cocoa farming, farm size, farm age, CHED empathy and communication, knowledge, attitude, skills, aspirations, participation in FBS and certification; adoption of Farmer Level Purchases innovations, and yield influenced the cocoa extension delivery effects. Financial support; improved number of private extension actors, coverage; and programmes; and an efficient labour system provided by COCOBOD, and private organisations are required to increase cocoa production levels in the Volta Cocoa Region of Ghana.

KEY WORDS

Cocoa farmers

Cocoa innovations

Extension delivery outcomes

KASA change

Pluralistic extension

ACKNOWLEDGEMENTS

My deepest gratitude goes to my supervisors, Prof. Festus Annor-Frempong (Principal) and Dr. Albert Obeng Mensah (Co-supervisor) at the Department of Agricultural Economics and Extension for supervising and guiding me through the preparation of the thesis. I am indebted to my parents: Cdr. Daniel Reynold Jiss Osei Agyeman (Rtd), Ps. Rejoice Yawa Ankude, and Ms. Regina Narkie Amam(late) for their upbringing and supports. Much thanks to Mr. Samuel Apreku, Mr. Hayford Selawoe Agyeman, Lawyer Martin Archie-Danso Jnr. and Hajia Maria Adamu-Zibo (FEDCO) for their diverse supports. I thank Dr. Selorm Akaba, Dr. Suleyman Demi, Dr. Kafui Kwesi Agyeman, Ms. Jacqueline Onumah, Mr. Charles Amankwah Adzim, Mr. Richard Yao Kuma Agyeman and Mr. Isaac Kojo Agyeman for sharing their experiences.

I appreciate the support provided me by the Regional Manager and staff of COCOBOD-Volta Cocoa Region; Cocoa Abrabopa Association, Solidaridad, and data collection assistants during data collection for the thesis. Ms. Sabina Abuga deserves mention for her support in generating the Volta Cocoa Regional map for the study. I thank the School of Graduate Studies, University of Cape Coast for the award of Emelia-Brew Buttler grant that facilitated data collection and processing of the thesis. Much gratitude to Mr. Godwin Deh and my grandparents: Togbe Adzendzi Agyeman IV (late) and Madam Comfort Apoh (late) for their contributions to my upbringing. My wife, Mrs. Doreen Agyeman, children: Regina, Peniel, and Daniel deserve special mention for their inspiration and forgoing the time that I invested in this thesis writing. I thank Mrs. Irene Amedior (Mother-in-law), In-laws, and my siblings for their goodwill messages and encouragement.

DEDICATION

To my wife Mrs. Doreen Agyeman, and children: Regina Aseye Abra Agyeman, Peniel Sedem Korsi Agyeman, and Daniel Woyram Kodzo Agyeman.

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AEA	Agricultural Extension Agent
AGRA	Alliance for Green Revolution in Africa
CAA	Cocoa Abrabopa Association
CDD	Centre for Democratic Development.
CEA	Community Extension Agent
CERT	Certification
CFA	Communauté Financière Africaine
CHED	Cocoa Health and Extension Division
CI	Cocoa income
CMC	Cocoa Marketing Company
COCOBOD	Cocoa Board
CODAPEC	Cocoa Disease and Pest Control
CRIG	Cocoa Research Institute of Ghana
CSIR	Council for Scientific and Industrial Research
CSSVD	Cocoa Swollen Shoot Virus Disease
DAES	Directorate of Agricultural Extension Services
ETM	Extension Training Material
ExDQUAL	Quality of Extension Delivery
FAO	Food and Agricultural Organisation
FBO	Farmer Based Organisation
FBS	Farmer Business School
FEM	Farm Enterprise Management
FGD	Focus Group Discussion
FLA	Fair Labour Associations

FLP	Farmer Level Purchases
GAPs	Good Agricultural Practices
GDP	Gross Domestic Product
GFRAS	Global Forum for Rural Advisory Services
GH¢	Ghana Cedis
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft fuer Internationale Zusammenarbeit
GSS	Ghana Statistical Service
Ha	Hectare
IAL	Innovation Adoption level
ICCO	International Cocoa Organisation
ICT	Information Communication Technology
IPM	Integrated Pest Management
IRB	Institutional Review Board
IVR	Interactive Voice Response
JHS	Junior High School
JICA	Japan International Cooperation Agency
KASA	Knowledge, Altitude, Skills, and Aspirations
Kg/ha	Kilogramme per hectare
KIT	Karlsruhe Institute of Technology
KPMG	Klynveld Peat Marwick Goerdele
LBC	License Buying Company
LIVSTI	Livestock Income
MEAS	Modernization of Extension and Advisory Services
MMYE	Ministry of Manpower, Youth & Employment

MoFA	Ministry of Food and Agriculture
MSLC	Middle School Living Certificate
MT	Metric Ton
NGO	Non-Governmental Organisation
PBC	Produce Buying Company
PC	Purchasing Clerk
PEP	Productivity Enhancement Programme
PPE	Personal Protective Equipment
PPRC	Producer Price Review Committee
QCC	Quality Control Commission
RA	Rainforest Alliance
ROCO	Royal Commodities
SD	Standard Deviation
SERVPERF	Service Performance
SERVQUAL	Service Quality
SHS	Senior High School
SMS	Short Message Service/ Subject Matter Specialist
SPD	Seed Production Division
SPSS	Statistical Package for the Social Sciences
THI	Total Household Income
UCC	University of Cape Coast
USD	United States Dollars
UTZ	Universal Trade Zone
WCF	World Cocoa Foundation
WILDAF	Women in Law and Development in Africa

CHAPTER ONE

INTRODUCTION

Introduction

This introductory chapter describes efforts of the COCOBOD Cocoa Health and Extension Division (CHED) and private extension actors in delivering extension in the Volta Cocoa Region of Ghana. The problem statement, objectives, key research questions, and hypotheses are all stated. The chapter continues with the significance of the study, the delimitations and limitations, definition of terms, and ends with the section on the organisation of the study.

Background to the Study

According to the Ministry of Food and Agriculture (MoFA), the agricultural sector of Ghana employs 45 percent of the total workforce including smallholder farmers (MoFA, 2017). The contribution of agriculture to the Gross Domestic Product (GDP) of Ghana, however, has fallen from 18.3 percent in 2018 to 17.3 percent in 2019 (Statista, 2021). Despite these declining trends, the agricultural sector of Ghana continues to be relevant due to its contributions to food security, poverty reduction, rural transformation, and job creation, among other important gains (Alliance for Green Revolution in Africa (AGRA), (2016).

The crops sub-sector of the agricultural sector of Ghana is a key contributor to overall agricultural growth, accounting for 74 percent of total agricultural GDP (Ghana Statistical Service, 2017). The most important crops produced in Ghana include cocoa, oil palm, coffee, maize, rice, yam, and cassava (MoFA, 2016). Globally, Cocoa (*Theobroma cacao*) is important in the economic and social lives of over 25 million people in poor rural areas and 5 million households (Pohlan, Herman & Perez, 2010). In West Africa, the cocoa industry directly employs over two million people and indirectly five million persons (Paschall & Seville, 2012a).

Ghana ranks as the second largest cocoa producer globally, behind Côte d'Ivoire (Bangmarigu & Qineti, 2018). Cocoa is grown in ten (10) out of the sixteen (16) political regions of Ghana. The Ghana Cocoa Board (COCOBOD), the cocoa sector regulator of Ghana however divides these political cocoa-growing regions into seven Cocoa Regions of which the Volta Cocoa Region is a part.

Cocoa farmers in Ghana are usually smallholders operating family farms (Ministry of Manpower, Youth and Employment, 2007) and producing under various ownership systems. According to Cocoa Research Institute of Ghana (CRIG) and World Cocoa Foundation (WCF) (2017), a total of 62.7 percent of cocoa farms are managed by their owners, while 22.7 percent and 14 percent are respectively cultivated using the *Abunu* and *Abusa* sharecropping systems. Cocoa farmers in Ghana have also been found to be involved in various livelihood diversification activities (for example crops, livestock and commercial activities in farm and non-farm sectors) to supplement and sustain their cocoa farming efforts in order to reduce food insecurity and poverty in their households (Dagunga, Ehiakpor, Parry & Danso-Abbeam, 2018; WCF, 2015).

Cocoa farmers, researchers, buyers, transporters, public officers, private service providers, consumers and policymakers all play crucial roles in the cocoa innovation system of Ghana (Essegbey & Ofori-Gyamfi, 2012; Kpienta

& Jasaw, 2012). The cocoa farmer has been central to these stakeholders' and extension efforts to improve cocoa production in all cocoa-producing regions of Ghana, including the Volta Cocoa Region, in order to deliver quality cocoa beans that meet the requirements of Ghana COCOBOD and particularly processing firms.

Christoplos (2010 p.3) define agricultural extension as a “system that should facilitate the access of farmers, their organisations and other market actors to knowledge, information, and technologies, facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions; and assist them to develop their own technical, organisational and management skills and practices”. Extension thus plays critical role in organising and developing the capacities of for instance cocoa farmers to innovate. Anderson (2008) emphasis this and indicate that extension improves farmers’ technical and management capabilities, increases their competencies to adopt generated innovations, contributes to yield, and generally improves farmers’ standards of living and livelihoods.

Major factors such as “the changing nature of agriculture, its unprecedented challenges and the need to provide broader support to producers; increasing pluralism in advisory service delivery; renewed examination of the role of the state and the private sector as well as new modes of funding or financing and delivering advisory services; and new insights from communication and innovation research and the digital revolution” (Blum, Cofini and Sulaiman, 2020 p. 2) have necessitated the need for extension reforms globally and particularly in Ghana. Blum et al. (2020) further indicates that multi-stakeholder governance and coordination are required to successfully respond to the needs and demands of the increasingly diverse smallholder farms, as well as their advisory needs such as business services, climate change, and ICTs.

The cocoa extension system of Ghana is decentralised, led by the COCOBOD Cocoa Health and Extension Division (CHED) through its national, regional, district, and operational area systems, and pluralistic, involving private extension actors. The pluralism of extension providers is crucial and leads to coordinated partnerships among the public, profit oriented organisations, non-governmental organisations to improve the delivery of extension (Rivera, 2001). Okorley, Gray and Reid (2010) define pluralistic extension as provision of extension services by more than one source of extension. Muzenda, Chimbwanda, and Kugedera (2018) found pluralistic extension to increase the output, cultivated area, and income of farmers. The cocoa farmers in the Volta Cocoa Region operate within a context of pluralistic extension (Löwe, 2017), receiving extension from CHED and private organisations such as the Cocoa Abrabopa Association (CAA), the Solidaridad-West Africa MASO programme, and Yayra Glover. These extension providers provide cocoa farmers in the Volta Cocoa Region with similar and differentiated cocoa extension services and supports.

Particularly, cocoa farmers in the Volta Cocoa Region benefit from CHED cocoa Productivity Enhancement Programmes (PEP) such as Cocoa Disease and Pest Control (CODAPEC), Cocoa Hi-Tech, cocoa Hand pollination, and Farmer Business Schools (FBS) services. CAA provides sustainability (certification), input credit schemes including fertilizers, insecticides, fungicides, and sprayers (knapsack and motorised), and entrepreneurial training to registered farmers in order to increase their cocoa farm productivity (Agyekum, 2015). The youth targeted Solidaridad MASO training and mentorship programmes together with the aforementioned supports from CAA complement COCOBOD CHED extension delivery efforts in the Volta Cocoa Region of Ghana. There is thus evidence on the prevalence of cocoa extension delivery and related support services to cocoa farmers in the Volta Cocoa Region that needs to be investigated.

Statement of the Problem

Cocoa production in the Volta Cocoa Region involves farming households acting as owners, caretakers, and sharecroppers: *Abunu* and *Abusa* systems (Ghana Statistical Service, 2013). For efficient administration, cocoa extension delivery, and cocoa purchases by License Buying Companies (LBC), the Volta Cocoa Region is grouped into three main CHED districts: Hohoe, Jasikan, and Papase.

The Volta Cocoa Region has been an important and integral part of the cocoa production history of Ghana, contributing 20,729 metric tons (9.6 percent of total COCOBOD purchases) at the start of COCOBOD cocoa purchases records in the 1947/48 season. Since then, the Volta Cocoa Region significantly contributed an average of 10 percent from 1947/48 to 1959/60 seasons and 4 percent (from 1960/61-1982/83 seasons) to national cocoa purchases (COCOBOD, 2019). However, Cocoa production Figures for the Volta Cocoa Region dwindled and fluctuated after the 1983 bush fires, whereas other cocoa-producing regions in Ghana faced with similar challenges continued to increase production.

The recent ten-year COCOBOD cocoa production record (Figure 1) of the Volta Cocoa Region emphases these fluctuating and dwindling cocoa production trends. Thus, in recent years, the Volta Cocoa Region contributed less than one percent in the 2015/16, 2016/17, 2017/18, and 2018/19 seasons to total national cocoa production volumes (COCOBOD, 2021).

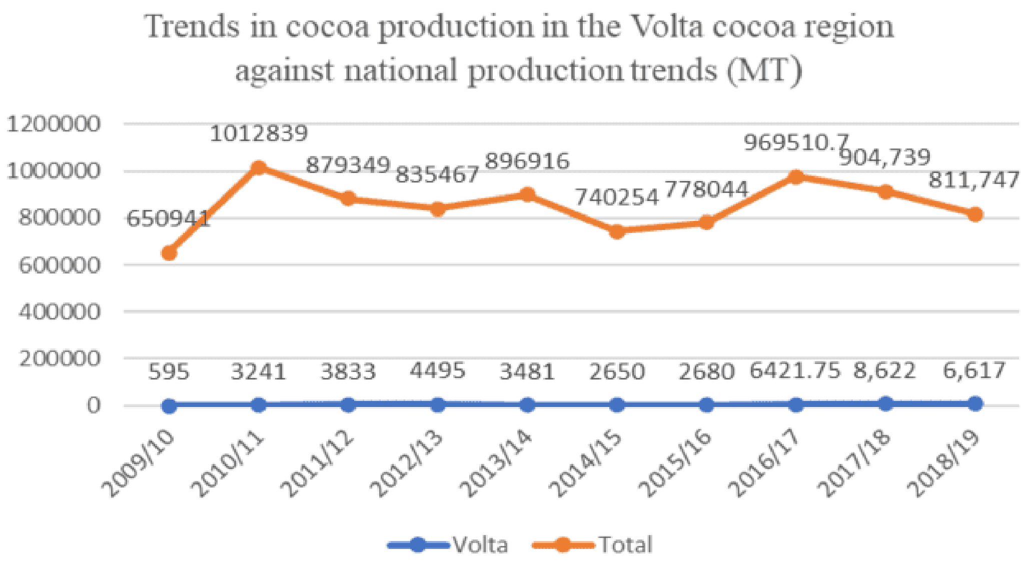


Figure 1: Trends in cocoa production in the Volta Cocoa Region of Ghana

Source: COCOBOD, 2021

According to Tsiboe (2021), the most important contributors to cocoa production in Ghana are land, household and hired labour, and the application of pesticide and fertilizer. Adoption of environmentally sustainable practices, investment decisions, and farm enterprise development are all positively influenced by favourable land and labour use systems (Murtadlo & Burhan, 2013; Quaye, Asafu-Adjaye, Yeboah, Osei & Agbedanu, 2017) in cocoa farming. Findings show Volta Cocoa Region has a technology gap ratio of 0.78 Meta-Stochastic Frontiers determined by the availability and magnitude of adoption of technologies (Tsiboe, 2021). Also, Ghana currently has a yield gap of about 23 percent compared to global standard (Effendy et al., 2019), as cocoa farmers are only producing 56 percent of the potential cocoa output given the available technology (Tsiboe, 2021).

Particularly, Ofori-Baah and Asafu-Adjaye (2011) and Danso-Abbeam and Baiyegunhi (2019) indicate the Volta and Ashanti Cocoa Regions are the least efficient cocoa producing regions in Ghana. Tsiboe (2021) adds that policies involving technology transfer (improved planting materials and fertilizer combinations) and training in good cocoa farming practices are required to improve cocoa farmers' managerial skills and increased outputs in the Volta Cocoa Region. There is an indication therefore of cocoa production shortfalls in the Volta Cocoa Region when compared to previous gains and potential of the region. There is also the need to improve farmer competencies and provide cocoa farmers in the Volta Cocoa Region with access to cocoa farming supports which extension delivery can help to address.

Thus, improved, and high-quality extension activities play important roles in increasing farmers competencies to adopt innovation (Adel & Adeed, 2016). As a result, farmer competency gaps have been found to result in yield gaps (Ferroni & Zhou, 2012). According to Asare and Sonii (2011), increasing cocoa productivity necessitates the need for government to make cocoa extension more effective. The findings of Akudugu, Guo, and Dadzie (2012) and Danso-Abbeam et al. (2018) emphasis the importance of extension services, socioeconomic factors, and institutional effectiveness, farm specific variables in influencing farm household technology adoption decisions and farm income. Ultimately, Cocoa farmers' active participation in extension processes, including decision-making will influence them to express their needs and seek programmes and opportunities that address these needs (Suvedi & Ghimire, 2011).

The low cocoa production levels records for the Volta Cocoa Region despite prevalence of CHED (Public) and private extension delivery activities require investigation. This production shortfalls, gaps in literature and knowledge on cocoa extension delivery and effects (competencies, adoption, yield, and the income), socio-demographic and economic characteristics and challenges of cocoa farmers for the Volta Cocoa Region have therefore necessitated this research on the factors influencing extension delivery in the Volta Cocoa Region of Ghana.

Objectives and Research questions of the Study

General Objective

The general objective of this study is to examine the factors influencing extension delivery in the Volta Cocoa Region of Ghana.

Specific Objectives

The specific objectives of the study are to:

1. Describe the nature of extension delivery in the Volta Cocoa Region of Ghana,
2. Describe the socio-demographic, and economic background of cocoa farmers in the Volta Cocoa Region of Ghana,
3. Examine the production, marketing, and extension delivery challenges faced by cocoa farmers in the Volta Cocoa Region of Ghana,
4. Examine the effects of extension delivery on cocoa farmers in the Volta Cocoa Region of Ghana in terms of

   (a) competencies in cocoa farming

(b) level of adoption of cocoa innovations

(c) yield of cocoa farmers over the year

(d) income of cocoa farmers

5. Determine the nexus between effects of extension delivery and the socio-demographic, and economic factors of cocoa farmers in the Volta Cocoa Region of Ghana.

Research Questions

The research questions guiding the study are:

1. What is the nature of extension delivery in the Volta Cocoa Region of Ghana?
2. What is the socio-demographic and economic background of cocoa farmers in the Volta region of Ghana?
3. What is the production, marketing, and extension delivery challenges faced by cocoa farmers in the Volta Cocoa Region of Ghana?
4. What are the effects of extension delivery on cocoa farmers in the Volta Cocoa Region in terms of

   (a) competencies of cocoa farmers in cocoa farming

   (b) level of adoption of cocoa innovations by cocoa farmers

   (c) yield of cocoa farmers over the year

   (d) income of cocoa farmers
5. What is the nexus between the effects of extension delivery and the socio-demographic and economic factors of cocoa farmers in the Volta Cocoa Region of Ghana?

Hypotheses

1. H_{O}: There is no significant difference between the competencies of cocoa farmers under CHED and pluralistic extension

   H_{a}: There is a significant difference between the competencies of cocoa farmers under CHED and pluralistic extension

2. H_{O}: There is no significant difference between the innovation adoption levels of cocoa farmers under CHED and pluralistic extension

   Ha: There is a significant difference between the Innovation adoption levels of cocoa farmers under CHED and pluralistic extension

3. H_{O}: There is no significant difference between the yield of cocoa farmers under CHED and pluralistic extension

   Ha: There is a significant difference between the yield of cocoa farmers under CHED and pluralistic extension

4. H_{O}: There is no significant difference between the income of cocoa farmers under CHED and pluralistic extension

   Ha: There is a significant difference between the income of cocoa farmers under CHED and pluralistic extension

Significance of the Study

Vibrant extension support services that lead to increased cocoa production contribute significantly to poverty reduction, food security, and increased income levels among cocoa farmers and rural dwellers. The results of the study highlighted the significance of extension delivery in the Volta Cocoa Region of Ghana, including providers (CHED and private). The study also emphasised perceived characteristics of Good Agricultural Practices, Certification, Farmer Level Purchases, and Farm Enterprise Management innovations shared to Cocoa farmers as well as the extension methods, and materials used. Policymakers can use this information to develop extension programmes that employ appropriate extension methods, materials, and incentives to ensure effective extension delivery in the Volta Cocoa Region of Ghana.

Furthermore, the research identified and provided quality extension delivery service indicators such as responsiveness, reliability, assurance, tangibility, communication, and empathy. This could be of concern to researchers, COCOBOD as well as private extension actors involved in bringing more people into the cocoa sector and improving aspects of extension delivery.

The findings of the study will influence policy to improve cocoa land-use practices in the Volta Cocoa Region. Labour is a critical factor in cocoa farming. The study explores the existing cocoa labour systems and practices in the Volta Cocoa Region and suggests ways to improve labour availability and use systems to ensure timely and reliable labour for cocoa farmers to adopt shared cocoa innovations. The study identified cocoa production, marketing, and extension delivery challenges faced by cocoa farmers in the Volta Cocoa Region. This gives COCOBOD and the private extension organisations, including non-governmental organisations (NGOs) direction in designing and implementing extension programmes to address these issues.

The findings of the study, in particular, provide basis for assisting the Volta Cocoa Region to regain its cocoa production potential and records to significantly contribute to the cocoa production volumes of Ghana. COCOBOD and private extension actors such as businesses, non-governmental organisations, farmers associations and civil society groups have been provided with information on the cocoa extension delivery effects such as competencies (knowledge, attitudes, skills, and aspirations), adoption, yield, and the income on cocoa farmers and associated determinants in the Volta Cocoa Region of Ghana. The information could be used to innovate, and bridge expected knowledge, attitude, skills, and cocoa farming aspiration gaps in the region. This is also important for informing policymakers and extension providers to develop training, adoption as well as yield, and income improvement strategies that meet the needs of cocoa farmers in the Volta Cocoa Region of Ghana. A thriving cocoa economy creates cocoa farming related employment opportunities such as farm labour, transportation services, cocoa hand pollination, and participation in agrochemical enterprises for the youth. As a result, a productive cocoa farming sector will reduce the number of people migrating to seek employment outside the Volta Cocoa Region.

The study lays foundation for future research to investigate the approaches, methods, materials and supports required in improving cocoa farming and delivery of extension in the Volta Cocoa Region of Ghana. In general, this study adds to the body of knowledge about cocoa extension delivery in the context of cocoa production and associated effects on cocoa farmers in the Volta Cocoa Region, Ghana and globally.

Delimitations of the Study

This study involved cocoa farmers cultivating at least a cocoa farm of five years and more. This provides basis for assessing cocoa farmers' experiences in cocoa farming, extension delivery and associated effects related to competencies, adoption, yield, and income. Moreover, climatic factors such as temperature, rainfall and humidity influence the adoption of cocoa farm-specific innovations and the yield of cocoa farmers. The scope of this study, however, did not consider data on these climatic factors.

Limitations of the Study

The service quality model originally has five dimensions: Responsiveness, Reliability, Assurance, Tangibility, and Empathy. The study finds communication as an important aspect of extension delivery; hence included it as the sixth dimension to assess farmers' perceptions of the communication aspects of the quality of CHED and private extension delivery particularly related to the use of extension methods, language, and feedback processes.

Definition of Key Terms

The definition of key terms important to the study include:

Cocoa farmers: This refers to farmers who manage at least a cocoa farm of five years and more as owners, sharecroppers, or caretakers.

Cocoa innovations: This refers to new cocoa farming ideas and practices on Good Agricultural Practices (GAPs), Certification (CERT), Farmer Level Purchases (FLP), and Farm Enterprise Management (FEM) shared with cocoa farmers in the Volta Cocoa Region of Ghana.

(a) **Good Agricultural Practices (GAPs) innovation:** This refers to new ideas, skills and practices on cocoa nursery, pre-and post-harvest practices shared with cocoa farmers. These innovations particularly include raising cocoa seedlings in poly bags, raising cocoa seedlings on beds, selecting a good site for cocoa farming, demarcation of cocoa farm/land, preparing permanent land for cocoa farming, transplanting nursed seedlings, planting cocoa seedlings in lines, planting seedlings using recommended spacing, providing temporary shades, regular pruning of cocoa trees, application of fertilizer by broadcasting method, application of foliar fertilizers using sprayers, application of organic manure on cocoa farm, Blackpod disease control, cocoa mirids control, observing re-entry period for applied chemicals, erosion and drainage control, regular weed control on the cocoa farm, creating fire belts around cocoa farms, identification of ripened cocoa pods, observing pre-harvest interval, harvesting cocoa pods without damaging flower cushions, breaking cocoa pods 2-3 days after harvest, breaking harvested cocoa pods, fermentation of cocoa beans for six days, drying cocoa beans to right moisture level and storage of dry cocoa beans in jute sacks

(b) **Certification (CERT) innovations:** This refers to strict adherence to new cocoa farming innovations related to environmental, economic, and social issues on Universal Trade Zone (UTZ) and Rainforest Alliance (RA) standards shared to beneficiary cocoa farmers. These innovations include: planting desirable shade trees in cocoa farms, practicing non-use of children under 15 years to undertake hazardous work, observing good treatment of workers, practicing protection of other plants and animals in cocoa farms, creating buffer zones between cocoa farms and water bodies, practicing good sanitation in the farm, home, and community, registering mapped farmland to own a farm plan, wearing PPE when undertaking cocoa farming activities, storing agrochemicals in storage rooms and disposal of used agrochemical bottles, sachets, bags etc.

(c) **Farmer Level Purchase (FLP) Innovations**: This refers to farmer level new ideas, methods and skills associated with the marketing of cocoa beans shared to cocoa farmers. These innovations include conveying bagged cocoa beans to cocoa sheds without contamination, selling all cocoa beans to COCOBOD LBCs, using testing stones and/or body weight to detect scale adjustments, ensuring cocoa sales are recorded in COCOBOD Passbook and Promptly paying advanced loans from LBCs in cocoa or cash.

(d) **Farm Enterprise Management (FEM) innovation:** This refers to new ideas and methods on farm business management shared with cocoa farmers. These innovations include: budgeting for cocoa farming activities, keeping records on cocoa farming activities, contracting labour to undertake activities on cocoa on time, supervising contracted labour work activities, mobilizing financial and material resources (e.g., inputs, equipment etc.) for cocoa farming, paying for received cocoa inputs and service credits on time, saving cocoa income in banks and other financial organisations, regularly participating in cocoa related meetings and trainings, estimating cocoa farming expenditure, diversifying farming enterprises, estimating profit realized from cocoa farming and Investing cocoa income in cocoa farming and other enterprises.

Cocoa Extension delivery: This refers to the dissemination of cocoa farming innovations and facilitation of cocoa farming inputs and related services by

CHED (public) and private extension providers to cocoa farmers to raise their competencies, adoption, yield, and income levels.

Effects of cocoa extension delivery: This refers to cocoa farmers increased competencies, adoption, yield, and income as a result of participation in CHED (public) and private extension delivery systems.

Competencies of cocoa farmers: This refers to the knowledge, attitudes, skills, and aspirations (KASA) cocoa farmers possessed in cocoa farming.

i. Knowledge refers to what cocoa farmers know about cocoa farming.

ii. Attitudes refer to the opinions and feelings cocoa farmers have towards cocoa farming.

iii. Skills refer to the mental and physical abilities cocoa farmers have to practice shared cocoa farming innovations.

iv. Aspirations refer to the ambitions, hopes or desires of cocoa farmers in cocoa farming.

Adoption of cocoa innovations: This refers to cocoa farmers' decision to practice or use shared cocoa farming innovations.

Cocoa yield: This refers to cocoa output in kilograms per hectare (kg/ha) produced by cocoa farmers during the 2018/19 main and light crop cocoa season.

Cocoa income: This refers to the amount of money (in Ghana cedis) made from the sale of cocoa beans and premiums received by cocoa farmers.

Cocoa farming challenges: These are the production, marketing and extension delivery constraints faced by cocoa farmers whilst engaging in cocoa farming as a livelihood and business.

Pluralistic cocoa extension: This refers provision of extension service supports by CHED and private extension organisations to cocoa farmers within same time frame.

Private extension provider: This includes legally established cocoa farming associations, NGOs, and for-profit businesses that register and deliver extension to cocoa farmers.

Organisation of the Study

The research is organised into nine chapters. The background of the study, problem statement, objectives and research questions, hypotheses, study delimitations and limitations, significance of the study, definition of terms, and study organisation were covered in Chapter one. The second chapter was devoted to reviewing relevant literature. Aspects include the theoretical framework, conceptual framework guiding the study, and a review of literature on relevant concepts. The research methods followed in the study were described in Chapter Three. Particularly Chapter three described the research design, research philosophy, study area, population, sampling, instrumentation, methods of data analysis, and presentation. In Chapters Four through to Eight, the results were presented and discussed based on the five specific objectives. The summary, conclusions, recommendations, contribution to theory and knowledge and suggestions for future research were presented in Chapter Nine.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents the work of other authors on the factors influencing extension delivery. The application of the Bandura social learning and McClelland competency theories in the theoretical framework of the study is presented in this chapter. The chapter also discusses the conceptual framework and empirically reviewed works on the various concepts related to the study. Particularly, the chapter presents the extension approaches, methods, training materials and methods of service quality measurement applied to measuring the quality of extension delivery in this study. The chapter also presented literature on the historical perspectives of cocoa production, COCOBOD mandates, cocoa botany, agronomy, and cocoa innovations. The socio-demographic and economic factors of cocoa farmers including land and labour issues related to cocoa farming are also reviewed. The adoption of innovations, cocoa yield and income, challenges associated with cocoa farming as well as the application and relevance of the mixed-method research approach are also reviewed in this chapter. The chapter concludes with a summary.

Theoretical and Conceptual Framework of the Study

The Theoretical Framework of the Study

Extension under decentralized and pluralistic systems is critical in addressing farmers' changing needs (Global Forum for Rural Advisory Services, 2012). This study looks at the factors influencing extension delivery in the Volta Cocoa Region of Ghana. The study is linked to understanding the characteristics of shared cocoa innovations, extension methods and materials, extension quality, socio-demographic and economic factors of cocoa farmers under cocoa extension delivery systems; challenges faced by cocoa farmers and associated extension outcomes regarding the competencies, adoption levels, yield and realised income of cocoa farmers. These factors have enormous implications for effective and efficient extension delivery. A theoretical framework entails theoretical principles, constructs, concepts, and the tenets of a theory employed to describe a phenomenon according to Grant and Osanloo (2014). The social learning theory (Bandura, 1971) and McClelland competency theory (McClelland, 1973) provide the theoretical framework for comprehending the factors influencing extension delivery in the Volta Cocoa Region of Ghana investigated in this study.

Social Learning Theory

The Bobo Doll experiment by Bandura resulted in the social learning theory. The design of the experiment involved children exposed to adult models aggressively playing with inflated Dolls with others observing non-aggressive groups and a control group. The outcome of the experiment showed that children exposed to aggressive models replicate more aggressive behaviours similar to the models, with mean aggressive scores significantly higher than subjects in the non-aggressive and control groups (Bandura, Ross, and Ross, 1963).

The Social learning theory thus has used been used in a number of studies on social learning. For instance, Deaton (2015) used the social learning theory to increase understanding of social media in classroom settings. The Social learning theory is similarly applied in this study to ascertain cocoa farmers learning behaviours, related factors, and support services in the Volta Cocoa Region of Ghana. The Social learning theory posits that "new patterns of behaviour can be acquired through direct experiences or by observing the behaviour of others" (Bandura, 1971 p. 3). The social learning theory thus suggests cocoa farmers under cocoa extension systems (CHED and pluralistic) learn from their own experiences or through observation of extension providers. Bandura also emphasis that "Most of the behaviours displayed by people are learned either deliberately or inadvertently through the influence of example" (Bandura 1971 p.5). The theory further emphasis the importance of competent modeling of human behaviour through demonstrations to avoid mistakes or errors during actual performance (Bandura, 1971). This is buttressed by the attentional, retention, motoric reproduction and reinforcement, and motivation interrelated sub-processes. How these processes are related to this study is further clarified.

Bandura indicates that for the attentional process, "a person cannot learn much by observation if he does not attend to or recognise the essential features of the model's behaviour" (Bandura, 1971 p.6). This implies that cocoa farmers exposed to extension systems must pay close attention to the innovations shared and assess their relevance to their cocoa farming enterprises. According to Bandura, attention to models is channeled through interpersonal attraction, and models with interesting or winsome qualities are sought after, whereas those without pleasing qualities are ignored or rejected, even if they excel in other ways (Bandura, 1971). That is, extension providers are expected to use various extension approaches, methods, and materials(aids) to maintain the attention and interest of cocoa farmers during learning or extension delivery. This particularly includes the interpersonal relationships, verbal and non-verbal expressions, language, subject matter relevance and listening skills extension providers use in delivering extension to cocoa farmers. The effective delivery of cocoa innovations thus correlates with farmer acceptance and practice.

In terms of the retention process, Bandura (1971 p.7) posits that a "person cannot be much influenced by observation of models behaviour if he has no memory of it" Thus, to have long-term retention of what has been modeled at one time or another require imagining and verbally coding what has been learned (Bandura, 1971 p.7). Cocoa farmers are expected to remember shared cocoa innovations to be able to practice them when extension providers are no longer available. Again, the use of appropriate methods and learning aids by extension providers is relevant in improving cocoa farmers retention capabilities. Bandura contends that the diverse symbolic modeling provided by television, films, and other pictorial displays, as well as mass media helps in shaping the individual's behaviour and attitudes. Thus, the modeling process is the same for words, images, and actions. However, Bandura suggests, some types of modeling may be more effective than others in capturing people's attention. As a result, extension providers must make informed decisions about the methods and materials to use in delivering extension to cocoa farmers from a variety of backgrounds (e.g., young, women, adults as well cocoa farmers with formal education and the uneducated)

According to Bandura (1971), motoric reproduction process is concerned with processes in which overt actions are guided by symbolic representations. Hence, Bandura (1971 p.8) indicates "a learner must put together a given set of responses according to the modeled patterns". Moreover, the amount of observational learning a person can exhibit behaviorally depends on whether or not the person has acquired the component skills. This implies cocoa farmers can only replicate the extension provider's behaviour and implement the shared cocoa innovations if they have the necessary competencies.

According to Bandura's social learning theory's reinforcement and motivational process, “a person can acquire, retain, and possess the capabilities for skillful execution of modeled behaviour, but the learning may rarely be activated into overt performances if it is negatively sanctioned or otherwise unfavourably received” (Bandura, 1971 p.8). That is, when positive incentives are provided, previously unexpressed observational learning is speedily translated into action. Cocoa farmers in the Volta Cocoa Region require additional support and incentives to put shared innovations into action.

The quality of extension delivery regarding the reliability, responsiveness, assurance, communication, tangibility, as well as empathy which are relevant for encouraging farmers to remain in the cocoa farming as a business are crucial in this direction. That is identifying and addressing cocoa farmers' constraints has extension delivery implications regarding training and facilitation of supports for the cocoa farmers to express the competencies that are being modelled. Scholarships and awards from COCOBOD and private extension providers are also important to encourage the expression of observational learning by the leaners (Cocoa farmers) in the Volta Cocoa Region of Ghana.

McClelland Competency Theory

Motoric reproduction, according to Bandura's social learning theory, suggests the acquisition of skills to express shared cocoa innovations provided by models (extension providers). This is buttressed by the McClelland competency theory (McClelland, 1973). The competencies of individuals and groups have been variously studied. For instance, Warner, Stubbs, Murphrey and Huynh (2016) applied the competency theory to identify the competencies required to apply social marketing to extension programming. Particularly, Conner, Roberts, and Harder (2013) applied the McCleland Competency theory to understand competencies and experiences required by entry level international agricultural development practitioners.

The McClelland competency theory emerged as alternative to traditional approach to intelligence testing. McClelland posits that "the best testing is criterion sampling" (McClelland 1973 p.7). According to McClelland (1973), criterion sampling involves both theory and practice which implies measurement of competencies according to Conner et al. (2013). Measurement of the competencies of Cocoa farmers thus require both theoretical (what should be done) and practical knowledge (perfectly undertaking the activity). In this regard McClelland (1973 p.7) indicates that "If you want to know how well a person can drive a car (the criterion), sample his ability to do so by giving him a driver's test" and a such "tests which sample job skills will predict proficiency on the job" (McClelland 1973 p.7). Similarly, to determine how well a cocoa farmer performs for instance, cocoa farming innovations or activities such as pruning, fertilizer application, pest control, harvesting and drying of cocoa beans (the criterion), it is critical to sample the cocoa farmers' ability to do so by providing them with the requisite tools and equipment to perform the tasks.

Furthermore, McClelland (1973) posits that "tests should be designed to reflect changes in what the individual has learned" (McClelland 1973 p. 8). and concludes that tests should assess competencies in clusters of life outcome and as such it is difficult, if not impossible, to find a human characteristic that cannot be modified by training or experience (McClelland 1973 p.8). The McClelland Competency theory brings to the fore the relevance of training which is core to extension delivery to result in the expected changes required of cocoa farmers. This further buttress the importance of the application of the relevant extension methods and materials during training. The McClelland competency theory is thus relevant in understanding the competencies such as the knowledge, attitude, skills, and aspirations of cocoa farmers under the cocoa extension delivery system (CHED and pluralistic) in the Volta Cocoa Region of Ghana.

Suvedi and Kaplowitz (2016) indicate the knowledge, skills and attitudes of a worker determine his or her performance. This suggests cocoa farmers could achieve the expected cocoa farming outcomes if they possessed the requisite competencies.

Rockwell and Bennet (2004) emphasis this assertion and indicate that extension is expected to reflect changes in, for instance, cocoa farmers as demonstrated by their KASA levels. That is, cocoa farmers in the Volta Cocoa Region of Ghana provided extension by CHED and private extension providers are expected to exhibit the required competencies such as knowledge, attitudes, skills, and aspirations towards cocoa farming which is a direct outcome of extension delivery as buttressed by McClelland (1973 p.9) that ‘tests should assess competencies involved in clusters of life outcomes’.

The competencies possessed by cocoa farmers are expected to result in the adoption of the shared innovations on Good Agricultural Practices, Certification, Farmer Level Purchases and on Farm Enterprise Management to achieve specific social, economic, and environmental outcomes

(Rockwell & Bennet, 2004). These adopted innovations are expected to for instance result in increased per hectare cocoa yield and associated income of cocoa farmers in the Volta Cocoa Region.

Key Concepts from Bandura's Social Learning and McClelland Competency Theories

Key concepts from the social learning and McClelland competency theories are expanded upon. The concepts of observational learning, intrinsic reinforcement and modeling are associated with social learning theory (Nabavi, 2012), whereas competency testing emanates from the McClelland competency theory.

Observational Learning

Observational learning refers to the process of people learning through observation. The observed behaviour changes in individuals such as cocoa farmers can and does occur through observation, even if it occurs incidentally, in the context of other activities (Fryling, Johnston & Hayes, 2011). Coding and rehearsal are essential components of observational learning. Coding refers to describing what has been observed in some way, whereas rehearsal refers to practicing what has been observed. Individuals, such as cocoa farmers, who verbally describe every action of a model (extension providers, examples in training materials) perform best when assessed for behaviour change at a later time, indicating the importance of early recognition of cognitive factors in observational learning (Fryling et al., 2011). Furthermore, participants (e.g., Cocoa farmers) who symbolically coded a model's action and immediately rehearsed (i.e., practiced) those codes are likely to obtain the best results (Bandura & Jeffrey,1973) of competencies to improve farming outcomes such as yield and income. It is important therefore to provide cocoa farmers with the appropriate supports to adopt shared innovations.

Intrinsic Reinforcement

Intrinsic reinforcement connotes internal reward entailing the feelings of pride, satisfaction, and accomplishment (Nabavi, 2012) of individuals. This is connected to the motivation perceived by the individual. Also, intrinsic motivation refers to doing an activity for its inherent pleasures rather than for some separate benefit (Ryan & Deci, 2000). This explains why cocoa farmers must achieve significant levels of self-satisfaction such as yield and income through their involvement in the cocoa farming enterprise. Reinforcement and punishment perspectives according to Nabavi (2012) are categorised as follows: indirect effects on learning, the extent to which a learned behaviour is displayed by an individual, the expectation of reinforcement on cognitive processes that promote learning, and attention paid that is critical in learning and influenced by the expectation of reinforcement. As a result, cocoa farmers require reinforcement in the form of farm inputs supports, research-based innovations, incentives, and rewards as forms of motivation to sustain and improve their cocoa farming enterprises.

Modelling

In Bandura's social learning theory, people who are being observed are referred to as models, and the process of learning is referred to as modeling (Bandura, 1971). Bandura reiterates that learning does not always result in a behavioral change; it must be followed by a modeling process. Bandura's live model (e.g., Community Extension Agents, Technical Coordinators, Facilitators), verbal models (using languages), and symbolic models, which are representative models, all have applications in the use of appropriate extension methods and materials in cocoa extension delivery in the Volta Cocoa Region of Ghana.

Competency Testing

The term “competencies” refers to all personal characteristics that are applicable in various life contexts, regardless of the level of performance attained through their application (Evangelista, 2009). Competencies are the determining factors that make work performance possible (Evangelista, 2009). These personal attributes are the individual's knowledge, attitudes and skills which determine main task performance. A better way to therefore identify competent people is to direct the evaluation directly on how the person performs his or her job, a phenomenon known as competency testing according to McClelland (1973).

Furthermore, Shavelson (2010) defines competence as a physical or intellectual ability, skill, or both; performance capacity to do as well as to know; performed under standardized conditions; judged by some level or standard of performance as sufficient, adequate, suitable, proper, or qualified; can be improved; draws on an underlying complex ability; and must be observed in real-life situations. As a result, cocoa farmers' competencies in cocoa farming refer to the underlying characteristics of cocoa farmers that enable them to perform cocoa farming activities.

The personal attributes (e.g., gender, age, marital status, etc.); socio-economic characteristics (e.g., income, assets, education, etc.); personality characteristics (e.g., self-confidence, independence, etc.); position in social networks (e.g., network size, connectedness, forms of interaction, etc.); and status characteristics (e.g., control over political power or economic resources) (Shavelson, 2010) influence cocoa farmers' knowledge, attitudes, and perceptions. The improvement in cocoa farmers' KASA levels could be evaluated following awareness (exposure) to cocoa farming innovations and practices through training by extension providers (CHED and private).

Conceptual Framework of the Study

This conceptual framework (Figure 2) illustrates related concepts that provide an exhaustive understanding of the factors influencing extension delivery in the Volta Cocoa Region of Ghana.

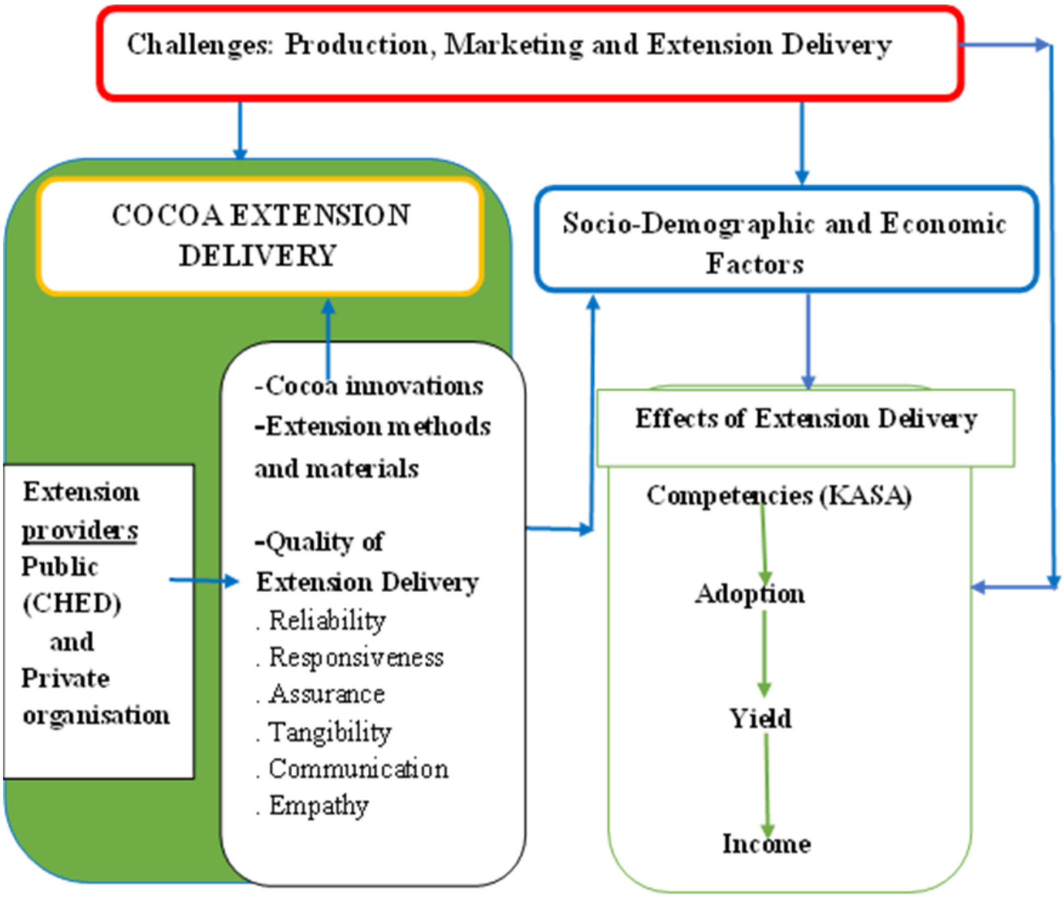


Figure 2: Conceptual framework on the factors influencing extension delivery in the Volta Cocoa Region.

Source: Agyeman (2020).

The cocoa extension delivery system in the Volta Cocoa Region is characterised by the providers, perceived characteristics of shared cocoa innovations as well as the extension methods, materials, and quality of the delivery. The COCOBOD Cocoa Health and Extension Division and private providers such as Cocoa Abrabopa Association (CAA) and Solidaridad-MASO are the main cocoa extension providers in the Volta Cocoa Region of Ghana. Receivers of private extension in addition to CHED extension are under pluralistic extension in the Volta Cocoa Region of Ghana. Cocoa farmers who participate in cocoa extension delivery receive trainings and have access to various programmes and incentives. CHED trains farmers and facilitates government-subsidised or free agrochemicals, seedlings, productivity enhancement programmes (mass spraying, pruning, pollination, and so on), international projects, and COCOBOD scholarships for cocoa farmers in the Volta Cocoa Region. Cocoa farmers who voluntarily register with CAA and under the MASO programme of Solidaridad receive additional training, input credits, certification, and extra cocoa income through premiums (particularly for CAA farmers) beside trainings received from CHED.

Good Agricultural Practices, Certification, Farmer Level Purchases, and Farm Enterprise Management are the four categories of cocoa innovations shared with cocoa farmers in the Volta Cocoa Region. Following Rogers (1983), new innovations are accepted by cocoa farmers based on their perceived characteristics such as relative advantage, trialability, complexity, compatibility, and observability. Thus, to enhance and facilitate the sharing of cocoa innovations to cocoa farmers in the Volta Cocoa Region of Ghana, extension providers (CHED and private) are expected to use appropriate extension methods (e.g., farm and home visits, demonstrations, and mass media such as radio and television); as well as extension materials (e.g., posters, manuals, books, and calendar etc.) to ensure acceptance and use of the disseminated cocoa innovations.

The reliability, responsiveness, assurance, tangibility, communication, and empathy aspects of quality extension delivery is critical in ensuring cocoa farmers derive benefits from the shared cocoa innovations by the extension providers. The quality of extension delivery generally is important in improving the relationship between extension providers and farmers for effective adoption of cocoa innovations and farmer retention in cocoa farming enterprise.

The socio-demographic and economic factors of cocoa farmers in the Volta Cocoa Region form basis for extension delivery design and implementation by providers. Some of these characteristics of cocoa farmers of relevance include their age, gender, education, marital status, native of the community; farm-specific factors: farm age, farm size; economic factors: land and labour, productive assets owned, access to credit, mobile phone ownership; and amongst others influence effective extension delivery and realisation of the associated outcomes.

Extension delivery is expected to directly result in improved cocoa farmer competencies (knowledge, attitudes, skills, and aspirations). These competencies influence cocoa farmers' decisions to use or adopt the shared cocoa innovations, for example, planting cocoa seedlings and shade trees at recommended spacing, pest and disease control, fertilizer application, harvesting, fermentation, drying and storage. Farmers can also sell cocoa beans to Ghana COCOBOD approved LBCs, test scales, and adhere to certification standards such as buffer zone observation, storing agrochemicals in storage rooms, and avoiding child labour, among others having acquired the requisite competencies. Moreover, cocoa farmers can adopt Farm Enterprise Management innovations such as budgeting, supervising workers, savings, meeting attendance and diversification by participating in COCOBOD Farmer Business Schools and trainings provided by private extension organisations as a result of improved competencies. Adoption of shared innovations is expected to lead to realisation of the desired cocoa yields and associated incomes. Participation in CAA certification programmes for instance contributes to increased cocoa income because farmers receive premiums for each kilogram or bag of cocoa bean sold to dedicated LBCs.

To achieve the goal of cocoa extension delivery and its associated effects, cocoa farmers in the Volta Cocoa Region of Ghana require support to address the production, marketing, and extension delivery challenges without which the expected outcomes of extension delivery will be unattainable. For instance, access to finance, inputs, price, extension contacts are critical for improved cocoa yields and income and hence need to be improved through access and supports.

Whilst there are extant literature and knowledge on cocoa farming and extension delivery for most cocoa regions of Ghana, there are knowledge gaps regarding the nature, cocoa extension delivery and its related effects and determining factors for cocoa farmers in the Volta Cocoa Region of Ghana. It is therefore important to identify these knowledge gaps which are critical in identifying the factors influencing extension delivery in the Volta Cocoa Region. This will generally influence the policies, programmes, and projects of

COCOBOD, private stakeholder and international cocoa related organisation to enhance extension delivery and to increase cocoa production levels and incomes of cocoa farmers in the Volta Cocoa Region of Ghana.

Empirical Review of Related Literature

This section entails a review of related literature on various aspects of extension delivery and effects, cocoa botany and production, cocoa innovations, socio-demographic and economic factors of cocoa farmers, challenges (production, marketing, and extension delivery) and effects of extension delivery and the mixed method research approach.

Nature of Extension and Delivery

In the second half of the nineteenth century, the term "extension" was used to describe adult education programmes in England (Swanson, 2008). The terms "extension" and "advisory services" have been used interchangeably to refer to practises and processes that provide farmers with innovations, among other advantages (Swanson & Rajalahti, 2010). The definition of extension has evolved to include the process of knowledge generation and exchange, which is a method of introducing new knowledge and ideas into rural areas to bring about change and to improve the lives of farmers and their households (Khalid & Sherzad, 2019; Kpienta & Jasaw, 2012). According to Birner et al. (2009), agricultural extension also refers to the entire set of organisations that assist and facilitate people engaged in agricultural production in solving problems and obtaining information, skills, and technologies to improve their livelihoods and well-being.

Agricultural extension assists farmers to make decisions on what and when to perform farming activities (Payne, 2010). Also, Swanson (2008) summarises the main goals of extension as (a) Technology transfer: Extension aims to transfer developed technologies to farmers in order for them to adopt and use them; (b) Human capital development: Extension continuously improves the human capital of farmers, youth, women and the rural population base in order for them to take up innovations delivered and improve their livelihoods; (c) Natural resource sustainability: related to maintaining the natural resource base, for example, forests and water bodies, while farmers produce; and, (d) social capital development: Extension works to help its clients (farmers) organize themselves into groups in order to improve the efficiency and effectiveness of extension delivery.

Issues regarding job creation, food security as well as local and regional economic development rely on the agricultural extension system (Alemu, 2017) of an area or a country. The extension agent is the communicator who initiates the communication process in the context of agriculture and rural development (Japan International Cooperation Agency, 2008). The key competencies and qualities that extension agents must possess in order to provide better extension services to farmers are summarised in Table 1.

Table 1: Knowledge, Skills, Qualities of Extension Workers and Basic Characteristics of Adult learners

Knowledge Required	Necessary personal skills	Key personal qualities	Basics on adult learning
1.Technical 2.Rural life 3. Policy 4.Adult education 5.Cultural knowledge 6.Etiquette & language 7.Religious protocols	1. Organisation 2. Planning 3.Communication analysis and diagnosis 4. Leadership 5. Initiative 6. Public speaking 8. Report writing	1.Commitment to extension work 2.Reliability 3. Humility to work and farmers 4.Confidence in own abilities 5.Determined to achieve something	1. Adults are autonomous and self-directed 2. Adults have accumulated a foundation of life experiences and knowledge 3. Adults are purposeful 4. Adults are relevancy-oriented 5. Adults are practical 6. Adults need to be shown respect

Source: Khalid and Sherzad (2019)

Extension Approaches

To effectively deliver extension to farmers, extension providers employ a number of, or a combination of extension approaches to design and meet the objectives of the extension delivery to the targeted farmers (beneficiaries). According to Axinn (1988), an approach is a method of action used within a system whereas Hagmann, Edward and Oliver (2000) define an approach as a method of applying various guiding principles in a specific situation to achieve various goals. Hagman et al. (2000), reiterates extension approach comprises a set of procedures for planning, organising, and managing the extension institution, as well as implementing practical extension work by staff with technical and methodological qualifications, and using the necessary and appropriate adapted means. Extension approaches help extension practitioners to understand the fundamentals, functional methods and concepts of extension used by extension organisations to achieve their goals, particularly during the planning stage (Dormon, Stoian, Foundjem & Degrande, 2004).

According to the Directorate of Agricultural Extension Services (n.d), extension approaches are characterised by dimensions such as:

(a) The fundamental assumptions upon which it was founded. This refers to perceived problems and issues that require a specific strategy to resolve.

(b) The assumptions influenced by perceptions of the human, technical, biological, physical, social, cultural, administrative, political, and diplomatic ecosystem in which extension operates.

(c) The objectives that it seeks to achieve. The approach's purpose or aim refers to the underlying principles of the approach's foundation. It also determines what it is supposed to achieve and the underlying goals.

(d) The means by which the programme planning is controlled, as well as the relationships between the primary target audience of the programme and those in charge of programme planning.

(e) The nature of the field personnel regarding their density in relation to clientele, reward systems, levels of training, origin, gender, and transfers.

(f) The resources required and various cost factors such as the substantial reliance on workforce versus greater mass media usage

(g) The typical method of executing the programme.

(h) The systems success is determined by the variables or outputs it produces.

Various extension delivery approaches have been found to produce satisfactory results, particularly in improving farmers' knowledge of newly developed agricultural technologies (Kaur & Kaur, 2018). Axxin (1988) proposed the General Agricultural Extension, Commodity Specialized, Training and Visit, Agricultural Extension Participatory, Project Approach, Farming Systems Development, Cost Sharing and Educational Institution as the approaches to extension delivery. These various extension approaches available and practiced according to Axxin, (1988) are further described as:

General Agricultural Extension Approach

The General Agricultural Extension approach assumes that technology and knowledge are available but not being implemented by farmers to help in increasing their crops and livestock production, and other enterprises. The approach is led by government or its mandated organization usually a ministry in charge of agriculture extension. For instance, in Ghana, MoFA is charge of the general agricultural extension delivery (MOFA, 2016). Typically, programme planning using the General Agricultural Extension approach is centralised and controlled by the government (which involves professional, administrative, and political personnel). Field staff are assigned to political divisions across the country as part of the implementation process. Field staff are assigned to political divisions across the country as part of the implementation process. The resource required rely on large number of field personnel stationed at small political sub-divisions hence the cost of personnel is usually high. Success is measured by increase in national production of commodities being emphasised by stated national programme.

The merits of the General Agricultural Extension approach include the fact that the programme is managed by the center (government) and covers the entire country. It involves the use of demonstration plot, supported by mass media such as radio, and the use of other extension training materials and publications which are widely distributed. The approach has however been criticized for its communication challenges due to the lack of feedback. It is also perceived as being expensive and inefficient due to its high-cost levels related to high number of extension staff involved in the extension delivery (Axinn, 1988).

Commodity Specialized Approach

Due to specialization of some farmers in some commodities, it is important to address the associated peculiar extension needs. The commodity specialized approach thus focused on one export crop, for instance cocoa, coffee, cotton, oil palm, rubber, and cashew (Axxin, 1988). The aim of the approach is to increase the quality and quantity of the targeted commodity or product. This approach has been used by for instance the Ghana COCOBOD (led by CHED) to focus its extension delivery mainly on the cocoa commodity to improve production levels and quality. The key characteristic of this approach groups all the functions for increased production, extension, research, input supply, marketing, and prices under one administration. Program planning and implementation are controlled by the commodity organization. The governing board of the organization usually decides on the extension goals, messages, schedule of activities, staffing and program participants, and require farmer cooperators to strictly follow the predetermined package of technology. The resources for the delivery of extension under this approach are usually provided by the extension organization which invests into the managerial functions of planning, organization, staffing, leading, and controlling. Sometimes highly qualified scientific and field personnel and credit scheme for the farmers are put in place and practiced (Axinn, 1988).

Extension staff from the extension organisation provide instructions to farmers during implementation. This is accomplished through face-to-face communication, either individually or in groups, as well as the use of printed training materials where the literacy level of users is considered high. The primary benefit of the commodity-specific approach is that technology tends to fit the product problems, so the messages that extension officers send to farmers are relevant to their activities. Coordination with research and marketing entities allows messages to be delivered to producers on time. The approach is usually thought to be easier to monitor and evaluate, as well as less expensive than other approaches. However, the approach is hampered by the fact that farmers' interests may be given lower priority than those of commodity production organisations. In the case of farmers who produce more than one commodity or whose problems are not limited to the use of a single commodity, the approach does not provide advisory services to other aspects of farming (Axinn, 1988).

Training and Visit Approach

According to Axinn (1988), the assumption of the World Bank implemented Training and Visit (T&V) extension approach is that field personnel are poorly trained; not up to date; stay in office rather than visit farmers, and management and supervision are not adequate. The approach further assumes inadequacy of management and supervision. Hence, the purpose of the approach, to induce farmers to increase production of specified crops. In this approach schedule are fixed for subject matter specialist training of village extension workers as well as for visits by village extension workers to farmers. The T&V programme is centralised and involves interaction between extension and research personnel of the ministry of agriculture, and decision on what and when to teach resides with the extension agent who follows the cropping pattern of the prioritised crops. The approach is implemented through visits by village level extension workers to small groups of farmers or to individual contact farmers. There is also fortnightly training of extension agents by village extension workers' subject matter specialists.

According to Axxin (1988), resources for programme implementation typically come from outside the country in the form of large international loans to cover the high costs of logistics and remuneration. The measure of success is anchored on increased yields and total production of the crops being emphasised. The success is seen by its extension philosophy which influences the messages to be sent to farmers.

The advantages of the T&V approach are that it puts pressure on government to organize a large number of small agricultural extension units into one or more integrated services and also puts pressure on agricultural extension officers to get out of their offices and meet with farmers. It is important greater technical supervision and logistical support is made available to extension field staff to improve extension delivery. The disadvantage is that T&V cannot function effectively without an effective research programme, as the system is designed to transfer technology rather than create it. Also, T & V cannot increase production unless the contemporary parts of the small farmer development package like input supply and credit, market mechanisms and price incentives are in place. It also lacks two-way communication, lacks flexibility to change programs as needs and interests of farming people vary with place and time.

Agricultural Extension Participatory Approach

According to Axinn (1988), the participatory agricultural extension approach assumes that farming people operate in indigenous knowledge systems regarding production, which could result in improved levels of living and productivity by learning more from external contact. Effective interaction between indigenous knowledge systems and scientific knowledge systems is required. The goals of this approach are to increase farmer production and consumption, improve rural dwellers' quality of life, and secure appropriate recommendations from agricultural researchers through participatory feedback from farmers to researchers.

Local farmer groups or associations (cooperatives) and representatives of agricultural research organisations control programme planning. Implementation is frequently decentralised and flexible, with active participation of extension agents and farmers through regular meetings and demonstrations. This strategy includes input suppliers and marketers as well.

The approach necessitates the use of human resources, such as extension agents who facilitate group formation and motivate group efforts to achieve predetermined goals. The continuity of local extension organisations, the benefits of extension activities to the community, the number of farmers actively participating, the sustainability of local extension organisations, and the extent to which agricultural research personnel and others involved in supply and marketing participate in both programme planning and programme implementation are used to determine success. The benefit of the extension participatory approach is that implemented programmes meet the goals of the participating actors. Another advantage of the approach is the supportive relationship that develops among the participants. In general, the approach increases farmer awareness, confidence, and activity. One of the approach's drawbacks is the government's lack of control over the programme. When other ministries have the authority to form groups, it leads to misunderstandings and unfair competition. It is also difficult to manage central reporting and account for participatory approaches. Local leaders can also have an impact on personnel management decisions such as the selection, transfer, and promotion of extension field workers, which may be viewed as problematic by the central government.

Project Approach

The project approach is based on the assumption that there are high-impact activities that, when carried out under artificial conditions, will continue to have some continuity after outside financial support is no longer available. The large government bureaucracy featured in some other approaches is assumed to have little impact on agricultural production or rural people. In addition, the method emphasises that better results can be obtained in a specific location. The goal of the project extension approach is to show what can be accomplished within the project area in a relatively short period of time. Another objective is to offer extension services as part of a larger integrated rural development project. Control over programme planning is usually exercised outside of the village, through central government, a donor agency, or a combination of the two.

Implementation typically consists of a project management team, project allowances for field staff, better transportation, facilities, equipment, and housing than regular government programmes, and foreign advisors for local staff. The term "success" is usually associated with short-term changes at the project site, such as increased output (Axxin, 1988). The project approach has the advantage of yielding quick results while also allowing for the testing and experimentation of novel techniques and methods. The disadvantages are that it is time-limited and assumes a flow of "good ideas" from the project area to other locations. When the funding is depleted, so is the project. In general, it appears that the assumption of continuity is unwarranted. When the end of a project approaches, staff leave, and the field unit suffers as it is reintegrated into a larger national system. Another disadvantage is that a large proportion of resources are spent on baseline surveys and the establishment of a temporary logistic base. However, without projects, for example, there are no or very few resources available to pay for extension service needs such as fuel, vehicles, supplies, and demonstration plots under the current MoFA extension financial structure. Furthermore, nearly all extension activities delivered today revolve around projects, as well as the themes and goals of projects. Many of the projects are designed and implemented from the top down, even if they claim to be farmer-led, demand-driven, and market-oriented (Modernization of Extension and Advisory Services , 2012).

Farming Systems Development Approach

One distinguishing feature of the farming systems development approach is that it is a holistic approach at the local level (Axxin, 1988). The approach assumes that technology that meets the needs of farmers, particularly small farmers, is unavailable and must be developed locally. The goal is to provide research results tailored to the needs and interests of local farming system conditions to extension personnel. Because the programme must be considered a holistic approach to the plants, animals, and people in each specific location, programme planning is linked to varying climatic and ecological farm eco-system types. Local farmers, agricultural extension officers, and agricultural researchers share control of the programme. The programme may differ across locations, as may reporting, financial administration, and other issues.

Implementation is accomplished through collaboration of research and extension personnel with one another and with local farmers, using a system approach to farming and sometimes involving multiple scientific disciplines. The approach also necessitates that researchers visit farms, listen to farmers, and work with them and extension personnel to try to understand the farm as a system. The extent to which local people adopt and continue to use the program's technologies is used to determine success. The effectiveness of this system is dependent on the relevance and appropriateness of the messages generated, as well as the recommendations made by field agricultural extension personnel. The farming systems approach is in charge of ensuring effective collaboration between extension and research personnel. The approach has a clear disadvantage in that it produces results slowly and requires a great deal of specification within the scientific agricultural disciplines. The cost of bringing together teams of agricultural researchers from various disciplines at a cooperating farm can be quite high.

Cost-Sharing Approach

Axxin (1988) further indicates the cost-sharing approach assumes that any non-formal educational programme will be more successful if those who benefit from it contribute to its costs. The cost-sharing approach also assumes that farm workers are too poor to cover the entire cost, so central and regional governments usually cover the majority of it. Local people are willing to pay a portion of the cost to assist farmers in learning what they need to know for self-improvement and increased productivity. Another goal of the cost-sharing approach is to fund agricultural extension that is both affordable and sustainable at the national and local levels. The various levels paying the costs share control of the programme but must be responsive to local interests in order to maintain cooperative financial arrangements. Field personnel are recruited locally and stay in the project area for an extended period of time to carry out the project. Farmers' willingness and ability to contribute a portion of the cost, either individually or through their local government units, determines the success of the cost-sharing approach. Local residents must be continuously satisfied for such a system to last.

By allowing for some local control over programme planning, the cost-sharing approach has the advantage of increasing the relevance of programme content and methods to meet the needs and interests of clients. The ability of field extension officers to communicate effectively and gain the trust of rural people is enhanced by local influence in their personnel selection. In Nigeria, for example, a majority (64.6%) of farmers were found to have contributed to cost-sharing practices in the provision of housing to public extension agents (Attah & Obinne, 2015). The approach also normally carries with it a lower cost to central governments, as cost are shared by lower levels of government, and by local people. The disadvantages of the cost sharing approach are that it is more difficult for central government to control either programme or personnel, and reporting, financial management and other aspects of the administration tend to be complex and difficult. This is the trade-off associated with the advantages of cost sharing extension approach. Similarly, Ozor et al. (2013) found that majority of farmers (95.1%) were willing to pay for improved extension service as long as it remained relevant to their needs.

Educational Institution Approach

According to Axinn (1988), the Educational Institution approach assumes that agricultural institutions (schools or colleges) have technical knowledge which is relevant and useful to people, and a such teaching staff must interact with real farmers in order to be good agricultural teachers. The educational institution approach's primary goal is to teach rural people about scientific agriculture while also teaching teachers and students at the school about actual farming practises in their community. Those who determine the curriculum of educational institutions typically have control over programme planning. Non-formal instruction in groups, with individuals, and other methods and techniques are typically used for implementation. In some cases, educational institutions serve as an intermediary or Subject Matter Specialist (SMS), enrolling field officers from other agricultural extension systems as students and learning from research personnel at their own institutions on a regular basis. The size of their audience and the extent of participation by farm people in the school's agricultural extension activities, as well as learning by their enrolled students and regular teachers from the farmers with whom they interact, have been used as measures of success for some educational institutions.

According to Axxin (1988), the benefits of the education institution approach include the school adding real-world relevant examples to their textbooks and academic teaching materials, as well as the reduction of national budgetary allocation to extension and specialist costs. Another benefit is that the interaction between specialised scientists and field extension personnel provides good training for both. There is also extensive access to ongoing agricultural extension activities as a laboratory for the agricultural curriculum's social science dimensions. However, the approach is hampered by the fact that instructors are removed from the classroom and the tendency to speak too academically to farmers. When the agricultural extension system has its own trained specialisation personnel, competition arises. The educational institution approach fosters competition, for example, between personnel from the ministries of agriculture and education. While such competition is normal in any bureaucracy, it is beneficial to have clear administrative understandings of who owns which territory.

New Paradigm Approaches to Extension Delivery

In philosophy and practice, extension delivery has evolved to include decentralization and pluralism. Decentralization entails the assignment of fiscal, political, and administrative responsibilities to lower levels of government in order to respond to global demand for equity, accountability, and efficient service delivery, as well as to meet the needs of locals in general (Muriisa, 2008). Agricultural extension decentralisation refers to the management of agricultural extension from the state to the local level through more vertical or horizontal approaches. Nambiro, Omiti and Mugunieri (2006) found that increasing levels of decentralisation improved knowledge for empowerment, service provision and cost-effective public delivery channels.

Decentralization is defined by Rondinelli (1981) and Muriisu (2008) in the context of deconcentration, delegation, devolution, and privatization, which is also supported by Rajasekhar, Babu, and Manjula, (2018). Deconcentration defines the allocation of power from central government ministry headquarters to local administrative offices of the central government by shifting workload from central government ministry headquarters to staff located in offices outside the national capital. Local-level employees typically lack the authority to manipulate or make decisions about how the functions expected of them are to be carried out. Deconcentration of agricultural extension in Ghana refers to a situation in which district agricultural extension operates under a decentralized system with a high farmer-to-extension agent ratio and limited and uncertain levels of government funding (Okorley, 2004).

Delegation refers to the transfer of power to sub-national governments, parastatals, or other government entities. This includes the transfer or creation of board authorities, parastatals, and statutory bodies, as well as collaborations, among other things, to plan and implement decisions concerning specific activities or a variety of activities within a specific spatial boundary of an organisation. Local organisations are responsible for making decisions and carrying them out administratively and technically, as in the case of CHED which is mandated to oversee and manage Ghana's new cocoa extension system.

Devolution is the most comprehensive form of decentralisation, entailing the establishment of separate levels and units of government (Rondinelli, 1981). Devolution is an inter-organisational pattern of power relationship in which state power is shared in terms of both decision making and legislative power and is mostly achieved through elective and legislative provisions.

Privatization form of decentrailsation is the transfer of power from the public to the private sector through the use of parallel organisations such as trade associations or professional groups, cooperation, NGOs, and so on (Muriisu, 2008). This entails private organisations, for example, Cocoa Abrabopa Association, Solidaridad, Mondellez, and GIZ, among others, participating in cocoa extension delivery (Agyekum, 2015).

Anderson (2008) argues for the benefits of decentralized agricultural extension. Decentralization improves accountability because extension agents become employees of local governments which are eager to receive positive feedback on service from the clientele-electorate mostly through election (Anderson, 2008). According to Modernization of Extension and Advisory Services (MEAS) (2014), local governments advocate for the need to strengthen the capacity to use extension to improve smallholder incomes and food security so that decentralisation does not further erode smallholder farmers' ability to receive extension services. Moreover, MEAS (2014) observed that increasing levels of decentralisation result in improved access to extension services which further indicates the relevance of descentralised extension delivery by public and private providers.

Pluralism of Extension Delivery

Umali-Deininger (1997) indicates that the commercialisation of farming activities increases demand for specialised client and location-specific extension services provided by for-profit private business organisations. Umali-Deininger (1997) reiterates that the government's role in a pluralistic extension system is to provide a regulatory framework to ensure fair competition and to maintain quality standards in the context of market failures. Farmers' preference for a variety of technical advice and enterprise-specific technology in developing their agricultural enterprises also contributed to the emergence of pluralistic extension (Chowa, Garforth & Cardey, 2013). Moreover, the need for pluralistic extension emanates from the perception that specific services are required due to differences in specific contexts, economic enterprises, livelihood functions, and farmer categories, which are defined by disparities in entrepreneurship, poverty, and gender (Anderson, 2008).

Pluralistic extension assumes the coexistence of multiple public, private and mixed extension systems, and approaches; multiple providers and types of services; diverse funding streams; and multiple sources of information, all of which benefit from some level of coordination and regulation that promotes interaction and learning among service providers and farmers (World Bank, 2012). The government and other stakeholders are expected to work together to build a robust institutional framework to guide and strengthen these useful mutual collaborations (Nambiro, Omiti & Mugunieri, 2006). The involvement of multiple extension agencies strengthens project implementation, and thus pluralistic extension services provide smallholder farmers with opportunities. Public extension officers are required to coordinate the provision of pluralistic extension as well as improve the human resource personnel and funding resources needed to improve the delivery (Kau, Mahlangu & Maku, 2009).

Actors Involved in the Pluralistic Extension System

Pluralistic extension includes sub-sectoral bodies such as private organisations, market-oriented farmers, producer or farmer organisations and cooperatives at the meso level, local and international NGOs, input suppliers and agro-dealers, private business contacts and the relations that provide informal advisory services, by village/community extension workers (Global Forum for Rural Advisory Services, 2012).

Examples of investment avenues to promote pluralistic extension delivery (Table 2) include deconcentration, decentralisation, provision of various services, empowerment of farmers, as well as outsourcing related services, collaborations, and extension approaches (Global Forum for Rural Advisory Services, 2012).

Table 2: Options for providing and financing pluralistic agricultural advisory services.

	Source of finance for service				
Providers of service	Public sector	Private sector: farmers	Private sector: companies	Third sector: NGOs	Third Sector: FBOs
Public Sector	Public sector advisory services, no fees, different degrees of decentralization	Fee based public sector advisory services	Private companies contract staff from public sector advisory service	NGOs contract staff from public sector advisory services	FBOs contract staff from public sector advisory services
Private Sector: companies	Publicly funded contracts to private service providers	Private sector companies providing fee-based advisory services	Embedded services: companies provide information with input sale or marketing of products.	NGOs contract staff from private service providers	FBOs contract staff from private service providers
Third Sector: Non-Governmental Organisations (NGOS)	Publicly funded contracts to NGO providers	Advisory services agents hired by NGO farmers pay fees	Private companies contract NGO staff to provide advisory services.	NGOs hire own advisory staff and provide services free of charge	
Third Sector: Farmer-Based Organisations (FBOs)	Publicly funded contracts to FBO providers	Advisory service staff hired by FBO; farmers pay fees		NGOs fund advisory service staff who are employed by FBO’s	FBOs hire own advisory staff and provide services free to members

Source: Anderson (2008)

To promote and strengthen private sector involvement in pluralistic extension according to Global Forum for Rural Advisory Services (GFRAS) (2012) require:

a. Creating a programme to evaluate and expand farmers' organizations' ability to directly hire, finance and use agricultural extension agents (AEAs).
b. Building on existing and previously developed and implemented programmes of community extension volunteers (lead farmers etc.) through strengthening, training, and supporting them in order to meet the needs of farmers' groups and their extension needs.
c. Creating and promoting small-scale independent farm advisors who provide fee-for-service to farmers.
d. Implementing an extension programme aimed at mechanization service providers (tractors, combines, threshers, etc.) in order to improve farmers' business skills and technical capacity.

Nature of Cocoa Extension Delivery in Ghana

The partnership involving the public-private cocoa extension providers in Ghana was established to support cost-effective and efficient extension service to cocoa producers in order to increase farm productivity and associated income and livelihoods. The public and private partners in this arrangement contribute funds for recruiting and training extension agents, as well as training materials, publications, and the cost of training farmers (Bymolt, Laven & Tyszler, 2018b). The public partners involved in the extension system entails COCOBOD and subsidiaries such as Mondelêz, Solidaridad-West Africa, the World Cocoa Foundation (or the Cocoa Livelihoods Programme) and allied agencies, Armajaro Ghana Limited, Rainforest Alliance, while the cocoa farmers form the private partners. The Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) through the sustainable cocoa business programme collaborates with other partners to train cocoa farmers under the Farmer Business School system (Bymolt et al., 2018b).

It is clear that cocoa extension in Ghana takes place amidst a public-private partnership which includes extension and research institutions, input distributors, produce buying agencies, NGOs, farmers, and individuals (Baah & Anchirinah, 2011). CHED operates with a lean professionally trained and motivated staff to support provision of a cost-effective and efficient cocoa extension to business focused cocoa farmers. Cocoa farmers are educated on Good Agricultural Practices using extension methods such as meetings, farm and home visits, rallies, and radio programmes (CHED & WCF, 2016). Farmers are also trained in various diversification enterprises in addition to the FBS. COCOBOD also encourages youth group formation to raise and facilitate farmers' access to land, extension, inputs, and credit (CHED & WCF, 2016). Furthermore, as part of the National Farmers' Day, COCOBOD recognises hardworking cocoa farmers at the district, regional and national levels. Farmers are selected based on performance indicators such as output, community contributions and use of good agronomic practices. (CHED & WCF, 2016).

Extension effectiveness is affected by the level of farmer awareness of extension services, the number of visits paid by community extension agents, the percentage of scheduled meetings held between farmers and extension workers, and the number and of field meetings held by the extension agent (Agbarevo & Benjamin, 2013). Other factors that to the effectiveness of extension include the number of field days and demonstrations scheduled within a specific period (monthly, quarterly, or annually), number of supervisory visits, the number and frequency of research-extension linkage workshops and farmer training sessions as well as the number of farmers trained (Agbarevo & Benjamin, 2013). Private extension has been found to be skewed toward high potential regions due to profit or quick results motives on the part of extension providers. Private systems also benefit from public extension staff in pluralistic extension systems. The government is therefore expected to provide the funding, quality control, mediation, monitoring and infrastructure to reduce the costs incurred by the private sector (Muyanga & Jayne, 2008) in order to sustain pluralistic extension systems.

Failures in agricultural extension, according to Birner and Anderson (2007), are caused by issues with information, incentives, capacity, political interests, and bureaucratic procedures and attitudes. Whereas market failures in extension delivery result from some information types deemed public goods such as knowledge on prices, particularly when delivered via radio, which has characteristics of non-excludability (internet passwords through certain websites are private goods) and undervaluing of extension information with the merit of public good characteristics. Furthermore, poor farmers with a high time rate of discount may overestimate the benefits of extension if these benefits are only realised later (Birner & Anderson, 2007).

Extension Methods and Training Materials

The use of live models to enhance learning as emphasised by the social learning theory (Bandura, 1971) leads to improvement in the competencies (McClelland, 1973) of cocoa farmers. Extension methods and materials are thus critical components of an effective and efficient extension delivery system. The promotion of knowledge flows among various actors in the agricultural innovation system is also crucial in achieving the objectives of extension. As such, communication skills are essential for the successful implementation of extension programmes. Communication characteristics of importance include the source (where the communicated information or idea originates), message (what the main idea or message being communicated is), channel (how the information is distributed), and listener (the group of people who receive the information) (GFRAS, 2012).

According to Famuyiwa, Olaniyi and Adesoji (2016), an extension method is the process and techniques used by extension agencies to complete a task. Extension teaching methods and aids have also been described as the channels and tools used to clarify ideas and new agricultural technologies, as well as to transfer innovations to a large and diverse audience of farmers (Al-mashhadani, Magd & Keshta, 2017). For example, Okorley, Adjargo and Bosompem (2014) found Farmer Field School to be effective in facilitating farmers' knowledge acquisition in all cocoa technologies used. Participatory approaches, farmers' field schools, and public–private extension approaches have also been found to have greatest impact on Ghana’s sustainable agricultural development (Omar, Hassan, Baker, Jais & Shallof, 2013). According to Famuyiwa et al. (2016), the choice of an extension method to use in extension delivery is determined by technological applicability related to applicability, adaptability, and acceptability into the system. The decision to use a particular extension method is also influenced by economic feasibility, environmental safety, social acceptability, cultural acceptability, suitability for the long term, audience configuration, and content relevance. The method of choice is also influenced by factors such as the tenure system in the area, community organisation, and the resources available for extension (Famuyiwa et al., 2016). Individual/household, group, and mass approaches are the three broad categories of extension methods. A method or a combination of these methods is used to deliver extension to farmers, depending on the situation and plan of the extension programme (Anandajayasekeram, Puskur, Workneh, & Hoekstra 2008) It is believed that combining multiple extension methods is more beneficial than using just one. For instance, in areas where tenure is communal or land management is based on communal efforts, a group strategy is likely to be more effective than an individual (Anandajayasekeram et al., 2008).

Individual Extension Method

Individual extension methods are most effective when carried out by or under the sole authority of a single farmer or household. The extension agent meets with the farmer face-to-face and provides information and guidance, allowing the farmer to receive the extension agent's full attention (Luukkainen, 2012). The individual extension methods pertain to home and farm visits; office and phone calls; informal contacts; personal letters; adoptive or mini-kit trials; farm clinics, and so on (JICA, 2008). According to Banson, Nguyen, and Bosch (2016), the most prevalent form of individual extension method used is farm visits which represents more than half of the agent’s extension activities.

Farmers' visits to extension officials' offices are known as ‘office calls’ (Luukkainen, 2012). This demonstrates the interest that extension agents arouse in farmers, as well as the trust that farmers place in the extension agent, resulting in additional visits (Luukkainen,2012). Office calls take less time for the extension worker, and farmers should be encouraged to make them. Extension agents use telephone calls to provide specific advice or information to farmers and to receive feedback. When making phone calls to provide specific advice or information, extension agents are expected to speak effectively, remember the important points mentioned, and record them against farms (Luukkainen, 2012).

Informal contacts are a type of individual extension method that occur frequently during an agent's stay in a specific operational region. Market days, holiday celebrations, and religious holidays are all common times for extension agents to meet with farmers and discuss issues. The extension agent is able to get to know the farmers in his area, deal with their problems, and provide them with ideas and information informally (Luukkainen, 2012).

Individual contact allows the extension officer to secure cooperation and inspire confidence in the farmer and his family, and it allows for immediate feedback on discussions and participation in decision-making. The individual extension requires time and transportation leading to only few farmers being visited culminating in a limited area covered (Luukkainen, 2012).

Group Extension Methods

Group extension approaches allow the agent to meet with a group of farmers to conduct extension work and are appropriate when discussing issues that affect the entire community. Types of group extension methods include group meetings, method and result demonstration, Farmer Field School, field day or farmers day, tours (Luukkainen, 2012; JICA, 2008) among others.

Meetings are useful for gathering community information, deliberating on issues of personal or common interest, and disseminating new ideas. The two types of group meetings are small group meetings, which usually consist of one extension agent and no more than ten farmers, and large group or community meetings, which usually consist of several extension agents organising a meeting in a local community to convey important or urgent information to farmers. During a meeting, a lecture or presentation, the agent is able to deliver a detailed and well-prepared message to his audience on a specific issue (FAO, 2018).

A field day is a group extension event for any type of method or result that is held at a demonstration site. Field days provide opportunities for ten or more farmers to visit a demonstration site, learn about what is being demonstrated, ask questions, and be inspired to try new ideas on their own farms. Field days are scheduled at various points throughout the demonstration to demonstrate a farming pattern and to provide farmers with an opportunity to reconnect. Field days are expected to last not more than an hour, to be free of charge, and to have dates and times set in advance and advertised to neighbouring farmers (FAO, 2018).

Farmer rallies are large extension events that typically include a variety of activities centered on a central theme, such as folk song, dance, and banners, and are used to introduce successful innovations. Farmers' rallies are more costly to organise than other extension activities, but they have the advantage of attracting several farmers from diverse backgrounds (FAO, 2018).

Folk media is a traditional form of entertainment and communication for extension programmes. Examples include songs, drama, storytelling, dancing, and puppets. These activities allow for the communication of agricultural knowledge in a culturally acceptable manner, the encouragement of farmers to debate local issues, and the enjoyment of extension gatherings. These methods are less expensive because they do not require modern technology, and they are useful in areas where literacy is low. They are also appealing for radio broadcast, so inviting local radio or Television service provider to record the events involving songs, drama, or storytelling can be beneficial (FAO, 2018).

Motivational tours or field trips typically last a day and involve transporting a group of up to ten farmers from one location to another. Farmers are exposed to new technologies and innovations developed at research stations or used by farmers in other areas. Tours are an excellent way for farmers from different regions to exchange ideas (FAO, 2018).

Demonstration extension methods (method and result) are especially important when teaching practical methods. The disadvantage of demonstration is that people must travel to see the demonstration, which may incur travel costs and could be inconvenient. Furthermore, unconvincing presentations, as well as lack of resources may cause farmers to lose confidence in their ability to do the same as demonstrated (GFRAS, 2012). A result demonstration shows the outcome of a demonstration as indicated as 'seeing is believing,' whereas a method demonstration shows farmers how to perform activities step by step. Method demonstrations thus focus on equipping groups with the knowledge and the skills required to implement shared innovations and practices (Luukkainen, 2012).

Mass Media

According to GFRAS (2012), mass media is a powerful tool for delivering extension to a vast audience within a short period of time. Broadcast media including radio, film, music, and television, enable long-distance transfer of information whereas digital media (Internet and mobile communication) necessitate computer and mobile phone access (GFRAS, 2012). Also, JICA (2008) cites broadcast media: radio and television, print media leaflet, folder, bulletin, newsletter, magazine, projected media, film, video, and other types of media exhibitions, campaigns, mass meetings, and agricultural festivals as useful examples of extension mass media.

Mass media according to GFRAS (2012) also comprises YouTube, Facebook and Twitter social media sites, all of which can be used to raise awareness and to disseminate information on cocoa innovations and other farming practices. Other types of mass media include outdoor media such as large advertisements including large buildings and print media positioned at strategic locations to disseminate information through pamphlets, books, newspapers, and magazines as well as events and public speaking.

GFRAS, (2012) reiterates effective media usage is anchored on access (forms of media client have access to), usage (extent to which clients are using the media), and message (ascertain whether the message being sent is informative, easier to realise and well presented)

Empirical evidence suggests individuals remember 10 percent of what is heard, 50 percent of what is seen, and 90 percent of what is heard, seen, and practiced at same time and hence critical to use a variety of extension methods and materials in extension delivery (Al-mashhadani et al., 2017). Because more than one sense is used in the learning and teaching process, the use of a variety of extension methods and aids ensures that every member of the farmers' audience is affected by the ideas and new agricultural technologies communicated and encourages farmers to receive the agricultural information and skills that are transferred to them (Al-mashhadani et al., 2017).

Extension aids improve the effectiveness of extension education teaching methods like lectures, discussions, field demonstrations, and meetings. Field visits to farmers, field days, training courses, and extension bulletins were found to be the most commonly used extension methods and aids, while sound recorders, over-the-head devices, private messages or letters, charts, radio, and maps were discovered to be the least frequently used (Al-mashhadani et al., 2017).

The drawbacks of mass extension methods include the limited amount of information that can be transmitted, poor radio and television reception in some areas, and a lack of access to sets, particularly televisions, among the target group. Issues pertaining to no immediate feedback leads to difficulty in assessing the impact of mass extension methods. Moreover, production of both programmes and printed materials has been found to be costly and requires specialized skills regarding use of mass media. Farmers may however find the extension delivery process and methods ineffective (Al-mashhadani et al., 2017). Moreover, the CRIG has been found to also provide cocoa extension to farmers in order to meet their information needs. Among these activities are farmer educational campaigns on farms and on the radio, farmer field schools, open days, and active participation in the government's cocoa pest and disease control programme (Baah & Anchirinah, 2011).

Extension Training Materials

According to MEAS (2013), good extension materials are strongly linked to achieving the intended goal of extension delivery. The primary goal of extension materials should be to transfer information correctly and effectively. The following are important criteria of high-quality extension material: whether the information is transferable, which refers to how easily the information is presented by the target or groups of individuals could be understood; how well the information is usually organised and arranged; and the extent to which information could be mainstreamed to realise the set objective(s) (MEAS, 2013). Generally, a good extension material should appeal to farmers' interest; assist farmers in understanding the value of the technology; and prompt farmers to act (MEAS, 2013).

Agbamu (2006) defines audio-visuals as devices that transmit ideas and experiences through the eyes and ears, emphasising the importance of nonverbal experience in the learning process. As a result, radio (72.5 percent) and market information, storage information, and fertilizer application were identified as important sources of information received by farmers (Adebisi, Akinosho, Owolade, Ayobioloja, & Jatto, 2015). Furthermore, farmers rated the use of a combination of meetings, handbills, and films as the most effective.

Moreover, Ofuoku and Agumagu (2008) find significant relationship between the combination of extension materials and the effectiveness of the dissemination of information. CRIG, for example, uses a variety of methods and approaches to meet farmers' information needs, including farmer educational rallies to exchange knowledge and ideas with cocoa farmers. Posters, leaflets, and flyers, as well as calendars written in simple language and designed to attract the attention of cocoa farmers, are used during these interactions with farmers. Also, Cadbury International Limited and CRIG established the project on the ‘cocoa farmers' newspaper’ to help in the distribution of recommended cocoa packages. The goal was to disseminate recommended technologies to cocoa farmers for adoption to increase cocoa output (Aneani, Anchirinah, Owusu-Ansah, & Asamoah., 2012).

The use of each extension material has advantages and disadvantages (Table 3).

Table 3: Advantages and Disadvantages of Types of Extension Training Materials

ETM	Advantages	Disadvantages
Brochure	1.Ease of production 2.Low cost 3.Ease of distribution 4. Easy of reading 5.Could be read at home repeatedly	1. Little information (it may require extra guidance 2.Only for literates
Booklet	1.Easy to produce 2. Low cost 3.Easy to distribute 4.Can be taken home to read repeatedly 5. More information than brochure.	1.A little harder to approach. 2.Support by lecture or other means may be required to convey more detailed information 3.Only for literates
Poster	1.Can be accessed by many audiences 2 low cost involved 3.Easy to distribute 4.Appropriate for illiterates	1.Less information provided 2.Graphical skills required
Video	1.More practical information 2.Easy to understand 3.Suitable for illiterates	1.High cost 2.Require equipment 3.Video production skills is required 4.Script writing skills and Information is required

Source: MEAS (2013)

MEAS (2012) recommends that training materials be widely distributed and made available electronically in order to reach a large target audience. These materials are also made available on tablets for use and deployment by AEAs and other personnel at the village or community level. MEAS (2012) also suggests compiling and sharing a comprehensive set of all extension training materials for Ghana via the internet and a resource library. This is intended to lower material development costs while also encouraging information sharing and extension programmes.

Information Communication Technologies use in Extension Delivery

The processes of communicating, sharing, and scaling up agricultural knowledge require a focus beyond the scope of research, extension services, and farmers to other stakeholders, which necessitates the effective and efficient use of Information Communication Technologies (ICTs) (Okyere & Makonnen, 2012). Consequently, extension agents are required to be up to date on new ICTs and use them in their work (Suvedi & Ghimire, 2011). Mapiye, Makombe, Molotsi, Dzama and Mapiye (2021) indicate the use of internet and mobile phones to revitalise prevailing extension systems and for the continual development of the smallholder productions systems.

ICTs have the potential to completely transform how extension is organised and delivered, including interactions with farmers. It is also a point of entry for non-traditional actors who see advisory services as a potential area of intervention and a way to focus on subjects that have traditionally been underserved by extension services. ICTs can also be used to document and mobilize indigenous knowledge, share, and elicit local knowledge, and monitor and evaluate agricultural interventions (Suvedi & Ghimire, 2011).

Mobile learning addresses some of the shortcomings of the delivery of traditional agricultural extension. Some of the developed systems support unified learning by combining both mobile learning (m-learning) and the electronic learning (e-learning) systems. Web and mobile-phone-based systems can reach a greater number of smallholder farmers (Sanga, Mlozi, Haug, & Tumbo, 2016).

According to MEAS (2014), the extensive ICT infrastructure development of Ghana has facilitated the use of various ICT platforms in the delivery of extension and advisory services. Rahman (2015) reports that farmers use ICTs such as e-mail, mobile phones, computer projectors, radio, television, websites, flash drives, WhatsApp, smartphones, and video cameras. Other ICTs used include blogs, e-consultations, and teleconferences, amongst others (Rahman, 2015). The lack of smartphones, technical expertise, and agriculture ministry’s internet centres, personal computers, and the high cost of ICT are possible constraints to application of ICTs to improve agricultural communication (MEAS, 2014).

Primarily, e-extension enables quick access to agricultural and related information pertaining to input, products, services, and their costs; weather information, insurance, Good Agricultural Practices (GAPS), certification, international agricultural news, and so on. Moreover, data on these issues can also be evaluated at any time and in any location through e-extension systems.

In Ghana, e-extension platforms such as cocoalink, Esoko, and farm radio are available. Cocoalink is a Hershey corporation outreach programme created in partnership with the WCF and the Ghana COCOBOD (MEAS, 2012). The Cocoalink mobile technology service provides Ghanaian cocoa farmers with timely improved farming practices, crop disease prevention, post-harvest production, social and marketing information in order to improve their incomes and livelihoods. Cocoa farmers who subscribe to Cocoalink platform receive and share practical information via short message service (SMS) and voice messages with industry experts and other farmers. Cocoalink can be used by any Ghanaian with a cell phone, and messages are delivered in English or the local language. Cocoalink receives agricultural and social messages from COCOBOD's research division—CRIG. Farmers who participate in the Cocoalink programme are able to share their knowledge and ask specific questions about issues that they face (COCOBOD, 2012).

The current focus of Esoko is on providing market and weather information to farmers via short message service (SMS). The application, on the other hand, is best suited for sophisticated farmers such as lead farmers with strong literacy and numeracy skills. To provide farmers with a broader range of information, the Esoko platform is being used more extensively and intensively. MEAS, (2012) finds that up to 50 percent of farmers are willing to pay for the services of Esoko. Moreover, evidence indicate extension agents contacts and the farmer-to-farmer extension delivery provided to farmers have significant effect on farmers' decision to use mobile phone-based weather and market information (Etwire et al., 2017). Furthermore, challenges such as complex text messages, information that is incorrect and costly to implement, as well as the lack of infrastructure are some barriers associated with the use of applications that involve mobile phone usage (Etwire et al., 2017).

Radio messages are used to reinforce the extension programme as an already effective demonstration programme is made even more effective by the use of associated radio messages (Moussa, Otoo, Fulton, & Lowenberg-DeBoer, 2011). Also, for videos to be perceived as effective extensions, they must be short, concise, practical, and advert-free, as well as visually depict how to implement the practice. According to Chivers et al. (2021), podcasts can be longer and more detailed, and they allow individuals to multitask. Both videos and podcasts should use farmer-friendly language, be easily accessible, be of high quality, free of bias, and produced by and individual respected by farmers (Chivers et al., 2021; Van Campenhout, 2017).

Despite the fact that ICTs are critical for extension delivery, evidence suggests that extension agents use ICTs for personal gain in order to increase professional productivity while still using traditional interaction methods with farmers. To increase extension officers' productivity and expand cocoa farmers educational opportunities, public and private extension providers are required to increase their knowledge in ICTs for the benefit of targeted stakeholders (Strong, Ganpat, Harder, Irby, & Lindner, 2014). Moreover, the poor development of ICT infrastructure, high costs of broadcast equipment, expensive fees for television and radio presentations, high cost of access and interconnectivity, and issues with electricity have all been discovered to have an impact on ICT application in extension delivery (Mabe, & Oladele, 2017; Akpabio, Okon, & Inyang, 2007). To improve ICT incorporation into extension advisory services, agricultural extension services must provide intensive ICT training to extension workers (Nyarko & Kozári, 2021).

Annor-Frempong, Kwarteng, Agunga and Zinnah (2006) indicate that due to the high demand for ICT applications to extension delivery, extension workers require training, infrastructure, finance, and technical supports to meaningfully apply ICTs in extension. It is also suggested that there is the need for systems approach which will include internet service providers, research, and training organisations, policymakers and farmers in the use and scaling up of the use of ICTs in the delivery of extension (Annor-Frempong et al., 2006).

Assessing Quality of Extension Delivery

Extension professionals are evaluated based on how well they serve their clients in terms of listening, rapport, and familiarity with the contexts and issues that they face (Suvedi & Ghimire, 2011). Farmers require quality extension delivery to achieve positive farming outcomes. Farmers therefore have tendencies of rating quality of extension received as basis of seeking other service opportunities if not satisfied. For instance, farmers rated the quality of services received as poor to very poor and indicated dissatisfaction with the quality of extension received (Loki, Aliber. & Sikwela, 2021). Agricultural extension delivery falls under the domains of service delivery and knowledge sharing. The intangibility, homogeneity, inseparability, and perishability of a service distinguishes it (Parasuraman, Zeithaml & Berry 1985). As a result, unlike goods, measuring services is difficult, so alternative methods are employed.

Typically, service quality is measured to determine users' perceptions and experiences with various aspects of the service provided. Service is defined as a useful immaterial product created by human labour (activity) in the manufacturing process by affecting the structure of a specific object (human or material object) in order to meet human needs (Daszkowska, 1998). Furthermore, Stoma (2012) states that evaluating levels of service quality depends on subjective and objective factors, the customer's level of satisfaction, and the mood of customer. Empirical evidence suggests that the Service Quality (SERVQUAL) and Service Performance (SERVPERF) approaches have been widely used to assess service quality (Ahuja, Mahlawat, & Masood., 2011;

Handrinos, Folinas, & Rotsios., 2015; Theerthaana, 2015; Jain & Gupta, 2004). These service quality models are further expanded upon.

SERVQUAL Measurement

Parasuraman, Zeithaml and Berry (1985, 1988) describes service quality is the difference between consumer expectations of what they want and their perceptions (experiences) of what they get and proposed a measurement of the service quality scale known as the 'SERVQUAL. Estimation of the SERVQUAL model is expressed as:

$$\text{SQ} = \sum_{j=1}^{k} \left(P_{ij} - E_{ij}\right)$$

SQ_i= perceived service quality of individual ‘i’; k = number of service attributes or items, P = perception of individual ‘i’ with respect to performance of a service firm attribute ‘j’, E = service quality expectation for attribute ‘j’ which is the relevant norm for individual ‘i’. Table 4 shows various dimensions of the quality of service proposed by the model. The total questions for the Service quality (Q) are 44, i.e., 22 questions each for the (E) and (P) dimensions. When the Q value for all service quality constructs is summed, this provides an overall assessment of service quality (Adil et al., 2013).

Table 4: Dimensions of service quality

Dimensions	Interpretation	Number of questions
Reliability	The ability to perform the promised services accurately and dependably.	5
Responsiveness	The willingness to help customers and provide prompt service.	4
Assurance	The knowledge and courtesy of employees and their ability to convey trust and confidence.	4
Tangibles	The appearance of physical facilities, equipment, personnel, and communication materials.	4
Empathy	The caring, individualised attention provided to customer.	5

Source: Adapted from Soterio and Zenious (1997) cited in Adil, Ghaswyneh, Al, & Albkour, 2013 p.4)

The SERVQUAL model has been found empirically to be associated with some limitations. Particularly, the expectation concept in SERVQUAL has been criticized for its vagueness as respondents do not provide information on it. Hence the expectation has validity issues and subject to multiple interpretations (Zeithaml & Parasuraman, 1991). Besides, there could be more than five or less dimensions employed in a study. Hence a need for another measure of service quality (Adil et al., 2013).

Also, Butter (1995) provides a theoretical and operational criticism of the SERVQUAL model despite its growing popularity and applications. Theoretically, the SERVQUAL model is criticised based on:

a. The paradigmatic objections: Thus, SERVQUAL is formed based the paradigm disconfirmation instead of the paradigm of attitudinal which makes no use of the established statistical, economic, or psychological theory.
b. Gaps model: There is little evidence that customers evaluate service quality based on P (Perceptions) – E (Experience) gaps.
c. Process orientation: SERVQUAL is concerned with the process of service delivery rather than the outcomes of the service encounter.
d. Dimensionality: SERVQUAL's five dimensions are regarded as not universals; the number of dimensions that comprise SQ is contextualized because items do not always load on to the factors that one would expect a priori; and the five rater dimensions have a high degree of intercorrelation.

Regarding the operational dimension, the SERVQUAL Model is criticized based on:

a. Expectations: The expectation term is polysemic because consumers evaluate SQ using standards other than expectations, and SERVQUAL fails to measure the absolute SQ expectations.

b. Item composition: The four or five items used by the SQ dimensions are regarded as insufficient to capture the variation within each SQ dimension.

c. Moments of truth (MOT): Assessments of SQ by customers may vary from MOT to MOT.

d. Polarity: Error by respondents is regarded to be stemmed from the scales' reversed polarity.

e. Scale points. A Likert scale of seven-point is defective.

f. Issues with two administrations: Boredom and confusion emanate from the two administrations of the data collection instrument.

g. Variance extracted: A dissatisfactory proportion of item variances are accounted for by the over SERVQUAL score.

Despite the fact that the original SERVQUAL model had five dimensions, other authors have added more and modified the dimensions depending on the type of service being studied. Handrinos et al. (2015) had five dimensions and used 'Security' as one of the dimensions rather than 'Assurance.' Others used six or more dimensions without distorting or increasing the total number of questions (22) for the model's experience and expectation dimensions (Pakurár, Haddad, Nagy, Popp, & Olah, 2019).

SERVPERF Model

The SERVPERF (Service Performance) model by Cronin and Taylor (1992) is an improvement on the SERVQUAL model. An argument is raised that the Expectation (E) dimension of SERVQUAL needs to be rejected, resulting in only Performance (P) or the Experience aspect (Cronin & Taylor, 1992). Therefore, the SERVPERF scale being a variant of the SERVQUAL model has Performance (Experience) only component which comprises 22 items (questions). A higher perceived performance implies higher service quality. The SERVPERF model is expressed as:

$$\mathrm{SQ} = \sum_{j=1}^{k} P_{ij}$$

SQ_i=Perceived service quality of individual, K=number of attributes/items, P=Perception of individual 'i' with respect to performance of service firm's 'j' or attributes.

Methodologically, the SERVPERF model's ability to explain more variance in the summed service quality is estimated when a scale involving a single item is used (Adil et al., 2013). SERVQUAL and SERVPERF are analysed using descriptive and inferential statistics. Birner et al. (2007) found that half of farmers rated the quality of information received from most information sources as good on a scale of good, satisfactory, and poor, and that approximately one-third of farmers suggested the need to improve the quality and reliability of information provided by extension.

Challenges of Cocoa Extension Delivery

Extension problems identified by Babasanya, Ajibade, Zaka, Sirajo and Apene (2013) include technological linkage issues, technical training, extension training, mobility, equipment, a lack of teaching aids, and organisational issues. Others concern the nonexistence of a legal and policy context for providing extension services (Olandele, 2011). Cocoa extension challenges have an impact on the adoption and realisation of cocoa production goals. According to Baah and Anchirinah (2010), cocoa farmers face related extension problems such as poor linkage between farmers, researchers, and extension officers; poorly motivated extension staff, limited funding for cocoa extension, a lack of a separate extension system from cocoa, and poor contacts between them, extension officers, and researchers.

Furthermore, farmer groups and organisations require capacity-building training in order to access and receive agricultural extension services as well as capacity-building at the national level in order to improve coordination of extension activities and programmes across a wide range of extension providers. Poor government support for extension has also been found to reduce extension agent effectiveness (Baah & Anchirinah, 2010). Extension agents who live far from their assigned operational areas due to a lack of housing, lack of transportation for extension agents, and a lack of a participatory approach among extension agents, are unable to meet farmers' needs (Mwamakimbula, 2014).

Chowa et al. (2013) further indicates rather than addressing farmers' expressed market access needs, extension providers dominate and dictate programmes and activities to farmers by promoting a specific technology to increase farm productivity. Furthermore, it has been found that extension providers do not strive to strengthen active interaction and linkage to input and produce markets, limiting farmers' ability to continue with innovations after service providers withdraw. Pluralistic extension is also hampered by a lack of coordination among providers, which limits the utilization of potential synergies among actors (Chowa et al., 2013). The awareness level of farmers, high cost of farming inputs, a lack of rainfall, as well as providing the enabling environment for improved organisation of farmers' associations and cooperatives contribute to observed significant agricultural services impacts (Alemu, 2017).

Historical Perspectives of Cocoa Production

Cocoa is grown in tropical regions around the world, including Ghana. The *Theobroma* genus of cocoa originated from the Orinoco and Amazon basins prior to spreading to areas of Central America. Cacao was in the past consumed by Maya traders in Costa Rica as early as 400 BC, and by 1635. The Capuchin friars of Spanish origin were growing the Criollo cacao in Ecuador (Pohlan et al., 2010). Moreover, spread of the cultivation of cocoa also stemmed from several sources. Thus, France introduced cacao to several countries like Grenada in 1714, Guyana in 1684 and Brazil in 1677, and England also grew cocoa in Jamaica in 1670. Before this period, when the Dutch seized Curaçao in 1620, they took over the island's cocoa plantations. Cacao cultivation increased due to increased demand for cacao and cacao products. As a result, the Brazilian Amelonado cacao was planted in Principe in 1822, Sao Tomé in 1830, Fernando Po in 1854, Nigeria in 1874, and later in Ghana (Pohlan et al., 2010).

Tetteh Quarshie brought cocoa into Ghana from Fernando Po (current Equatorial Guinea) in 1879 after prior efforts by the Dutch in 1815 and the Swiss in 1843 were unsuccessful. After about three decades of cocoa introduction, Ghana became the main exporter of cocoa before independence and by 1936, Ghana was producing almost half of cocoa bean output globally. Till 1977, Ghana still led the global cocoa output till it was overtaken by Brazil, which was also similarly overtaken by Côte d'Ivoire in 1979. Côte d'Ivoire, Ghana, Indonesia, Cameroon, Nigeria, and Ecuador are respectively the leading cocoa producers globally. Others such as Peru, Dominican Republic, and Colombia add up to the top ten leading cocoa producers in the world respectively (Kozicka, Tacconi, Horna & Gotor, 2018).

Cocoa Botany

Theobroma cacao is the most widely cultivated species. *Theobroma* is a genus of 22 species in the Malvaceae family. Other cocoa species include *grandiflorum* (cupuassu), *angustifolium* (cacao de mono) and *Theobroma bicolor* (pataste). Roots, trunk, leaves, flowers, and fruits are the main parts of the cocoa tree (Table 5). Knowledge of the various functions of these parts of a cocoa tree influences technology transfer and adoption in order to increase cocoa farm productivity (CHED & WCF, 2016).

Table 5: Description of main parts of a cocoa tree

Parts	Description
Roots	A mature cocoa tree has a root system consisting of a tap root of 120-200cm long, extensive system of lateral feeder roots, the majority of which lie in the top 20cm of the soil but may extend to 40-50 cm where
Trunk	The stem of a cocoa plant grows vertically for 14 to 18 months after germination and the formation of the primary leaves. The degeneration of the terminal bud halts the growth of the stem. The first branches of the stem form a whorl of five branches that grow horizontally. The jorquette is the fan branches that form the framework of the tree. One of the dormant axillary buds on the trunk below the jorquette develops and produces an orthotropic shoot, 'Chupon,' which behaves like the main stem.

Table 5 continued

Leaves	The leaves of a cocoa tree are usually produced in flushes in March–April and September–October. The young leaves of cocoa tree are soft, with green midribs and veins. When the leaves mature, they turn a green colour. Stomata are only found on the underside of the leaves. The intensity of the light influences the number of leaves per unit area, as does the size and thickness of the leaves.
Flowers	The flowers of cocoa are small pinkish white or greenish white and borne in clusters on the trunk and branches of the tree near the cushions on small flower stalks. Midges are the insects responsible for pollination of the
Fruit	The cocoa tree's fruit matures 5–6 months after flowering. Cherelle is the name given to the young cocoa fruit. Depending on the variety and sometimes environmental factors, the cocoa fruit comes in various colours, shapes and sizes.

Source: CHED & WCF (2016)

Cultivated cacao is categorized into Theobroma cacao and further divided into: Criollo, Forastero, and Trinitario- hybrid of Criollo and Forastero and species (Pohlan et al., 2010). Cacao is classified into twelve geographical regions: Brazil, Colombia, Central America, Mexico, Ecuador, Peru, Trinidad, and French Guiana (Zhang, Mischke, Johnson, Phillips-Mora, & Meinhardt, 2009).

According to Addae (2014), a number of hybrid cocoa varieties entailing crosses with local Trinitario, Amelonado, and Criollo materials which have been bred in Ghana besides the Tetteh Quarshie variety (Amelonado specie). COCOBOD's Seed Production Division (SPD) uses mass hand pollination techniques to propagate the new cocoa hybrid variety developed by CRIG by crossing the Amelonado and upper Amazon clones (Kolavalli, Vigneri, & Gockowski. 2016). High hybrid seedling prices as well as a scarcity of seedlings during the planting season have been identified as barriers to hybrid variety adoption (Aneani et al., 2011). It is also found that without increased nutrient use, hybrid cocoa variety deplete the nutrients from the soil quickly and age quickly as a result of stress caused by higher yields (Daniels, Läderach, & Paschall, 2012). Traoré, Kobenan, Kouassi and Gnonhouri (2009) however identified hybrid cocoa as more resistant to black pod diseases.

Classification of Cocoa Tress or Farms

Based on the age of the plants (Takyi, Amponsah, Inkoom, & Azunre, 2019) or farms, cocoa farms have been classified into four classes: A, B, C, and D. The age of the cocoa farms affects yield and serves as the basis for farm rehabilitation or replanting. According to Ward and Faris, (1968) cited in Mahrizal, Nalley, Dixon and Popp (2012 p. 2), cocoa tree productivity is divided into four stages: i) Early period of no yield occurring between 1-3 to years; ii) Period of increasing yield at an increasing rate; iii) Period of increasing yield at a decreasing rate; and iv) Period of decreasing yields. Based on these stages of cocoa productivity, Lartey (2013) classified cocoa trees or farms into classes of A, B, C, and D (Table 6).

Table 6: Classification of cocoa farms according to age

Class	Description	Implications
A	Age class between one to seven (1-7) years	A sapling cocoa field
B	Age class between eight to fifteen (8-15) years	A matured cocoa field
C	Age class between sixteen to thirty (16-30) years	An old cocoa field
D	Age class above thirty (30) years	A very old cocoa field (died out cocoa fields)

Source: Lartey (2013)

According to Nelson et al. (2013), the age of cocoa trees averaged 20.29 years in Ghana. Similarly, the cocoa trees age in the Western, Ashanti and Brong-Ahafo regions averaged 19.44, 19.98, 21.79 years respectively (Kolavalli et al., 2016). Asare (2008) cited in Vekua (2013 p.14) identifies pod count per tree as an indicator for evaluating the performance of cocoa trees/farms and provides the following criteria for assessing cocoa plant yield performance:

a. Good performance: Producing 25 or more pods per tree.

b. Average performance: Producing 15-24 pods per tree.

c. Poor performance: Producing 14 or less pods per tree.

Soil Requirements for Cocoa Cultivation

A good cocoa farming soil has a texture that is good for water retention, drainage, and aeration. To thrive during periods of erratic distributed rainfall patterns, loam, or clayey loam soils with at least 1.5m depth are most preferred for cocoa farming. To allow for easier root penetration, the soil structure should be as homogeneous as possible. Also, the soil must be rich in nutrients, with high levels of organic matter at the topsoil. A PH of 5–8 is also appropriate for cocoa cultivation (CHED & WCF, 2016).

Climatic Requirements for Cocoa Cultivation

Cocoa thrives between 1100mm and 3000mm of rainfall per year, with 1500mm-2000mm being ideal for production. Extremely wet, marshy, or dry environments are unsuitable for cocoa production. The temperature range for cocoa is 30-32^{o}C maximum and 18-21^{o}C minimum, with 21^{o}C being the optimum for production. Cocoa grows well under environments with relative humidity of 70-80 levels during day and 100 percent at night. The climatic conditions have implications for farm cultural maintenance, pest and disease control, shade, and other husbandry practices that must be followed to achieve the best yield (CHED & WCF, 2016).

Scope of the Cocoa Industry of Ghana

COCOBOD is in charge of managing the cocoa sector of Ghana on a strategic and day-to-day basis. COCOBOD founded in 1947 as a statutory public organisation is mandated to regulate the cocoa industry of Ghana regarding the production, processing, and marketing of cocoa as well as coffee and shea (COCOBOD, 2018). According to Essegbey and Ofori-Gyamfi (2012), Ghana's cocoa sector is viewed as an innovation system with critical actors who play roles in supporting the sector's development and sustainability. The various actors play roles in the cocoa innovation system (Table 7).

Table 7: The critical actors, roles, and functions in Ghana's cocoa innovation system

	Actors	Roles and functions
1.	Ministry of Finance and Economic Planning	Oversees Ghana's economic policies and programmes, national budget, and resource allocation
2.	Ghana Cocoa Board (COCOBOD) and the subsidiaries	Implement policies and the programmes of government on cocoa and other cash crops.
3.	License Buying Companies	Responsible for internally marketing of cocoa. Buy cocoa from farmers on behalf of COCOBOD
4.	Cocoa Processing Companies	Mandated with the processing of cocoa
5.	Cocoa farmers	Responsible for cocoa cultivation and on-farm processing of cocoa
6.	International buyers or companies	Creating demand for cocoa
7.	Civil Society Organisations	Promoting the rights and corporate responsibilities
8.	Research Institutions (CRIG, ISSER, RM&E) of Ghana	Conducts research and development on the cocoa tree and farming systems for innovations

Source**:** Essegbey and Ofori-Gyamfi (2012)

Pre-harvest Sector Functions of COCOBOD

CRIG, SPD and CHED are responsible for the pre-harvest functions of COCOBOD (COCOBD, 2020).

CRIG conducts multidisciplinary research on cocoa establishment, management, and improvement as well as insect management and product development. CRIG conducts agronomic research on issues related to the long-term production of cocoa and other COCOBOD crops under its mandate. In order to diversify utilization and generate additional income for farmers, CRIG also conducts research on the development of cocoa byproducts and other mandate crops. CRIG manufactures the best planting materials for SPD. To effectively transfer research findings, new technologies and agronomic practices to cocoa farmers, CRIG has strong collaboration with the extension delivery systems.

SPD is in charge of multiplying and distributing high-quality cocoa and coffee planting materials to farmers as efficiently and cost-effectively as possible. SPD currently operates in twenty-seven (27) cocoa stations and four (4) coffee stations spread across the cocoa and coffee-growing regions. SPD currently has 380 locations throughout the country (COCOBOD, 2021). Table 8 lists a few of these SPD from the various cocoa regions.

Table 8: List of some COCOBOD Seedling Production Division locations

Region	Seed Production Divisions
Eastern	Apedwa, Bunso, Asamankese, Pankese/Akuase, Bieni, Oyoko, Akwadum and Tafo
Ashanti	Jamasi, Akomadan, Kwadaso, Poano, Fumso, Juaso
Central	Breman Asikuma, Baako and Assin Fosu
Western	Achechere, Saamang and Buako
Brong-Ahafo	Sankore, Goaso, Wamfie and Bechem
Volta	Ampeyo, Akaa and Saviefe

Source: CHED and WCF (2016).

CHED is in charge of eliminating the Cocoa Swollen Shoot Virus Disease (CSSVD), rehabilitating old and inefficient cocoa farms, and providing extension services. The division is in charge of supervising and managing the new Cocoa Extension System, which is a Public-Private Partnership. CHED assists cocoa farmers to efficiently and cost-effectively acquire the knowledge and skills associated with good agricultural practices. Farmers are also educated on basic economics designed to convince them accept farming as profitable business enterprise.

COCOBOD (2019) indicates that agrochemicals will be supplied to CHED to supply cocoa farmers in various districts. All CHED districts received 230,079 litres of fungicides to spray artificially pollinated farms as well as newly established farms. Farmers received a total of 2,865,900 bags of granular fertilizer (organic and inorganic). Furthermore, 2,498,829 bags of fertilizer were distributed to farmer associations or cooperatives and Licensed Buying Companies (LBCs). In 2018/19, a new spraying regime and schedule were implemented to interrupt insect population buildup early in the season.

Throughout the year, COCOBOD added new spraying machines to its stock of spraying machines in use.

Post-harvest Functions of COCOBOD

The post-harvest function of COCOBOD is carried out by the Quality Control Company (QCC) and Cocoa Marketing Company (CMC). The QCC is in charge of inspecting, grading, and sealing cocoa, coffee, and sheanut products for the domestic and international markets. The QCC is also in charge of fumigating and disinfecting produce, as well as maintaining the quality of other exportable crops like coffee and sheanuts. The cocoa produced in Ghana is efficiently marketed by the Cocoa Marketing Company (CMC). Furthermore, CMC coordinates the purchasing, transportation, storage, and marketing of cocoa both internally and externally. The CMC oversees the activities of the state-owned Produce Buying Company (PBC) as well as private licensed purchasing companies such as Federated Commodities Limited, Adwumapa Buyers, Agro-Ecom, Olam, Armajaro, Cocoa Merchants Limited, Trans-Royal Limited, Nyonkopa Limited, Kuapa Cocoa Company Limited, and others.

Cocoa Innovations

Innovations are critical components of the communication process. An idea, practice, or object perceived as novel by an individual or other unit of adoption is referred to as an innovation (Rogers, 1983). Also, the individuals' reactions to ideas are determined by their perceived newness not just new knowledge (Rogers, 1983). Communication is a two-way convergence process in which participants generate and share information with one another in order to achieve mutual understanding (Rogers, 1983).

The innovations are expected to be diffused to become relevant to end users, usually farmers. Diffusion is the process by which an innovation is communicated to members of a social system over time through specific channels (Rogers, 1983). According to Laryea (1981), cocoa innovation defines the total stock of knowledge including traditional skills essential for cocoa production, processing, and marketing which is related to new ideas. In addition to these perceived attributes of an innovation, other variables: type of innovation-decision; nature of communication channels diffusing the innovation at various stages in the innovation-decision process; nature of the social system; and the extent of change agents' promotion efforts in diffusing the innovation influence the rate at which the innovation is adopted (Sahin, 2006).

It is important cocoa farmers have full knowledge of the cocoa production process and innovations to achieve high outcomes as for instance 10 percent of farmers were found to perceive quality cocoa using physical characterization, and though more than 95 percent of cocoa farmers knew about good cocoa farming practices, only 48 percent undertake these practices (Levai et al., 2015). This shows knowledge gaps and use by cocoa farmers regarding the cocoa innovations shared.

According to Rogers (1983), the characteristics of innovations perceived by individuals explain their different rates of adoption. Rogers further enumerates the relative advantage, trialability, compatibility, complexity, and the observability of the innovation as characteristics (Table 9) influencing farmers’ adoption. These characteristics of innovations were used to investigate cocoa farmers' perceptions of the shared innovations: Good Agricultural

Practices (GAPs), Certification (CERT), Farmer Level Purchases (FLP), and the Farm Enterprise Management (FEM) in the Volta Cocoa Region of Ghana.

Table 9: Rogers' characteristics of innovations

Characteristics	Definition
Relative Advantage	The extent to which an innovation is perceived as being better than the idea it supersedes. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption.
Compatibility	The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. An idea that is not compatible with the prevalent values and norms of a social system will not be adopted as rapidly as an innovation that is compatible.
Complexity	The degree to which an innovation is perceived as relatively difficult to understand and use.
Trialability	The degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the installment plan will generally be adopted more quickly than innovations that are not divisible.
Observability	The degree to which the results of an innovation are visible to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt.

Source: Rogers (1983)

The shared cocoa innovations to cocoa farmers in the Volta Cocoa Region of Ghana by extension providers are further enumerated and highlighted in this section.

Good Agricultural Practices (GAPs) innovations

Cocoa farming households that adopt GAPs have increased cocoa yields and associated income to reinvest in cocoa farming activities the following year, a system known as a "high input-high output" system (Bymolt, et al., 2018b). In order to improve farm productivity and increase cocoa yield, cocoa farmers have been found to be supported by rehabilitation of old and non-producing farms as well as establish new cocoa farms using best agronomic practices (Asare & Sonni, 2011). The Good Agricultural Practices (GAPs) for nursery, pre-harvest and post-harvest practices are included in this section.

Nursery Practices

Though COCOBOD's Seed Production Division provides cocoa seedlings to new and existing cocoa farmers in the Volta Cocoa Region, innovations in seedling raising are also shared with them. Site selection, land preparation, shading, sowing, weed and pest control, hardening-off, and transportation of seedlings to permanent sites are all nursery practices required in raising cocoa seedlings. Cocoa seedlings are typically raised from seed because it is the simplest and cheapest method. Site selection is followed by land preparation. This is accomplished through weeding, stump removal, and debris removal. A two-meter-high temporary shades made of palm fronds or shade nets are erected to manage the effects of shade and sunlight on the seedlings (Janny, Barbara, Ritchie & Flood 2003).

Cocoa seeds are typically raised in polybags (small for three months, larger for six months) and on beds. Prior to filling the polybags with topsoil, drainage holes are drilled. Polybags are typically arranged in lines to facilitate farm operations (watering, weeding, and disease and pest control activities). Digging, loosening, and turning an already weeded site about half a metre wide is used to prepare seed beds. The dimension of a bed is 12.5cm high, width of 120cm wide, and may be of any of convenience. The beans are usually sown with the pointed end up to a depth of 2cm and flat at the same depth. When good topsoil is used potting medium, leads to a reduction of the nutrient requirements of cocoa seedlings at the nursery (WCF & CHED, 2016).

After applying granular fertilizer, seedlings are expected to be watered thoroughly to dissolve the granules for root uptake. Recommended agrochemicals are to be used to protect seedlings from pest and diseases (e.g., Phytophthora blight and damping-off and leaf eaters). Herbicide sprayers that were previously used are expected to be avoided. Nursery shade should be gradually removed a month before transplanting and completely removed a week before transplanting to harden the seedlings (WCF & CHED, 2016).

Pre-harvest Cocoa Innovations

Pre-harvest innovations range from permanent site selection to the planting of cocoa seedlings to the harvesting of cocoa pods. A suitable cocoa farming site should be gently sloping land and steep slopes should be avoided. Also, a rocky, hard pans, or marshy areas are not suitable to prevent inhibition of long tap roots of cocoa trees and death of the plan. Land preparation for cocoa planting is typically done in December through to February by felling large undesirable shade trees which habour particularly CSSVD. The cleared debris is expected to rot and provide organic manure to the soil. Selective burning is used where necessary to prevent nutrient loss and as an erosion control measure. Cocoa farming necessitates the planting of 15–18 desirable permanent shade trees per hectare (Asare & Sonii, 2011; WCF & CHED, 2016).

Accurate land demarcation has a positive impact on plant population and output. Before planting cocoa seedlings, farms should be lined and pegged. This is accomplished by tying a rope to a peg to a reference point, which is followed with tying the peg to a horizontal line which is about 100 meters long at the baseline. Cocoa seedlings are planted at a spacing of 3.0m x 3.0m (10ft x 10ft), which results in 1,111 trees per hectare (which is about 435-450 seedlings per acre). Closely planted farms inhibit farming activities and outputs, however, properly spaced cocoa trees are usually healthy, yields high and supports easier performance of farm operations including weeding, fertilizer application, harvesting of cocoa pods (Asare & Sonii, 2011; WCF & CHED, 2016).

Shade establishment: It is necessary to provide either temporary or permanent shade plants. Plantain and cocoyam are used to provide temporary shade to young cocoa plants. The plantain and cocoyam are planted 1.50 m in between two cocoa seedlings and 1.0 m away from the cocoa (Asare & Sonii, 2011; WCF & CHED, 2016). Table 10 shows some examples of desirable and undesirable permanent shade trees. The type of shade trees planted influences productivity, disease control and adherence to certification standards.

Table 10: Examples of desirable and undesirable permanent Shade trees

Desirable Shade Trees	Undesirable Shade Trees
*Terminalia ivoriensis (Emire)***	*Ceiba petandra (Onyina),*
Terminalia superb (Ofram/Framo)	*Cola gigantea (Watapuo)*
Albizia coriaria (Awiemfuo samina)	*Chlamydocola chlamydantha (Kra bise, Osonkrobia, Penamfera)*
Entandrophragma angolense (Edinam, cedar)	*Adansonia digitata (Odadee)*
Funtumia elastica (Ofuntum)	*Blighia sapida (Akyewobiri)*
Alsonia boonei (Nyamedua),	*Canthium glabriflorum (Gyapam, Nteteadupon),*
Pycnanthus angolensis (Otie)	*Musanga cecropioides (Odwuma) Carapa*
Milicia excelsa (Odum)	*Carapa procera (Kwakuo bise)*
Entandropragma angolense (Sapele)	*Lecaniodiscus cupanoides (Dwindwera)*
Tieghemella heckelli (Baku/Makore)	*Myrianthus arboreus (Nyankuma)*
Khaya grandifoliola/ ivoriensis/anthotheca (Mahogany)	
Entandrophragma utile (Utile)	

Source: CHED and WCF (2016) ** *Common names in parenthesis*

Cocoa seedlings are transplanted in the middle of the rainy season, from May to July, to ensure optimum seedling survival. A day before transplanting, polybag-raised seedlings are heavily watered, followed by holing (making holes) with appropriate spacing, removing the polybags and planting with ball of soil around the roots, and are covered with the same soil that is dug. For bed-raised seedlings, water the beds and remove seedlings with a machete or hand trowel (Asare & Sonii, 2011; WCF & CHED, 2016).

Mulching is usually done at the end of the rainy season by wrapping dry plant materials or plantain pseudo stem at the base of the cocoa seedling. The mulching material in termite-infested areas is treated with a Termiticide solution. Mulching has several benefits including helping to conserve soil moisture, promoting soil organism activity, restricting weeds by preventing them from obtaining source of light to grow, reduction in the direct effect of rain drops on the soil as well a reducing run-off and supporting infiltration and the nutrient level of the soil from decay of the mulch. Mulching also regulates soil temperature (Asare & Sonii, 2011; WCF & CHED, 2016).

Pruning is the removal of undesirable growth or parts of a cocoa plant in to increase productivity and make field operations easier. Pruning keeps the shape of the cocoa plant, improves air circulation reducing incidence and spread of the black pod fungal disease, reduces cost of chemical application, and allow more light into the farm. Pruners, cutlasses, motorized pruners, and secateurs are examples of pruning tools (Asare & Sonii, 2011; WCF & CHED, 2016).

According to Vanegtern, Rogers, and Nelson (2015), some self-incompatible cocoa varieties require cross-pollination while others are completely self-compatible. Midges are in charge of natural pollination of cocoa flowers. Pollination is significantly greater at the base of the cocoa tree as a result of the presence of numerous midges at the base of the cocoa tree leading to more flowers to emerge at canopy level of the branches. Cocoa flowers produce pods all year, but the peak and lean seasons are influenced by the seasons (Frimpong, Gordon, Kwapong & Gemmil-Herren, 2009). Because cocoa has high flower drop rates when naturally pollinated, artificial pollination has been a key area of research for increasing productivity (Kwapong, Frimpong-Anin, & Ahedor, 2014). Hand pollination is one of the productivity-boosting innovations introduced by COCOBOD. Trained youth are mainly used by COCOBOD to hand pollinate cocoa farms all year round.

Weeds are typically controlled manually or chemically on the cocoa farm. Manual weeding occurs three to four times a year in cocoa farming for young farms and approximately twice a year for mature farms. The farm is brushed when the weeds reach a height of 30 to 45 cm. In weeding climbers are removed and weeds brushed down to the ground. Manual weeding is indicated as more environmentally friendly than chemical weed control, which is thought to be harmful to the environment.

In order to achieve higher cocoa yields and returns, it is necessary to raise the fertility of the soil to required levels. Fertilizers are applied to the soil or plant leaves to provide nutrient to cocoa trees to promote its growth and yield. Continuous fertilizer applications over a period of 3-4 years can double cocoa yields. COCOBOD has approved cocoa fertilizers used in Ghana through the Cocoa Research Institute of Ghana. The different types of fertilizer used are Granular (Granules) and Foliar (liquid). In addition, organic fertilizers are used. Among the approved brand fertilizers used in cocoa production are Asaasewura, Nitrabor, Cocoa Nti, and Cocoa Adwuanepa Plus. Fertilizer is broadcasted (Granular type) at the start of the rains in April, and foliar fertilizers are sprayed. Soil erosion is a persistent and serious risk to soil fertility as the most fertile soil is washed away by erosion. Erosion is controlled on the farm by constructing drainage channels, avoiding planting on hills, and allowing fallen leaves to remain on the farm without clearing or burning them.

Pests and diseases are major issues in cocoa farming. Many efforts are required to control diseases and pests in order to prevent reducing cocoa output to increase income (Baah & Anchirinah, 2011) lists Blackpod disease which is caused by Phytophthora megakarya and Phytophthora palmivora; CSSVD, and mirids (capsids) as major diseases and pests affecting Ghanaian cocoa farmers. The improper timing and inefficient application of agrochemicals contributes to the reduction of pests and diseases to acceptable levels. The use of strategy of Integrated Pest Management (IPM) for controlling of insects particularly mirids in cocoa farms necessitates a significant investment in pest surveillance as well as cultural practices such as excess chupons removal as well a management of shade and use of the insect host variety resistance method (Adu-Acheampong et al., 2015).

Cocoa farm rehabilitation is an important good agricultural practice in cocoa farming. Cocoa farm rehabilitation is the process of restoring the productivity of old, dormant, or unproductive cocoa farms that have been affected by pests and diseases, neglect, have a declining soil fertility, as well as lacks the requisite shade cover.

The harvesting of cocoa pods concludes pre-harvest activities on GAPs cocoa innovations. Cocoa has two crop seasons in a year. From October to March, this is the main crop, and from May to August, it is the mid-crop. Cocoa pods are harvested Every 3-4 weeks when ripen and yellow. The pods are harvested in order to harvest the beans that grow inside the pods. Each pod is expected to hold between 30 and 60 cocoa beans (Vanegtern et al., 2015). The pods closest to the ground are harvested with a cutlass or knife, while sickle-shaped knives fixed on long poles are used to harvest pods on the higher branches During harvesting, precautions are taken to prevent damaging the cushions containing the flowers and fruits. Harvesting should be done every two weeks if there are not many ripe pods, and every week during peak periods (ICO, 2008). Cocoa harvesting is described as labour intensive, and farmers need to exhibit high levels of carefulness when cutting the pods from the tree to avoid causing damage to the entire cocoa tree (Asante-Poku & Angelucci, 2013). It is also advised to remove diseased and rodent-damaged pods during harvesting (WCF & CHED, 2016).

Post-harvest Cocoa Innovations

Post-harvest innovations start with pod picking and gathering, then move on to pod breaking, fermentation, drying, and storage. The pods are picked and gathered at a central or a number of points after harvesting. Pod breaking is done within 2-3 days of harvesting through cutting the pods open with blunt cutlasses or other objects such as wooden clubs which is recommended because cutlasses have been found to injure the beans inside the pod (Asante-Poku & Angelucci, 2013). The beans are then manually scooped from the broken pod discarding the husk and placenta. Germinated and black beans, and other foreign materials, are also discarded since they are potential sources of contamination which could lead to poor quality of the cocoa beans and other by products.

Cocoa fermentation leads to the production of chocolate precursors or chocolate flavour in the cocoa bean. The sweet and white mucilaginous pulp that cover the beans serves as substrate for fermentation. Fermentation starts and ends on the same day that the pods are broken. Microbial succession normally completes cocoa fermentation in two stages in six days. Fermentation typically takes five to seven days (ICO, 2008). Fermentation is affected by factors such as type of cocoa, ripeness of pod, pod storage before breaking, the quantity of beans and the quantity of pulp, turning of fermenting mass, seasonal effects/climate, and pod diseases. Fermentation methods include heap, basket, box, and tray. CRIG has also commenced distillation of alcohol from liquid pulp during the fermentation process (Asante-Poku & Angelucci, 2013).

Drying begins the same day fermentation ends, with the goal of reducing the moisture content of beans from 55 percent to 7.5 percent. The fermented beans are transported and spread thinly on the drying mat. The beans are frequently stirred to remove germinated, flat, and black beans, as well as placenta and foreign materials. Both sun and mechanical drying methods are used. Sund drying results in a reduction of the astringency and bitterness in cocoa bean compared to mechanical drying.

Mechanical drying is expensive and has a negative impact on bean quality due to smoke contamination and high acid retention in beans, hence not recommended. During sun drying process the beans are covered to keep the beans from rain, and showers and dew in the evening. The beans are considered dried when they make a 'cracking' sound when lightly pressed in the first for a minimum of seven days. Significant differences in drying time were observed depending on the type of mat used and the various loading densities affecting the rate of drying of the beans. The 3kg loadings on both mats dried the fastest, but chemical analysis revealed that beans from these treatments had high acidities and free fatty acid levels that exceeded the permissible levels recommended by the Quality Control Company (Anti, 2014). Cocoa beans are packaged properly sewn and sealed clean, strong jute bags recommended by COCOBOD and used by LBCs (Anti, 2014).

In general, the months of August to November are the busiest for maintaining a cocoa farm. During this time, cocoa farmers work averagely 34 hours per week, while the months of January to May are the least busy, whilst working on their farms averagely 15 hours per week (Kolavalli et al., 2016).

IPEC, (2013) reiterate and categorize cocoa farming activities as:

a. Land preparation: This involves clearing of land, felling, chopping, and burning of tree as well as removal of stumps and cutting of trees and the lining and pegging of the land.
b. Cocoa planting: This activity entails preparing seedlings including spraying with agro-chemicals, transporting of seedlings as well as sowing at stake and use of seedlings.
c. Cultural maintenance: This cover activities such as weeding of farm, and thinning, sanitation, pruning including mistletoe removal, application of fertilizer and pesticides; and providing water for spraying.
d. Cocoa pod harvesting: This practice involves pod plucking and heaping of pods, breaking of pods, scooping and fermentation of the beans.
e. Post-harvest practices: This involves transportation of fermented beans to the cocoa drying mat, drying, and the sale of dry cocoa beans at the cocoa shed.
f. Other activities: This basically includes cooking, catering for toddlers, as well as watching over drying beans during the night.

Certification Innovations in Cocoa Farming

Demand for sustainably produced cocoa beans has increased in developed countries, as major chocolate manufacturers have committed to sourcing only certified cocoa (Russillo, 2014). In cocoa farming, sustainability is defined as cocoa production of cocoa with inputs and farming methods that do not harm human health, surrounding communities, or pose a significant threat to the natural environment in the short to the long term (Neale, 2016). Certification of the cocoa production process and products is one way to ensure sustainability. Furthermore, farmers' interest in ecosystem management can be seen in activities such as preparation of land and planting; farming systems including agroforestry, mixed Crop rotation, cropping, soil, and water management practices; disease and pest management, including IPM; and climate management at local settings' (Asare, David & Sonwa, 2009).

Certification is defined as a 'procedure in which an independent inspection body issues a certificate indicating that a farm, farmer group, processing facility, trader, importer, or exporter has been assessed and meets specific standards' (CHED & WCF, 2016). Certification interventions are beneficial to the long-term development of the cocoa sector and require adequate investment, particularly for farmers described as weakest linkage in the cocoa supply chain (ICCO, 2014). Certification has a positive impact on yield and income through premiums that vary depending on the label, implementing Organisation, and policy of the certifier. Farmers also benefit from other incentives from certification schemes, such as cutlass, Personal Protective Equipment Wellington boots, gloves, hats, overall, googles, and hats) (Deppeler, 2014).

Furthermore, certification allows farmer groups to collaborate on future planning, resulting in a social capital benefit. Farmers also benefits from improved competencies such as skills and knowledge as well as health benefits from safe agro-chemical cocoa input handling and storage practices as well as compliance towards education and avoidance of child labour etc. (Paschall & Seville, 2012b).

In 2012, Ghana produced 16 percent of its cocoa under third-party audited certification: Rainforest Alliance, UTZ Certified, Organic, and Fairtrade Standards (Deppeler, 2014). Particularly, certified cocoa farmers have improved GAPs implementation, productivity, and increased cocoa and household income (from premiums) (Waarts et al., 2014). Farmers under the UTZ standard also has improved health status and ward education and generally satisfied with the UTZ programme, whereas uncertified cocoa farmers continue to be less professional with time (Waarts et al., 2014). Related study by Ingram et al. (2014) found that cooperative membership facilitates member exchanges because farmers with more knowledgeable are more likely to join a group. In Ghana, 24 percent of cocoa farming households are certified (Bymolt, Laven & Tyszler, 2018b).

UTZ Certification Standard

The UTZ certification aims for better crop (compliance with GAPs), better income (improved crop leads to increased production and income), better life (better working conditions with improved farmer resilience), training and awareness raising, better environment (safe handling and storage of agrochemicals, and waste and management, as well as improved productivity and production efficiency, all contribute to less environmental pressure). UTZ is also committed to improving farmer livelihoods so that they can compete in the global cocoa market by providing training on agricultural practices, farm business management skills, and safety standards with the goal of increasing productivity (Stop the Traffik Australian Coalition Baptist World Aid Australia & Influence Global and the Voice Network) (2017).

The UTZ code of conduct contains specific terms including the use of child labour use issues on cocoa farms, regarding; not involving any individual under 18 years in hazardous work. Labourers from the 15-18 years can be hired to undertake non-hazardous work. The UTZ standard also stipulates children under the age of 15 are not permitted to undertake cocoa farming activities but can provide some assistance at the farm outside school hours in the company of an adult (Ingram et al., 2014). These non-work-related activities children under 15 years are permitted to undertake include catering for siblings, provide water, as well as cooking, gathering firewood, cleaning etc. (FAO, 2012).

Rainforest Certification Standard

The Sustainable Agriculture Network's Rainforest Alliance (RA) ‘aims to conserve biodiversity and ensure sustainable livelihoods by transforming land-use practices, business practices, and consumer behaviour’ (Rainforest Alliance, 2017). In 2008, Rainforest Alliance expanded the cocoa certification efforts in the West Africa sub region by collaborating with organisations in the New Business Models project, including the Global Business Consulting Company (Côte d'Ivoire) and the Agro-Eco or Louis Bolk Institute in Ghana (Paschall & Seville, 2012a). The primary goals of the Rainforest Alliance are environmental conservation and protection, as well as improved farmer livelihoods and well-being (Stop the Traffik Australian Coalition, Baptist World Aid Australia, Influence Global, and the Voice Network, (2017).

The RA seal is a frog, and the standard 'focus social and environmental management systems, ecosystem conservation, wildlife protection, water conservation, worker fairness and good working conditions, occupational health and safety, community relations, integrated crop management, soil management and conservation, and integrated waste management' (Paschall & Seville, 2012b) practices. For instance, the number of recommended shade trees per hectare in Ghana range from 12 to 18 shade trees, however, most farmers own less than ten shade trees per hectare of cocoa farm (Kolavalli et al., 2016).

To reduce transaction costs, smallholder cocoa farmers are certified in groups. RA seeks to provide financial value to farmers by positively influencing incomes that are supported by 'price, improvement yield, best management practice, farm efficiency, access to business and financial services, improved knowledge, and market opportunities' (Paschall & Seville, 2012b). Cocoa yield, for example, was found to be 28 percent of the Rainforest Alliance Cocoa yield, which was 78 percent of the High-Tech yield (Gockowski, Afari-Sefa, Sarpong, Osei-Asare & Agyeman, 2013).

The CAA offers Rainforest Alliance and UTZ certification to registered cocoa farmers in the Volta Cocoa Region of Ghana (Agyekum, 2015).

Organic Certification Standard

Organic standards govern the use of organic materials in cocoa farming, such as fertilizers, pesticides, and insecticides. With a marginal effect value of 0.1295, empirical evidence suggests that smaller households with less cocoa farming experience, access to extension services, and access to credit all positively influenced the adoption of organic cocoa production. (Djokoto, Owusu & Awunyo-Vitor, 2016).

Glin, Oosterveer and Moi (2015) indicate despite the government's mass spraying programme, cocoa farmers in Brong-Ahafo (Densuso), and in Eastern Region (Suhum) have halted spraying their cocoa farms with chemical pesticides. This to address their health-related problems as chemical pesticides have been noted for their negative effects on animal and human health. Organic cocoa cultivation requires use of crop diversity, shade, and the avoiding the usage of synthetic agrochemicals including fertilizers (Agro-Eco, 2008). Also, the Cocoa Research Institute of Ghana (CRIG) have examined the infrastructure and knowledge required for organic cocoa farming (Glin et al., 2015; Agro-Eco, 2008).

Fairtrade Certification Standard

The Fairtrade Cocoa standard is designed to meet the needs of cocoa producers (farmers) and traders. Both Fairtrade Trader and the Fairtrade Standards for cocoa must be followed by cocoa traders involved in the production, purchase and associated sale of cocoa beans and the processing of cocoa. According to Fairtrade standard, a producer is any entity including individual producers certified under the Fairtrade Standard for Small Producer Organisations or the Fairtrade standard for Contract Production (Fairtrade International, 2017). The Fairtrade buyers are required to pay the producer within 15 days of receiving the documents transferring ownership of the produce, in accordance with international customary conditions (Fairtrade International, 2017).

Fairtrade is concerned with eliminating inequalities throughout the global value chain. Farmers who participate in the Fairtrade scheme receive premium to help them overcome the unfair deal by supporting farmers with holistic local development and giving farmers a voice through trade justice advocacy. This premium is paid to cooperatives, which democratically decide how to invest it, whether by distributing it to farmers or investing it in local projects. (Stop the Traffik Australian Coalition Baptist World Aid Australia & Influence Global and the Voice Network, 2017).

Farmer Level Purchases Innovations

Farmers bag the dried beans and sell them to LBC agents. Collectors, purchasing clerks, or aggregators gather cocoa bags for purchase by LBCs (CHED & WCF, 2016). Ghana has two main buying seasons for cocoa. The main season starts in October and lasts until December. The light season typically lasts from April to July (Bymolt, Laven & Tyszler, 2018a). COCOBOD may extend the harvesting and marketing seasons for the main crop season, which typically runs from October to May, in order to maximise foreign currency earnings, while shortening the light crop period spanning June-September due to small bean volume during that period (Asante-Poku & Angelucci, 2013).

The License Buying Companies provide cocoa farmers with a variety of marketing systems. LBCs set up local purchasing/collection systems where they buy directly from farmers for subsequent evacuation (primary) by LBCs. The LBC occasionally enters into contractual agreements with farmers by providing them with advance loans or input credits that they can repay with cocoa and then selling them all of their cocoa beans. Other farmer-based certification

Organisations, such as the Cocoa Abrabopa Association in the Volta Cocoa Region, ensure that farmers sell directly to dedicated LBC for proper stock taking, accountability, and premium payment.

According to Laven (2016), the farm-gate price in Ghana is annually determined by the Producer Price Review Committee (PPRC) of COCOBOD. Because of its high quality, uniformity, and volume, Ghanaian cocoa commands a higher price on the global market. The producer price of cocoa accounts for 70 percent of FOB, while haulers receive 3 percent, LBCs receive 8 percent, and COCOBOD receives 9 percent. COCOBOD pays a premium for certified cocoa, despite the fact that there is no price difference for (other types of) quality cocoa (e.g., origin, fine flavour etc.).

Access to finance or credit has been a challenge for farmers and a major constraint in Ghana which results in farmers inability to attract loans from banks due to low repayment capacity and farmers perception of loans as a gift from government (Baah & Anchirinah, 2010). As a result, myriad individuals are willing to usually lend money to cocoa farmers at high interest rates of up to 100 percent, and if the farmers are unable to repay the loans, their farms are used as collateral. (Barrientos & Okyere, 2012). Furthermore, cocoa farmers in Ghana prefer LBCs that provide cash and credit advances (Asante-Poku & Angelucci, 2013). Farmers who owe an LBC are required to repay the entire debt before selling their cocoa to another LBC, which may lead in a cocoa farmer selling to multiple LBCs or to a not preferred LBC (Waarts et al., 2013). Furthermore, smuggling has been found to hinder the operations of the Produce Buying Company particularly amongst communities in the Volta region neigbouring republic of Togo (Gift, 2014).

The presence of an LBC in a cocoa region or CHED district is critical for efficient internal marketing of cocoa in Ghana. A total 40 of the 48 COCOBOD LBCs were operational during the 2018/2019 season. Particularly, the Produce Buying Company (PBC), Adwumapa Buyers Limited (ABL), Royal Commodities Limited (RCL), and Yayra Glover Limited (YGL) were among LBCs which operated in the Volta Cocoa Region during the period (COCOBOD, 2019).

Cocoa farmers are provided with various purchasing innovations as a result of cocoa purchasing activities, allowing them to participate effectively in the cocoa value chain. Sales of cocoa beans to COCOBOD dedicated LBCs and others not indulging in smuggling of cocoa beans, conveyance, or transportation of beans to cocoa sheds in bags without contamination, scale testing to detect scale adjustments, recording in cocoa passbook, payment of advanced cash (pre-financing), and so on are among these innovations.

Farm Enterprise Management Innovations

Farmers are expected to address issues related to management, marketing, and finances. Farm management extension thus includes management, marketing, and market access advice provided to farmers by extension providers (Nuthall, 2010). Farmers' management responsibilities include planning, execution, and control (Nuthall, 2010). Furthermore, FAO (2013) emphasises that farm planning enables farmers to find new ideas and methods of farming, assess current and past situations, make firm decisions, identify new markets, assess profitability and competitiveness, quantity of what to produce as well as handling costs, identify input supply needs, credit, and repayment needs, estimate yields, and profit margins, and make investment decisions. Farmers also keep records, account for their farm activities (profit estimation), participate in collaborations and group activities, and implement risk management practices such as farm diversification (FAO, 2013).

In line with the development of cocoa farm enterprise management capacity, the Ghana COCOBOD was supported in running the Farm Business School for cocoa farmers across the seven cocoa regions of Ghana including the Volta Cocoa Region. GIZ / Sustainable Cocoa Business and local partners from Ghana and as well as Nigeria, Côte d'Ivoire, and Cameroon formed the Farmer Business School (FBS) in 2010 for cocoa production systems. Farmer Business School trainers go through a special qualification programme that includes classroom and learning trainings with farmers in order to deliver training in accordance with the principles of adult and found learning as well as FBS quality standards (GIZ, 2016).

The updated FBS covers a variety of modules, including; “farming a business”; “know the units to know your assets”; “manage for more and better food”, “money-out, money-in”; “know whether you do good business”, “decisions for more income”; “diversify your farm enterprise for more income throughout the year”; and “manage your money throughout the year” (GIZ, 2016). Other modules cover, obtaining good financial services, the added value of quality cocoa, the benefits of membership in farmer organisations, managing for more and better food, and becoming a practicing entrepreneur. The application workbook templates cover how to plan and evaluate production, assess the production year, manage money throughout the year, and manage loan and reimbursement (GIZ, 2016).

Cocoa farmers are thus expected to adopt these various Farm Enterprise management innovations in order to manage their cocoa farming as a business. Budgeting, input mobilization, supervision, record keeping, savings, access to credit facilities and loans, diversification, expenditure and profit determination, and investment are some of the innovations. Makinem (2013) finds farmers managerial thinking to be connected to their farm profitability and thus successful farmers have firm confidence in their managerial skills, and a high appreciation of farming as occupation.

Social, Demographic and Economic Factors of Cocoa Farmers

Several social, demographic, and economic variables are related to cocoa production, extension delivery, and effects. Anang (2016) and Asamoah, Arthur, and Stephen (2013) found the average cocoa farmers age in Ghana to be respectively 48 and 48.7 years, whereas Laven & Boomsma (2012) found cocoa farmers to be more than 50 years in Ghana. Aging cocoa farmers have potential of reducing cocoa yield because of their incapability to perform certain tedious cocoa farming tasks such as mistletoe removal culminating in increasing farmers' reliance on household or paid labour (Aneani, Anchirinah, Asamoah & Owusu-Ansah, 2011). As a result, farmers' age has been linked to lower yields per hectare and lower rates of adoption of new farming innovations (Barrientos & Okyere, 2012). Furthermore, Loki, Aliber and Sikwela, (2021) indicate the age of the household head has a positive influence on extension services, and the older the farmer, the more likely he or she will receive extension services, as extension officers are more likely to visit older farmers in order to improve their indigenous knowledge with new technologies.

According to Bymolt et al. (2018b) gender is central to agricultural extension and production. Men perform the majority of activities in the cocoa value chain of Ghana at a rate of 98-100 percent. Bymolt et al. (2018b) further indicated women assist men with planting, granular fertilizer and manure application, pod breaking, transporting, and drying. Women thus scarcely participate in difficult and activities that are labour demanding such as weeding, and application of inputs etc. (Ragasa, Berhane, Tadesse, Taffesse, 2013; Bymolt et al., 2018a). Female household heads have also been found to be less likely than their male counterparts to receive extension services through various channels and to access quality services (Ragasa et al., 2013). Males have also been found to likely seek extension advice or receive visits by agents which requires attendance to gender issues particularly targeting females in for extension programmes to raise their productivity (Effendy et al., 2019). In areas with a high concentration of agricultural activities, the gender of the household head is a key determinant of seeking out extension services (Nambiro et al., 2006).

Education has a positive impact on rural extension delivery service, and membership in an association increases productivity and production capacity. Farmers' participation in extension delivery is also improved when extension agents use farm visits and a variety of teaching techniques to address individual characteristics in farming households, as well as when extension programmes are coordinated, and farmers are consulted during the planning process (Agholor, 2016). Furthermore, illiterate farmers could also be cheated by Purchasing Clerks compared to experienced and educated farmers who are able to a large extent estimate the weight of their cocoa bags (Baah, Anchirinah, Badger & Badu-Yeboah, 2012).

Moreover, adoption of new farming techniques, young and more educated farmers have been found to usually cultivate more productive farms compared to farmers who have advanced in age (Barrientos & Okyere, 2012). Farmers with a higher education level use more technological inputs because they have a better understanding of new techniques (Oomes et al., 2016). Farmers with lower levels of education are, however, more likely to receive extension services, as education has been shown to have a negative relationship with extension services. This implies that the higher the level of education of the farmers, the less likely they are to see the need for extension services because they believe they can use their own knowledge (education) to perform activities on their farm (Loki et al., 2021).

Membership in an association have been found to be more beneficial to cocoa farmers' ability to access better market services and is more likely to earn a higher average income than non-members. Adoption was also influenced positively by social capital, occupational group membership, and the diversity of social group members (Seyi et al., 2019). Belonging to group, access to the input and credit also influence the income of farmers according to Barrientos & Okyere, (2012). Similarly, Obuobisa-Darko, (2015) indicated belonginess to association and frequency of extension advice received from extension providers influences cocoa technology adoption. Group participation is essential in cocoa farming. However, Kapoor (2016) reported approximately 80 percent of farmers to be non-members of a farmer group. This requires extension efforts that direct and support farmers into groups.

Moreover, extension delivery may be ineffective due to irregular visits by extension agents as well as extension agents not effectively meeting farmers' aspirations (Aderinto, Agbelemoge & Dada., 2017). The most important factors influencing farmers' commitment to pay for extension were the items purchased and the major activities engaged in. In Nigeria, for example, most farmers (64.6 percent) supported the cost sharing practices related to providing housing to government extension agents (Attah & Obinne, 2015). According to Ozor, Garforth, and Madukwe (2013), the majority of farmers (95.1 percent) have been found to be willing to pay for an improved extension services so far as the services continue to be useful to their needs.

The income and literacy levels of farmers, distance from towns, and access to telephone networks had a significant impact on access to extension services (Nambiro et al., 2006). In addition, public extension delivery channels were the least expensive and ranked first in terms of quality. Farmers have been found to be more likely to seek extension advice pro-actively in areas with higher levels of decentralisation which raises awareness of the availability of such services, which may empower farmers to seek out extension advice on their own (Nambiro et al., 2006).

Furthermore, the frequency of extension has been found to affect technical and allocative efficiencies, as well as cocoa farm economies (Effendy et al., 2019). Extension services are also effective if they provide farmers with relevant and high-quality information. Active participation of farmers and promoting partnerships with local farmer organisations raise awareness of famers.

Distance from towns and telephone access influence access to agricultural extension services because they facilitate direct communication, particularly in rural areas. Telephone communication also allows meetings to be scheduled ahead of time and allows the extension provider to determine whether or not farmers will be available before making the visit. Public extension delivery channels are considered most regarding affordability and quality compared to private extension delivery perceived to be of lowest quality (Nambiro et al., 2006). Moreover, farmers who had access to extension services and credit have been found to generate more farm income than those who did not (Vu, Ho & Le, 2020) indicating the critical role of credit to improved farming outcomes.

Cocoa Land use System in Ghana

Adoption of shared innovations resulting from extension delivery is influenced by land. The amount of land cultivated has a significant impact on production, with a 0.5 percent increase in production resulting in a 1percent increase in farm area dedicated to cocoa (Vigneri, 2007). Land tenure defines a system of landholding which has evolved from the peculiar economic and political circumstances, religious practices and cultural norms, people in relation to land as a natural resource, use, and its development, according to the Ministry of Lands and Forestry Ghana (2003). In Ghana, the various land interests include the allodial interest, customary freehold, common law freehold, leasehold including subleases, and customary tenancies (Ministry of Lands and Forestry Ghana, 2003).

Allodial interest is the highest proprietary interest known to customary law, beyond which there is no superior title according to the Centre for

Democratic Development (CDD) (2002). A such allodial interest in land is formerly held by skins, stools, *tendama*, sub-stools, clans, or families (CDD, 2002). This ownership interest or title is transferable from one owner to another through purchase made by a different community, or an individual given to another community or individual as a gift. The customary freehold (usufruct) is an interest in land to which members or indigenes of the landowning community that holds the allodial interest in land are entitled as of right under that community's customary law. It is a right to occupy and derive economic benefit from any portion of communally owned land that has not previously been occupied by any member of the community acquired through first cultivation or allotment from the land-owning group of which they are members. The customary freehold is freely transferable, and the freeholder may dispose of his interest to community members either inter vivo or testamentary. If the beneficial user's lineage is abandoned or extinction occurs, the allodial owner of the land has a reversionary interest in such land.

Leaseholds refer to the rights usually approved to an individual to inhabit and put land into use for a stated period of time in exchange for certain agreed-upon agreements and the payment of a set rent. The holder of an allodial title, customary freehold, or common law freehold may grant a lease over land that has not already been granted. Leaseholders may grant additional sub-lease agreements (Ministry of Lands and Forestry Ghana, 2003).

The minor interests' holders of an allodial title, customary freehold, or common law freehold who create various lesser interests under customary law are referred to as holders of a customary tenancy tenure system. These are contractual arrangements for sharecropping. The 'abunu' (one-third of produce given to landowner) and 'abusa'(two-thirds of farm produce given to farmer) systems are examples of systems such as rents, easements, profits a prendre, restrictive covenants, reversions, and common law licenses according to the Ministry of Lands and Forestry Ghana (2003).

The CRIF and WCF (2017) highlighted various land tenure systems used in Ghana. The findings indicate approximately 40 percent of cocoa farmers were migrants with the remaining being natives. Moreover, majority of farmers are reported to own land through customary systems, while others held land through less formal arrangements, such as 22.7 percent abunu (22.7 percent), abusa (14.5 percent), and renting (0.1 percent). Generally, most cocoa farmers own multiple cocoa farms (CRIF & WCF, 2017).

The majority of farmers (72 percent) were found to be lacking in formal documents pertaining to their land transactions. Farmers' lack of legal documentation (32.1 percent), for example, leads to disputes between sharecroppers and landowners (21.1 percent). High cost of land levies from landowners are major challenges in land use. In terms of land productivity, the abusa tenure is reported to produce the highest yield (372.4kg/ha), while the abunu arrangements produced lower yield of 214 kg per hectare. Furthermore, farmers (25.1 percent) have been reported to obtain lands through the abunu sharecropping system, with 24.8 percent receiving land as gift whilst 22.6 percent acquired them through inheritance and family land (10.9 percent). Regarding farm inheritance, cocoa farmers indicate sons (24.2 percent), children (22.3 percent), and wife and children (19.1 percent) as the likely heirs to cocoa farms (CRIF & WCF, 2017).

Labour Systems in Cocoa Farming in Ghana

In cocoa farming, labour is an important economic factor. According to Takane (2000), the term ‘cocoa farmer’ includes labour arrangements such as:

a) Absentee farmers i.e., farm owners living in cities or urban areas.
b) Farmers who their own farms, live closer to them and work on them,
c) Sharecroppers who receive one-third (Abusa) and half (abunu) of the cultivated cocoa output.
d) Temporally hired worker on short term or long-term basis (one month to a year)

Farm labour in the cocoa sector thus includes sharecropping, farm families, hiring, and other formal labour services (transactional or full farm management) (Egebjerg, 2016). Households on cocoa farms rely on a combination of household, communal and hired labour. Ghanaian households use one hundred and twenty labour days cultivate a per hectare of cocoa farm (Bymolt et al., 2018a). In certain labour-intensive activities, additional labourers are hired to supplement household efforts. Some absentee landowners or ‘retirees’ hire more labourers than the average.

Long-term and daily waged are the main wage labour arrangements in Ghana. When a person is hired to perform a specific task during the course of a day (by day), this is referred to as ‘daily wage labour,’ whereas ‘long term’ refers to periods of up to a year. In this case, the farmer will usually provide for the needs (such as clothing, housing, food, and healthcare) of labourers and will pay the labourer an agreed-upon sum when the period ends. The labourer usually males are supported by wife and children (Barrientos & Asenso-Okyere, 2012).

Labour shortages are a major issue in cocoa farming, especially in smaller communities. Cocoa households spend an average of fifty-three labour days per hectare, and as the supply of hired labourers diminishes, Ghana's labour costs naturally rise (Barrientos & Asenso-Okyere, 2012). Furthermore, weed control and other activities are physically taxing, and women and older farmers must rely on hired help to complete them. Farmers who are unable to perform these tasks have poor farm maintenance, which leads to lower yields and income. Evidence also suggests that a lack of appropriate tools makes labour provision difficult. For example, where cocoa farmers lack standard pruners, they must climb cocoa trees to prune, which is both physically and mentally involving regarding female and older farmers (Barrientos & Asenso- Okyere, 2012).

Hired labourers are usually seasonal and fluctuate with the demand for labour for specific cocoa related activities and interacting other crops labour demands (Tano, 2012). Migration of labourers to mining communities and districts to earn more money than farm labour is one reason for Ghana's low availability and affordability of labour. Furthermore, the scarcity of labour suggests that people (including migrants) are preoccupied with establishing and improving their own farms, including land tenure arrangements judged as more important than providing labour.

Due to reasons of no perceived cost and household heads are deemed to be interested in maintaining the quality of their farms through extensive use of family labour. Hired labour for some farmers is judged as expensive and usually averted unless additional work is expected to be performed or the skilled labour required for certain activities.

Nnoboa is a system in which farmers form workgroups in their communities to help each other undertake cocoa farming activities in turn, thereby reducing individual workloads is another form of available labour in cocoa farms. Currently, the Nnoboa system appears to be eroding due to individualism and trust issues, which has resulted in poor farmer organisation. Farmers are also skeptical of the idea of sharing money and inputs, hence are hesitant to form groups (Egebjerg, 2016; Damnyag, Saastamoinen, Appiah, & Pappinen, 2012).

Tanno (2012) differentiates two types of cocoa worker contracts as daily wage and seasonal works. Daily work entails performing specific tasks on a daily basis, such as tending to food crops, weeding cocoa farms, breaking pods, and so on. The daily wage is usually agreed upon by the labourer and the farmer and does not have an official minimum wage. Seasonal work typically consists of a six-month contract to provide specific tasks over an extended time period. Furthermore, leasehold type of contracts is prevalent in parts of Ghana (Damnyag et al., 2012). The farmers in this arrangement land lease system from the community leaders on a long-term contract basis up to 99 years (Bymolt et al., 2018a).

Moreover, FLA (2016) found that cocoa farmers rely on groups, or contract workers to keep their farms running. Family workers who work permanently on the farm all year round include members of a household. Other workers provide labour temporarily during vacations to undertake certain task including harvesting and related pod breaking. Income from the farm is therefore expected to meet the needs of the family. On special occasions, employees in the family may also benefit from gifts or an amount provided by the household head which is depends largely on the quantity of the cocoa harvests. Moreover, family members employed by parents as sharecropper, are paid in accordance with the *abusa* arrangements (FLA, 2016)

Maytak, (2014) reiterate women involvement in cocoa farming include activities pertaining to domestic (99 percent), production of food crops (75 percent), pod breaking (16 percent), cocoa fermentation (34 percent), and cocoa drying (22 percent). Female labour efforts in cocoa farming in specific households have been found to contribute to male farmers' income instead of theirs (FLA, 2016).

Effects of Extension Delivery on Cocoa Farmers

Extension has a number of direct and indirect effects on cocoa farmers. Extension enhances competencies through training, resulting in the adoption of innovations. The adopted innovations increase cocoa yield and income. These effects are discussed further.

Competencies of Cocoa Farmers

McClelland competency theory places an emphasis on testing competencies rather than intelligence (Bandura, 1971). Competency according to Yuvaraj (2011 p.3) refer to "an underlying characteristic of an individual that is related to effective performance in a job or situation". Competency and competence have been used interchangeably. However, a distinction is provided by Yuvaraj (2011) which looks at competency to focus on an individual's behaviour, describes attributes of the person, constitute the underlying attributes of a person for superior work performance, is transferable from one individual to another; can be assessed in terms of behaviours and attitude and is people oriented. Whereas competence looks at results, description of features of job performance, skills and knowledge needed to perform a job, not transferable, assessed by job performance and task-oriented Yuvaraj (2011).

The concept of competency comprises the totality of the individual's abilities, skills, behaviors, and the knowledge geared toward effective performance in a specific working environment (Kolibácová, 2014). Extension delivery results in an increase in competencies (Knowledge, Attitudes, Skills, and Aspirations). Knowledge gain pertains to understanding the economic, social, and environmental principles, as well as the decision-making process of group and individual decision-making. The Attitudes of farmers are concerned with their beliefs, feelings and opinions, feelings. Skills competency however connotes Individuals' mental and physical abilities to use innovations. Individuals' ambitions, hopes, objectives, or desires are referred to as their aspirations. Individuals' KASA can change when they respond positively to their participation in programme activities (Rockwell & Bennet, 2004). According to empirical evidence, if an individual's competency rate is one unit higher than the competency rate of another individual, his performance rate is assumed to be 7 to 12.5 percent higher (Kolibácová, 2014).

Individual outcomes can be improved by increasing the quantity and quality of results. Thus, achieving elevated levels of performance is evidenced in increases in the quality, capability, capacity, knowledge, and skills of the individuals (van Dyck, Frese, Baer, & Sonnentag, 2005).

Having the requite competencies is critical for cocoa farming innovation adoption. Asamoah, Owusu-Ansah, Brannor, Ofori and Darkwa, (2017) finds some level of variations between farmers' knowledge regarding recommended practices and what they practiced. Particularly only 34.5 percent of surveyed cocoa farmers to have the right knowledge on for instance frequency of insecticide application and 24.2 percent adopted the recommended frequency of insecticide application whilst for efficient control of the disease is only 23.9 percent had it right on knowledge while only 15.2 percent adopted the recommendation. For approved machines 94 percent knew while 91 percent used it. Farmers attitudes regarding following CRIG recommendations may culminate in inefficiencies or abuse of chemicals (Asamoah et al., 2017).

To assess the competencies of cocoa farmers in cocoa farming, hard data (changes in scores on validated measures of knowledge, attitudes, skills, and aspirations) can be used. Direct observation of skills and use of soft data: (self-reported perceptions of change in participants' knowledge, attitudes, skills, and aspiration from farmers (Bennet, 1979) are critical.

Cocoa Innovation Adoption

According to Rogers (2003), adoption is the decision to 'make full use of an innovation as the best course of action available, whereas rejection is the decision not to adopt an innovation' (p.177). According to Rogers (2003), the rate of adoption is the rate at which a social system's members adopt an innovation. Individual farmer final adoption relates to the degree at which the farmer in the long term applies an innovation when the farmer is fully informed on the innovation and the related potentials (Dontsop, Nguezet, Diagne, & Okoruwa1, 2010). As a result, adoption entails putting knowledge, attitudes, skills, or aspirations into practice. (Bennet, 1979). The rate of adoption of an innovation can be calculated by counting the number of people who use it over time (Rogers, 1983). Agyekum (2015) determined the rate of innovation under the innovation system by calculating the proportion of people who used a specific technology or innovation.

Aneani et al. (2012) found that adoption rates of CRIG-recommended technologies such as capsid control with insecticides, black pod disease control with fungicides, weed control manually or with herbicides, hybrid cocoa variety planting, and fertilizer application were 10.3 percent, 7.5 percent, 3.7 percent, 44 percent, and 33 percent, respectively. Access to credit, cocoa farms owned, and age of farm, farm size and yield, gender, migration influence cocoa farmers' adoption decisions, according to the authors. Furthermore, while more than 95 percent of farmers are aware of farming innovations, only 48 percent practice them. Farmers' attention was focused on bean weight, and 64 percent believe that quality has little impact on price. Subsidizing inputs, granting credit, establishing cooperatives, regulating cocoa prices, and providing postharvest management training in decreasing order could all help to improve practices that ensure quality cocoa production (Levai et al., 2015).

Empirical evidence shows, the agricultural technology adoption decisions of farm households are influenced by right to land ownership and security, distance to the nearest market and home, and participation in off-farm activities. Adoption of agricultural technology have a positive effect on farmer’s income, with adopters outperforming non-adopters (Hailu, Abrha & Weldegiogis, 2014). The findings show that low innovation awareness limited the sample adoption rate of improved varieties, as well as an adoption gap caused by the population's insufficient exposure to the innovations (Simtowe et al., 2011).

Furthermore, farmers with smaller farm sizes have fewer resources to invest in new farm innovations and as a result receive lower returns on investment, whilst those with larger farmers have with increased rate of innovation adoption (Oomes et al., 2016). Furthermore, risk and uncertainty influence technology adoption because technology may not result in an increase the productivity or investment made. Other risks may be associated with the weather, pests, insufficient and timely availability of important inputs as well as price fluctuations. Moreover, insecure ownership of land and land tenure influences innovation adoption. Inability to provide inputs or providing it at an inconvenient time by markets or governments impacts negatively on adoption. Rates of technology adoption are also positively related to the educational level and farm size (Oomes et al., 2016) of farmers. Moreover, older farmers are less likely to adopt new technologies, which may reduce farmer investment in cocoa or make it more difficult to introduce new technologies (Oomes et al., 2016). However, younger cocoa farmers have likelihood to engage in diversification of crops because of their level of innovativeness according to Ruf and Schrotz, (2015).

Moreover, Obuobisa-Darko, (2015) found credit access, primary education, hired and own labour to influence cocoa technology adoption. Natural factors such as (rainfall and temperature) and anthropogenic factors (farm management practices) have also been found to influence adoption of cocoa innovations (Badu, 2019). The adoption rates of disseminated innovation have been found to be low among farmers whilst sex and level of education of cocoa farmers affected the adoption of disseminated cocoa innovation decisions to cocoa farmers (Nmadu, Sallawu & Omojeso, 2015).

Cocoa yield in Ghana

In 2016, the annual area planted to cocoa in Ghana was 1751.79,000ha (MOFA, 2017). According to research, the average cocoa yield in Ghana is 0.5MT/ha, with a potential yield of 1.0MT/Ha (MOFA, 2017). Aneani and Ofori-Frimpong, (2013) indicated estimated cocoa yields (Table 11) on farm trials and farmers' fields.

Table 11: Cocoa yield gap estimates of two methods of estimating yield potential in Ghana

Item	Experimental Potential	Farmer potential	National Average
Estimated Cocoa yield (kgha-1)	1891.3 (Approx.30 bags (64kg)/ha and 12 bags/acre	1875.1 29bags(64kg)/ha and 12 bags/acre	337.9 (5.3 bags/ha and 2.1 bags/acre)
Yield gap (kgha-1)	1 553.4	1 537.2	
Percentage yield gap to potential (percent)	82.1	82	
Percentage estimated average yield to potential (percent)	17.9	18	

Source: (Aneani & Ofori-Frimpong, 2013)

Waarts et al. (2013) and Laven and Boomsma, (2012) identified three cocoa yield classes based on inputs or GAPs usage as:

(a) High class at an average output of 1400 kg/ha: This entails use of improved planting material, spacing of cocoa trees at the recommended a 3m x 3m, control of pest (four times in a year) and control of disease (five to six times per year), regularly managing weed, regular pruning, application of fertilizer once a year per year as well as adherence to frequent harvesting and shade management.

(b) Medium class of an average output of 650 kg/ha: This involves planting improved seedlings in line using recommended spacing, good management of weed and pruning regularly, control of diseases and pest two times yearly as well as practicing shade management and regular harvesting.

(c) Low class of an average output of 350 kg/ha: This entails planting cocoa seedlings at stake, nonuse of recommended planting material, uneven spacing, high density, irregular weeding, little or no pruning practices, irregular disease, and pest control practices as well as little shade management, and irregular harvesting practices.

Moreover, empirical evidence indicates the average farm size for cocoa farmers in Ghana is 3.0 ha, which implies cocoa cultivation is dominated by small-scale farmers who achieve yields of 317 kg/ha (Aneani, 2012). Similarly, Barrientos et al. (2008) state that more than 90 percent of cocoa farmers are smallholders with farm holdings ranging 1 to 3 hectares. These farmers have however been found to be suffering from low yields and income. The age of cocoa farms (Tree age) and farming experience improve cocoa yield (Vigneri et al., 2016).

Significant increases in cocoa output can be attributed to farm expansion, particularly when land prices are low; an increase in inputs such as fertilizer use and labour, as well as the participation of private cocoa License Buying Companies, has boosted productivity and investments in the cocoa sector (Teal & Zeitlin, 2006). According to related research, higher yields occur on smaller farm sizes due to farmers with larger farm sizes' inability to decrease cost of production (Vigneri et al., 2016). Cocoa farmers participation in fertilizer application, spraying of insecticides and fungicides, pruning and the use of hybrid seedlings to increase cocoa yield, whiles practices such as hand pollination, irrigation and planting of shade trees are least practiced by farmers (Badu, 2019).

Furthermore, Bosompem, Kwarteng, and Ntifo-Siaw (2011) reported that the overall impact of the Cocoa Hi-Tech programme (CHTP) on farmers' livelihoods was higher, but still fell short of cocoa farmers' expectations. The CHTP, however, was found to significantly improve cocoa farmers' yields after three years of implementation (mean increase of 72 percent-from 2.85 bags/acre to 4.9 bags/acre). Moreover, fertilizer application, harvesting, fermentation, and drying technologies, as well as fungicide application, are reported as best predictors of the impact of CHTP on cocoa farmers livelihoods (Bosompem et al., 2011).

Cocoa Incomes

Farmers are poor due to their per capita income typically falling below one dollar per day or mean daily income ranging between USD 0.42 and USD 0.63 of total household income (Barrientos et al., 2008). It is important to continually raise the income of cocoa farmers. Cocoa income is primarily derived from the sale of cocoa beans. Though there has been some level of research into the use of cocoa by products such as sweating,' pods and others, cocoa farmers primarily earn their living from the beans. Gross FOB price, and the net FOB price are considered in determining the producer price (Steijn, 2016). The Producer Price Review Committee determines the annual cocoa farmer or producer price usually ranging 70 to 80 percent of FOB price (net), at the onset of the new cocoa season in October (Asante-Poku & Angelucci, 2013).

Setting cocoa price is associated with both advantages and disadvantages. The fact that farmers are shielded from price volatility on the global market level is an advantage of this price setting arrangement. In situations where global prices rise, smuggling of cocoa to neighbouring countries such as Togo and Ivory coast for a higher price is a major disadvantage to setting of fixed producer prices.

Farmers are required to be paid a significant portion of the gross and net FOB price by COCOBOD and supported with CODAPEC and Hi-tech (e.g., spraying and fertilizer distribution). These programmes have been deemed inequitable because not all farmers benefit from the inputs in sufficient quantities and a such farmers usually indirectly pay for the supplies through the farm gate price leading to reduction in the actual value of the producer price (Oomes et al., 2016; Steijn, 2016). Due to the available market for cocoa produce, LBCs compete for cocoa purchases on a regular basis. Cocoa farmers benefit equally as a result of price uniformity (that is if transportation costs are not considered) of the cocoa produce. Farmers, on the other hand, have a choice among the LBCs providing credit and cash services (Asante-Poku & Angelucci, 2013) to increase their overall satisfaction from sale of cocoa beans.

Cocoa LBCs are critical actors in the internal marketing system of Ghana. It has been noted for the recent past that except in the Volta Cocoa Region, where only PBCs dominate cocoa purchases, LBCs are active in all cocoa farming regions. Besides LBCs entice farmers by providing credit, extension as well as gifts such as boots or equipment to attract and retain them. Some LBCs also try in paying bonuses at the end of the season to supplement other COCOBOD bonuses. Other certification Organisations, such as the Cocoa Abrabopa Association into RA and UTZ (also operating in the Volta Cocoa Region), and Kuapa Kokoo under the Fairtrade label pay a premium (Barrientos & Asenso-Okyere, 2012).

The advantage of multiple LBCs enables farmers to switch to others due to felt cheating (Barrientos & Okyere, 2012). Due to this LBC's also try to increase their speed of payment. The majority of cocoa farmers are usually paid on the point of sale for their cocoa (Blackmore & Heilbron, 2015).

Cocoa income range of 604 to 16,400 cedis per year (Steijn, 2016), and a mean of GH¢4,596 and GH¢5073 per year in Ghana (Kumi & Daymond, 2015; Asamoah et al., 2013) have been found. Donovan et al., (2016) found for 2013/13 season the annual total household income of cocoa farmers USD 2951. Cocoa income constitute more than 67 percent or more of total household income in most cocoa producing households in Ghana (Asamoah et al., 2013) and (Kolavalli & Vigneri, 2003), indicating the importance of cocoa production to cocoa producing families. Cocoa income accounting for 70-100 percent of total income (Anang, 2016), 80-90 percent (Oomes et al., 2016), and respectively 76.3 percent and 75.8 percent for uncertified and certified farmers (Nelson et al., 2013) have also been found.

According to Oomes et al. (2016), strategies for increasing income of cocoa farmers include increasing farm size to increase productivity, increasing productivity per hectare, reducing costs by improving on cost-efficiency, and increased in cocoa price. Assiri et al. (2012) also indicate farm income could be raised by increasing the yields through replanting with selected planting material, rehabilitation aged farms as well as adopting good agricultural practices. The achievement of these strategies is largely dependent on the producer price of cocoa. Furthermore, empirical evidence suggests that larger farms have lower cocoa profitability because the per hectare cost of production rise quicker than yields, resulting in lower per unit earnings of the cultivated land (Vigneri et al., 2016).

Higher cocoa farming income has been positively correlated with extension services access and productivity. Also, the age of a cocoa farmers is inversely related to cocoa income. This is due to the fact that older farmers are less able to perform labour demanding task in their cocoa farms which results in declining farm investments in their farms (Wiggins & Leturque, 2011; Schouten, 2016).

Income Diversification Strategies

Evidence shows that when cocoa is intercropped with food crops, income from the cocoa and income in general higher (Ameyaw, Ettl, Leissle & Anim-Kwapong, 2018). This emphasises the significance of diversifying farmers' assets, activities, and incomes. According to Barret and Reardon (2000), non-farm activities account for 45 percent of total household income in African rural households. Diversification is influenced by both push and pull factors. Farmers are pushed into diversification by push factors related to means of reducing risk in the face of climatic, epidemiology, market variability, resource challenges, and the desire to avoid poverty (Kumi & Daymond, 2015), whereas pull factors are conducive environments that draw farmers into diversification. According to Ruf and Schrotz (2015), diversification emerges from the process of farmers attempting to adjust to changes in the relative costs of factors of production such as land, labour, and capital, profitability, market, and political risks. Furthermore, the seasonality of cocoa farming activities forces farmers to diversify their incomes, as men and women work on cocoa farms for 15-19 hours per week to raise income which usually form a small portion of their total household income (Barrientos & Asenso-Okyere, 2012).

Barret and Reardon (2000) indicate income diversification is divided into three categories: sector (farm and non-farm), function (wage and self-employment), and space (local and migratory). According to national accounting systems, sectors are classified as primary (agriculture, mining, and the extractive activities), secondary (e.g., manufacturing), and the tertiary (other services). Crops, livestock, forestry, fish products, and non-farm income are all classified as agriculture (farm).

Following Barret and Reardon (2000) and using the sectoral approach, Agyeman, Assuming-Brempong, and Onumah (2014) classify farm income into food crop, cash crop, natural resource, livestock, and farm wage, while non-farm wage income includes income from self-employment, remittance income, and other sources of income. Farm income from food crop production includes cassava, plantain, cocoyam, and local vegetables (pepper, garden eggs, etc.) according to Agyeman et al. (2014).

Cash crop activities include cocoa, rubber, oil palm, coconut, rice, and sugarcane, whereas natural resource collection activities include firewood collection, fishing, and hunting. Domestic chicken, cattle, goat, sheep, pigs, grasscutter, guinea fowls, duck, and rabbit are examples of livestock kept by farmers as a form of diversification (Agyeman et al., 2014). Cocoa farmers also engage in farm wage services such as weeding other farms, herbicide spraying, rubber tree tapping, and temporary or permanent work as factory hands (Agyeman et al., 2014).

Non-farm income sources were found to include non-farm wage activity, teaching, sanitation, construction work, masonry, vehicle station masters, and mining work. Gold mining, for example, has been cited as being environmentally damaging (Oomes et al., 2016). Self-employment among farm households included tailoring, carpentry, oil processing, transport business operations, lottery vending, masonry, purchasing clerks, as well as fish mongering, food, sales, and petty trading in drinks and agrochemicals, sale of fishing gears, and mending of damaged fishing nets. Remittances are received from spouses and relatives living in cities and used to expand farming and meet household needs. Cocoa farmers as a means of diversifying their incomes have been found to migrate to cities in search of new sources of income (Oomes et al., 2016).

Due to the scarcity of land, cocoa producers rarely invest savings in expanding their cocoa farm holdings. Cocoa revenue realised by cocoa farmers for instance are usually invested in business activities such as trading, crop diversification, agrochemical sales, transportation business, or housing for residence (Kolavalli et al., 2016). Anaman and Adjei (2021) indicate prevalence of income diversification among households in rural areas of the Volta cocoa Region to reduce among the age range of 17 to 31 years, increased for the 31 to 74 years, then declined at the advanced age and period of retirement of the household head.

Challenges Associated with Cocoa Farming

The challenges experienced in cocoa production have a significant negative impact on the Economy of Ghana, as cocoa accounts for 3 percent of the total GDP of Ghana (MOFA, 2016). Institutional constraints to cocoa production in Ghana summarised by Barrientos and Asenso-Okyere (2008) are as follows:

Production constraints: This includes:

a) Inadequate access to technology and knowledge: These includes farmers' lack of education and the knowledge of new agronomic practices; high costs, preventing farmers from adopting the GAPs; poor provision and inadequate cocoa extension services (Barrientos and Asenso-Okyere, 2008)

(b) Inputs and equipment: This relates to poor access and cost of cocoa farming inputs, low cocoa producer price, labour shortage and rising cost; poor rural credit infrastructure; limited access to capital stemming from farmers poor creditworthiness and delayed payments to cocoa farmers by LBCs (Barrientos and Asenso-Okyere, 2008).

Market access constraints: This include poor roads and associated transportation cost, leading to poor market access, low cocoa prices stated by COCOBOD, length and the breaks in cocoa buying periods leading to hardship when farmers because farmers are not able to sell cocoa beans produced. lack of communication and low information flow also account for marketing constraints (Barrientos and Asenso-Okyere, 2008).

Social constraints: This generally entails inadequate social amenities which covers poor quality of education in rural areas, poor roads in cocoa-growing communities to increase accessibility; lack or low social capital and benefits of group membership (Barrientos and Asenso-Okyere, 2008).

Other constraints associated with cocoa production include smuggling, poor extension contacts, labour scarcity and cost, and land tenure insecurity (Agyeman et al., 2014; CRIF & WCF, 2017). Though empirical evidence suggests that cocoa farmers are satisfied with, for example, the introduction of privatization in cocoa marketing, which has resulted in speedy payments for produce sold by the farmers; provision of loans, inputs, incentives and bonuses by the LBCs, and proximity to cocoa sheds, cocoa farmers also report being constrained by the long distances covered in moving cocoa from the farm to the drying sheds; theft of cocoa beans in the process of drying, and dissatisfaction (Anang, Adusei & Mintah, 2011).

With an average farmer age of fifty years, there are youth-related challenges to cocoa production in Ghana, which has implications for the sustainability of cocoa production. Access to land, access to finance, insufficient skill training challenges, and perception issues are among the barriers that youth face. There are, however, programmes such as the MASO consortium led by Solidaridad (involving 10,800 youth aged 18 to 25 years in the Ashanti, Western, Brong-Ahafo, Central, and Volta regions, and COCOBOD youth in cocoa farming to empower the youth in cocoa farming (Löwe, 2017).

Furthermore, Aneani et al. (2018) state that low cocoa incomes are caused by low cocoa yields, which are caused by a high incidence of pests and diseases. Other factors limiting cocoa production include declining soil fertility and the use of unapproved planting materials, financial constraints and credit, high labour availability and cost (from May to July, when farm activities are at their peak), and poor rural facilities. Poor access to credit, high input costs, insufficient access to other inputs or agro-chemicals, and labour dynamics. Inadequate access to inputs/agrochemicals (due to poorly implemented policies such as the CODAPEC programme mass spraying policy and late supply of inputs due to non-liberalized input supply).

Moreover, in other areas, low cocoa yields are caused by illegal mining, Galamsey, which was caused by labour dynamics. Soil fertility decline was attributed to poor soil management practices, which were in turn attributed to a lack of knowledge. Planting of unapproved materials was caused by inadequate of access to approved seeds and seedlings, which was caused by the Seed Production Division's (SPD) limited resources (Aneani, et al., 2018).

Due to the injustices of LBCs to purchasing clerks regarding low commissions, they resort to malpractices such as adjusting weighing scales to the detriment of cocoa farmers. Adjusting the weighing scale: Every 64 kg bag of cocoa purchased by the purchasing clerks (PC), District Officers deducted two kilograms of cocoa beans. This amount was deducted prior to the District Officer handing over the funds for the cocoa purchases, resulting in a scale adjustment. The Ghana COCOBOD liberalization of the internal marketing system of cocoa resulted in competition by LBCs, so PCs advance financial loans to farmers. Unfortunately, some of these farmers fail to repay the loans, putting the Purchasing Clerks in debt (Aneani, et al., 2018).

According to Agyinah and Opoku (2010), the implementation of the CODAPEC programme was hampered by issues such as a lack of adequate farmer cooperation, insufficient spraying gangs, a lack of reliable statistical data on cocoa farmers and farm sizes, the charging of fees by some Spraying Gangs from farmers before farms were sprayed and pilfering and diversion of inputs. Others include late arrival of agro-inputs such as chemicals (pesticides), fuel, motorized pneumatic spraying machines, late payment of allowances for CODAPEC sprayers, gang formation restricted to COCOBOD alone; the high cost of programme; and the excessive involvement of politicians and opinion leaders, including some chief farmers who take over the pesticides and other inputs.

The Cocoa High Technology Programme (Hi-Tech) launched by the Government/COCOBOD in the 2002/2003 season in response to low soil fertility of cocoa farms entailed the provision of fertilizers such as Sidalco liquid fertilizer, Cocofeed, Asaase Wura, and Ammonium Sulphate ('Ammonia') to cocoa farmers for application to replenish lost nutrients and increase cocoa output (CRIG, 2011). The Hi-Tech programme ran into issues such as low input subsidies, which resulted in higher fertilizer prices; farmers failing to apply fertilizers at the recommended rates; and fertilizers arriving late.

Meanwhile, the CSSVD control programme faced some challenges, such as opposition from some farmers to the cutting of diseased trees due to a lack of funds to replant and maintain the household, the older age of some farmers, overdue payment of compensation, and land tenure systems caretaking/ abusa/abunu systems (Aneani et al., 2013).

The mistletoe control programme, which was established in 2011 to remove all mistletoes, which are parasitic plants on cocoa trees (CRIG, 2012), faced challenges such as a lack of protective clothing, particularly goggles to protect the eyes and nose from wood dust and insect bites, an insufficient allowance paid to casual workers for mistletoe removal, weak standard pruners with no sharpening tool, non-payment of accommodation costs and traveling allowance for mistletoe removal (Aneani et al., 2013).

The decline in the level of cocoa production is also attributable to several other interconnected factors, including old and low yielding cocoa trees; removal of shade trees leading to stress in cocoa trees as well as increased disease conditions; and poor farm management practices. Overaged cocoa trees account for 25percent of total area. COCOBOD estimates that 40 percent of cocoa farms require replanting. Also, due to the old nature of cocoa farmers, the high cost of cocoa tree removal, and farm renovation and rehabilitation, old and diseased trees are not being replanted quickly enough. Furthermore, farmers lack access to finance and knowledge of modern agroforestry and farm renovation and rehabilitation best practices, as well as have uncertain tenure, which impedes replanting of cocoa farm (Roth, Antwi & O'Sullivan, 2017).

Bymolt et al. (2018a) also identify the causes of low yields in cocoa farms as emanating from small farm sizes, high input prices, low farmgate price, poor farm maintenance attitude and diseases control. Also, increased spraying costs, as well as weed infestation have also been reported as major issues affecting cocoa bean quality (Anang et al., 2011) in Ghana.

Mixed-Method Research Approach

This study hinges on a mixed research method where both qualitative and quantitative approaches are followed. It is therefore crucial to review the existing literature on the designs and analytical approaches of the mixed research method.

Three major research methods: quantitative, qualitative, and mixed methods exist. The term methods have been used infrequently. Johnson, Onwuegbuzie, and Turner, (2007) emphasize the word methods in relation to mixed methods because it allows for the inclusion of strategies and issues surrounding methods of data collection such as use of questionnaires, interviews, observations; and research methods involving experiments, phenomenology, ethnography) as well as philosophical issues (ontology, epistemology, and constructionism) underpinning research. The mixed methods approach to research allows researchers to design a single research study that answers questions about both the complex nature of phenomena from the participants' point of view and the relationship between measurable variables (Williams, 2007).

In Mixed methods research type of research, the researcher or group of researchers combine elements of qualitative and quantitative research approaches (e. g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration' (Schoonenboom & Johnson, 2017). The method is distinguished through integration which involves at least a component of one quantitative and qualitative methods according to Johnson et al. (2007).

Almalki (2016) lists the benefits and drawbacks of mixed methods. The advantages include the fact that mixed research methods are a suitable approach to any given project, which usually results in positive benefits. Furthermore, combining different approaches in a single study the potentially provides more information breadth and depth than using a single approach in isolation. However, mixed method research is perceived as time-consuming and as not providing research with opportunities to have a well-versed conversation entailing information derived from quantitative and qualitative data collection methods. Almalki (2016) concludes that, rather than limiting research opportunities by utilising only one method, the mixed methods approach supports researchers with a greater scope to investigate by using both numbers and words with immense benefits to society.

To construct a mixed method research, it is important to consider the research dimensions of primary and secondary research (Table 12).

Table 12: List of primary and secondary dimensions in mixed method research

Dimension	
Primary	1. Purpose 2. Theoretical drive 3. Timing (Simultaneity and dependence) 4. Point of integration 5. Typological vs interactive design approach 6. Planned vs emergent design and 7. Complexity
Secondary	1. Phenomenon 2. Social Scientific theory 3. Ideological drives 4. Combination of sampling methods 5. Degree to which the research participants was similar or different 6. Degree to which the researchers on the research team was similar or different 7. Type of implementation setting. 8. Degree to which the methods similar or different, 9. Validity criteria and 10. strategies and full study vs multiple studies dimensions

Source: Schoonenboom and Johnson (2017)

Primary Dimensions

1. Purpose: Schoonenboom and Johnson, (2017) citing Greene et al. (1989, p. 259) distinguished the five types of purposes for mixing in mixed methods research:

(a) Triangulation: This seeks convergence, corroboration, correspondence of results from different methods used in the study.

(b)Complementarity: This seeks elaboration, enhancement, illustration, clarification of the results from one method with the results from the other method employed in the study.

(c) Development: This seeks to use the results from one method to help develop or inform the other method in areas of sampling, implementation and measurements used in the study.

(d) Initiation: This seeks to discover the paradox and contradiction, new perspectives of frameworks, the recasting of questions or results from one method with questions or results from the other method employed in the study.

(e) Expansion: This seeks to expand the breadth and range of inquiry through the use of different methods for diverse inquiry components.

2. Theoretical drive dimension

The 'core' and 'supplemental' components present in mixed-methods According to Johnson et al. (2007), p. 123), cited in Schoonenboom and Johnson, (2017), have three drives: qualitative dominant (which is qualitatively driven and has a constructivist view), quantitative dominant (which is quantitatively driven and has a positivist view), and mixed-methods research (which is dependent on a quantitative and the post positivist point of view of the research process whereas recognizing simultaneously addition of qualitative data and support.

a. Timing (simultaneity and dependence): This distinguishes which is done first, as well as which is primary and secondary in terms of dependency. As a result, simultaneity underpins the distinction between concurrent (both qualitative and quantitative done at the same time or simultaneously) and sequential (where quantitative comes first or vice versa) designs**.**

b. Point of integration: A true mixed method research at least has one 'point of integration' – also known as the 'point of interface' – where the qualitative and quantitative components are combined. Morse and Niehaus (2009) identified two possible integration points: the results point and the analytical point. The results of the first and second components are combined at some point during the writing process in the results point of integration, whereas the first analytical stage of a qualitative component is followed by a second analytical stage in which the topics identified in the first analytical stage are quantified in the analytical point of integration.

Mixed methods designs are also classified into a mixed methods typology or taxonomy. Creswell and Plano Clark (2011) grouped mixed methods designs into six. According to Schoonenboom and Johnson, (2017) the various of types of mixed methods include:

(a) Convergent parallel design: In this design, the qualitative and quantitative fundamentals of the study are undertaken independently which is followed by integration in the summed interpretation.

(b) Explanatory sequential design: This design employs a first phase of quantitative data collection and analysis which is followed by the collection of the qualitative data used to clarify the results of the quantitative results initially obtained.

(c) Exploratory sequential design: The design follows a phase of collection and analysis of at qualitative data which is followed by the phase involving quantitative data collection which is meant to generalize or test the initial qualitative results obtained.

(d) Embedded design: In this method, a traditional qualitative and quantitative design is combined with an element of the other type to improve the overall design.

(e) Transformative design: This design employs a transformative theoretical framework, such as feminism or critical race theory, which influences the interaction, timing, priority, and mixing of quantitative and qualitative elements.

(f) Multiphase design: This design involves more than two phases (or both concurrent and sequential strands are put together over a period within the study to address the overall objective of the programme

c. Planned versus emergent designs: The planned designs occur when a researcher decides prior which research components to include in the design to make the conclusion robust whist emergent designs arise when a researcher discovers an inadequacy in designs during the study (Morse and Niehaus 2009).

d. Dimension of complexity: This indicates whether a study's mixed methods are simple or complex. The primary significance is that it is the researcher's responsibility to develop more complex designs as required to answer the research question (s). Fully integrated mixed designs and Multilevel complex designs are both complex designs used for the different purposes (Teddlie and Tashakkori, 2009).

Because mixed methods involve multiple levels of reality, a multilevel mixed research design is appraised as more ontologically complex (Yin, 2013). The issues pertaining to the secondary design issues considered in the development of a strong mixed methods research design include:

1. The phenomenon: These require answering questions such as: are they the same or various parts of the same phenomenon? Different phenomena, or the same phenomenon/phenomenon seen from different angles. Is the phenomenon expected to be unique (for example, a historical event or a specific group), expected to be part of a more regular and predictable phenomenon, or a complex mixture of these.
2. Social scientific theory: This reflects if the study generates a new substantive theory, test an existing theory, or do both in a sequential order or is the researcher uninterested in empirically supported substantive theory.
3. Ideological drive: Reflects an explicitly stated ideological drive (e. g., feminism, critical race paradigm, transformative paradigm) of the study.
4. Combining sampling methods: This considers particular quantitative qualitative sampling method(s), and how they are combined or related.

Analytical Considerations of Mixed Methods Research

According to Cresswell (2014) a variety of methods are used in the independent data analysis of mixed methods. Since mixed methods includes both qualitative and quantitative aspects; and the findings of the mixed method analysis are combined to indicate a complete understanding of the method employed. Creswell (2014) proposed steps for analyzing qualitative data. The first step is to organize and prepare the data for analysis by transcribing interviews, optically scanning the material, typing up field notes, cataloguing all visual material, and sorting and arranging the data into various types based on their information sources.

The second step is reading or inspection of the data. This first step provides an overview of the information as well as an opportunity to reflect on its overall significance. It is important to ascertain what broad ideas participants are expressing, and how they express them. The researcher's overall impression of the depth of information, credibility, and utility is also critical. In this regard, qualitative researchers make notes in the margins of transcripts or observational field notes. Data coding which is the third step involves process of organizing data by bracketing chunks (or text or image segments) and writing a word representing a category in the margins (Rallis & Rossman, 2012). Coding also entails taking text data or images gathered during data collection, categorising sentences (or paragraphs) or images, and labelling those categories with a term, which is frequently based on the participant's actual language (referred to as in vivo). Tesch (1990), cited in Creswell (2014 p.248), outlines the following eight steps in the formation of codes:

a. Getting a sense of the big picture by taking time to read all transcriptions and jotting down ideas that come to mind.

b. Choosing a document; the most interesting, the shortest, and top of the pile. It is critical to go through the document and questioning 'What is this about?' without focusing on the content of the information but on its underlying meaning and writing them at the margin of the book.

c. After completing the preceding task for several participants, a list for all topics is made. Related topics are grouped. The topics are formed into columns and should sequences of key issues, unique, and leftover issues to attend to.

d. It is important to return to the data with considered list. The topics are abbreviated as codes, and the codes written to the appropriate sections of the text. This preliminary organisation scheme is tried to determine emergence of new codes.

e. The next step is the determination of the most descriptive wording for topics and organizing them into categories. The ways of reducing the total number of categories by grouping topics are sought by relating one to another. This is followed by drawing lines between categories to determine relations.

f. Decide on an abbreviation for each category and alphabetize the codes.

g. Assemble the data material from each category in one location and conduct a preliminary analysis.

h. Recode your existing data if necessary.

Creswell (2014) divides codes into three categories. Codes on topics that readers would expect to find based on previous literature and common sense; codes that were unexpected at the start of the study; and codes that are unusual and, in and of themselves, of conceptual interest to readers are included. In addition, regarding coding, researchers must decide whether to develop codes solely based on emerging information gathered from participants, use predetermined codes, and then fit the data to them, or use a combination of emerging and predetermined codes (Creswell, 2014). Qualitative or mixed method data analysis is done following various approaches such as content analysis, thematic and grounded theory.

Thematic Analysis

Thematic analysis, according to Braun and Clarke (2006), is a method for identifying, analyzing, and reporting patterns (themes) in data. The theme captures an important aspect of the data in relation to the research question, represents some level of patterned response or meaning within the data set, and helps to determine themes (and occurrence) in many ways based on the consistency of the analysis.

Themes are presented inductively or ‘bottom up,’ or theoretically, deductively, or ‘top down.’ The way the data is coded determines whether inductive or theoretical reasoning is used. Furthermore, semantic, and latent levels serve as the primary guides for thematic analysis. The semantic approach of thematic analysis identifies the themes within the surface meanings of the data and not anything beyond what has been said or written by a participant whereas the latent level begins to identify or examine underlying ideas, assumptions, conceptualizations, and ideologies- that are theorized as shaping or informing the semantic content of the data. Those approaches that consider specific aspects, latent themes, and are constructionist frequently cluster together, whereas those that consider meanings across the entire data set, semantic themes, as well as are realist frequently cluster together (Braun and Clarke, 2006).

According to Braun and Clarke (2006), thematic analysis is divided into six stages. Phase 1: Familiarizing with the data which entails the researcher immersing in data by getting acquainted with the depth and breadth of the content of the data. Immersion into the data usually entails ‘repeated reading’ of the data as well as ‘active reading’ (looking for the meanings, patterns etc.). This is followed by verbal data transcription into written form and, to a minor extent, an orthographic transcript, which is an account of all verbatim verbal (and could be nonverbal) utterances.

The second stage is concerned with the generation of preliminary codes. When the data is first coded and compiled, a lengthy list of the various codes is obtained, and the data is identified across the data set. The third stage is concerned with observation of themes. This involves categorising various codes into potential themes and compiling all relevant coded data extracts within the identified themes, which refocuses the analysis on themes rather than codes. The fourth stage concerns reviewing themes by refining those themes. Other themes may be separated into their own categories.

The last stage entails defining and naming themes which entails determining the significance of each theme and the aspect the data theme captures. Report production begins when you have a complete set of themes and includes final analysis and report writing. Importantly, the analysis is expected to provide a coherent, concise, non-repetitive, logical, and engaging account of the story the data is expected to tell (Braun & Clarke, 2006).

Content Analysis

The goal of content analysis is to describe the characteristics of the document's content by looking at who says what, to whom, and with what effect (Bloor & Wood, 2006). Content analysis explores considerable amounts of textual information in an unobtrusive manner to determine trends and patterns in words used, their frequency, relationships, and the communication structures and discourses (Mayring, 2000; Pope et al., 2006; Gbrich, 2007).

Elo and Kyngäs (2008) define preparation for content analysis as immersing oneself in the data and gaining a sense of the whole, selecting the unit of analysis, and deciding whether to analyse manifest or latent content. The process entails organizing open coding and creating categories, grouping codes under higher order headings, formulating a general description of the research topic by generating categories and subcategories as abstracting, and finally, reporting the analysis process and results using models, conceptual systems, maps, and categories, as well as a story line.

Qualitative Data Analysis using the NVivo tool.

NVivo is a large and complex piece of software which is most helpful when working with large amounts of data, particularly where the data include different formats. It is useful for managing and organizing projects with many separate data sources to support more transparent and systematic approaches to coding' (QSR, 2017). The four stages of using the NVivo analytical tool in qualitative data analysis are 'descriptive (i.e., entering data sources into NVivo), topic (i.e., data organisation and coding analytic), data analysis and querying and conclusion: The steps of drawing answers from the data (O'Neill, 2013) are considered.

The project descriptive stage includes project details and research design, as well as input sources, attribute assignment, value creation, and categorising. The topic stage entails identifying obvious topics and establishing initial nodes. The analytical stage includes 'merging nodes into hierarchies, setting models and relationships using queries, running queries matrix coding queries, cross-case queries analysis, and conclusion: verification developing theories' (Edmund, 2011 cited in O'Neil, 2013).

Theoretical saturation occurs when new data or new settings no longer yield new insights, and the circle is eventually closed. It also describes a situation when accumulation of new data no longer yields new theoretical insights or reveals new properties of the core theoretical categories (Edmund 2011 and cited in O'Neil, 2013). Thus, theoretical saturation brings closure to the use of data gathered in explaining the research objectives.

Chapter Summary

This chapter on literature review covered the theoretical framework of the study, which was supported by Bandura's Social Learning and McClelland competency theories, as well as key concepts. The conceptual framework which described related factors influencing cocoa extension delivery is also covered in this chapter. Delivery of Extensions (approaches, methods, and materials), SERVQUAL and SERVPERF models, which are useful for assessing the quality of extension delivery by CHED and private providers in the Volta Cocoa Region, were described. The historical perspectives of cocoa production, cocoa agronomy, yield, and income are described in this chapter. Particularly, relevant cocoa innovations on GAPs, Certification, Farmer Level Purchases, and Farm Enterprise Management shared by extension providers are also described in this Chapter.

The chapter also discusses the socio-demographic and economic factors including land and labour issues affecting cocoa farmers. The production, marketing, and extension delivery challenges affecting cocoa farming, the effects of extension delivery such as competencies, innovation adoption, yield, and income were also reviewed in this chapter. The literature on the mixed-method research and procedures for analysis is also described in this chapter.

CHAPTER THREE

RESEARCH METHODS

Chapter Three looks at the methods and procedures employed to examine factors influencing delivery in the Volta Cocoa Region of Ghana. Areas included in the chapter are research design, the philosophy of the research, study area, instrumentation, the study population, sampling techniques used, data collection procedures, analytical framework, procedures used in data analysis as well as data presentation. The Chapter ends with a summary.

Research Design

Research design provides specific direction for the procedures in qualitative, quantitative, or mixed methods research (Creswell, 2014). The achievement of the objectives of this research required quantitative as well as qualitative data. The study therefore used the convergent parallel mixed research design which supports undertaking the qualitative and quantitative research elements independently and integrating the results in the overall interpretation (Schoonenboom and Johnson, 2017). The design thus supports a comprehensive collection of quantitative data on cocoa farmers socio-demographic, and economic factors, characteristics of shared cocoa innovations, the effectiveness of extension training materials, frequency of use of extension methods, quality of extension delivery, competencies, cocoa innovation adoption levels, yield, income, and challenges of cocoa farmers. The study also thoroughly collected and analysed qualitative data on land and labour factors, cocoa innovation adoption at the farm, community, and shed levels and on extension materials used as aids in the delivery of extension in the Volta Cocoa Region of Ghana by the application of the convergent parallel design.

Specifically, Focus Group Discussions, in-depth interviews and observations qualitative procedures were followed in this direction.

Research Philosophy

This research is premised on the pragmatism philosophy. This philosophy focuses on understanding the world or a phenomenon through practical ways as opposed to the extremist views of positivism and constructionism. Pragmatist view research regarding consequences of actions, problem-centered, and is as well real-world practice oriented (Creswell, 2014). That is ‘pragmatic approach involves using what works in the research process to seek answers to the research questions’ (Creswell,2007; Creswell, Klassen & Plano Clark,2011). The pragmatic philosophy provided basis for application of mixed-method research in this research resulting in the collection, analysing, and interpreting the quantitative and qualitative data in this study on the factors influencing extension delivery in the Volta Cocoa Region of Ghana’.

Study Area

The study area of the research is the Volta Cocoa Region of Ghana. The Volta Cocoa Region covers middle to northern parts of Volta Region and almost entirely the Oti political region of Ghana (Figure 3). The Volta Cocoa Region shares boundary with Togo to the east, with Eastern and Brong-Ahafo regions to the west and to the north with the Northern Region. The region used to be a major cocoa growing region of Ghana, which covered Hohoe, Jasikan, Kadjebi, and Nkwanta as major production areas and accounted for immigration of various ethnic groups from Northern parts of Ghana to the region (GSS, 2013). Cocoa production in the region area covers 8,244.25 ha, spanning the three COCOBOD CHED districts: Hohoe, Jasikan and Papase, and farmed by about 13,528 cocoa farmers according to the (Volta Regional CHED Department, 2019). Over 240 communities (Appendix A) are involved in cocoa farming across the three CHED districts in the Volta Cocoa Region of Ghana.

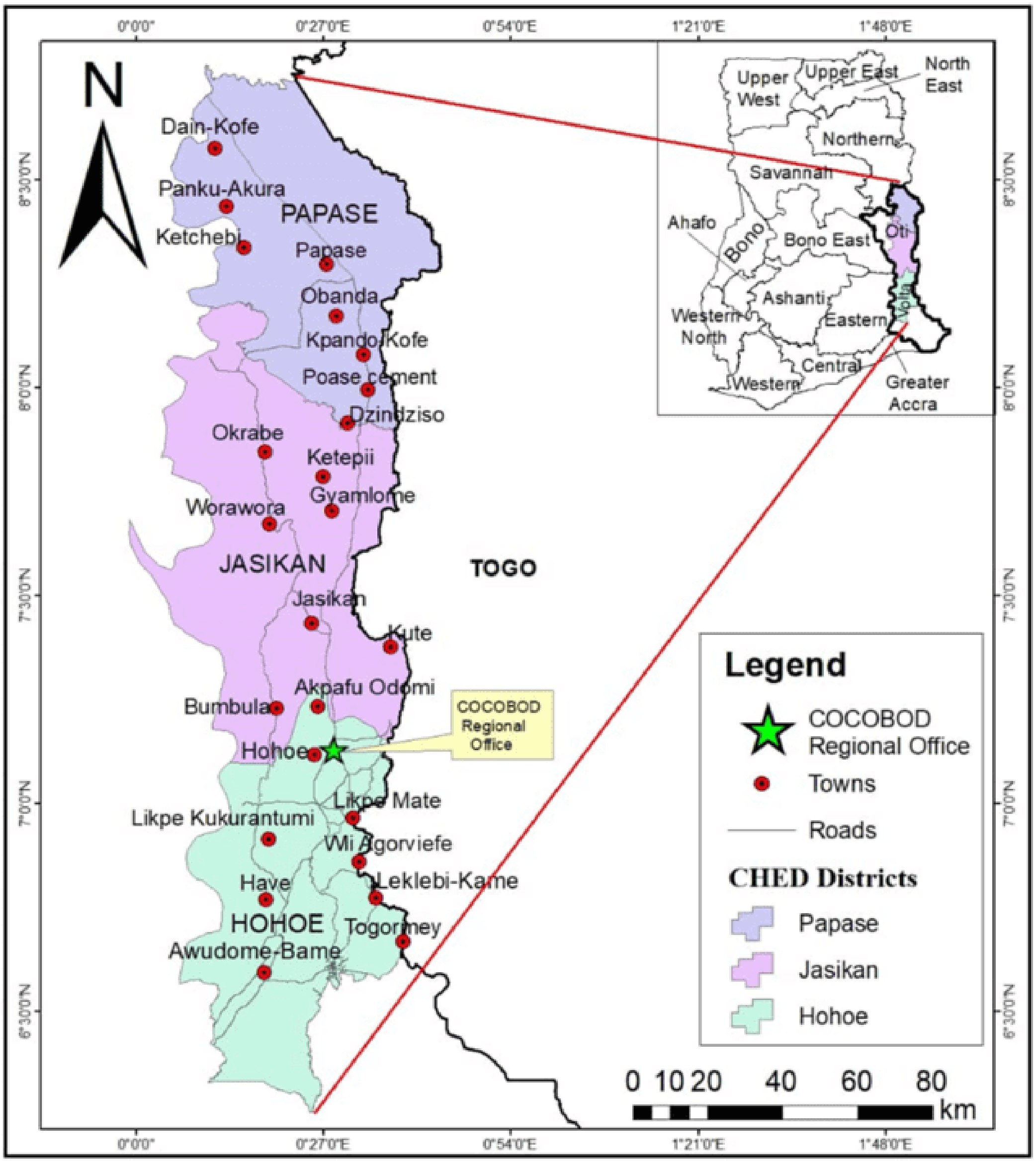


Figure 3: Map of the study area indicating CHED Districts and sampled communities.

Source: Field survey, Agyeman (2020).

The vegetation of the Volta Cocoa Region is semi-deciduous with fertile loamy clay soil which supports cocoa cultivation (Danso-Abbeam & Baiyegunhi, 2017). The region has a well distributed rainfall pattern (mostly relief rainfall), which support agriculture. Planting of cocoa seedling is usually undertaken between May and August each year depending on the distribution of rainfall of an average of 1,168 mm and 2,103 mm. The annual temperature of the region ranges between 22° C and 28° C with a relatively humidity of about 95 percent which are conducive for cocoa farming.

There are three types of cocoa namely Amelonado (Tetteh Quashie), Amazonia and hybrid grown in the Volta Cocoa Region. However, due to the infestation of Cocoa Swollen Shoot Virus Disease (CSSVD) outbreak resulting in cutting out of the cocoa trees and rehabilitation of moribund farms, most of the Amelonado and Amazon cocoa trees no longer exist. The Hybrid cocoa specie currently occupies 60 percent of the Volta Cocoa Region production land area. Moreover, the Cocoa production level in the region has been sustained by farmer education, treatment of disease and replanting of farms, adoption of Good Agricultural Practices (GAPs) and hand pollination. Cocoa farmers have also been trained on engagement in additional livelihoods such as chili pepper, cassava production or gari processing, maize production, snail rearing, cocoyam production etc.

There is pluralism in cocoa extension delivery in the Volta Cocoa Region. The CHED is the public mandated organisation responsible for cocoa extension delivery in the Volta Cocoa Region. Extension activities such as training, rallies, radio programmes, group meetings, farm visits, home visits and Farmer Business School (through GIZ partnership) is used to deliver extension in the region. CHED partnered Solidaridad West Africa to support the youth into cocoa farming; Calli-Ghana has also been reported to provide agro-chemicals to farmers on credit basis as well as Yayra Glover supporting farmers to practice organic cocoa farming. Also, Cocoa Abrabopa Association (CAA) registers cocoa farmers into certification programme as well as provides them with access to input credits in the Volta Cocoa Region. Cocoa farmers receiving private extension besides CHED in the Volta Cocoa Region are described as being under the pluralistic extension delivery system. Road network, financial institutions, telecommunication, and public goods such as roads, health, water system, market, security have all supported cocoa farming in the Volta Cocoa Region of Ghana.

Population of the Study

The research population includes cocoa farmers in the Volta Cocoa Region who are part of the three COCOBOD CHED districts and have at least a cocoa farm of five years or more. Moreover, lead farmers and stakeholders such as staff of CHED and private extension providers as well as opinion leaders (chiefs, assembly members) also form part of the population of the study. Dealing with this population of cocoa farmers and stakeholders allowed for collection of data on farmers perceptions of the characteristics of cocoa farming innovations, socio-demographic and economic characteristics, competencies, adoption of cocoa farming innovations, yield, income, and general cocoa farmer experiences in the Volta Cocoa Region of Ghana.

Sampling Procedure

To reflect the quantitative and qualitative sampling methods, both probability and non-probability sampling techniques were followed in this study. Cocoa farmers were chosen for the survey using a multi-stage probability sampling procedure. The first stage involved determination of sampling frame and sample size for the study. The population of cocoa farmers in the region is estimated at 13,528 according to COCOBOD Volta Regional CHED Extension Manager, and about 35 percent of these cocoa farmers have their entire farms below five years. This is as a result of new farms and the massive rehabilitation undertaken in the Volta Cocoa Region due to the CSSVD. Therefore, the sample frame for the study was estimated at 8,793 cocoa farmers**.** The sample size was determined following Yamane (1967) as: Sample size (n) = $\frac{N}{1+N(\alpha)^2}$, Where: N = Sample frame/Population, n = sample size, α = margin of error at 95 percent (0.05) confidence level.

$$n = \frac{8793}{1+8793(0.05)^2} = \frac{8793}{1+8793(0.0025)} = \frac{8,793}{22.9} = 384 \text{ farmers.}$$

Following Nilima (2017), a 10 percent non-response rate was estimated employing the equation: Final sample size = $\frac{\text{Effective sample size}}{1-\text{Non response rate anticipate}}$

This resulted in a sample size of 426 cocoa farmers for the study.

The second stage involves the stratification of the Volta Cocoa Region into the three CHED districts namely Hohoe, Jasikan, and Papase to ensure the inclusion of cocoa farmers in each of the cocoa CHED districts into the study. The third stage involved obtaining list of cocoa growing communities (Appendix A) and cocoa farmers who met the criteria of having at least a cocoa farm of five years and more for the respective Districts. Then using a simple random sampling technique, cocoa farmers were selected in the various communities until the sample was saturated.

A purposive sampling technique was used to select participants for the In-depth interviews and Focus Group Discussions. The selected samples include lead/chief farmers, assembly members, CHED, and private extension staff. The selected stakeholders were included in the study based on their cocoa farming experiences and knowledge on extension delivery in the Volta Cocoa Region and Ghana in general. Entities for observations were purposively and accidentally selected. The entities observed include farms, communities, cocoa sheds, extension delivery materials, etc. The final sampled communities and sample size (survey, FGD, in-depth interviews) used in the analysis is presented in Table 13.

Table 13: Summary of communities and selected sample size used in the study

CHED District	Communities/societies	Survey	FGD	In-depth Interview (Farmers)
Hohoe	Likpe-Mate	19	12	-
	Likpe-Kukurantumi	6	-	1
	Akpafu-Odomi	40	-	1
	Wli-Agorviefe	11	-	-
	Have	10	-	-
	Togormey	29	-	1
	Leklebi-Kame	20	-	-
	Awudome-Bame	5	8	-
Total	8	140	20	3
Jasikan	Gyamlome	28	9	-
	Ketepii	21	-	-
	Okrabe	8	-	-
	Kute	41	20	-
	Worawora	17	-	-
	Bumbulla	25	-	1
	Jasikan	-	-	1
Total	7	140	29	2
Papase	Panku-Akura	8	10	-
	Dain-Kofe	13	-	-
	Ketchebi	24	-	-
	Obanda	23	-	1
	Dzindzinso	25	-	-
	Poace-Cement	22	15	-
	Kpando-Kofe	25	-	-
	Papase	-	-	1
Total	8	140	25	7
Staff	-	-	-	6
Grand Total	23	420	74	13

Source: Field survey, Agyeman (2020)

Data Collection Instruments

Interview schedule and Focus Group Discussion (FGD), in-depth interview, and observation guides (Appendix B) were used as data collection instrument for the study. These data collection tools were created using Microsoft Office Word. The interview schedule includes open and closed ended questions and sections on the socio-demographic factors, cocoa farming issues, land and labour issues in cocoa farming, extension delivery, adoption issues, and cocoa farming challenges (Production, marketing, and extension delivery).

The Likert scale proposed by Rensis Likert has been widely used as a psychometric tool in social science research to assesses attitudes—thinking (cognition), feeling (affective), and action (psychomotor) (Joshi, Kale, Chandel & Pal, 2015). The Likert approach has implications of universal applicability, their precise wording can vary, and responses are comparable across different questions. Likert scales are summed scales because answers to each question are added up to provide an overall score (Johns, 2010).

Cocoa farmers level of agreement on the perceived characteristics of cocoa innovation were measured on Likert scale. This study also used the Likert scales to test farmers level of agreement on quality of extension delivery; frequency of extension methods used, and effectiveness of extension materials as well as cocoa farmers competencies (knowledge, attitudes, skills, and aspirations) and their level of adoption of shared cocoa innovations as proposed by Brown (2010).

The ratings, interval and interpretation of the Likert scales used in the indicated measurements are presented in this section. The Likert scale used in measuring cocoa farmers perception of the characteristics (Relative advantage, Trialability, complexity, compatibility, and observability) of shared cocoa innovations is presented in Table 14.

Table 14: Ratings and interpretation of perception of the characteristics of shared cocoa innovations scale

Rating	Interval	Interpretation
1	1.0-1.44	Very Lowly Agree (VLA): Farmer perceives the cocoa innovation very negligibly possess the characteristics (relative advantage, trialability, complexity, compatibility, and observability)
2	1.45-2.44	Lowly Agree (LA): Farmer perceives the cocoa innovation negligibly possess the characteristics (relative advantage, trialability, complexity, compatibility, and observability).
3	2.45-3.44	Moderately Agree (MA): Farmer perceive the cocoa innovation fairly possesses the characteristic (relative advantage, trialability, complexity, compatibility, and observability).
4	3.45-4.44	Agree (A): Famer perceives the cocoa innovation highly possess the characteristics (relative advantage, trialability, complexity, compatibility, and observability)
5	4.45-5.0	Strongly Agree (SA): Farmer perceives the cocoa innovation very highly possess the characteristics (relative advantage, trialability, complexity, compatibility, and observability).

Source: Agyeman, (2020)

The description of the Likert scale used in determining cocoa farmers perception of used extension methods in delivery of cocoa extension to them is presented in Table 15.

Table 15: Ratings and interpretation of frequency of use of extension methods scale

Rating	Interval	Interpretation
1	1.0-1.44	Very lowly frequent (VLF): This refers to farmers perception of the very rare use of the extension method to deliver cocoa innovations to cocoa farmers by extension providers in the Volta Cocoa Region
2	1.45-2.44	Lowly frequent (LF): This refers to farmers' perception of the rare use of the extension method to deliver cocoa innovations to cocoa farmers by extension providers in the Volta Cocoa Region
3	2.45-3.44	Somewhat frequent (SF): farmers' perception of the occasional use of the extension method to deliver cocoa innovations to cocoa farmers by extension providers in the Volta Cocoa Region.

Table 15 continued

4	3.45-4.44	Frequent (F): This refers to farmers' perception of the regular use of the Extension Method to deliver cocoa innovations to cocoa farmers by extension providers in the Volta Cocoa Region.
5	4.45-5.0	Very frequent (VF): This refers to farmers' perception of the very regular use of the Extension Method to deliver cocoa innovations to cocoa farmers by extension providers in the Volta Cocoa Region

Source: Agyeman (2020)

The ratings and interpretations of cocoa farmers perceived level of effectiveness of various extension training materials used in delivering extension in the Volta Cocoa Region was determined on a five-point Likert scale. The rating, interval and interpretation of the Likert scale is presented in Table 16.

Table 16: Ratings and interpretation of effectiveness of extension training materials scale

Rating	Interval	Interpretation
1	1-1.44	Very lowly effective (VLE): The ETM contributed negligibly to cocoa farmers understanding of shared innovations
2	1.45-2.44	Lowly effective (LE): The ETM contributed slightly to cocoa farmers understanding of shared innovations.
3	2.45-3.44	Moderately effective (ME): The ETM fairly contributed to cocoa farmers understanding of shared innovations.
4	3.45-4.44	Effective(E): The ETM contributed highly to cocoa farmers understanding of shared innovations
5	4.45-5.0	Very effective (VE). The ETM contributed very highly to cocoa farmers understanding of the shared innovations

Source: Agyeman (2020)

A description of the quality of extension delivery dimensions, number of questions making up each dimension as well as Likert scale are presented in Table 17 and 18.

Table 17: Description of Extension quality dimensions and number of questions involved

Extension Quality Dimension	Description	Number of questions
Reliability	The ability of the extension provider to execute the service in a safe and efficient manner.	4
Responsiveness	The availability of the extension provider to attend voluntarily to cocoa farmers, providing extension in an attentive manner, with precision and speed of response as well as supervisors and managers of the extension Organisation assisting users and providing the service in a prompt manner.	4
Assurance	The courtesy, knowledge of cocoa extension providers and their ability to convey trust to cocoa farmers.	4
Tangibility	The appearance of physical facilities, equipment, personnel, and communication materials used in delivering cocoa extension.	3
Communication	The methods and manner used to share innovations to cocoa farmers and feedback practices employed by extension providers to ensure farmers understand the shared innovations.	4
Empathy	The cares and assistance given to farmers in an individualized manner and ability to demonstrate interest and personal attention to cocoa farmers. Includes accessibility, sensitivity, and effort in understanding the needs of cocoa farmers.	3
6 dimensions		22

Source: Adapted from Wong, Ong, Kuek, Tunku and Rahman, (2012)

Table 18: Ratings and interpretation of quality of extension delivery scale

Rating	Interval	Interpretation
1	1-1.44	Very lowly Agree (VLA): Cocoa farmers' perceive their experiences of cocoa extension delivery are of very poor quality.
2	1.45-2.44	Lowly Agree (LA): Cocoa farmers' perceive their experiences of extension delivery are of poor quality.
3	2.45-3.44	Moderately Agree (MA): Cocoa farmers' perceive their experiences of extension delivery are of acceptable quality.
4	3.45-4.44	Agree (A): Cocoa farmers' perceive their experiences of extension delivery are of good quality.
5	4.45-5.0	Strongly Agree (SA): Cocoa farmers' perceive their experiences of extension delivery are of very good quality.

Source: Agyeman (2020)

The ratings, interval, and interpretations of the competency indices (Knowledge, attitudes, skills, and aspirations) and overall competency scales is shown in Table 19.

Table 19: Ratings and interpretation of cocoa farming competency scale

Rating	Interval	Interpretation
1	1-1.44	Very Lowly Agree (VLA): Cocoa farmers' perception of their KASA (Competency) levels in cocoa farming is very negligible.
2	1.45-2.44	Lowly agree (LA): Cocoa farmers' perception of their KASA (Competency) levels in cocoa farming is negligible
3	2.45-3.44	Moderately agree (MA): Cocoa farmers' perception of their KASA (Competency) levels in cocoa farming is fair
4	3.45-4.44	Agree (A): Cocoa farmers' perception of their KASA (Competency) levels in cocoa farming is high
5	4.45-5.0	Strongly Agree (SA): Cocoa farmers' perception of their KASA (competency) levels in cocoa farming is very high.

Source: Agyeman (2020)

The open-ended questions in the Focus Group Discussions and in-depth interviews are mostly about land and labour, extension delivery, and challenges of cocoa farming. The observation guide has questions on cocoa innovations and practices observed at the farm, community, and shed settings.

The research instruments were developed to respond to the research questions underlying the study. The questions for developing the instruments were obtained from literature, researcher as well as expert views on the research questions being investigated. The item format was developed based on the demographics, farming related activities, questions based on the research questions as well as general questions.

Pre-testing

Prior to pre-testing a reconnaissance survey was undertaken in the Volta Cocoa Region from July to August 2018 to understand and identify the research issues, environment, extension providers, and respondents including key informants. These formed the bases for developing protocols for pretesting. Pre-testing entails determining whether instruments will function in the 'real world' by testing them first on a small group of people (Centre for Evaluation and Research, 2011). Moreover, pilot study has also been indicated to test the feasibility of a study protocol, recruitment of subjects, test of measurement instruments as well as data entry and analysis (Hassan, Schattner & Mazza, 2006; Fraser, Fahlman, Arscott & Guillot, 2018).

Pre-testing of the research instruments (interview schedule; FGD, In-depth interview, and observation guides) was undertaken in the Brong-Ahafo Cocoa Region from in 15th to 19th July 2019. The Brong-Ahafo Cocoa Region was chosen because it has ecological and geographical resemblance to the Volta

Cocoa Region. Particularly the Brong-Ahafo Cocoa Region shares boundary with Côte d'Ivoire compared to the Volta Cocoa Region which also shares boundary with the Republic of Togo.

Following Johanson and Brooks, (2010) a total sample size of 60 farmers were surveyed in the pre-testing. A total of 30 cocoa farmers were sampled from each of the selected Nkrankwanta (Frempongkrom and Techimanfuokura communities) and Goaso (Fawohoyenden and Ayumso communities) CHED districts. A total of two focus group Discussions each were conducted in the Frempongkrom and Ayumso communities, four in-depth interviews in the four communities and three farm observations were also undertaken at Techimanfuokura and Fawohoyeden communities.

Testing Validity

Research supervisors, management staff, and Technical Officers from CHED and private extension Organisations assessed the content validity of the instruments (interview schedule and the Focus group discussion, interview schedule and observation guides)

Reliability of the Instruments

Sarmah & Hazarika (2012) emphasis the suitability of the Kuder-Richardson Reliability test (K-20) for testing reliability of constructs involving Binary responses (yes or no). Farmers were thus expected to respond 'Yes' or 'No' to shared innovations on GAPs, Certification, Farm Level Purchases and Farm Enterprise Management constructs and the 'Kuder-Richardson reliability' procedure was employed to measure the reliability of questions measuring the constructs.

In relations to Likert scale type constructs, the Cronbach Alpha of reliability test was used to test the internal consistency of the variables measuring constructs such as knowledge, attitudes, skills, aspirations, and extension delivery quality. The Kuder-Richardsons Reliability (K-20) test and Cronbach Alpha reliability test value of 0.7 and above was accepted for the reliability of the constructs following Gliem and Gliem (2003) and Tavakol and Dennick (2011). The results of the reliability tests of the research instrument scales are presented in Table 20.

Table 20: Reliability Coefficient of Research Instruments

Constructs	Number of Items	Type of reliability	Cronbach Alpha
Good Agricultural Practices	27	K-20	0.79
Certification	10	K-20	0.76
Farmer Level Purchases	5	K-20	0.88
Farm Enterprise Management	12	K-20	0.96
Knowledge	22	Cronbach’s	0.72
Attitudes	11	Cronbach’s	0.70
Skills	25	Cronbach’s	0.95
Aspirations	11	Cronbach’s	0.82
Quality of Extension Delivery	22	Cronbach’s	0.94

Source: Field survey, Agyeman (2019). n=60

The following observations were made from the pre-testing of the instruments. During administration of the interview schedules maturation was generally observed amongst respondents. Respondents were also observed to have challenges providing a single assessment of the quality of extension received from CHED and Mondellez in the piloted area. Following the outcomes of the pre-testing, estimates of the reliability test and validity checks, the following actions were taken to improve the instruments for main data collection. The common questions on the survey instrument were moved to the FGD guide. This helped to reduce the number of questions and pages on the interview schedule. The questions for measuring quality of extension delivery were split on basis of CHED and private extension providers to enable independent assessment of both providers.

Data Collection Procedures

The period for main data collection spanned 16th December 2019 to 8th February 2020. The community entry protocols in each of the selected communities were followed during the data collection. Generally, it involved contacting the assembly member; chief farmers and/or opinion leaders who then introduced the research team to the Chief or leaders in the communities to explain the aims and objectives of the research and seeking of necessary permissions. With respect to the development agents, permission was first sought from COCOBOD head office, followed by the regional office and then the district office prior to interviewing the technical officers/community extension agents and farmers. Permission was also sought from supervisors and managers of private extension providers to engage farmers in the study and to seek information on their mode of extension delivery.

Four enumerators with formal education levels and knowledge on cocoa farming in the Volta Cocoa Region Ghana were trained to assist the researcher in gathering data using the interview schedules, FGD and in-Depth interview guides. In training the research enumerators, the researcher collected data whilst the enumerators observed. Under the supervision of the researcher, enumerators were given the opportunity to collect data from two respondents each. The researcher then had a discussion with the enumerators about some of the questions that were not well asked.

FGDs were conducted to build consensus on cross cutting and diverse issues such as information on land, labour extension delivery and challenges associated with cocoa production from the participants. The researcher facilitated the six FGDs which lasted between 45 to 60 minutes in each case. The FGD proceeded with a prayer, introduction of the researcher and an indication of purpose of the FGD, indication of assurance of confidentiality of information and the need for each participant to respect each other's expressed views after which participants also introduced themselves. The researcher then posed questions of which any of the participants had opportunity to answer by show of hands. The researcher probed further and introduced other questions on the guide until all questions on the FGD guide were exhausted. The researcher then summarised discussions and thanked participants for availing themselves for the FGD. Proceedings of each of the conducted FGD were recorded using the mobile phone audio recorder with the consent of the participants.

The 13 in-depth interviews conducted were targeted at chief farmers, CHED and private extension Organisation staff and opinion leaders. These was conducted on a face-to-face basis per individual at a time. At the interviews the objectives of the study were clarified with the respondents and the necessary permission sought to record the proceedings using a mobile phone audio recorder for transcribing purposes only. Each participant was asked questions on land and labour issues affecting cocoa production, challenges of cocoa extension staff and solutions to cocoa production, marketing, and extension delivery challenges.

Observations were undertaken obtrusively on cocoa and other diversified farms, communities, sheds, and training materials in each of the three cocoa CHED districts and various cocoa farming activities. Photographs were taken on the activities observed with consent of the farmers. Cocoa farmers were also observed undertaking cocoa farming activities. Participants including farmers, key informants were asked questions during the observations and responses accordingly noted. The main problem encountered during data collection pertains to the fact that the period of data collection coincided with intense post-harvest cocoa handling activities such as pod breaking, fermentation, drying and purchases. With support from Community Extension Agents and contact persons meetings were pre-arranged at participants conveniences to deal with the challenge.

Data Processing and Analysis

Data cleaning was undertaken by checking words wrongly written as well as correctness of estimates for cocoa yields and incomes. A template was created in the Statistical Product Service Solution (SPSS) version 25 software (Pallant, 2018) for data entry purposes. Five trained persons supported data entry into the SPSS 25. To deal with anonymity and confidentiality concerns, the voice recordings from the in-depth interviews and Focus Group Discussions were uploaded onto the computer, transcribed, and labeled with pseudo names. Responses and photographs from the observations were respectively recorded, labeled, and saved according to activity and location. The transcribed FGD and in-depth interviews qualitative data collected were analysed using the NVivo 12 data analysis tool. Nodes (themes or topics) were created. The responses from the transcribed qualitative data were used as references (Appendix C). The qualitative and quantitative data were thus analysed separately, and results integrated with the survey (quantitative) data.

Methods of Data Analysis

The research unit of analysis was cocoa farmers in the respective cocoa districts (Hohoe, Jasikan and Papase) in the Volta Cocoa Region of Ghana. Descriptive statistics including frequencies, percentages, means, standard deviation (SD) and range and inferential statistic: Independent t-test, regressions, Friedmans test, and Wilcoxon signed-rank test were used to test the differences in the means. The thematic analysis procedure was used to analyse the qualitative data to answer the research questions and for purposes of corroborations and complementarity.

Analytical Framework for the Study

The analytical framework (Table 21) specifies the objectives, variables of major consideration, level of measurement, sources of data, method of data collection, and method of data analysis. This is followed by the analytical procedures employed in analyzing each specific research question.

Table 21: Analytical framework for the study

Specific Objectives	Variables/major considerations	Level of measurement	Sources of data	Method of data collection	Method of data Analysis
1. Description of nature of extension delivery in the Volta Cocoa Region of Ghana	Extension providers Characteristics of shared innovations (Relative advantage, Trialability, complexity, compatibility observability) Extension methods, Extension Training Materials, Quality of extension delivery	Nominal, Interval Ordinal ratio	Individual farmers (Primary) Key informants FGD	Survey using interview schedule. observation using observation guide	Descriptive analysis (frequencies, means, Standard Deviation (SD), percentages, range), Application of SERVPERF Model
2. Examine the socio-demographic, and economic factors of cocoa farmers in the Volta Cocoa Region of Ghana.	Age, sex, education, nativity, ethnicity, household size, farm size, classes of farm owned, Farm age, marital status, experience in cocoa farming, leadership role, access to credit, Mobile phone ownership, mobile money registration status, productive assets ownership, access to government interventions. Land and labour production factors	Nominal, interval, ratio	Individual farmers In-depth interview	A survey using interview schedule. In-depth interview and	Descriptive statistics (frequencies, means, Standard Deviation, Range) Thematic analysis
3. Examine production, marketing and extension delivery challenges faced by cocoa farmers in the Volta Cocoa Region of Ghana.	Production challenges Marketing challenges Extension delivery challenges	Ordinal Ratio	Individual Farmers In-depth Interviews FGD	Survey using interview schedule	Mean scores, rankings
4. Estimate effects of extension delivery in the Volta Cocoa Region in terms of competencies, innovation adoption, yield, and income.	Competencies (Knowledge, Attitudes, Skills and Aspirations, Adoption rates, Innovation adoption levels, Yield, Income	Nominal, interval, ratio	Individual farmers (Primary) FGD guide Key informants	Survey using interview schedule. FGDs, in-depth interviews observations using guides	Frequency, percentages, Means, Standard Deviation, Friedman Test, Wilcoxon signed-rank and Independent T-test.
5. The nexus between effects of extension delivery from socio-demographic, and economic factors of cocoa farmers in the Volta Cocoa Region	Competency, Innovation adoption level, yield, Income (Dependent variables) Independent variables (Socio, demographic, and economic factors	Ratio interval	Individual farmers (Primary)	Survey using interview schedule	Multiple linear regression analysis

Source: Agyeman (2020)

Objective One: Description of Nature of Extension Delivery in the Volta Cocoa Region.

The nature of extension delivery in the Volta Cocoa Region is described regarding extension providers involved in the cocoa extension delivery, cocoa farmer's perception of characteristics of shared cocoa innovations, frequency of use of extension methods, the effectiveness of extension training materials and quality of the extension delivery.

a. The CHED and private extension providers in the Volta Cocoa Region were described according to structure, objectives, and activities.

b. Cocoa farmers perception of the characteristics of shared cocoa innovations were rated on a 'yes' (1) or 'no' (0) basis for being exposed to Good Agricultural Practices (GAPs), Certification (CERT), Farmer Level Purchases (FLP) and Farm Enterprise Management (FEM) innovations by extension providers. The total number of farmers (n) who indicated 'yes' were denoted as being aware of the shared innovations. Cocoa farmers perceptions of the characteristics of innovations were determined following Rogers (2003) innovation characteristics (Relative advantage, compatibility, complexity, trialability and observability).

The means and standard deviations of cocoa farmers' perceptions of the characteristics of each of the items of the cocoa innovation constructs (GAPs, CERT, FLP and FEM) measured on the five-point Likert scale were estimated. The composite means and standard deviations of the GAPs, CERT, FLP and FEM cocoa innovations indicated cocoa farmers perceptions levels of the characteristics of cocoa innovations shared with them by extension providers.

(c) Frequency of use of extension methods: The Extension Methods: Home visits, farm visits, office calls, method and result demonstrations, meetings, lecture, field days, field trips, radio, Television were assessed for their frequency of use by extension providers within the season. These were assessed on basis of cocoa farmers indication on whether the method was Used (1) and never used (0) in sharing cocoa innovations with them. The frequencies and percentages of Extension method used and never used were estimated. The perceived frequency of use of the extension methods by farmers were determined on a five-point Likert scale as: Very frequent (5), frequent (4), Somewhat frequent (3), lowly frequent (2) and very lowly frequent (1). The frequencies, means and standard deviations of the frequency of use of the extension methods were estimated.

(d) Perception of the Effectiveness of Extension Training Materials(ETMs): The levels of effectiveness of the ETMs perceived by farmers to contributing to their understanding of cocoa farming innovation and practices shared were determined on a five-point Likert scale from Very effective (5), 4-Effective (4), Moderately effective (3), Lowly effective (2) and very lowly effective (1) following Ofuoku and Agumagu, (2008). The cocoa farmers were separated into those who cannot tell (0) of the effectiveness of the ETMs and those who could determine the effectiveness of the ETMs. The assessment of the levels of effectiveness of extension training materials were descriptively analysed using frequencies, means and standard deviations. The estimated means and standard deviations represent the cocoa farmers perceptions of the level of effectiveness of extension materials used by extension providers in the delivery of extension in the Volta Cocoa Region of Ghana.

(e) Perception of quality of Extension delivery**:** The six (6) extension quality dimensions such as reliability, responsiveness, assurance, tangibility, communication, and empathy were used to measure the quality of cocoa extension delivered by CHED and private providers in the Volta Cocoa Region. Cocoa farmers' indicated level of experiences of the quality of CHED (public) and private extension was measured on a five-point Likert scale.

An independent assessment of the quality of CHED (Public) and private (CAA and Solidaridad) were estimated using the SERVPERF Model. The following the procedures were followed in the application of the SERVPERF model.

(a) The score for each of the 22 Experience statements (items) were obtained.

(b) The mean score and standard deviations for each of the dimensions for CHED and private providers was estimated by summing the scores of the statements making up the dimensions (constructs) and dividing by the number of statements making up the dimension.

(c) The mean score and standard deviations in step two were summed and divided by 6 (number of dimensions) to obtain the overall Extension Delivery Quality (ExDQUAL) for CHED and private extension providers in the Volta Cocoa Region of Ghana.

Objective Two: Examining the socio-Demographic, and Economic Background of Cocoa Farmers in the Volta Cocoa Region.

a. Socio-demographic and economic characteristics of cocoa farmers were analysed descriptively as frequencies, percentages, range, means, and Standard Deviations.

b. The qualitative data on land (ownership, tenure security, use etc.), labour (availability, group work, costs, women roles etc.) were also analysed descriptively. Nodes on specific topics were created in the NVivo 12 software. Issues emanating from the FGDs, in-depth interviews, and observations were used as references (Appendix C). The references obtained were analysed and discussed as a narrative with photographs where appropriate.

c. The quantitative data on land and labour issues were estimated and presented as frequencies and percentages.

Objective Three: Examining the Production, Marketing and Extension Delivery Challenges Faced by Cocoa Farmers in the Volta Cocoa Region.

There are several methods for ranking factors that influence respondents. Among these methods are frequencies, the Kendall's Coefficient of concordance, and the Garret ranking technique. The Kendall's coefficient of concordance (W) as a nonparametric method measures the agreement among a group of (p) judges evaluating a given set of n objects. The ‘judges’ are usually variables, characters, amongst others (Egendre, 2005; Kendall, 1938). A drawback of the Kendall’s coefficient of concordance is that the method does not accommodate zero or no cases in its analysis as it confines judges/respondents to a set of factors even if the factors do not affect them. This is a significant challenge for the model for ranking factors because it cannot be applied effectively in heterogeneous study settings or study areas that may have enormous diversity.

Conversely, the Garret Ranking Technique proposed by Garrett and Woolworth (1969) is useful for policy making and applied in diverse settings as judges or respondents first identify which factors affect them or they deem challenging, and then rank them in order of importance. Since Volta Cocoa Region is heterogeneous in terms of ecology, the Garrett ranking technique was used to identify cocoa farming challenges facing the cocoa farmers. Following Dhanavandan, (2016), Sedaghat, (2011), and Kumar and Kumar, (2008), Agyekum, 2015, the Garrett ranking technique was applied in this study to rank the challenges.

A list of factors (production, marketing, and extension delivery) from literature and recognisance survey were made available to sampled cocoa farmers in the Volta Cocoa Region to identify and rank in order of importance. The ranks assigned to the factors were converted to percentage positions using the Garrett formula: Percentage Position $= 100\frac{(\boldsymbol{Rij-0.5})}{\boldsymbol{Nij}}$, Where: R_{ij}=Rank given for the i^{th} factor by the j^{th} individual, and N_{ij}=Number of factors ranked by the j^{th} *individual*.

The percentage positions were compared to the Garrett conversion score table to read the Garrett scores for the percentage positions of each ranked factor by the respondent. The mean score for each factor were estimated per the number of respondents who ranked the factor. The mean scores for all factors for each of the production, marketing and extension delivery were arranged in descending order. This allowed to identify the most pressing production, marketing and extension delivery challenges facing the cocoa farmers in the Volta Cocoa Region. An illustration of these steps followed in ranking the challenges facing cocoa farmers in the Volta Cocoa Region of Ghana is shown in Table 22.

Table 22: Garrett ranking technique procedure followed in identifying challenges faced by cocoa farmers in the Volta Cocoa Region

Constraints (P, M and ED)	Ranks by (i^{th} person)	Ranks by (n^{th} person)	Percentage position $=100(R_{ij}-0.5)/N_{ij}$	Percentage position $=100(R_{ij}-0.5)/N_{ij}$	Conversion to Garrett scores (i^{th} person)	Conversion to Garrett scores (nth Person)	Mean scores	Mean scores arranged in descending order
A	1	2	A	C	xx_1	xx_1	$Tsxx+n^{th}/N$	F1
	3	1	C	D	xx_3	xx_3	=F2	
	4	4	D	A	xx_1	xx_1		
	i^{th} rank	i^{th} rank	B	B	xx_i	xx_i		
B	2	1	B	D	yy_2	yy_2	$Tsyy+n^{th}$	F2
	1	3	A	A	yy_3	yy_3	/N	
	3	4	C	C	yy_1	yy_1	=F1	
	i^{th} rank	i^{th} rank	D	B	yy_i	yy_i		
C	4	3	D	D	zz_4	zz_4	$Tszz+\ n^{th}$	F3
	1	1	A	A	zz_1	zz_1	/N	
	2	2	B	C	zz_2	zz_2	=F5	
	i^{th} rank	i^{th} rank	C	B	zz_i	zz_i		
D	3	4	C	C	kk_3	kk_3	$Tskk+\ n^{th}$	
	4	3	D	A	kk_4	kk_4	/N	F4
	1	2	A	D	kk_1	kk_1	=F4	
	2	5	B	E	kk_2	kk_2		
	i^{th} rank	i^{th} rank	E	B	kk_i	kk_i		
i^{th} constraint	1	1	A	B	ss_1	ss_1	$Ts+\ n^{th}/N$	F5
	i^{th} rank	i^{th} rank	B	A	ss_i	ss_i	=F3	

Source: Agyeman (2020). P= Production, M=Marketing and ED= Extension Delivery, R=Rank given to a factor, N= Total number of individuals ranking the factor, A-i^{th} (challenges), F1-F5 (challenges arranged in descending order, Ts=Total score.

Objective Four: Estimating effects of Extension Delivery on Cocoa Farmers in the Volta Cocoa Region.

The effects of cocoa extension delivery are evident in the competencies, Innovation adoption level, yield, and income (from cocoa produce) of cocoa farmers. The procedures for analysing each of these extension delivery effects is presented in this section.

(a) Determining the competencies of cocoa farmers in the Volta Cocoa Region

Farmer competencies in cocoa farming were analysed descriptively. The competencies relate to the knowledge, attitudes, skills, and aspirations (KASA) cocoa farmers possess in cocoa farming. A five-point Likert scale of Very lowly agree (1), lowly agree (2), moderately agree (3), agree (4) and strongly agree (5) was used in the analysis. The means and standard deviation of each of the items under the competency indices of cocoa farmers on cocoa farming innovations were estimated. The composite means and standard deviations of the knowledge, attitude, skills, and aspirations competencies were also estimated.

The overall competency of cocoa farmers in the Volta Cocoa Region were estimated following the procedures as:

$$Competency = \frac{MeanKno + MeanAtti + MeanSki\ + MeanAsp}{4}$$

Where: Kno=Knowledge, Atti=Attitude, Ski=Skills and Asp=Aspirations indicated the competency level of cocoa farmers in the Volta Cocoa Region.

The Friedman Test was run to test significance difference in the mean rankings of the competency indicators (knowledge, attitude, skills, and aspirations) of cocoa farmers. To determine where significant difference between the competency indicator pairings exists, a post-hoc analysis was performed using the Wilcoxon signed-rank test.

(a) Examining Innovation adoption levels of cocoa farmers in the Volta Cocoa Region

a. Rate of adoption of cocoa innovations: The adoption rate of cocoa innovations was obtained by summing up the number of respondents who answer 'yes' (1)-adopters and 'no' (0)-non-Adopters to adopting the innovations. The frequencies of adopters and non-adopters of each of the cocoa innovations were indicated. The percentage rate of innovation adoption for the Volta Cocoa Region was obtained by dividing the number of adopters over total number of farmers multiplied by 100. This is expressed as:

$$Rate\ of\ adoption\ (percent) = \frac{number\ of\ adopters}{Total\ number\ of\ sampled\ farmers\ (n)} X\ 100$$

Where n=420 cocoa farmers expected to adopt GAPs, FLP and FEM innovations; n= 64 for certification beneficiaries.

b. Cocoa farmers Innovation Adoption levels (IAL): The number of adopted Good Agricultural Practices (GAPs), Certification (CERT), Farmer Level Purchases (FLP) and Farm Enterprise Management (FEM) innovations by each cocoa farmer were used to categorise them into Innovation adoption levels on five-point Likert scale ratings (Table 23) as Very high adoption (VHA)-5, High adoption (HA)-4, Moderate adoption-3 (MA), Low adoption (LA)-2 and very low adoption (VLA)-1.

Table 23: Estimation of Innovation Adoption Levels by cocoa farmers in the Volta Cocoa Region.

Rating	Interval	Interpretation	GAPS Innovation	CERT Innovation	FLP Innovation	FEM Innovation
1	1.0-1.44	Very low adoption	<5	1-2	1	1-2
2	1.45-2.44	Low adoption	5-9	3-4	2	3-4
3	2.45-3.44	Moderate adoption	10-15	5-6	3	5-6
4	3.45-4.44	High adoption	16-21	7-8	4	7-9
5	4.45-5.0	Very high adoption	22-27	9-10	5	10-12

Source: Agyeman, (2020)

The frequencies, percentages, means and standard deviations for each of the adopted innovations were estimated. The Innovation Adoption levels (IAL) of the cocoa farmers in the Volta Cocoa Region were estimated. Farmers who received all four innovations (GAPs, CERT, FLP, and FEM) the estimated mean level of innovation adoption level equation is expressed as:

$$IAL = \frac{MeanAdoptGAPs + MeanAdoptCERT + MeanAdoptFLP + MeanAdoptFEM}{4}$$

and for farmers who were not under certification, the mean innovation adoption level equation is expressed as:

$$IAL = \frac{MeanAdoptGAPs + MeanAdoptFLP + MeanAdoptFEM}{3}$$

Where, IAL=Innovation Adoption level; MeanAdoptGAPs= Mean GAPs innovation adoption level; MeanAdoptCERT= Mean certification innovation adoption level MeanAdoptFLP = Mean Farmer Level purchases innovation adoption level and MeanAdoptFEM= Mean Farm Enterprise Management innovation adoption level

This was followed by estimation of the overall mean Innovation Adoption levels (IAL) for the cocoa farmers in the Volta Cocoa Region. Similarly, the Friedman Test was run to test significance difference in the mean rankings of the Innovation adoption levels (GAPs, CERT, FLP and FEM)) of cocoa farmers. To determine where significant difference exist between the innovation adoption levels for GAPs, CERT, FLP and FEM indices pairings, a post-hoc analysis was performed using the Wilcoxon signed-rank test.

Direct observations made on adoption of the various cocoa innovations and practices at farm, community and cocoa shed levels were summarised and presented as narratives and images.

Cocoa Yield Estimation

The cocoa yield was estimated as cocoa output (kg) from all cocoa farmer farms realised during the 2018/2019 cocoa season (both main and light crop). The cocoa outputs were converted to kilograms per hectare (Kg) by dividing the cocoa outputs by the total cocoa farm size (hectares) of the cocoa farmer. The mean cocoa yield (kg/ha) and standard deviation were estimated to determine cocoa farmers' yield levels in the Volta Cocoa Region.

Income levels estimations

i. Cocoa Income (CI) was estimated as income from sale of cocoa bean and premiums (money received per bag from participation in certification programmes provided by CAA) received by cocoa farmers. This is expressed as $CI(GHC) = cocoa\ sales + premium$

ii. Total Household Income (THI) was estimated following Agyeman et al. (2014) as: Farm Income Sources: Cocoa income (***ci***), other crops income (*oci*), livestock income (*livsti*), natural resource income (*nri*), farm wage income (*fwi*) and Non-Farm Income Sources: Non-farm wage income (*nfwi*), self-employment income (*sei*), remittance income (*rei*), other sources income (*othersi*). Total Household Income (THI) is estimated as:

$$THI(GHC) = ci \quad + Otherci \quad + livsti + nri + fwi + nfwi + sei + rei + othersi$$

iii. Cocoa income share was estimated as: $= \frac{ci}{THI} \; x\, 100$,

Where Ci=Cocoa Income, THI=Total Household Income.

iv. The mean farm and non- farm income shares were estimated.

v. The per capita household income was estimated as

$$Per\ capita\ income = \frac{THI}{Householdsize}$$

vi. The income (Cocoa and Total household income) was estimated as nominal income.

An independent t-test which is suitable for comparison of two unrelated samples or groups following Carrasco, Garcia, Rueda, Das & Herrera, (2020) and Harris et al. (2008) was run to ascertain the significance differences between cocoa farmers receiving CHED and pluralistic extension (CHED and private extension receivers) based on the effects of extension delivery (competencies, Innovation adoption levels, yield, and cocoa income) at 95 percent confidence interval. The Levene's test, means and level of significance of the variables were reported.

Objective Five: Determinants of effects of Extension Delivery from the socio- Demographic, and Economic Factors of Cocoa Farmers.

According to Pallant (2018), multiple regressions indicate the extent to which set of independent variables predict a particular outcome. Sarstedt and Mooi (2014), indicate the benefits of using regression in the research process which is related to its ability to determine the significant relationship independent variables have with a dependent variable; determine strength of the effects of the different independent variables have on the dependent variable, and ability to make predictions.

When two independent variables are highly correlated (Sarstedt & Mooi, 2019), collinearity issues arise; and in situations when more than two independent variables are correlated, a situation of multicollinearity occurs. Perfect collinearity occurs when more than two or two independent variables having same data are entered, (Sarstedt & Mooi, 2019). As a result, prior to performing the regression analysis, it was ensured that there was no or little collinearity (Sarstedt & Mooi, 2014) amongst the independent variables.

The tolerance and Variance Inflation Factor (VIF) values are indications of whether or not multicollinearity issues exist amongst the independent variables. Tolerance is the percentage of variance in a given predictor that cannot be explained by the other predictors (Pérez, 2007). Tolerance is estimated as: Tolerance = $1-R^2$, where R^2 is the coefficient of determination for the regression of the explanatory variable on all remaining independent variables (Senaviratna & Cooray, 2019). Tolerance near one indicates that there is little multicollinearity, whereas tolerance near zero indicates that multicollinearity may be a threat.

The VIF is the reciprocal of tolerance and is denoted as follows:

$VIF = \frac{1}{Tolerance}$ Where, VIF is the extent of coefficient variance estimate which is inflated by concerns of multicollinearity. The values of VIF estimation exceeding ten indicate multicollinearity (Midi, Sakar & Rana, 2013). Suggested solutions to overcoming multicollinearity include combining variables, increasing sample size, omitting highly correlated variables, ridge regression, and principal component analysis (Senaviratna & Cooray, 2019).

The R-squared value close to 100 which determines the models strength and the significance of the explanatory variables are used to determine the strength of a regression analysis (Pallant, 2018). Piekutowska et al. (2021) used the multiple linear regression method to identify factors associated with yield prediction of very early Potato cultivars before harvest. The multiple linear regression was used in this study to assess the determinants of the effects of extension delivery (competency, innovation adoption level, yield, and income) from socio-demographic and economic factors of cocoa farmers in the Volta Cocoa Region.

Four set of multiple linear regressions were run using the SPSS 25 to determine factors associated with the competency, Innovation adoption level, yield, and income of cocoa farmers under cocoa extension delivery systems in the Volta Cocoa Region. The regression equations and description of the independent variables in each of the four set of linear regressions are presented in this section.

(a) Determinants of the competency of cocoa farmers from socio-demographic, and economic factors of cocoa farmers.

The regression model is specified as:

$$\text{Competency} = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \varepsilon$$

Competency= the dependent variable, $X_1 - X_{10}$ = Independent variables and ε= error term.

Table 24: Independent variables determining competency of cocoa farmers, measurements, a priori expectations and explanations.

Variables	Measurement	a priori expectation	Explanation
Age (X_1)	Years	+/-ve	Being older result in farmers having experience in cocoa farming and expected to improve cocoa farmers competencies. conversely, aging farmers who are not literate may not have improved competencies particularly in new innovations
Education (X_2)	Years	+	Attainment of formal education is expected to increase farmers literacy levels resulting in increased competencies (Knowledge, Attitude, skills, and aspirations)
Experience in cocoa farming (X_3)	Number of Years	+	Farmers experiences in cocoa farming and related activities is expected to improve their competencies
Participation in FBS (X_4)	Yes=1, No=0	+	Cocoa farmers participation in Farmer Business School is expected to improve their competencies
Registered under certification (X_5)	Yes=1, No=0	+	Participation in certification results in strict adherence to cocoa innovations under specified by the certification standards. This is expected to improve cocoa farmers competencies in cocoa farming.
Extension contact (X_6)	Number/year	+	Number of times cocoa farmers have contact with extension providers for training and related activities is expected to improve their competencies.

Table 24 continued

CHED-Empathy (X_7)	level	+	The individual attention provided by CHED staff to cocoa farmers is expected to improve their competencies
Private-Communication (X_8)	Level	+	Communication during extension provision process by private extension providers is expected to increase cocoa farmers competencies
Private-Empathy (X_9)	Level	+	Empathy (Individual attention) provided by private extension providers is expected to increase cocoa farmers competencies
CHED-Communication (X_{10})	Level	+	Communication by CHED is expected to improve cocoa farmers competencies.

Source: Agyeman (2020)

(b) Determinants of cocoa farmers innovation adoption levels of innovations from socio-demographic and economic factors

The regression model is specified as:

Innovation adoption level=$\beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + \beta_{13}X_{13} + \varepsilon$

Where, Innovation Adoption Level (IAL)= Dependent variable, $X_1 - X_{13}$ = Independent variables and ε= error term.

Table 25: Independent variables determining innovation adoption levels, measurements, a priori expectations and explanations.

Variables	Measurement	a priori expectation	Explanation
Sex (X_1)	Male=1, Female =0	+	Being a male cocoa farmer positively influence adoption innovations over female farmers.
Age (X_2)	Years	+/-ve	Being older result in experience which lead to low adoption levels. Younger farmers are expected to adopt innovations compared to older farmers.
Education (X_3)	Years	+/-ve	Education has higher returns to cocoa farmers adoption levels. Some educated farmers are also not able to adopt shared innovations hence could have a negative association with level of adoption.

Table 25 continued

Experience in cocoa farming (X_4)	Number of Years	+	Farmers experiences in cocoa farming and related activities is expected to improve their adoption levels
Participation in FBS (X_5)	Yes=1, No=0	+	Cocoa farmers participation in Farmer Business School is expected increase adoption levels
Quality of CHED Extension (X_6)	Interval	+	Quality of CHED Extension delivery is expected to improve adoption levels of cocoa farmers.
Knowledge competency (X_7)	Interval	+	Knowledge in cocoa farming is expected to improve adoption levels
Aspiration competency (X_8)	Interval	+	Aspirations of cocoa farmers towards cocoa farming is expected to improve cocoa farmers adoption levels
Skills Competency (X_9)	Interval	+	Skills of cocoa farmers are expected to increase cocoa farmers adoption levels.
Farm size (X_{10})	ha	+/-ve	Larger farm size results in increased adoption of innovations. In situations where farmers do not have access to required finance for labour and inputs, could results in low or inverse adoption levels relationships
Farm age (X_{11})	Years	+-	Higher farm ages are expected to increase adoption levels of farmers.
Attitude competency (X_{12})	Interval	+	The increased feelings farmers have to cocoa farming is expected to increase adoption levels
Leadership position (X_{13})	Yes-1, No-0	+	Farmers having various cocoa farming leadership positions are expected to result in increased innovation adoption levels

Source: Agyeman (2020)

(c) Determinants of yield from the Socio-demographic and economic factors of cocoa farmers.

The regression model is specified as:

$$Yield=\beta_0 + \beta_1X_1+ \beta_2X_2+ \beta_3X_3+ \beta_4X_4+ \beta_5X_5+ \beta_6X_6+ \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} +\beta_{12}X_{12} + \beta_{13}X_{13} + \varepsilon$$

Yield= Dependent variable, $X_1 - X_{13}$ = Independent variables and ε= error term.

Table 26: Independent variables determining yield, measurements, a priori expectations and explanations.

Variables	Measurement	a priori expectation	Explanation
Sex (X_1)	Male=1, Female =0	+ /-	Being male or female cocoa farmer positively/negatively influence cocoa yields.
Age (X_2)	Years	+/-ve	Being older result in experience to improve yield. Conversely, aging farmers have tendency not to invest in cocoa farms leading to reduced yield
Education (X_3)	Years	+ve	Education has higher returns to cocoa farmers yield by increasing adoption of innovations. Educated farmers could have lower levels of adoption which could result in lower yield.
Experience in cocoa farming (X_4)	Number of Years	+	Farmers experiences in cocoa farming and related activities are expected to increase their adoption levels leading to higher yield.
Participation in FBS (X_5)	Yes=1, No=0	+	Cocoa farmers participation in Farmer Business School aid farmers to farm as a business hence expected to improve yields.
Quality of CHED Extension (X_6)	Interval	+	The quality of CHED extension delivery is expected to increase adoption levels leading to increase yields.
Knowledge competency (X_7)	Interval	+-	Knowledge competency influences farmers skill hence could lead to higher yields. Knowledge without the requisite skills could lead to low adoption levels resulting in low yields.
Aspiration competency (X_8)	Interval	+	Aspirations are expected to influence cocoa farmers to invest in their cocoa farms to increase yields (Callahan, 2019).
Skills Competency (X_9)	Interval	+	Skills competency of cocoa farmers is expected to result in higher adoption rates leading to higher yields.

Table 26 continued

Farm size (X_{10})	ha	+-	Increased farm size requires higher investment of inputs and labour. Farm size is expected to result in higher yields, however low access to resources could lead to lower yields.
Farm age (X_{11})	years	+-	The age of farm requires farm inputs such as fertilizer and agrochemicals to improve yields.
AdoptFEM Innovations (X_{12})	Interval	+	Adopting cocoa farming FEM innovations such as budgeting, supervision, expenditure, savings, investment etc. is expected increase cocoa farmers' yield.
AdoptGAPs Innovations (X_{13})	Interval	+	Adoption of the necessary pre-harvest and postharvest GAPs innovations is expected to increase cocoa farmers yields.

Source: Agyeman, (2020).

(d) Determinants of income from the socio-demographic and economic factors of cocoa farmers.

The regression model is specified as:

$$\text{Cocoa income} = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + \beta_{13}X_{13} + \beta_{14}X_{14} + \varepsilon$$

Cocoa Income= Dependent variable, $X_1 - X_{14}$ = Independent variables and

ε= error term.

Table 27: Independent variables, measurements, a priori expectations and explanations.

Variables	Measurement	a priori expectation	Explanation
Sex (X_1)	Male=1, Female =0	+	Being male cocoa farmer positively influence access to land for cocoa farming and to undertake innovations hence expected to influence cocoa farmers' income.
Age (X_2)	Years	+/-ve	Being older affects cocoa farmers' ability to adopt innovations as well as has high dependency ratio. Hence age could have a positive or negative relationship with farmers cocoa income

Table 27 continued

Education (X_3)	Years	+ve	Education has higher returns to improving farmers' competencies to adopt innovations. Education could influence cocoa farmers to attract other employment outside the cocoa farming. Hence education could have a positive or negative relationship cocoa farmers income
Experience in cocoa farming (X_4)	Number of Years	+	Farmers' experiences in cocoa farming and related activities is expected to improve their income levels
Participation in FBS (X_5)	Yes=1, No=0	+	Cocoa farmers participation in FBS aid farmers to keep their farms as a business hence expected to increase their cocoa income
Quality of CHED Extension (X_6)	Interval	+	The reliability, responsiveness, tangibility, communication, assurance, and empathy of CHED extension delivery is expected to result in higher yields of cocoa farmers and increased income levels
Knowledge (X_7)	Interval	+/-ve	Knowledge competency is expected to increase adoption and yields. However, without skills to adopt innovations will lead to lower yields and hence lower cocoa income.
Aspiration ($X_{8)}$	Interval	+-	Cocoa producers with aspiration competency are expected invest in their cocoa farm to achieve the required yield and income. Aspirations without the required skills and support lead to lower income.
Skills ($X_{9)}$	Interval	+	Possession of requisite cocoa farming skills results in the adoption of innovations by cocoa farmers to improve yield. Yield is therefore expected to increase cocoa farmers income
Farm size ($X_{10)}$	ha	+-	Higher farm sizes lead to overall output. However, higher farmers result in lower cocoa outputs if farmers are unable to access the labour and inputs to manage the farms. Hence could lower cocoa incomes.
Farm age ($X_{11)}$	Years	+-	Very young and old farms lead to lower yields. Farm age particularly B and C class farms result in higher yields and hence expected to increase cocoa income.

Table 27 continued

AdoptFLP Innovations (X_{12})	Interval	+	Farmers' adoption of purchases innovations as selling beans to Ghana COCOBOD, use of testing stones to detect scale adjustment is expected to increase cocoa farmers income.
AdoptFEM Innovations (X_{13})	Interval	+	Adoption of Farm Enterprise innovations such as budgeting, supervision, diversification results increased income
Yield (X_{14})	Kg/ha	+	High yield of cocoa farmers results in income. Higher yield is positively related to higher premiums which increases income of farmers.

Source: Agyeman (2020)

Data Presentation

This research undertook mixing at the end of analysing the quantitative and qualitative data to establish expected triangulations as well as complementarities purposes associated with mixed-method research approach followed in this study.

Ethical Considerations

This study on the factors influencing extension delivery in the Volta Cocoa Region of Ghana focused on data collection from cocoa farmers and relevant stakeholders. The data collection process was linked to ethical considerations that needed to be addressed. As a result, the research proposal including data collection instruments were presented to the University of Cape Coast Institutional Review Board for ethical clearance (Appendix E).

A number of ethical issues were considered in this research. Participants were required to voluntarily participate in the study and were also assured of the confidentiality of their responses. Moreover, during data collection, it was ensured that community entry protocols were followed in interviewing sampled cocoa farmers at times that were convenient for them, such as mornings, late afternoons, and on taboo days. Consents of participating Cocoa farmers in the study were also obtained prior to recording the Focus Group Discussions and in-depth interviews. Permission was also sought from respondents to observe farms, cocoa sheds, take photographs, and record audios and videos on the cocoa farming issues being investigated as part of the ethical consideration.

Chapter Summary

The research methods employed in analysing data on the stated objectives of this study are presented in this chapter. The research design—convergent parallel design, research philosophy-pragmatism underpinning the study has been described. The research instruments for qualitative and quantitative aspects of the study, pre-testing and actual data collection procedures have been included in this chapter. A description of the analytical framework and methods for analysing each objective have been indicated in this chapter. Application of the descriptive statistics, SERVPERF Model, Garrett ranking techniques, independent T-test for testing stated hypotheses, Friedmans test and multiple regression procedures followed have also been indicated in this chapter.

CHAPTER FOUR

DESCRIPTION OF THE NATURE OF EXTENSION DELIVERY IN THE VOLTA COCOA REGION

Introduction

A description of the nature of extension delivery in the Volta Cocoa Region of Ghana is covered in this fourth chapter. Particularly, the chapter presents and discusses the structure and activities of extension providers, characteristics of shared cocoa innovations, the frequency of use of extension methods and effectiveness of extension materials used in extension delivery. Cocoa farmers perceptions of the quality of extension delivered to them by CHED (public) and private extension organizations in the Volta cocoa Region is also presented and discussed in this chapter. The chapter ends with a summary.

Nature of Extension Delivery in the Volta Cocoa Region

The extension approach used generally for cocoa extension delivery in the Volta Cocoa Region is the Commodity specialized extension (Axxin, 1988) to improve the quantity (production levels) and quality of the cocoa commodity in the region. The implementation of this approach by the extension providers (CHED and private) in the region, however, takes care of a disadvantage of the commodity specialized approach by supporting cocoa farmers not only in cocoa farming but also in other entrepreneurial activities engaged in.

The Cocoa Health and Extension Division (CHED), a subsidiary of the Ghana COCOBOD is the key public cocoa extension provider responsible for Cocoa farmers extension needs in the Volta Cocoa Region. The study found a total of 80.2 percent of the cocoa farmers to receive extension solely from the

CHED extension system. Nearly one-fifth (19.8 percent) of the cocoa farmers surveyed were under pluralistic extension system. That is these farmers are registered under the Cocoa Abrabopa Association (CAA) and Solidaridad-MASO private extension schemes in addition to participation in the COCOBOD CHED system. The cocoa extension system, providers and beneficiary cocoa farmers in the Volta Cocoa Region is presented in Table 28.

Table 28: Cocoa Extension system, providers, and beneficiary cocoa farmers in the Volta Cocoa Region

Extension Delivery System	Provider	Beneficiary cocoa farmers f	Percent
Public	CHED	337	80.2
Pluralistic	CHED and Private (CAA and Solidaridad-MASO)	83	19.8
	Number	f	percent
Number of private extension organizations registered with	1	76	91.6
	2	7	8.4

Source: Field survey, Agyeman (2020) n=420 (Total number of cocoa farmers) and n=83 (private cocoa extension beneficiaries)

Moreover, a majority of cocoa farmers representing 91.6 percent were found by the study to be registered with one private extension provider (i.e., either CAA or Solidaridad) whilst 8.4 percent were registered with both CAA and Solidaridad. The lower number of private extension beneficiaries in the Volta Cocoa Region could stem from the limited number of targeted beneficiaries. The low number of private extension providers in the region also contribute to the lower number of cocoa farmer participation found by the study.

Due to the importance of the Volta Cocoa Region to the Ghana cocoa economy, the Ghana COCOBOD has a physical presence in the region. The

Volta Regional COCOBOD head office located in the Hohoe cocoa district (Figure 4) houses the various departments of COCOBOD including CHED for efficient administration of extension and related services to Cocoa farmers in the region.

Figure 4: Photo of the Volta Regional COCOBOD office situated in the Hohoe CHED district.

The presence of COCOBOD regional office and decentralised district offices in the Hohoe (within the regional COCOBOD office building), Jasikan and Papase districts indicates the relevance of the Volta Cocoa Region as a contributor to the cocoa production volumes of Ghana.

The COCOBOD CHED organises extension services according to a well-defined structure (Figure 5). The District Extension Coordinators direct extension activities in their districts (Hohoe, Jasikan and Papase) and report to the Regional Manager, who reports to the National Deputy Technical Extension Manager. Community Extension Agents (CEAs) in charge of operational areas in the Hohoe, Jasikan, and Papase CHED districts are managed by the District Extension Coordinators. The CEAs are also in charge of assisting with the distribution of COCOBOD inputs, training, and other related activities.

The structure of CHED extension delivery is shown in Figure 5.

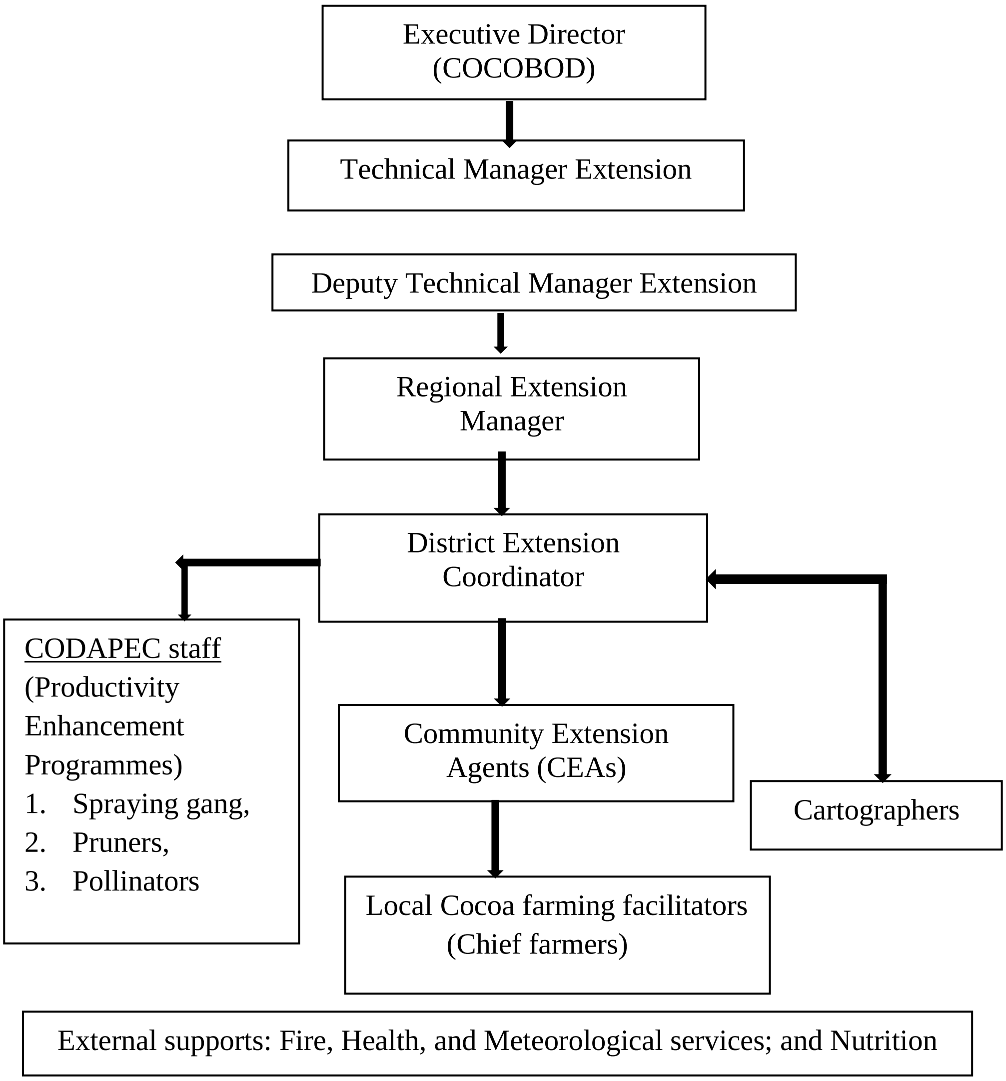


Figure 5: Structure of CHED delivery of extension in the Volta Cocoa Region

Source: Field survey, Agyeman, (2020).

Extension delivery by CHED predominantly focuses on the implementation of GAPs, rehabilitation of diseased and moribund farms, control of CSSVD, and implementation of Productivity Enhancement Programmes (PEPs) for increased yield. PEPs include mass pruning and spraying, artificial pollination, irrigation, and other similar practices. COCOBOD-engaged pruning and spraying gangs are provided with equipment such as pruners, Knapsack, and motorized sprayers as well as personal protective equipment (PPE) to prune and spray cocoa farms that have had their farms mapped to receive subsided or free inputs. Personnel of the spraying gang also work collaboratively with CEAs to provide and inform farmers about when cocoa farming activities should be performed.

The GIZ Farmer Business School is also being implemented by the CHED extension systems on a community and group basis in the Volta Cocoa Region (GIZ, 2016). Cocoa farmers who complete the FBS training are provided with certificates. Through the Farmer Business School, CHED assists farmers in diversifying their farming activities into other crops such as vegetables, cereals (maize, rice), yam, cassava, and livestock. Farmers also engage in processing (gari, dough, oil, and so on) and trading activities. The Volta Cocoa Regional cartography department farm mapping activities supplement CHED extension efforts by determining farm size. This informs COCOBOD about farmers input (fertilizer, insecticide, and fungicide) requirements, training needs and generally for COCOBOD decision making purposes. These extension activities by CHED are extended to cocoa farmers through a cooperative system that employs farm and home visits, demonstrations, radio campaigns, office call, rallies, and other methods.

The CAA extension structure, which is based on a sustainability (Certification) scheme, organizes cocoa farmers to produce certified cocoa for international clients for premiums. The CAA, which operates in the three CHED districts, has a council made up of elected regional representatives and led by a council chairperson. The management of CAA led by the executive secretary oversees the general management (recruitment, training, implementation of activities) of the association and reports to the council.

The Extension manager of CAA is directly responsible for programme design as well as field operational activities. The extension manager collaborates with the Regional Manager, who is in charge of overseeing farmer activities in the Volta Cocoa Region. Technical Coordinators (TCs) who directly work with the registered farmers report directly to the Regional Manager. CAA employ extension methods such as farm and home visits, demonstrations, group meetings, and Annual General Meetings (AGMs) in the delivery of extension to cocoa farmers in the Volta Cocoa Region of Ghana. Farmers are also given cropping calendars, record books, and posters, among other as primary extension materials. CAA also has slogan in the Twi language as '*Adwumaden ne Nokwaredi, eye paa!!*' (Meaning in English as '*hard work and truthfulness is very good'*). This slogan is usually recited at meetings and other gatherings as an 'ice breaker'.

The CAA operational year activities are divided into the following categories: sensitization and registration, input distribution, farm mapping, internal and external audits, cocoa purchases and records, and payment (Recoveries) for input credits. Sensitization and registration of Cocoa farmers are the responsibility of the TCs. Figures 6 and 7 illustrate the CAA registration process and identity card provided to registered cocoa farmers for traceability purposes.

Figure 6: CAA Technical Coordinator registering farmers at the Likpe-Mate community

Source: Field Survey, Agyeman (2020).

Cocoa farmers under the CAA extension scheme are registered by Technical Coordinators on group basis. They are expected to provide their biodata including names on their Voter or any National Identity cards as well as pay a stated registration fee. Farmers or groups are registered as new, continuing, or returning groups.

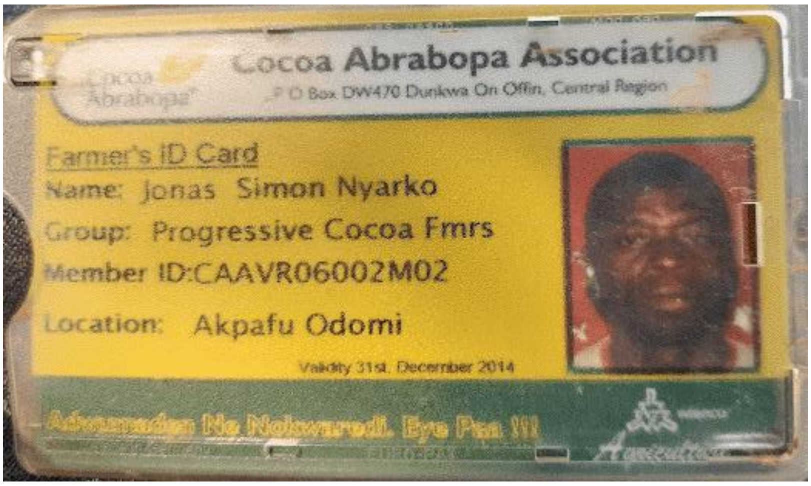


Figure 7: A sample of Identity Card provided by CAA to a registered farmer.

Source: Field Survey, Agyeman (2020)

The identity number on the provided identity card shown in Figure 7 indicate the name of the organization (CAA), region (VR), year of registration (06 for 2006), group number (002), farmer gender (M for male), and position (number) in the group (002 indicating second registered person in the group).

Agyekum (2015) indicate cocoa farmers registered under the CAA programme are given fertilizers (Asaasewura), insecticides (Confidor), fungicides (e.g., Nordox and Ridomil), Matabi Knapsack sprayer, and a group motorized sprayers on credit. The findings of the study revealed Technical Coordinators (TCs) are responsible for the distribution of these cocoa farming inputs as well as training, meetings, and repayment(recoveries) of input credits. TCs also oversee farm mapping, coordination of farm map generation and distribution, as well as CAA certification activities, ensuring farmers adhere to UTZ and Rainforest certification standards including 'free scale' (no scale adjustment by collectors) certification standards. TCs supervised by regional managers and Extension Manager also prepare registered cocoa farmers for internal and external audits (as part of the certification process), as well as distribute premiums to them. The Annual General Meetings (AGMs) is an important programme on the calendar of CAA. This usually marks the end of a programme year. The AGM is held to present audited financial statements to members, hold elections, and recognise outstanding cocoa farmers and groups at the regional, and national levels.

Under the MASO programme, Solidaridad delivers extension services that introduce youth to cocoa farming on a full or part time basis. MASO, which literally means 'picking up something or coming of age' in the Akan language, aims to reduce youth unemployment in cocoa-growing areas by providing holistic training to young people (17-25 years old) in cocoa agronomy, financial literacy, and social and legal literacy. So far, the MASO has trained 11,000 youth, 40 percent of whom are females, in the Likpe, Liate, Kpoeta, Kadjebi, Lolobi, Akpafu, and Jasikan areas of the Volta Cocoa Region of Ghana.

The extension delivery approach by the MASO programme includes recruiting youth and training them for six months using training facilitators and/or programme officers. Lectures, demonstrations, home and farm visits, and Flipcharts, Handouts are the main training methods and materials used by facilitators. Solidaridad uses hands-on practical and audio-visual aids, especially for individuals who cannot read or write. Trained youth put what is learned in the classroom into practice by establishing a model farm and implementing cocoa management practices like pruning and fertilizer application. Solidaridad divides the youth into groups to work as a team. Machetes and personal protective equipment, fertilizer, fungicides, insecticides, mistblowers, knapsack sprayers, and pruners kept at the Volta Region District office are made available to the trained youth group for demonstration upon request. Mentor(s) are also assigned to groups in order for them to share their experiences. In addition, Solidaridad field officers monitor and provide other supports to the groups.

The decentralised approach employed by CHED, CAA and Solidaridad in the delivery of extension to cocoa farmers is important for improved extension service provision in a cost-effective manner as emphasised by Nambiro et al. (2006). It is also critical that a number of other cocoa extension organisations operating in other cocoa regions of Ghana have a decentralised presence in the Volta Cocoa Region, as farmers in areas with higher decentralised extension have advanced awareness levels of the diverse channels of extension delivery and have improved knowledge, both of which are critical for empowering cocoa farmers and their communities (MEAS, 2014) in the Volta Cocoa Region. The government of Ghana and COCOBOD however, is required to provide increased supports such as funding, quality control, mediation, monitoring and infrastructure to reduce costs incurred by the private organisation involvement in pluralistic extension delivery in the Volta Cocoa Region (Muyanga & Jayne 2008).

Farmers Perception of the Characteristics of Shared Cocoa Innovations

This section discusses the extent to which cocoa farmers perceived the characteristics: Relative Advantage (RA), Trialability (TRI), Complexity (CPX), Compatibility (CPT), and Observability (OBS) of shared cocoa innovations (Good Agricultural Practices, Certification, Farmer Level Purchases, and Farm Enterprise Management) by CHED and private extension providers in the Volta Cocoa Region of Ghana.

The results (Table 29) show cocoa farmers in the Volta Cocoa Region generally perceive the shared GAPs innovations very highly (Mean-4.9 and SD: 0.3) possessed relative advantage over what is already known. Similarly, the Compatibility (Mean:5.0 and SD: 0.4) and observability (Mean:4.6 and SD:0.4) of the shared cocoa innovations were perceived to possess the characteristics very highly. Cocoa farmers however, perceived the GAPs innovations highly possessed the trialability (Mean:4.2 and SD: 1.0) and complexity (Mean: 3.9 and SD:1.8) characteristics. In terms of the complexity of the shared cocoa innovations shared, farmers consider re-entry period (the time between applying agrochemicals and returning to the farm) to be highly complex (Mean:4.2 and SD:0.9). Cocoa farmers moderately (Mean:2.7 and SD: 1.4) perceived the complexity of identification of ripened cocoa pods. Farmers particularly very highly perceived the observability of erosion and drainage control.

Table 29: Perceived characteristics of GAPs Innovations by cocoa farmers in the Volta Cocoa Region

Good Agricultural Practices Innovations	n	RA		TR		CPX		CPT		OBS	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Raising cocoa seedlings in poly bags	418	4.9	0.2	4.2	0.9	4.1	2.1	5.0	0.3	4.9	0.3
Raising cocoa seedlings on beds	399	4.7	0.9	3.7	1.2	3.6	0.9	5.0	0.2	4.9	0.2
Selecting a good site for cocoa farming	415	4.9	0.2	4.3	0.8	3.7	2.1	5.0	0.2	4.9	0.2
Demarcation of cocoa farm/land	419	4.9	0.2	3.9	1.1	4.0	3.3	5.0	0.3	4.9	0.2
Preparing permanent land for cocoa farming	418	4.9	0.4	4.4	0.8	4.0	1.7	4.9	0.3	4.9	0.2
Transplanting nursed seedlings	418	4.9	0.3	4.5	2.1	4.0	3.0	5.0	0.3	4.9	0.2
Planting cocoa seedlings in lines	415	4.9	0.2	4.1	1.0	4.1	2.2	4.9	0.4	4.8	0.2
Planting seedlings using recommended spacing	417	4.9	0.3	3.8	1.1	4.0	1.7	4.9	0.3	4.9	0.2
Providing temporary shades	420	4.7	0.4	4.3	0.9	3.9	0.8	5.0	2.5	4.9	0.2
Regular pruning of cocoa trees	416	4.9	0.3	4.3	0.8	3.9	2.6	4.9	0.4	4.9	0.2
Application of fertilizer by broadcasting method	420	4.9	0.4	4.3	0.9	4.2	1.3	4.9	0.4	4.7	0.2
Application of foliar fertilizers using sprayers	416	4.9	0.4	4.2	1.0	3.9	0.8	4.9	0.4	4.7	0.2
Application of organic manure on cocoa farm	420	4.9	0.4	4.1	1.3	4.3	0.8	5.0	0.3	4.9	0.2
Blackpod disease control	418	4.9	0.6	3.9	0.9	4.2	0.8	4.9	0.4	5.0	0.2
Cocoa mirids control	417	4.9	0.4	4.3	0.9	4.3	0.8	5.0	0.2	4.9	0.2
Observing re-entry period for applied chemicals	417	4.7	0.4	4.3	1.0	4.3	5.0	5.0	0.3	4.9	0.2
Erosion and drainage control	417	4.9	0.5	4.2	0.9	4.7	3.1	4.9	0.4	5.0	0.3
Regular weed control on the cocoa farm	414	4.9	0.3	4.2	1.0	4.1	2.7	4.9	0.3	4.1	2.5
Creating fire belts around cocoa farms	409	4.9	0.4	4.1	0.9	4.1	1.9	5.0	0.3	4.1	0.3
Identification of ripened cocoa pods	414	4.9	0.4	3.8	1.1	3.7	1.5	4.9	0.3	4.2	0.2
Observing pre-harvest interval	415	4.9	0.2	4.5	1.1	2.6	1.4	5.0	0.3	4.3	3.4

Table 29 continued

Harvesting cocoa pods without damaging flower cushions	418	4.9	0.2	4.3	0.7	3.5	2.7	4.9	0.3	4.4	0.2
Breaking cocoa pods 2-3 days after harvest	417	4.9	0.2	4.5	0.9	3.7	2.5	5.0	0.3	4.2	0.2
Breaking harvested cocoa pods	418	4.9	0.3	4.5	0.7	3.6	0.9	5.0	0.3	4.2	0.2
Fermentation of cocoa beans for six days	418	4.9	0.3	4.5	0.7	3.5	0.9	4.9	0.3	4.4	0.2
Drying cocoa beans to right moisture level	418	4.9	0.3	4.5	0.7	3.5	1.0	4.9	0.3	4.3	0.2
Storage of dry cocoa beans in jute sacks	414	4.9	0.3	4.3	0.8	3.6	1.0	5.0	0.3	4.3	0.2
Composite mean		**4.9**	**0.3**	**4.2**	**1.0**	**3.9**	**1.8**	**5.0**	**0.4**	**4.6**	**0.4**

Source: Field survey, Agyeman, (2020). Mean calculated from a scale of 4.45-5.0(Strongly Agree), 3.45-4.44 (Agree), 2.45-3.44 (Moderately Agree), 1.45-2.44**(**Lowly agree) and 1-1.44 (Very Lowly Agree)

The results indicate cocoa farmers in the Volta Cocoa Region perceived the shared GAPs innovations to possess a very high relative advantages over what is practiced. This supports the relevance of CRIG recommended cocoa innovations as indicated by Asamoah et al. (2017) to cocoa farming. It is, however, crucial to reduce the perceived complexities associated with cocoa innovations as indicated to ensure cocoa farmers reap the full benefits as found for the cocoa Hitech programme by Bosompem et al. (2011).

Table 30 present the extent to which beneficiaries of the certification scheme provided by CAA in the Volta Cocoa region perceived characteristics of shared certification innovations. The results indicate cocoa farmers perceive shared certification innovations possess very highly the relative advantage (Mean:4.8 SD:0.5), Compatibility (Mean:4.5 and SD:0.7) and observability (Mean:4.9 and SD:0.4) characteristics. Moreover, the trialability (Mean: 4.4 SD:1.8) of the shared innovations were perceived to highly possess the characteristics whereas the complexity (Mean:3.4 and SD:0.7) was deemed to moderately possess the characteristics. On mean rankings of the complexity of shared certification innovations, protection of other plants and animals' innovation was perceived as highly complex (Mean:3.6 and SD:0.8) whereas disposal of used agrochemical storage bottles and sachet innovations were perceived as moderately complex (Mean:3.0 and SD: 1.2).

Table 30 : Perceived characteristics of shared Certification innovations in the Volta Cocoa Region

Certification Innovations	n	RA		TR		CPX		CPT		OBS	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Planting desirable shade trees in cocoa farms	59	4.9	0.3	3.9	0.9	3.4	0.8	4.4	0.8	4.8	0.4
Practicing non-use of children under 15 years to undertake hazardous work	52	4.7	0.8	4.2	0.8	3.4	0.7	4.5	0.8	4.9	0.4
Observing good treatment of workers	49	4.9	0.5	4.2	2.5	3.4	3.0	4.5	0.8	4.9	0.4
Practicing protection of other plants and animals in cocoa farms	48	4.8	0.6	5.0	0.9	3.6	0.8	4.5	0.8	4.9	0.4
Creating buffer zones between cocoa farms and water bodies	54	4.9	0.5	4.2	1.0	4	4.2	4.5	0.6	4.9	0.4
Practicing good sanitation in the farm, home, and community	55	4.8	0.5	4.2	0.9	3.4	0.8	4.5	0.8	4.8	0.5
Registering mapped farmland to own a farm plan	53	4.8	0.5	4.1	0.9	3.4	0.7	4.5	0.8	4.8	0.5
Wearing PPE when undertaking cocoa farming activities	56	4.8	0.5	4.2	0.9	3.4	0.7	4.5	0.8	4.8	0.4
Storing agrochemicals in storage rooms	54	4.8	0.6	4.8	5.0	3.4	0.7	4.6	0.2	4.9	0.3
Disposal of used agrochemical bottles, sachets, bags etc.	40	4.8	0.3	4.8	4.1	3.0	1.2	4.6	0.6	4.9	0.3
Composite mean		**4.8**	**0.5**	**4.4**	**1.8**	**3.4**	**1.4**	**4.5**	**0.7**	**4.9**	**0.4**

Source: Field survey, Agyeman (2020). Mean calculated from a Scale of 4.45-5.0 (Strongly Agree), 3.45-4.44 (Agree), 2.45-3.44 (Moderately Agree), 1.45-2.44 **(**Lowly agree) and 1-1.44 (Very Lowly Agree).

The results imply need for increased supports for certification innovations for beneficiary farmers in the Volta Cocoa Region of Ghana to realise the required benefits including yield (Gockowski, Afari-Sefa, Sarpong, Osei-Asare & Agyeman, 2013).

The characteristics of shared Farm Level Purchases (FLP) innovations (Table 31) indicate the relative advantage (Mean:4.9 and SD:1.1), trialability (Mean:4.5 and SD: 0.9), compatibility (Mean: 4.9 and SD: 0.3) and Observability (Mean:4.8 and SD: 0.9) of the FLP innovations shared were respectively perceived by cocoa farmers to very highly possess the characteristics required. However, the complexity (Mean:2.6 and SD: 1.9) of the FLP innovation was perceived to moderately possess the characteristics. Particularly, cocoa farmers' perceptions of the conveyance of bagged beans to sheds without contamination (Mean:2.7 and SD:1.0) as well as payment of loans from purchasing clerks (Mean:2.7 and SD:1.2) were perceived as moderately complex. Moreover, regular use of testing stones or body weight was also regarded as moderately complex (Mean:3.0 and SD: 2.7). Selling all cocoa beans to COCOBOD LBCs was however perceived as lowly complex (Mean:2.2 and SD: 1.6). The results imply the need for cocoa farmers and purchasing clerks to build consensus in dealing with issues with scale adjustments to avoid diversions and smuggling which stems from scale adjustment and to an extent pricing concerns.

Table 31: Perceived characteristic of shared Farmer Level Purchases innovations in the Volta Cocoa Region

Farmer Level Purchases Innovations	n	RA		TR		CPX		CPT		OBS	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Conveying bagged cocoa beans to cocoa sheds without contamination	418	4.9	2.1	4.8	0.6	2.7	1.0	4.9	0.6	4.6	0.6
Selling all cocoa beans to COCOBOD LBCs	416	4.9	0.2	4.8	0.6	2.2	1.6	4.9	0.2	4.6	0.6
Using testing stones and/or body weight to detect scale adjustments	394	4.7	0.7	3.6	1.4	3	2.7	4.8	0.3	4.9	0.3
Ensuring cocoa sales are recorded in COCOBOD Passbook	416	5.0	2.5	4.6	0.9	2.6	3	4.9	0.5	5.0	2.5
Promptly paying advanced loans from LBCs in cocoa or cash	222	4.9	0.2	4.6	0.8	2.7	1.2	4.9	0.3	4.9	0.3
Composite mean		**4.9**	**1.1**	**4.5**	**0.9**	**2.6**	**1.9**	**4.9**	**0.4**	**4.8**	**0.9**

Source: Field survey, Agyeman (2020). Mean calculated from scale: 4.45-5.0 (strongly agree), 3.45-4.44 (agree), 2.45-3.44 (moderately agree), 1.45-2.44 **(**lowly agree) and 1-1.44 (very lowly agree)

The results (Table 32) show that cocoa farmers in the Volta Cocoa Region perceive the Farm Enterprise Management (FEM) innovations shared highly possess the relative advantage (Mean: 4.3 and SD:1.7), trialability (Mean 3.7, SD 1.4), complexity (Mean 3.7 and SD: 1.1), compatibility (Mean: 4.3 and SD: 2.1) and observability (Mean: 4.4 and SD: 1.1) characteristics. Diversification of farming activities was deemed to be moderately (Mean: 3.4 and SD: 0.9) complex whilst the trialability of budgeting (Mean:3.8 and SD: 0.9) and record keeping (Mean: 4.0 and SD: 1.9) innovations were perceived to moderately possess the characteristics. The FBS and entrepreneurial training provided by CHED and private extension providers (GIZ, 2016 and Agyekum, 2015) require further supports to reduce the cocoa farmers perceptions of the complexities of the FEM innovations.

Table 32: Perceived characteristics of shared Farm Enterprise Management innovations in the Volta Cocoa Region

Farm Enterprise Management Innovations	**n**	**RA**		**TR**		**CPX**		**CPT**		**OBS**	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Budgeting for cocoa farming activities	297	3.9	1.0	3.3	1.2	3.8	0.9	4.2	0.9	4.9	1.0
Keeping records on cocoa farming activities	299	4.3	1.0	3.2	3.2	4	1.9	4.2	5.0	4.2	1.0
Contracting labour to undertake activities on cocoa on time	340	4.4	4.5	3.7	1.3	4	3.0	4.2	0.8	4.2	0.8
Supervising contracted labour work activities	338	4.3	2.9	3.5	3	3.6	0.9	4.6	4.0	4.4	0.9
Mobilizing financial and material resources (e.g., inputs, equipment etc.) for cocoa farming	330	4.3	0.9	3.6	1.2	3.8	0.9	4.3	0.8	4.4	0.9
Paying for received cocoa inputs and service credits on time	276	4.3	0.9	3.6	3	3.7	1.8	4.2	0.9	4.3	0.9
Saving cocoa income in banks and other financial organisations	306	4.4	2.5	3.5	0.9	3.9	0.8	4.3	1.8	4.3	2.9
Regularly participating in cocoa related meetings and trainings	331	4.3	0.9	3.8	1.2	3.5	3.0	4.6	4	4.4	0.9
Estimating cocoa farming expenditure	301	3.9	0.9	3.3	2	3.8	0.9	4.1	0.8	4.2	0.9
Diversifying farming enterprises	368	4.6	2.8	4.1	1.2	3.4	0.9	4.5	2.8	4.4	0.9
Estimating profit realized from cocoa farming	301	4	1.0	3.5	1	3.7	1.0	4.3	0.9	4.2	0.9
Investing cocoa income in cocoa farming and other enterprises	342	4.3	0.9	4	1.3	3.7	0.9	4.5	2.9	4.4	0.9
Composite mean		**4.3**	**1.7**	**3.6**	**1.7**	**3.7**	**1.4**	**4.3**	**2.1**	**4.4**	**1.1**

Source: Field survey, Agyeman (2020). Mean calculated from a scale: 4.45-5.0 (strongly agree), 3.45-4.44 (agree), 2.45-3.44 (moderately agree), 1.45-2.44 **(**lowly agree) and 1-1.44 (very lowly agree).

Effectiveness of Extension Training Materials

This section discusses the perception of cocoa farmers on the effectiveness of the various extension materials used by CHED and private extension providers (particularly, CEAs, Technical officers, and facilitators) as aids in facilitating training to ensure cocoa farmers acquire the required competencies in cocoa farming. The results (Table 33) show that the majority of cocoa farmers (78-95 percent) could not tell the level of effectiveness of cocoa newspaper, handouts, folder, training manual, training guide, and calendar, whereas 5-44 percent could not tell the level of effectiveness of radio and books training materials, respectively.

Radio, calendar (Figure 7) poster (Figure 6), books (Figure 6), Television (particularly Akuafo TV programmes), and Training Guide were perceived as effective in increasing their understandings of cocoa innovations by the cocoa farmers in the Volta Cocoa Region of Ghana. Newsletter was perceived as moderately effective in terms of increasing farmers' understanding of cocoa innovations. Cocoa farmers cited the value of related radio programmes broadcast on Beyond FM-90.7 MHz (Nkwanta), Lorlornyo FM-93.3 MHz (Hohoe), and erstwhile Sekpellle FM-104.3 MHz (Likpe-Mate). The importance of the programmes broadcast on these radio stations was attributed to their convenient timing, cocoa farmers ability to contribute to the programmes, and feedbacks received almost immediately. Adeogun, Olawoye, Akinbile (2010) similarly found radio as major source of information for cocoa farmers.

Table 33: Effectiveness of Cocoa Extension Training Materials

Training Materials	CT		VE		EF		ME		LE		VLE		Mean	SD
	f	Percent	f	Percent	f	Percent	f	1.2	f	Percent	f	Percent		
Books	183	44	94	39.7	56	23.6	64	27.0	19	8.0	4	1.7	3.9	1.1
Training Guide	356	85	15	23.4	21	32.8	15	23.4	5	7.8	8	1.9	3.5	1.2
Folder	390	93	7	23.3	7	23.3	9	30.0	6	20.0	1	3.3	3.4	1.2
Newsletter	387	92	6	18.2	6	18.2	7	21.2	9	27.3	5	15.2	2.9	1.4
Training Manual	390	93	4	13.3	10	33.3	5	16.7	4	13.3	7	23.3	3.0	1.4
Cocoa Newspaper	400	95	4	20.0	5	25.0	4	20.0	3	15.0	4	20.0	3.1	1.4
Handouts	398	95	6	27.3	4	18.2	6	27.3	2	9.1	4	18.2	3.2	1.4
Poster	262	62	61	38.6	64	40.5	26	16.5	4	2.5	3	1.9	4.1	0.9
Calendar	328	78	59	64.1	14	15.2	10	10.9	3	3.3	6	6.5	4.2	1.2
Flipcharts	364	87	14	25.0	17	30.4	17	30.4	4	7.1	4	7.1	3.5	1.2
Power points	391	93	8	27.6	2	6.9	9	31.0	3	10.3	7	24.1	3.0	1.5
Radio	22	5.0	216	54.3	104	26.1	45	11.3	14	3.5	19	4.8	4.2	1.1
Television	373	89	15	31.9	11	23.4	8	17.0	7	14.9	6	12.8	3.5	1.4
Video	396	94	8	33.3	2	8.3	3	12.5	3	12.5	8	33.3	3.0	1.7

Source: Field survey, Agyeman (2020) CT: Can't Tell, VE: Very Effective, EF: Effective, ME: Moderately Effective, LE: Lowly Effective, VLE: Very Lowly Effective Scale: 4.45-5.0 (Very Effective), 3.45-4.44 (Effective), 2.45-3.44 (Moderately Effective), 1.45-2.44 (Lowly Effective), 1-.1.44 (Very Lowly Effective)

The findings of the study show CAA provides registered cocoa farmers with cropping and certification standard calendars. The provided cropping calendars (Figure 8) show the various steps to take in order to increase yields regarding times of application of fertilizer, insecticides, and fungicides using the appropriate spraying equipment (knapsack or motorized). The Calendar also depicts the six personal protective equipment (PPE) items (hat, respirator, goggles, overall, gloves, and wellington boots) that each farmer is required to own and use when engaging in various cocoa farming activities particularly agrichemical applications. The certification standard Calendar displays images and labels of various UTZ and RA internal standards that farmers are expected to strictly follow.

Figure 8: Certification calendar (left) and cropping calendar (right) extension. training materials used in the Volta Cocoa Region

Source: Field survey, Agyeman (2020).

The various posters used in training cocoa farmers in the Volta Cocoa Region is shown in Figure 9. The posters show a programme to be aired on child labour on radio (top left), display of Cocoasett agrochemical for increased yield and application of granular fertilizer using the broadcasting method. These posters are relevant in visually deepening farmers understandings on the issues they portray.

Figure 9: Examples of poster extension training material used in the Volta Cocoa Region.

Source: Field Survey, Agyeman (2020)

An edition of the cocoa newspaper (rated as moderately effective) and training guide (effective) is shown in Figure 10. Cocoa farmers in the Volta cocoa regions generally complained about the non-publication of the cocoa newspaper. Cocoa farmers look forward to reading the publication of new and updated versions of the paper in order to stay up to date on cocoa development issues in Ghana, particularly in the Volta Cocoa Region; and to improve their cocoa farming skills. CAA newsletters were rated as moderately effective. The newsletters usually include information about cocoa farming and development, as well as financial statements from the association. It is critical that beneficiary cocoa farmers under the CAA extension system are provided with the newsletters in order for them to feel included.

Figure 10: Cocoa Newspaper (left) and Training guide (right) Extension Training Materials used in the Volta Cocoa Region

Source: Field Survey, Agyeman (2020)

Figure 11: Flipchart extension training material used in the Volta Cocoa Region

Source: Field Survey, Agyeman (2020).

Flipcharts, commonly used by Solidaridad MASO facilitators (Figure 11) was perceived as effective by beneficiary cocoa farmers. During trainings at classroom setting, the flipchart is hung on a stand and flipped to highlight its contents by the facilitators. Notes and illustrations on GAPs and farm business are key lessons highlighted on the flipchart. In agreement with MEAS (2012), it is critical for CHED and private extension providers ensure availability of training materials in print and electronic formats in order to reach a broad target cocoa farming audience in the Volta Cocoa Region of Ghana.

The study found cocoa farmers in the Volta Cocoa Region were also provided with books (Figure 12). Titles of the provided books are 'Groups Record,' 'Field Training Workbook,' 'Farmer Business School,' as well as 'Doing Good Business with Cocoa.' The cocoa farmers are expected to read these books, take notes, and share information. Findings of the study show the books were written in English. Farmers who were not literate in the English language disclosed their literate dependents and group leaders were responsible for providing explanations on the content of the books. Audio-visuals illustrating the contents of these books could also help cocoa farmers to better utilize these books in the absence of supports from wards or group leadership.

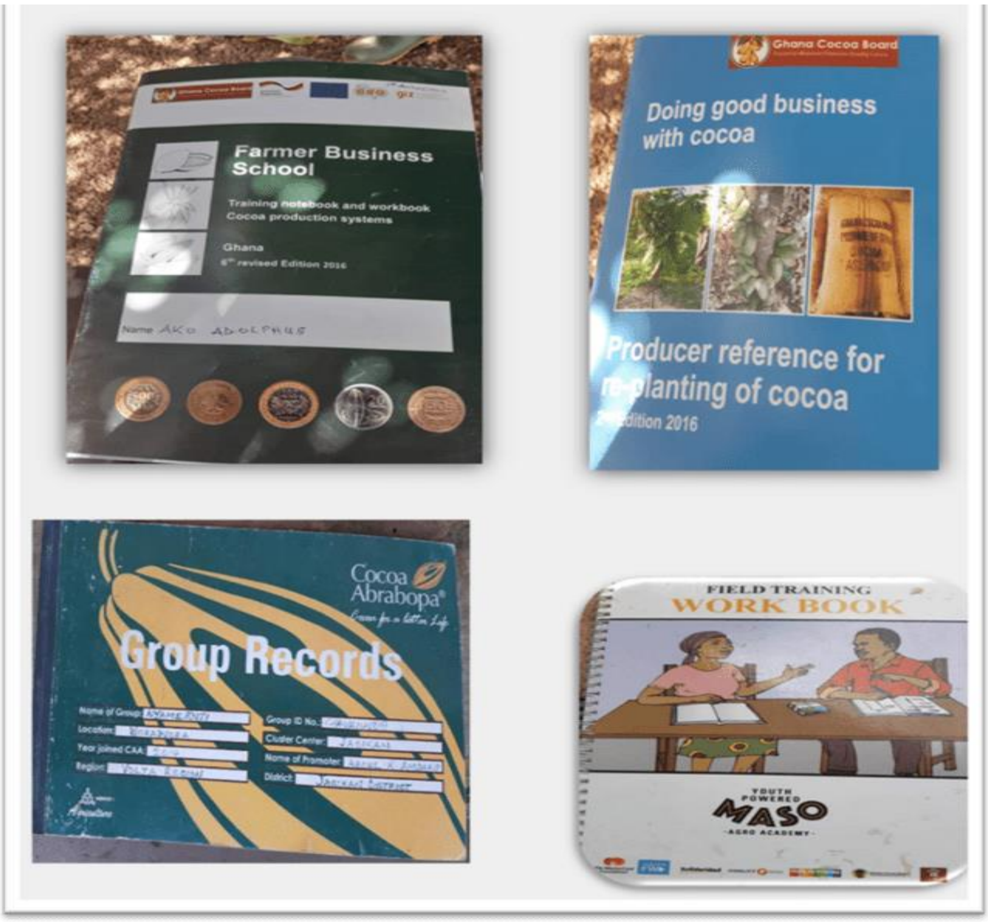


Figure 12: Types of books used as extension Training Material in the Volta Cocoa Region.

Source: Field Survey, Agyeman (2020)

According to David and Asamoah (2011), video viewing clubs among cocoa farmers are an effective, interactive training method with low cost for providing skills, knowledge, and information on complicated technical issues to low literacy populations. This study however found, only 6 percent of the cocoa farmers to have received trainings through the use of videos. These videos are however, perceived as moderately effective in assisting them in understanding cocoa innovations and practices. It is critical that extension providers extensively use videos in training cocoa farmers in the Volta Cocoa Region. aspects of the videos regarding accessibility, language, complexity of messages particularly with mobile phone applications as well as quality of video need improvement by extension providers (Etwire et al., 2017; Chivers et al., 2021; Van Campenhout, 2017) in the Vota Cocoa Region of Ghana.

Frequency of use of Extension Methods

The frequency of use of individual, group, and mass extension methods to deliver extension in the Volta Cocoa Region is presented in Table 34. Use of appropriate extension methods in extension delivery is critical for improved farmer competencies. For example, Agbarevo and Benjamin (2013) observed that farmer visits, meetings between farmers and extension personnel, and demonstrations held were the strongest links in the extension delivery process. The results (Table 34) show extension providers mainly use home visit, farm visit, office calls, phone calls, Meetings, Method and result demonstrations, field days, farmer rallies, drama, lecture in sharing information and innovations to cocoa farmers. A total of 68-86 percent of farmers indicated field days, field trips, lectures, office calls, drama; 10-59 percent indicated home visits, farm visits, meetings, E-extension were never used in training them. Both method and result demonstration methods had 3.6 and 3.1 percent of the cocoa farmers who indicated non-use of this methods respectively in training them. This shows the high level of use of demonstrations by CHED and private extension providers in training cocoa farmers in the Volta Cocoa Region of Ghana.

Table 34: Frequency of Extension methods used in extension delivery.

Extension Methods	NU		VF		FQ		SF		LF		VLF		Mean	SD
	f	Percent	f	Percent	f	Percent	f	Percent	f	Percent	f	Percent		
Home Visit	155	36.9	40	15.1	25	9.4	63	23.8	84	31.7	53	20.0	2.7	1.3
Farm Visit	120	28.6	44	14.7	39	13.0	95	31.7	86	28.7	36	12	2.9	1.3
Method demonstration	15	3.6	43	10.6	134	33.1	164	40.5	39	9.6	25	6.2	3.3	1.0
Result demonstration	13	3.1	37	9.1	134	32.9	179	44.0	40	9.8	17	4.2	3.3	0.9
Field days	321	76.4	15	15.2	24	24.2	34	34.3	16	16.2	10	10.1	3.2	1.2
Fieldtrip	362	86.2	6	10.3	10	17.2	13	22.4	16	27.6	13	22.4	2.7	1.3
Lectures	346	82.4	10	13.5	17	23.0	22	29.7	14	18.9	11	14.9	3.0	1.3
Office calls	286	68.1	37	27.6	16	11.9	31	23.1	27	20.1	23	17.2	3.1	1.5
Phone Calls	247	58.8	37	21.4	42	24.3	47	27.2	35	20.2	12	6.9	3.3	3.2
Meetings	44	10.5	55	14.6	79	21.0	167	44.4	53	14.1	22	5.9	3.2	1.1
Drama	353	84.0	8	11.9	11	16.4	28	41.8	10	14.9	10	14.9	3.0	1.2
Farmer rallies	257	61.2	34	20.9	35	21.5	59	36.2	19	11.7	16	9.8	3.3	1.2

Source: Field survey, Agyeman (2020). NU: Never Used, VF: very frequent, F: frequent, SF: somewhat frequent, LF: Lowly frequent VLF: Very Lowly Frequent Scale: mean calculated from 4.55-5.0(Very frequent), 3.45-4.44 (frequent), 2.45-3.44 (Somewhat frequent) 1.45-2.44 (lowly frequent), 1-.1.44 (very lowly frequent)

Farmers generally perceived that extension methods were used on a somewhat frequency basis. Farmers appreciate farm visits, home visits, and demonstrations is in line with the findings of Agholor (2016), who indicates that using farm and home visit extension methods increases farmers participation in extension activities. Cocoa farmers in the Volta Cocoa Region indicate that CEAs' inability to visit farms on a regular basis contributes to wastage of the provided cocoa farming resources (inputs), as some farmers, for example, do not use agrochemicals or plant seedlings provided them by the COCOBOD. Farm visits are essential for clarifying farmers' ideas and should therefore be enforced (Khalid & Sherzad, 2019). This buttressed findings from the FGDs, that cocoa farmers in the Volta Cocoa Region prefer demonstrations done on their farms over the use of electronic method using phones by extension agents.

Quality of Cocoa Extension Delivery in the Volta Cocoa Region

Table 35 shows cocoa farmers perceptions of the quality of CHED and private extension delivery in the Volta Cocoa Region of Ghana. Generally cocoa farmers in the Volta Cocoa Region of Ghana, perceive extension delivery quality dimensions as reliability (Mean 3.2 SD 0.8), responsiveness (Mean 3.1 SD 0.7), Tangibility (Mean 3.0, SD 0.7), Communication (Mean 3.1 and SD 0.7) and Empathy (Mean 3.1 and 0.9) of CHED extension delivery to be of acceptable quality whilst the assurance (Mean 3.5 and SD 0.9) dimension was perceived to be of good quality. Perceptions of the quality of private (CAA and Solidaridad MASO) extension delivery dimensions: reliability (Mean 3.9 SD 0.9), responsiveness (Mean 3.8 SD 0.9), assurance (Mean 4.1 and SD 0.9), tangibility (mean 3.5, SD 0.9), communication (Mean 3.9 and SD 0.9) and empathy (Mean 3.8 and 0.8) were perceived by beneficiary cocoa farmers to be of good quality.

Table 35: Cocoa Farmers perceptions of the quality of CHED and private extension Delivery

No.	Dimensions	Quality of extension delivery items	CHED Delivery (n=420)		Private Delivery (n=83)	
			Mean	SD	Mean	SD
1	Reliability	Informing farmers exactly when to perform farming activities	3.8	1.0	4.4	0.9
2		Provision of extension services at promised times	2.9	0.9	3.8	1.0
3		Provision of exact quantity of promised farming inputs	2.9	0.9	3.7	1.0
4		Punctuality at meetings/programmes by field officers	3.3	1.0	3.6	1.1
	Total		**3.2**	**0.8**	**3.9**	**0.9**
5	Responsiveness	Response to farmers always when in need and contacted	3.0	0.9	3.6	1.1
6		Sincere interests in solving cocoa farming problems	3.3	0.9	3.9	1.1
7		Attendance to reported issues and problems promptly	3.0	0.9	3.7	1.1
8		Willingness to visit cocoa farm to advise on problems	2.7	0.9	3.8	1.0
	Total		**3.1**	**0.7**	**3.8**	**0.9**
9		Consistently courteous with farmers	3.6	1.02	4.1	1.1
10	Assurance	Extension officer instills confidence	3.5	0.98	4.1	1.0
11		Enthusiasm in sharing information/undertaking duties	3.4	1.0	4.1	1.0
12		Provision of scientific information on cocoa innovations.	3.5	1.0	4.0	1.1
	Total		**3.5**	**0.9**	**4.1**	**0.9**
13		Wearing PPE during field activities by Extension officer	3.3	0.9	4.0	1.1
14	Tangibility	Use of modern training materials (ICTs) to share innovations	2.1	1.1	2.4	1.4
15		Professionalism of field officers	3.7	1.1	4.1	1.1
	Total		**3.0**	**0.7**	**3.5**	**0.9**

Table 35 continued

16		Use of appropriate extension method in trainings	3.4	0.9	4.0	1.1
17	Communication	Uses clear and common language during trainings	3.5	1.1	4.0	1.0
18		Provision of feedback on progress/shared problems	2.9	0.8	3.4	1.0
19		Provision of explanations on use of provided training materials	2.6	0.9	4.0	1.1
	Total		**3.1**	**0.7**	**3.9**	**0.9**
20		Provision of individual attention to farmers	2.9	0.98	3.8	1.2
21	Empathy	Extension officer has best interests of farmers at heart	3.2	0.97	4.0	1.2
22		Extension officer attends to farmers at periods of convenience	3.4	1.02	3.9	1.1
	Total		**3.1**	**0.9**	**3.8**	**1.1**
		Quality of Extension Delivery (ExDQUAL)	**3.1**	**0.6**	**3.8**	**0.8**

Source: Field survey, Agyeman (2020). Means calculated from a scale of 4.45-5.0 (strongly agree), 3.45-4.44 (agree), 2.45-3.44 (moderately agree), 1.45-2.44 **(**lowly agree) and 1-1.44 (very lowly agree)

The findings (Table 35) show cocoa farmers perceive the quality CHED and private extension organisations 'Informing farmers exactly when to perform farming' aspect of reliability of extension quality as good. Cocoa farmers rated the quality of timely provision of extension services at promised times, receipt of exact quantities of promised farming inputs, and punctuality at meetings to be of acceptable quality. For example, if farmers receive fertilizer on time, they can apply it at the start of the rainy season to hasten absorption by plants and achieve expected yields. This may prevent cocoa farmers tendency to sell lately government-supplied inputs. Lack of seedling availability may prompt farmers to seek alternative livelihoods other than cocoa farming (Steijn, 2016), which could be detrimental to cocoa farming in the Volta Cocoa Region of Ghana. The results (Table 35) also show that cocoa farmers rate CHED timely provision of services, punctuality, and genuine interest' as to be of acceptable quality.

Moreover, aspects of communication dimension regarding provision of feedback on shared progress/shared problems provided by both CHED and private extension providers were perceived to be of acceptable quality by cocoa farmers in the Volta Cocoa Region of Ghana. Cocoa farmers in the Volta Cocoa Region of Ghana report that these levels of feedback result in the persistence of problems. Though extension officers indicate that they are passing on some relevant information to superiors for solutions, they confirm that they are not receiving feedback to pass on to the requesting farmers. In general, cocoa farmers expressed dissatisfaction with the use of ICTs such as videos, projectors, and so on by both CHED and private extension providers. Individual attention is perceived to be moderately quality for CHED extension provision, whilst that from private providers were perceived as good. The large area and farmer population covered by CHED staff could account for the observed empathy, while the number of farmers covered by the CAA and MASO programmes could account for field officers' ability to provide improved individual attention to private extension beneficiaries. The group or cooperative concept currently being implemented by COCOBOD CHED is intended to increase the amount of individual attention provided to cocoa farmers in addition to the durbar and community-based methods currently used in extension delivery.

In general, cocoa farmers in the Volta Cocoa Region of Ghana perceive the quality of CHED extension delivery as acceptable whilst perceiving quality of private extension as good. To improve the scope and quality of extension delivery, private cocoa extension organisations such as CAA and MASO require support to hire, finance, and utilize agricultural extension agents, as suggested by MEAS (2014).

Chapter Summary

The description of the nature of extension delivery in the Volta Cocoa Region of Ghana has been discussed in this chapter. The structure, activities of CHED and private extension organisations such as CAA and Solidaridad have been detailed in this chapter. A majority of farmers 80.2 percent received only CHED extension while 19.8 percent were under pluralistic extension receiving extension from private extension organisations (CAA and Solidaridad MASO) beside CHED. The results and discussions on the perceived characteristics (Mean and standard deviations) of shared innovations such as Relative advantage, trialability, complexity, compatibility and observability of the GAPs, Certification, Farmer Level Purchases and Farm Enterprise Management innovations have been presented in this chapter. The frequency of use of individual, group, and mass extension methods as well as effectiveness of extension materials used as aids in sharing extension innovations to cocoa farmers in the Volta Cocoa Region have also been discussed in this chapter. Cocoa farmers perceptions of the items and dimensions (reliability, responsiveness, assurance, tangibility, communication, and empathy) of extension quality as well as overall perception of quality of extension delivery for CHED and private cocoa extension organisations have also been presented and discussed in this chapter. Generally, the study found the overall quality of CHED and private extension delivery was respectively perceived by cocoa farmers in the Volta Cocoa Region to be of acceptable and good quality.

CHAPTER FIVE

DESCRIPTION OF THE SOCIO-DEMOGRAPHIC AND ECONOMIC BACKGROUND OF COCOA FARMERS IN THE VOLTA COCOA REGION

Introduction

This chapter discusses results of objective two that describes the social, demographic, and economic characteristics of cocoa farmers in the Volta Cocoa Region of Ghana. Age, sex, occupation, education, household size, nativity, ethnicity, leadership role, farming experience, marital status, farm size, cocoa farm classes owned, mobile phone ownership, and mobile money registration status are discussed. The other factors such as access to credit, productive asset ownership, and participation in COCOBOD Productivity Enhancement Programmes (PEP), incentives and rewards among others are also presented and discussed in this chapter. The chapter particularly also discusses land and labour use and other economic factors related to cocoa production which has implications for extension delivery in the Volta Cocoa Region.

Age Distribution of Cocoa Farmers

The results (Table 36) indicate the age distribution of cocoa farmers in the Volta Cocoa Region, ranges from 20 to 87 years old, with an average age of 49years. This implies that cocoa farmers in the Volta Cocoa Region are aging. In fact, less than a third (28.3 percent) of cocoa farmers were found to below 40 years old. Although the mean age is higher than the 47.8 years reported by Tulane University (2015) for Ghana, it is lower than the 51 years found by Laven and Boomsma (2012).

Table 36: Age distribution of cocoa farmers in the Volta Cocoa Region

Age category	f	Percent
20-30	28	6.7
31-40	96	22.9
41-50	119	28.3
51-60	94	22.4
61 and above	83	19.8
Total	420	100.0
Mean 49 years	SD- 13years	Range: 20-87 years

Source: Field survey, Agyeman (2020)

Almost 20 percent of cocoa farmers in the Volta Cocoa Region were over the retirement age of 60. This implies that youth participation in cocoa farming in the region is important. Young farmers are thought to be more innovative, and thus more likely to adopt technology and improve cocoa farming (Ruf & Schrotz, 2015). As a result, Solidaridad implemented MASO programme and COCOBOD Youth in cocoa farming programme must therefore be sustained in order to increase youth participation in cocoa farming in the Volta Cocoa Region. To meaningfully engage in cocoa farming, youth require land, skill training, financial resources, and a change in mindset (Lowe, 2017). COCOBOD and private actors must take these needs into account when designing and implementing cocoa farming programmes for the youth.

Sex Distribution of Cocoa Farmers

The sex distribution of cocoa farmers in the Volta Cocoa Region (Table 37) shows that the majority of surveyed cocoa farmers (86.9 percent) are males, with 13.1 percent being females. Males typically inherit lands and are seen as family heads, so they dominate cocoa farming in the Volta Cocoa Region of Ghana.

Table 37: Sex distribution of cocoa farmers in the Volta Cocoa Region

Sex of respondents	f	Percent
Male	365	86.9
Female	55	13.1
Total	420	100

Source: Field survey, Agyeman (2020)

. Men have been found to adopt GAPs better than women, a phenomenon that could also be attributed their higher education levels (Waarts et al., 2013). Female cocoa farmers in the Volta Cocoa Region therefore require motivation, access to land and support to own and manage cocoa farms as a business.

Main Occupation of Cocoa Farmers

The main occupation of cocoa farmers (Table 38) shows that 94.8 percent of surveyed farmers were engaged in farming, with cocoa farming being the main occupation, while 5.2 percent worked mainly in occupations such as teaching, trading, purchasing clerks, and health care.

Table 38: Main occupation of cocoa farmers in the Volta Cocoa Region

Primary occupation	f	Percent
Farming	398	94.8
Others	22	5.2
Total	420	100

Source: Field Survey, Agyeman (2020)

Cocoa farmers also cultivate rice, maize, groundnut, plantain, banana, cassava, yam, oil palm, and spices like ginger and pepper. Cocoa farmers were also involved in animal husbandry (e.g., chicken, goat, sheep), mushroom cultivation, and beekeeping. Cocoa farmers typically feed on farm produce and sell surpluses for profit. It is important cocoa farmers in the Volta Cocoa Region consider these other crops and livestock activities as businesses in order to raise their household income to improve their livelihoods and standards of living.

Cocoa and General Farming Experience of Cocoa Farmers

The mean years of experience in farming and cocoa farming by cocoa farmers in the Volta Cocoa Region were found to be 22 and 15 years, respectively (Table 39).

Table 39: Experience of farmers in farming and cocoa farming (years)

Experience in farming	Mean (years)	SD	Range
Farming	22	12	2-62
Cocoa farming	15	9	2-51

N=420 Sources: Field Survey, Agyeman (2020)

The FGDs conducted across the districts revealed that cocoa farmers typically begin by cultivating other crops for consumption before engaging in cocoa farming either on their own farms or by outright purchase of farms, sharecropping, or by inheritance. The results show that while the farmers have worked as cocoa farmers for 2 to 51 years, they have also worked as farmers in general for 2 to 62 years. Farmers with less than five years of experience in cocoa farming were found to have either inherited and or purchased such farms. The upper range of 62 years of farming experience reiterates the aging population of cocoa farmers in the Volta Cocoa Region that requires attention of cocoa extension actors to bring more push more youth into cocoa farming in the region.

The Farm Size, Number of Farms and Age of Farms

According to the results (Table 40), cocoa farmers owned 0.2 to 10.1ha of cocoa farms, with an average of 1.4ha. This is in contrast to the 1.9 ha found by Baah et al. (2012) for the Volta Cocoa Region. This difference in the average farm size could be attributed to the massive rehabilitation efforts as a result of the CSSVD in the Volta Cocoa Region. Cocoa farmers in the Volta Cocoa Region must increase their farm holding as 4 ha farm holding has been identified as the minimum farm size required for a profitable cocoa farming business (Blackmore & Heilbron, 2015). Moreover, Asare and Sonii (2011), emphasis that in order to sustain the cocoa farming sector, farmers must cultivate hybrid cocoa on an average of 4-5ha.

The average number and age of cocoa farms owned by cocoa farmers in the Volta Cocoa Region (Table 40) indicate farmers owned from one to six farms with ages ranging 2 and 12 years respectively.

Table 40: Farm size, age and number of farms owned by cocoa farmers.

Farm characteristics	Mean	SD	Range
Farm size (ha)	1.4	1.4	0.2-10.1
Number of farms cultivated	2	1.3	1-6
Age of farm (years)	12	8.8	1.3-45

Source: Field survey, Agyeman (2020)

Cocoa farmers in the Volta Cocoa Region were found to own farms in multiple locations to increase their overall farm size and yield due to their inability to own large acreages of land for cocoa farming at same location. Cocoa farmers own cocoa tree with age range of 1.3 to 45 years. The average age of cocoa trees (Mean:12, SD 8.8) in the Volta Cocoa region was found to be lower than found for the Ashanti (20 years), Brong-Ahafo (21.8 years), Western (19.4 years) regions and average for Ghana (20.3 years) in general (Kolavalli et al., 2016). The maximum cocoa tree age range beyond 30 years emphasis the source of declining cocoa yield and supports the relevance of cocoa farm rehabilitation undertaken in the Volta Cocoa Region of Ghana.

The age classification of cocoa farms owned by cocoa farmers in the Volta Cocoa Region is presented in Table 41. The majority of farmers (71.6 percent) owned B Class farms (8-15 years), 35 percent and 52.6 percent owned C Class farms (16-30 years), and A Class farm (1-7 years) respectively. D-Class cocoa farms were found be owned by 9.3 percent of the cocoa farmers surveyed.

Table 41: The number of classes of cocoa farms owned in the Volta Cocoa Region

	Classes of farm owned by cocoa farmers in the Volta region				
Number of farms	Class A (1-7 years)	Class B (8-15 years)	Class C (16-30 years)	Class D (Above30 years)	n
1	75	206	104	35	420
2	107	70	30	2	209
3	26	17	12	1	56
4	9.0	6.0	1	1	17
5	3.0	1.0	-	-	4.0
6	1.0	1.0	-	-	2.0
Total class	221	301	147	39	
Percentage	52.6 percent	71.6 percent	35.0 percent	9.3 percent	

Source: Field survey, Agyeman (2020) n=420

The observed increase in A-class farms is due to farm rehabilitation, farm expansion, and completely new farm cultivation activities in the Volta Cocoa Region. Also, the result indicated D (over 30 years) class farms were owned by 9.3 percent of cocoa farmers. Farms older than 45 years were as well found in this category. Some farmers who owned D class farms indicated that they were unwilling to give such farms away for rehabilitation because they were financially unable to endure the waiting period between planting and bearing of the rehabilitated farms. As a result, farmers prefer to keep such aged farms in order to meet consumption needs despite declining yields.

The study found most farmers have multiple farms in the same or distant locations. Farmers stated that acquiring farms in various locations is dependent on whether individual forefathers farmed in various locations. The FGD and in-depth interviews indicate as a consequence of carving out 'Volta Region' from Republic of Togo as part of Ghana; some cocoa farmers in the Volta Cocoa Region still have farms in the republic of Togo.

Farmers indicate owning farms at different locations result in poor supervision by owners and sharecroppers' inability to attend to them leading to some farms *'suffering'* (being unattended to and yielding poorly). The in-depth interview revealed challenges associated with keeping multiple farms as farmers indicated that the *farmers hands are not able to cater for the farms without caretakers and labourers (In-depth interview, Likpe-Kukurantumi, 20th December 2019).*

However, other farmers' find it not difficult working on different farms as some farmers indicated having *Kofe* (farmhouses) at the distant farms to work on them whilst taking care of the closer farms from their main homes. Cocoa farmers however generally on consensus indicated having all farms on same land results in efficient management.

Level of Education of Cocoa Farmers in the Volta Cocoa Region.

The level of education of cocoa farmers in the Volta Cocoa Region is presented in Figure 13. The majority (89.5 percent) of cocoa farmers received formal education whilst 10.5 percent had no formal education. A total of (61 percent) of the surveyed cocoa farmers had completed JHS or MSLC, while 17.9 percent and 7.1 percent respectively completed SHS and Tertiary levels of education. Farmers who attained postgraduate education status constitute 0.2

percent of the cocoa farmers. Other types of education (3.3 percent) received by cocoa farmers include Arabic schooling and French education.

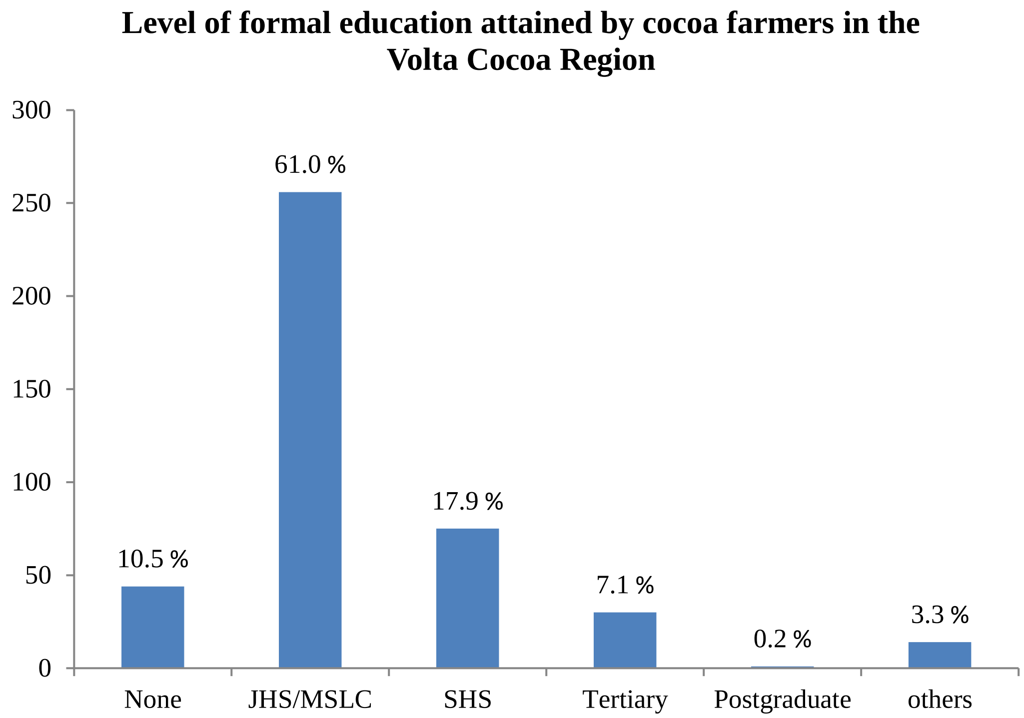


Figure 13: Level of education of cocoa farmers in the Volta Cocoa Region
Source: Field survey, Agyeman (2020)

As a result, it is expected that the majority of cocoa farmers in the Volta Cocoa Region will be able to read and comprehend the various cocoa farming innovations and training materials, such as books, manuals, and the use of e-extension applications.

The Household Size of Cocoa Farmers

The average household size of cocoa farmers in the Volta Cocoa Region (Table 42) is seven (7) members with SD of four (4) members. The result differs from the six-member household found by Hainmueller et al. (2011) for Ghana. The household size range was found to be 1-27 members. Moreover, each cocoa farming household in the region has an average of four (4) members under the age of 15 years.

Table 42: Household size of cocoa farmers in the Volta Cocoa Region

Household size	Mean	SD	Range
Total household size	7	4	1-27
Household size below 15 years	4	3	0-15

Source: Field survey, Agyeman (2020)

Households with children under the age of 15 have a range of 0-15 members, with a Standard Deviation of three members. The presence of children under the age of 15 in a household indicates that such individuals are unable to engage in potentially hazardous cocoa farming activities such as agrochemical application, pruning, and harvesting as indicated by Ingram et al. (2014). This necessitates farmers seeking labour outside of their homes, resulting in higher production costs. Higher household membership could also reduce the cocoa farming household per capita income, implying that more income is spent on consumption rather than savings and investment in their cocoa farms and diversification purposes.

Marital Status of Cocoa Farmers

The majority (86.4 percent) of cocoa farmers in the Volta Cocoa Region were found to be married, while a few (5.7 percent) had never married (Table 43). The marital status of cocoa farmers is important in improving innovation adoption because couples receive complementary supports to undertake aspects of farming (Takane, 2000). For example, wives have been observed for cooking for farm labourers and fetching water for agrochemical spraying while husbands undertake difficult innovations such as pruning and spraying, particularly fungicides, using motorized sprayers.

Table 43: Marital Status of cocoa farmers in the Volta Cocoa Region

Marital status	f	Percent
Married	363	86.4
Divorced	13	3.1
Widowed	8	1.9
Separated	12	2.9
Never Married	24	5.7
Total	420	100

Source: Field survey, Agyeman (2020)

The few widowed cocoa farmers (1.9 percent) who inherited cocoa farms were found through the FGD to have difficulty in maintaining them.

The importance of being marriage to farming is buttressed by the Women in Law and in Africa (WILDAF) (2016) that married women who have easy access to land through outright purchase or sharecropping arrangements still frequently require male witnesses (husbands or male family members) to sign contracts. As a result, unmarried women are less likely to receive such support from a male witness.

Religious Affiliation of Cocoa Farmers

The religious affiliation of cocoa farmers in the Volta Cocoa Region (Table 44) revealed that a majority of 83.6 percent of cocoa farmers were Christians, with Islams and Traditionalists accounting for 14.0 percent and 0.7 percent, respectively. Cocoa farmers with no religious affiliation account for 1.7 percent of the surveyed farmers.

Table 44: Religious Affiliation of cocoa farmers in the Volta Cocoa Region

Religious Affiliation	f	Percent
None	7	1.7
Christianity	351	83.6
Islam	59	14.0
Traditional	3	0.7
Total	420	100

Source: Field survey, Agyeman (2020)

The study found no religious hinderances to cocoa farming in the cocoa farming and extension delivery in the Volta Cocoa Region. The religious activities however promoted extension delivery particularly in use of premises for meetings and other cocoa farming related gatherings.

Ethnicity of Cocoa Farmers

The Ethnicity of cocoa farmers in the Volta Cocoa Region is shown in Figure 14.

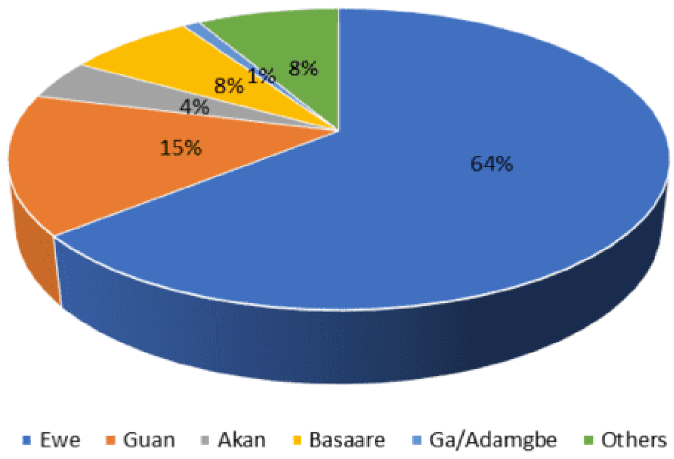


Figure 14: Ethnicity of cocoa farmers in the Volta Cocoa Region.

Source: Field Survey, Agyeman (2020)

The results indicate that Ewes account for 64 percent of cocoa farmers, with Guans' accounting for 15.0 percent. The remaining cocoa farming ethnicity groupings such as the Akans (7.4 percent), Basaare (7.4 percent), Ga/Adamgbe (1.0 percent, and others (8.3 percent) Busanga and Togolese were found to be farming cocoa in the Volta Cocoa Region of Ghana.

Despite the fact that indigenes dominate cocoa production, migrants are also involved in the Volta Cocoa Region. According to the findings (Table 45), more than two-thirds (66.9 percent) of the cocoa farmers were natives of their communities of residence.

Table 45: Nativity of cocoa farmers in resident farming community

Nativity of community	F	Percent
Natives	281	66.9
Non-Natives	139	33.1
Total	420	100

Source: Field survey, Agyeman (2020)

Non-natives were mostly migrants or indigenes who worked in cocoa production under various shareholding (Dema) systems.

Access to credit by cocoa farmers

Majority of farmers (73.6 percent) were found to not have access to any form of financial credit (Table 46).

Table 46: Number of farmers with access to credit

Access to credit	f	Percent
Yes	111	26.4
No	309	73.6
Total	420	100

Source: Field survey, Agyeman (2020)

Access to finance is critical for improving and diversifying cocoa farming, as well as for consumption (Nelson et al., 2013). In Ghana, inadequate and lack of credit is a key issue associated with farming. According to Baah and Anchirinah (2010), cocoa farmers were unable to obtain bank loans due to their low repayment capacities and high default rates, which stemmed from their perception that loans provided for farming and related activities were gifts from the government and thus did not require repayment. ironically, some cocoa farmers obtained loans from money lenders at a high interest rate (100 percent or higher) using their cocoa farms as form of collateral be sold to recover the loan in the event of default. Waarts et al. (2013) found that such loans were used to fund children's education (school fees), as well as to purchase of equipment for cocoa production and for hiring labour. CAA and COCOBOD should consider providing cocoa farmers in the Volta Cocoa Region with low interest financial credits besides input credits to attend to their labour, diversification and consumption needs.

Leadership Positions held by Cocoa Farmers.

Cocoa farmers in the Volta Cocoa Region held a various cocoa leadership position (Table 47). Less than a fifth (17.1 percent) of the cocoa farmers held cocoa farming leadership positions in their respective extension systems belonged to and communities.

Table 47: Leadership composition of cocoa farmers

Cocoa Leadership Position	f	Percent
Leaders	72	17.1
Ordinary members	348	82.9
Total	420	100

Source: Field survey, Agyeman (2020)

Positions held as chairpersons, secretaries, assistant secretaries, treasurers, and organizers made up 69.4 percent of the group leadership positions. Others included being PCs/Collectors (6.9 percent), Chief farmers (9.7 percent), MASO Mentor/facilitator (4.2 percent), opinion leaders (primarily chiefs) (4.2 percent), and CODAPEC Mass Sprayers (5.6 percent). Having a leadership position influences innovation adoption because lead farmers are more likely than others to adhere to cocoa innovations shared, including GAPs (Waarts et al., 2013). Purchasing clerks who hold other cocoa leadership positions may experience both positive and negative outcomes regarding their farm management. On one hand their productivity may be lower than that of farmers who are not PCs, because they have less time to manage their farms. However, productivity may also be higher because PCs usually have higher income to invest in their cocoa farms.

Productive Asset Ownership Status of Cocoa Farmers

Cocoa farmers in the Volta Cocoa Region owned various cocoa farming productive assets (Table 48) to support them to meaningfully engage in cocoa farming.

Table 48: Productive assets owned by cocoa farmers in the Volta Cocoa Region

Productive Assets	f	Percent	Total quantity	Rank
Water storage containers	256	61	1441	1
Basket/Pan	237	56	1082	2
Drying mat	352	84	975	3
Cutlass	408	97	967	4
Cocoa harvester	286	68	679	5
Knapsack sprayer	326	78	486	6
PPE owned (Any)	210	50	182	7
Motorbike	97	23	102	8
Bicycle	55	13	85	9
Pruner	48	11	73	10
Mistblower	56	13	67	11
Shovel	50	12	62	12
PPE fullset (Overall, hand gloves, goggles, Wellington boots, hat, respirator)	169	40	54	13
Weighing Scale	30	7	30	14
Motorcycle	12	3	29	15
Tapauline	19	5	21	16
Vehicle	4.0	1	6	17

Source: Field Survey, Agyeman (2020) n=420

The findings show, the majority of farmers (97percent) owned cutlasses and Knapsack sprayers (78 percent). Motorized sprayers, on the other hand, were owned by 13 percent of the cocoa farmers surveyed. Farmers also had motorcycles, tricycles, bicycles, and other modes of transportation. It is critical that input providers find sustainable financing methods for providing these expensive but vital productive assets to farmers. Drying mats were owned by

84 percent of cocoa farmers. The drying mats used in the Volta Cocoa Region (Figure 15) are mainly made of palm fronds. Farmers who do not own a drying mat borrow from friends, neighbours, and relatives.

Figure 15: Type of cocoa drying mats used in the Volta Cocoa Region.
Source: Field survey, Agyeman (2020)

PPE ownership (overall, googles, Wellington boot, hats, respirators, and gloves) is both a cocoa farming safety requirement and a requirement for participation in the CAA certification scheme. The study found 50 percent of cocoa farmers own at least one PPE, and 40 percent own the entire set of PPEs.

Water storage (61 percent) containers are the most commonly owned (1441 pieces) productive assets by cocoa farmers. This is followed in a in descending order of importance by ownership of basket/pan (1082), drying mat (975), cutlass (967), and cocoa harvester (679). Motorcycles (29), tarpaulins (21), and vehicles were the three least productive assets owned (6). Ownership of productive assets is important for innovation adoption and income diversification (Agyeman et al., 2014). Motorbikes and motorcycles, for example, were used for transportation of farmers and community members as well as to transports goods such as agrochemicals, fermented and dried cocoa beans to and from the farm and from the market.

Mobile Phone Ownership Status and Usage by Cocoa Farmers

Mobile phone ownership and usage by cocoa farmers in the Volta Cocoa Region is shown in Figure 16. A total of 95 percent (Figure 16) of cocoa farmers owned one to four phones. That is, 92.7 percent had at least one phone, 6.5 percent had two phones whilst 0.5 percent and 0.3 percent respectively owned three phones and four phones. Mobile phones make it easier for extension providers to schedule meetings and trainings, respond to shared problems, receive feedback, and conduct of financial transactions by farmers.

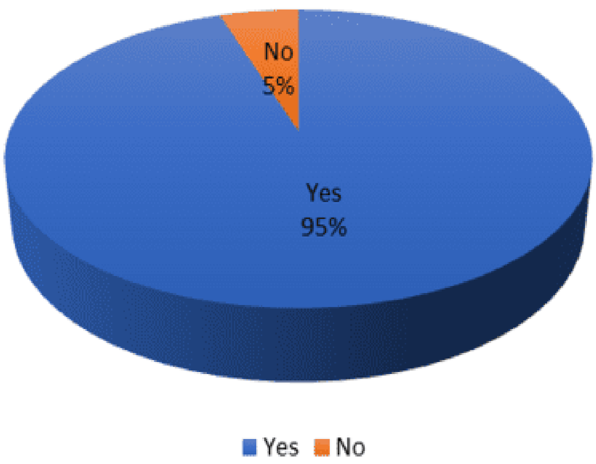


Figure 16: Mobile phone ownership status of cocoa farmers in the Volta cocoa Region

Source: Field survey, Agyeman (2020)

The majority (69.8 percent) of cocoa farmers owned non-smart phones (feature phones), which were variously referred to as *'Keypad,'* '*Gematsoe'* (*if it falls, will pick it'* in Ewe language), and '*Yam'* by the cocoa farmers. Smart phones (also known as 'Touch') were owned by 28.6 percent of the farmers surveyed. Smart phone ownership helps cocoa farmers retrieve information from electronic platforms, such as the cocoalink (Figure 17) platform, which combines voice and text messaging to train cocoa farmers on technology usage, agronomy, and child labour. Cocoa farmers can also send SMS inquiries to experts via the Cocoalink platform (MEAS, 2014).

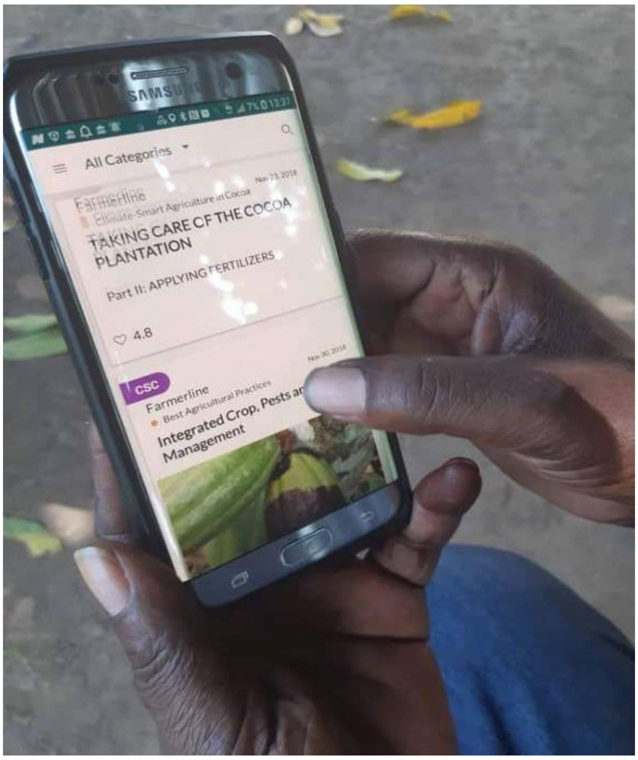


Figure 17: A cocoa farmer using the cocoalink app in the Volta Cocoa Region.

Source: Field survey, Agyeman, (2020).

Moreover, the FGD and in-depth interviews reveal price, rate of damage, and cost of repairs influence cocoa farmers decision to purchase either smart or non-Smartphones. To achieve the benefits of smart phones and associated advantages over non-smart phones, cocoa farmers in the Volta Cocoa Region must be introduced and trained to use to them. Cocoa farmers also require robust smartphones that do not easily get damaged.

Furthermore, mobile phones were found as essential tool for mobile money usage (Figure 18). MTN, Vodafone, and Tigo/Airtel telecommunication entities were the main mobile money service providers in the Volta Cocoa Region (Table 54) found by the study. A total of 98.3 percent of the primary phones and 50 percent of secondary phones owned by cocoa farmers in the Volta Cocoa Region were found to be registered with the MTN mobile money (MTN momo) service.

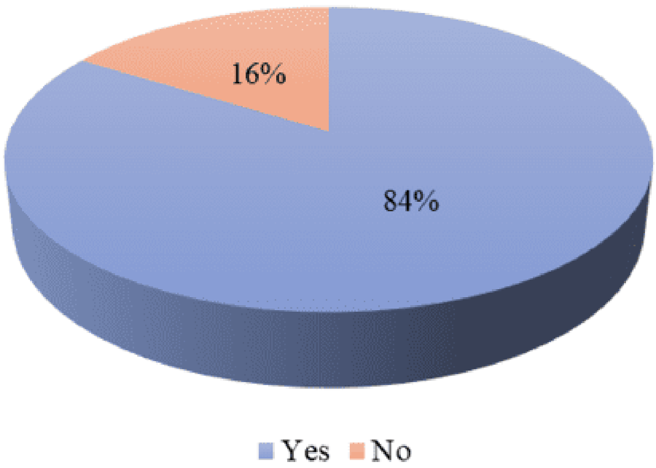


Figure 18: Mobile money registration status of cocoa farmers in the Volta cocoa region

Source: Field survey, Agyeman (2020)

Also, the results (Table 49) shows, 1.7 percent and 50 percent of primary and secondary phones owned by cocoa farmers are registered in the Vodacash system. The results further indicate MTN Momo dominates mobile money service usage by cocoa farmers in the Volta Cocoa Region. For example, in Togormey (Hohoe CHED District), despite the Tigo/Airtel cash signal being stronger, farmers preferred still MTN Momo. Farmers thus travel to neigbouring communities like Kpedze to conduct MTN mobile money transactions.

Table 49: Mobile Money Network Registration status of cocoa farmers

Network Registered	Primary phone contact		Second phone contact	
	f	Percent	f	Percent
MTN Momo	346	98.3	13	50
Vodacash	6	1.7	13	50
Total	352	100	26	100

Source: Filed Survey, Agyeman (2020)

It was found that 84 percent of cocoa farmers who owned phones were registered with at least one mobile money service provider. Cocoa farmers who were Mobile money registered use the service to receive and send money, pay for goods such as cocoa beans sold, receive remittances to purchase farm inputs. Cocoa farmers were also found to use their mobile money accounts as savings account. It is important cocoa farmers are provided training to fully utilize the full benefits of the mobile money services.

Group Membership Status of Cocoa Farmers

The group membership (Figure 19) was evident among cocoa farmers in the Volta Cocoa Region.

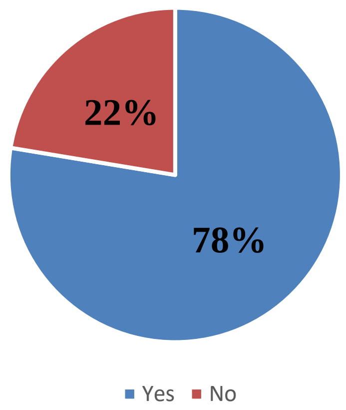


Figure 19: Group Membership status of cocoa farmers in the Volta Cocoa Region

Source: Field survey, Agyeman, (2020)

The majority (78 percent) of cocoa farmers (Figure 18) belonged to a farmer group organized by the CAA, MASO, or COCOBOD CHED. The study found COCOBOD-CHED to be currently organizing farmers into groups of 30 members. Organized farmer groups are expected to register with the district and national cooperative systems (i.e., department of cooperatives). Figure 20 shows the cooperative registration certificate of the Likpe-Kukurantumi cooperative cocoa and food farmers.

Figure 20: Photograph of leader of Likpe-Kukurantumi coo-operative cocoa and food farmers holding cooperative registration certificate

Source: Field survey, Agyeman (2020).

Ultimately, membership in an FBO and cooperatives will be required to receive technical assistance, access spraying machines, chain saws etc. which are typically expensive to obtain as an individual as buttressed by Donovan et al. (2016). Farmers are expected to participate in group activities to benefit from social capital through exchange of knowledge and dealing with common problems confronting them at meetings (Waarts et al., 2013; Ingram et al., 2014).

Extension Contacts Received by Cocoa Farmers

The extension contacts received by cocoa farmers from extension providers in the year is presented in Table 50. The extension contacts were made primarily through physical (face-to-face) and electronic (primarily via phone calls and WhatsApp) means. Cocoa farmers in the Volta Cocoa Region were found to receive an average of thirteen (SD: 34) extension contacts per year. This includes a mean of 7 (SD: 28) face-to-face meetings and Mean 5 (SD:14) electronic contacts. Farmers received an average of eleven (SD 32) extension contacts from CHED and mean of 2 (SD: 7) from private extension providers.

Table 50: Annual extension contacts received by cocoa farmers.

Extension Contacts	Mean	SD
Face -to -face contacts	7	28
Electronic contact	5	14
Total CHED contacts	11	32
Total Private Extension contact	9	7
Total Extension Contact	13	34

Source: Field survey, Agyeman (2020)

The In-depth interviews revealed that CAA farmers believe Technical Coordinators are more interested in visiting group leaders to follow up on input credit recoveries as well as collectors for cocoa purchases than in visiting many more members in these communities. Extension providers need to increase and regularise contact with farmers to boost their confidence and to receive and provide the necessary feedbacks (Luukkainen, 2012).

Beneficiaries of Cocoa Productivity Enhancement Programmes

Cocoa farmers access to COCOBOD cocoa productivity Enhancement programmes is shown in Tables 51 and 52.

Table 51: Type of government interventions received by cocoa farmers.

Type of government intervention	Yes		No	
	f	Percent	f	Percent
Seedlings (cocoa and shade tree)	301	71.7	119	28.3
Agrochemicals	334	79.5	86	20.5
hand pollination	185	44.0	235	56.0
Mass spraying	259	61.7	161	38.3
Farmer Business School	239	56.9	181	43.1
Farm rehabilitation	55	13.1	365	86.9

N=420, Source: Field survey, Agyeman (2020).

According to Asamoah et al. (2017), cocoa farmers need seedlings, fertilizers, and other agrochemicals to continue cocoa farming. From Table 54, cocoa farmers accessed these programmes in proportions of 71.7 percent (seedlings), 79.5 percent (agrochemicals such as fertilizer, fungicide, insecticides, and so on), 44 percent (cocoa hand pollination), 61.7 percent (mass spraying), 56.9 percent (Farmer Business School), and 13.1 percent (farm rehabilitation). Cocoa farmers in the Volta Cocoa Region request for increased quantity and frequency of such government (COCOBOD) assistance, as well as the elimination of problems associated with insufficient supply, in order to ensure the programme covers more farmers than it currently does. In line with findings of Asamoah et al. (2017), it is important government replace these schemes with a more sustainable effort of open market policy with subsidies to support cocoa farmers to purchase inputs on their own as well as increase private sector participation in cocoa farm input supply system.

Furthermore, only a small number of farmers (Table 53) had benefited from the established COCOBOD, and private extension provider established cocoa awards (5.0 percent) schemes and scholarships (2.9 percent).

Table 52: Rewards received by cocoa farmers in the Volta Cocoa Region

Awards and Scholarships	Yes		No	
	f	percent	f	percent
Cocoa farming related awards		5.0	399	95
COCOBOD scholarships for wards	12	2.9	408	97.1

N=420, Source: Field Survey, Agyeman (2020)

CAA cocoa farmers were rewarded at the yearly organised Annual General Meetings (AGM) for early input credit repayment, best group with higher cocoa sales volume, and other factors. Motorbikes, spraying machines, agrochemicals, and certificates of recognition (Figures 21 and 22) are among the items provided. The number of Wards who received COCOBOD scholarships to further their education require further improvement for cocoa farmers in the Volta Cocoa Region.

Figure 21: Award certificate as received by 2010 Volta Regional Best Cocoa Farmer

Source: Field survey, Agyeman (2020).

Figure 22: 2010 Volta Regional Best Cocoa farmer with award certificate

Source: Field survey, Agyeman (2020)

Incentives and recognition are important sources of motivation for cocoa farmers to continue investing in farming and to inspire the next generation of cocoa farmers. It is therefore important for Cocoa farmers in the Volta Cocoa Region to aspire towards this recognition of wards.

Land and Labour Issues Associated with Cocoa Farming in the Volta Cocoa Region.

Land and labour are important economic factors in cocoa production, influencing innovation adoption, yield, and farmer income. This section discusses findings on from the FGD, in-depth interviews and observations on land and labour use issues associated with cocoa farming in the Volta Cocoa Region of Ghana.

Land Issues Associated with Cocoa Farming in the Volta Cocoa Region

Land acquisition, sharecropping systems, land availability and fertility issues, shade tree availability, tenure security, and land cost are discussed in this section.

Land Availability and Fertility

The availability of land for cocoa farming varies throughout the Volta Cocoa Region. Land is said to be available in the southern parts, though it is not particularly fertile or suitable for cocoa farming in mountainous areas. Land is indicated as available in Togormey in the Hohoe district, but impossible to purchase up to 10 acres (4.0ha) at the same location. Farmers indicated clearing oil palm plantations to be replaced with cocoa farming. In general, land for cocoa farm expansion is scarce throughout the Volta Cocoa Region, and where available, it is located at farther distances from the communities where farmers live. Farmers through the FGDs indicated '*We travel four hours or 4-5 miles on foot to access those lands and to transport farm inputs such as fertilizer to the farms' (FGD Poace Cement, 6th January 2020*.

In particular, in the Akpafu areas where land for farm expansion was indicated as available, native cocoa farmers were prevented from cultivating it due to forest reserve by laws and restrictions on the forests surrounding the communities. A key informant indicated through In-depth interview '*These forces us to enter into the two governments and community held forest reserves near the Odomi river and Togo plateau though there is ban on us entering into the forest for farming purposes. The land is for us, the land was preserved for the future generation, and we are here. This time there is no work, no job, and they say we should not farm but we are not listening' (In-Depth Interview Akpafu Odomi, 26th January 2020).*

The population of the community according to the key informant had tripled since 1927 and hence the need to release part of the land to the community. Farmers' question, *'If my forefathers land is shared to his children* *and my father also shares amongst six of his children, you could see the land is small' (In-depth Interview, 26th January 2020 Akpafu-Odomi)*. The key informant reiterates the communities had petitioned government through the forestry commission to release portions of the forest for farming but to no avail and concluded '*the land is for us, and we won't stop farming' (In-depth Interview, Akpafu Odomi, 26th January 2020).*

Mode of Acquiring Land for Cocoa Farming in the Volta Cocoa Region

Land is acquired for cocoa farming through the use of family land, purchasing constituting ownership and sharecropping (*Dema),* and inheritance in the Volta Cocoa Region. There were no payments associated with family land use for cocoa farming, and usually not registered in the name of the cultivating family member. Family heads were in charge of distributing land to the children of deceased parents. When the cocoa trees on the family-owned land dies, any other member of the family (nuclear or extended) had equal opportunity to cultivate the land. Cocoa farmers through the FGD buttressed this fact that *'land does not even belong to the family members but what is on the land is yours' (FGD Likpe Mate, 22 January 2020).*

Family land use for cocoa farming has implications for farm expansion because cocoa farmers must continue to keep their cocoa farms alive by replacing diseased and dead cocoa trees in order for the land to be passed down to children. The COCOBOD farm rehabilitation programme has an impact on family land because the rehabilitation must adhere to the COCOBOD plan of dividing the farm into four sections and rehabilitating (cutting moribund trees and replanting with seedlings) them in turn on a yearly basis. Entire farm clearing for rehabilitation purposes may result in farmers losing their cocoa farmland to general family use, resulting in conflicts.

Although not common in recent times, outright land purchase for cocoa farming is another method of acquiring land for cocoa farming in the Volta Cocoa Region. Individuals who want to buy land contact landowners. The necessary arrangements result in outright payments of 1500-2000 cedis for an acre of land, 400 cedis for a quarter of an acre (16 square), with the buyer having complete right and ownership over the land. The trend of land prices in Papase shows that land was purchased at GH¢300/acre in 2012, GH¢600/acre in 2014/2015, and GH¢1000-1200/acre in 2019.

Cocoa farmers indicate that land was sold to their forefathers for 24 pounds in the past. In addition to payment, the buyer must provide sheep and drinks. Buyers in Likpe areas for instance may be required to provide cloth, ram, palm wine, 'foreign drink' (usually alcoholic), umbrella, mat, and yam tubers before signing a receipt. The provision of these items is believed to make the buyer of the land a member of the landowners' family and hence accorded the necessary respect- that is firm the FGD '*If one does not provide those items, it is likely the receipts will not be signed though you have paid for the land*' (FGD Likpe Mate, 22 January 2020).

When the land payments and rites are completed, the sellers (landowners) transfer the land documents to the buyer and the chief and family head witness by signing the land indenture provided by the landowner to authenticate it. When land is purchased, *'one 'paper' (*document) is made on it, and the landowner issues the buyer a land receipt from the post office.' The buyer is responsible for registering the purchased land with the lands commission. Some cocoa farmers have indicated that they have purchased land but have yet to complete payment.' Such farmers are expected to pay up and complete the registration process with the lands commission in order to fully own their cocoa farms.

Sharecropping Systems Practiced among Cocoa Farmers in the Volta Cocoa Region

Sharecropping is variously called *Dema in* Ewe *and Dibi or Dibimamedibi* in Akan in the Volta Cocoa Region. The various forms of sharecropping include dividing a mature farm or dividing the cocoa produce from the farm. The various forms of main farm ownership status of cocoa farmers in the Volta Cocoa Region are shown in Figure 23.

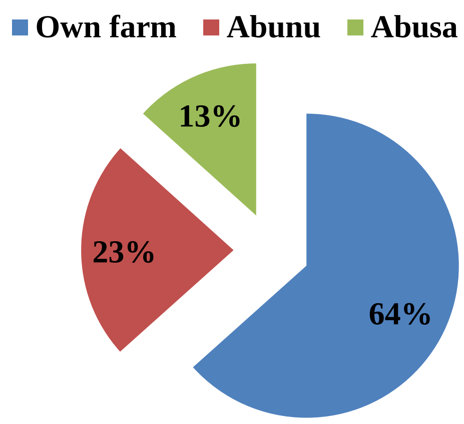


Figure 23: Main farm ownership status of cocoa farmers in the Volta region

Source: Field Survey, Agyeman (2020).

The majority of farmers (64 percent) own their cocoa farms, while the remaining 36 percent farm on a sharecropping basis (23 percent -*Abunu* and 13 percent -*Abusa*). Acquiring land for farming as a sharecropper entails several steps. The typical practice in the region begins with sharecroppers being shown land to cultivate as far as their efforts allow. To seal the agreement, the sharecropper pays a sum of amount to the landlord, usually accompanied by two bottles of schnapps. Prior to sharing matured cocoa farms or produce in the presence of witnesses, an agreement is reached on whether or not the landowner will participate in food crops produced. Prior to the maturity date of the farm usually 5-10 years or 2-3 years in the case of hybrid cocoa varieties, some landowners participate in food crops such as plantain (usually used as temporary shades for cocoa seedlings), cassava, vegetables, and so on produced by sharecropper. In situations where plantain and other food crops are not shared, sharecroppers, voluntarily provide food to landowners. According to Barrientos and Asenso-Okyere (2012), various sharecropping systems have similar food sharing arrangements. When the farm reaches maturity, the sharecropper and landowner agree to divide the farm into two or to split the cocoa beans at each sale. Where the farm is shared the *'sharecropper farm his and the landowner farm his also' (FGD Bumbulla, 28th January, 2020).*

In some communities, the process of sharing farms is carried out in the presence of elders, farmers (sharecroppers), landowners, and witnesses. Because land may not have the same productivity levels, the sharecropper is required to survey the farm and share it in the presence of community leaders and experienced farmers. Farmers use what is known as *'the local'* method, which involves measuring the farm by 30 squares and dividing the result by half, which farmers believed results in same farm size following the method used by COCOBOD officers or farm mappers.

Cocoa farmers also indicate measuring three times of the length of a cutlass is measured on a stick and 36 squares of the stick results in an acre of cocoa farm or land. The cocoa farmer (i.e., shareholder) divides the land, and the landowner gets the first pick. The sharecropper completes the sharing process by presenting a sheep/ram and two bottles of schnapps in most cases instance in the Nkonya areas. The ram is slaughtered, and libation is poured at the boundary of the two land parts; a bottle of schnapps is also buried, and an '*anya'* tree serving as *'Lifotii'* (boundary tree) is planted all the way to the end of the boundary line. After the farm is divided, neither the sharecropper nor the landowner has the right to enter the divided portion of the farm.

When a sharecropper and a landowner decide to share cocoa produce, they both agree to keep the farm running through a number of processes. This is because sharecroppers' children have been found to be uninterested in taking over their parents' farms. Produce sharing is a common sharecropping practice in the Volta Cocoa Region currently due to landowners' or natives' fear of losing their lands and identity. The sharecropper harvests, processes, and sells cocoa produce in the case of produce sharing. He or she sends the cash portion to the landowner. Where the landowner is not in the same community, as in the case of some Bumbulla sharecroppers whose owners live in Nkonya, sharecroppers send their portion of cocoa sales to them along with the cocoa sale receipt for confirmation. When both the landowner and the sharecropper purchase input, the cocoa sales proceeds are split in half (Abunu). When the sharecropper is responsible for purchasing farm inputs, the cocoa proceeds are divided into three parts (Abusa), with two-thirds going to the sharecropper and one-third going to the landowner, i.e., ‘one part: sharecropper, one part for inputs, and one part for landowner.’

Findings from the study reveal, it is critical that the sharecropper maintain the cocoa farm in order to avoid losing his land. When a sharecropper abandons his farm or leaves his cocoa trees to die, the land is returned to the owner. When cocoa farms become old and unproductive, the sharecropper is expected to notify the landowner if he or she wishes to continue, otherwise the farm will be returned to the owner. Farmers seem not worried about this situation as they indicate FGD that; *we do not take that issue so serious because the cocoa trees take a long time to die, our problem is when as sharecroppers, cocoa farming inputs become our sole responsibility is what we find problematic (FGD Panku Akura, 8th January 2020)*

COCOBOD officers map and demarcate farms for farmers at no cost. This is done to determine the farm size for the purpose of providing seedlings and other government farm inputs. Farm size, on the other hand, is usually mentioned to farmers. Farmers are rarely given documents such as farm plans. However, the Cocoa Abrabopa Association charges its registered members a fee (Table 53) for farm plans (Figure 24). Farm plan ownership gives the farmer complete ownership of the land for inheritance.

Table 53: Cost of farm plans provided by Cocoa Abrabopa Association

No.	Farm size(acres)	Cost (GH¢)
1	1-3	300
2	3-4	400
3	4-5	500
4	5-7	600
5	7-9	700
6	10-12	800

Source: Field survey, Agyeman (2020)

Farmers who have multiple farms that are close enough to one another that they can be projected onto one sheet of paper have reduced price of the map. Multiple farms on separate sheets, on the other hand, attract different prices. It is critical that the cost of land registration and map generation be reduced in order to encourage farmers to register and own farm plans.

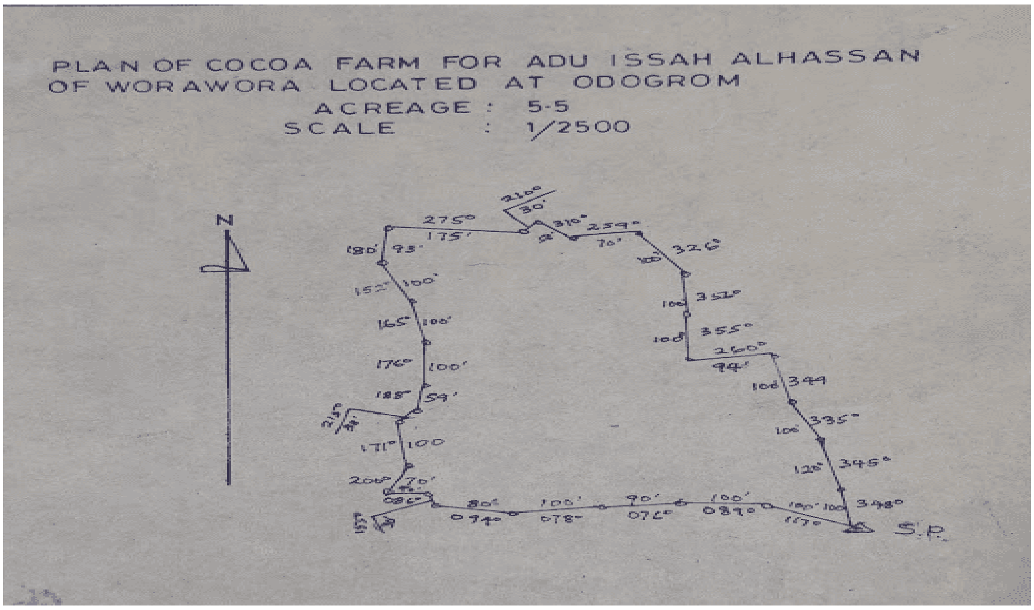


Figure 24: Sample farm plan provided by CAA to registered cocoa farmers.
Source: Field survey, Agyeman (2020).

Land Tenure Security

Tenure insecurity is a major issue for sharecroppers, despite the fact that some landowners have been instructed not to disturb sharecroppers during the agreement period. Landowners or their families irritate sharecroppers by threatening to evict them when the cocoa farm matures, or the true owner dies. In addressing land tenure issues, the FGD revealed that '*sometimes landowners try to sack sharecroppers when the farm is completely done but we talk about it and there is peace' (FGD Poace Cement, 6th January 2020).*

Furthermore, the sharecropper behaviour determines the nature of the relationship with the landowner. In some cases, landowners' dependents were cited as changing agreements in their favor, to the detriment of sharecroppers. Land is returned to landowners in other jurisdictions when farmers refuse to replant a burned farm. To avoid losing their land tenure rights, such farmers must be prioritized and supported by the SPD through CHED with seedlings to plant as soon as possible.

Furthermore, farmers indicate that once land is purchased with proper documentation, the buyer or farmer faces no tenure issues from the landowner. As previously stated, landowners prefer to share crops rather than farms; however, in the absence of the landowner's children, they may choose to share or not. In the event of a sharecropper's death, the next of kin takes over the agreement process. According to cocoa farmers, the only way to be certain of acquiring land for cocoa farming is through family and having documentation. Land obtained from individuals is undisputedly beset with problems. Cocoa farmers conclude that land tenure security problems are everywhere and as such '*your behavior depends on whether the landowner will disturb, sack you or keep you; Landowners can sack you or find ways to eliminate you, it does happen' (FGD, Gyamlome, January 2020).*

Farm Inheritance

Farm inheritance (Table 54) is critical for the sustainability of the Volta cocoa sector (Peprah, 2019). Cocoa farmers indicated multiple persons to inherit their cocoa farms.

Table 54: Cocoa farm Inheritance status of cocoa farmers

Inheritance	f	Percent
Spouse	137	67.4
Son	400	95.2
Daughter	124	29.5
Nephew	20	4.8
Others	6.0	1.4

n=420 Source: Field survey, Agyeman (2020)

The findings (Table 54) indicate 95.2 percent of respondents want their sons to inherit their farms, while 67.4 percent, 29.4 percent, and 4.8 percent want their spouses, daughters, and nephews to inherit their farms, respectively.

Others, such as caretakers, account for 1.4 percent. The farmer is expected to ensure that the cocoa farm(s) are in a state that beneficiaries can own and improve. The interests of cocoa farmers' spouses and dependents must be maintained in their farms by involving them in planning, land acquisition, and day-to-day management. Steijn (2016) finds sons to be the main successions to cocoa farms in Ghana. Land inheritance by number of individuals or sons frequently results in farmland fragmentation, resulting in smaller farm sizes. Smaller farms have lower yields because cocoa farmers usually are not encouraged to continue to invest in their farms through the purchase and application of fertilizer, fungicides, and pesticides (Steijn, 2016).

Labour Issues Associated with Cocoa Farming in the Volta Cocoa Region

This section discusses cocoa farming labour organisation, labour availability and cost issues, labour demanding activities, women's roles in cocoa farming, and cocoa farmers' perceptions of farm management establishment participation in cocoa labour provision.

Organizing Labour for Cocoa Farming in the Volta Cocoa Region

Own, family, sharecropper and hired labour are all options for cocoa farmers in the Volta Cocoa Region. Farmers used a variety of methods to organise hired farm labour. Labour is arranged in the community on a 'by-day' basis, which means farmers are paid on a daily basis for performing assigned tasks. Due to the high demand for labour, farmers may make an advance part-payment to these by-day labourers in order to engage them. Some farmers have regular or standby labourers working for them. The FGD revealed *'found some persons and have agreed with them to contract them to work for me. They are five in number who work for me all the time. I usually pre-inform them of the* *day to work for me say Monday and I try to entertain them a lot. When they work for me, I pay them regularly, feed them and find some other items to make some 'Show for them' (FGD Likpe-Mate, 22, January 2020).* Negotiations are held between farmers and serious labourers and agreed before commencement of work.

Beyond the community, cocoa farmers throughout the Volta Cocoa Region sought cocoa farm labour from the Akebu areas in the republic of Togo, which are on vacation from July to September. The labourers in Togo are contacted through their landlords, and the necessary contract terms are agreed upon. Some cocoa farmers also travel to Togo to negotiate yearly contracts with labourers and pay them at the end of the period. Farmers report that they usually rush for Togo labourers because they are in high demand and are perceived to work better and more efficiently than native labourers. The labourers are usually in groups of 5-6 persons.

The majority of labourers in the Volta Cocoa Region are employed on a seasonal or contract basis. In Ghana, the host(s) cocoa farmer organises and rent (at GH¢30.00/week) residences for the labourers, as well are provided with breakfast and supper throughout the period. Apart from cocoa farming, the labourers are forced to participate in a variety of farm activities (e.g., crops and livestock etc. carried out by the hosts' farmer.

Cocoa farmers who cannot make prior arrangements for Togo-based labourers plead with hosts to release their sourced labourers to perform farming activities for them for a fee. Farmers explain that if migrant labourers are not well cared for, they will not return to their host to the ensuing cocoa season.

Some cocoa farmers take good care of their labourers. In this case, the labourers prioritize work for landowners over work for others.

When labourers work on an activity basis, their efforts are measured and compensated in Ghanaian currency. The main issue with using Togo students is their unavailability during school hours. Even though these migrant students are not Ghanaians, it is critical that child labour laws are followed. Workers from Kpassa areas in Ghana also provided cocoa labour services in other parts of the region.

Labour Availability

Some farmers claim that labour is not an issue once you have money; however, due to a labour shortage, some labourers receive money prior to scheduled work start days but refuse to perform task. Due to the severity of labour shortages, opinion leaders in the Akpafu area, for example, planned to put up a notice board with personnel in charge to allow farmers in need of labourers to place their contacts on the notice to arrange for them as such.

Motor riding employment (*Zemija*) and youth migration to cities after completing particularly basic education have been identified as major contributors to the Volta region's labour problems, resulting in a labour shortage. Available youth are begged to offer cocoa labour services. Farmer emphasis *'You may have money but will not find labourers' (In-Depth Interview Papase, 9th January 2020).* Furthermore, labourers have indicated a lack of interest in remaining on the farms. Children (Figure 25) were found to assist parents in non-hazardous activities along the cocoa value chain. Teens were found assisting parents in removing placenta from fermented cocoa beans in the study. It is critical that children are made to participate learn about cocoa farming through non-hazardous activities in order for them to succeed their parents' farms without deprivation from education in particular.

Figure 25: Teenagers helping to remove placenta from fermented cocoa beans at Kpando-kofe community.
Source: Field Survey, Agyeman (2020)

Group work (*Fidodo or Nnoboa*)

Nnoboa (*Fidodo*, in Ewe) is usually used for weeding, holing, planting, and breaking cocoa pods (Figure 26). Cocoa farmers regularly agree on the terms of *fidodo* follow them through. In some cases, farmers agree that no food should be provided on the farm hence group members are expected to bring work to an end when they are hungry. Landowners contribute food when sharecroppers form *fidodo* groups. Farmers have suggested some positive and negative aspects of *Fidodo* (Table 55). Farmers, for example, suggest that when participating farmers do not cultivate the same crops and farm size, the labour system is difficult to implement.

Table 55: Positives and Negative issues associated with Nnoboa (Fidodo)

Positives	Negatives
1.Reduces time and cost of farming	1.Leads to selfishness and imbalance in work rates as some participants work harder than others, making hardworking farmers to suffer
2. Work period is reduced	2. Food provided during nnoboa (Fidodo) is expensive.
3. Work is done effectively.	3.Some farmers are not comfortable with other farmers knowing the progress of their cocoa farming enterprise.
4. Help some farmers to learn from other farmers	4. Some farmers are afraid other farmers will put charms in their farms
5. Reduces difficulty in catering for farms using an 'individual's strength'	5.Absenteism: Some group members do not turn up during other farmers turn
6. Leads to less work to attend to by farmer.	6.Some cocoa farmers farm other crops, hence, are not able to engage in effective nnoboa (Fidodo)
7. Reduces financial burden on farmers which can be used to take care of children or household needs.	7. Envy on the progress of other farmers. *'If you get to Kofi's farm, it is not a small thing' revealed in the FGD as indicating envy.*
8. Good for those who cannot fully work on their cocoa farms.	8.Some participating farmers faint sickness and engage in delay tactics
	9. Some farmers exhibit laziness during work.
	10. Some farmers are indicated to come back and steal after working on group members farm
	11. Distance and different farm locations of farms affects Nnoboa negatively.
	12. Different farm sizes: some farmers have small farms and others have big farms
	13. Long waiting periods. Should anyone fall sick, group ought to wait for the person to get healed before work continues
	14. Some Nnoboa team members no do not work effectively, and efficiently as they do not weed to the 'ground level'
	15. Most farmers do not know the usefulness of Nnoboa.

Source: Field survey, Agyeman (2020)

Figure 26: Farmers participating in Nnoboa (*Fidodo*) in the Gyamlome community

Source: Field survey, Agyeman (2020)

Labour cost

The cost of labour (Table 56) influences the timely adoption of shared innovations. The research reveals the costs of implementing various cocoa innovations in the Volta Cocoa Region of Ghana.

Table 56: Costs associated with undertaking cocoa farming activities in the Volta Cocoa Region

Activity	Cost/acre (GHS)/year/day
Land clearing /weeding	'By-day' weeding costs GH¢ 20-30/day or negotiable in cases of farm charge. 16-30 cedis (3 times of cutlass by 16), 100 cedis/care, One acre-240. Cost of weeding one line (9 lines=1 acre) per day cost 20 cedis. 180 cedis per acre for all jobs by-day basis. Weeding by measurement 200-250/acres and 300 cedis charged on average. *By-day*- GH¢15-30 cedis (7:30 am-12:00 noon).
Transporting of inputs to community.	Relative, depending on distance
Transporting of inputs to farm	Relative and negotiable.
Pruning	Pruners from COCOBOD are used. COCOBOD prunners do not cover all farms, hence farmers hire pruners to prune their remaining farms at a cost of 150 cedis/acre.

Table 56 Continued

Hand Pollination	Government support. Farmers do not pay for hand pollination which usually start from April for farmers who have flowers on their farms. The youth are mostly trained to pollinate farms.
Application of fungicides, insecticides etc.	Through 'Government'(COCOBOD) support. But farmers rate work as not effective. Hence spray themselves. 'COCOBOD gives us fungicides to spray gangs which are to farmers farms. In cases where government chemicals delay, farmers buy and apply themselves. Cocoa farmers fetch water at 20 cedis for spraying per day.
Fertilizer application	Spray gang is used. 5 cedis per filling (per 11L motorized sprayer) is charged by other service providers
Harvesting and pod breaking	Harvesting 10-20 cedis, Group work, *fidodo*. Harvesting/15 cedis/day, pod breaking, group work. Nnoboa and feeding (food and drinks) used; 30-35 cedis is also charged for harvesting per day
Transporting fermented cocoa to mat	15-20 cedis per person/ transportation 5-10 cedis. 5 bags/100 cedis, dried beans charged 5-30/bag based on distance to farm
Fetching water	Some have water near farms otherwise 8-10 cedis/ drum and distance. Barrel/10 cedis, 15-20 cedis/Tank if river or source of water is far, 1 tank/5cedis. 15 cedis/day
Drying of cocoa beans	Use of household members (spouses and adult 'children').
Transporting of dried beans to cocoa storage	Charges are based on distance. For distance such 3-4 miles (4.8-6.4km), 20 cedis is charged for transporting a bag of cocoa.
Transporting of bagged beans to shed	Household members are usually used. Transportation cost charged depends on distances between farmers houses and farms and sheds.
Farm mapping	No fees are charged by COCOBOD for the services. Private companies charge varying cost. COCOBOD However, provides no farm plan; it only maps new farms to determine farmers' seedlings and agrochemical requirement and for other decision-making purposes.
Repairs of tools, equipment, and machinery	Some Farmers are able to repair Knapsack sprayer (also locally called *kafukafu or kafikafi)*. Difficult to repair machines (Mistblowers) are sent to mechanics. Price charged for repairs depends on parts bought as parts are difficult to come by. Usually, 50 cedis is charged for repairs of minor issues and major issues cost 200 cedis or more particularly for Mistblowers. In case of knapsack, 20-30 cedis is usually charged for repairs.

Source: Field survey, Agyeman (2020)

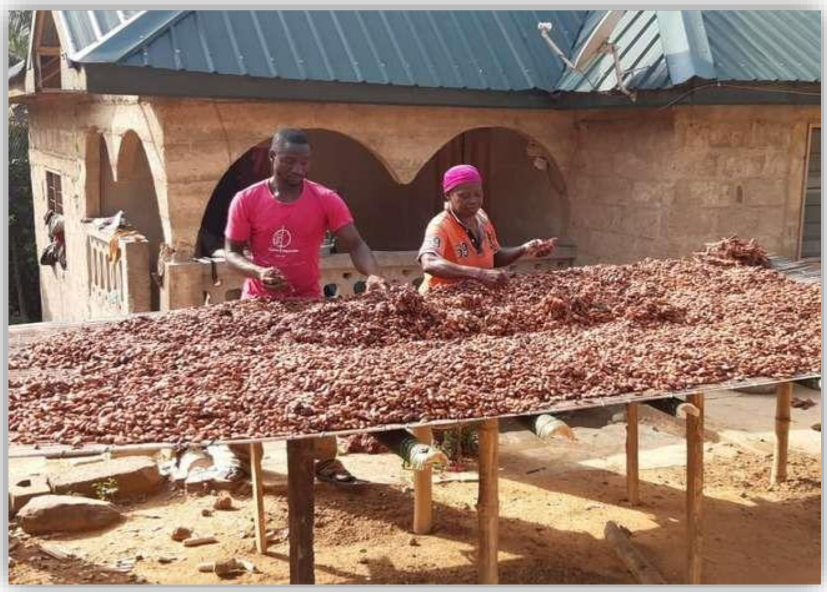
According to related research, the hired labourers daily paid wage was found GH¢15 or more depending on the task performed (Steijn, 2016). This result depicts recent increases in the wages paid to cocoa farm labourers particularly in the Volta Cocoa Region (Table 56). Barrientos & Asenso-Okyere (2012) reiterates this fact that cocoa labour costs in Ghana naturally rises as a result of diminishing supply of hired labour.

Women Roles in Cocoa Farming in the Volta Cocoa Region

Women, as spouses or household heads, participate in a variety of cocoa farming activities in the Volta Cocoa Region. Women transport cocoa seedlings to the farm, hole, and plant them, fetch water for spraying, harvest, gather pods, and some women are hired to gather and break cocoa pods from 8 a.m. to 1 O'clock p.m.

Women also cook and serve farm labourers, transport fermented beans home, remove placenta from fermented beans on drying mats, and dry and sell beans (Figure 27). Women were unable to perform tasks such as spraying and pruning effectively. Some of the women who attended MASO training reported being able to spray and prune their farms. Some women, particularly young women, are members of pollination gangs; women also help remove placenta from fermented beans. Some women are also able to spray agrochemicals, despite being advised by other male farmers not to do so. In this regard, some women cocoa farmers fetch water for men to spray their farms, and men spray for them in return. It is critical to provide women with simple equipment and machinery that will allow them to complete these difficult tasks independently and on time.

(a)



(b)

Figure 27: Women providing support to feed farm labourers (a) and to dry cocoa beans (b)

Source: Field Survey, Agyeman (2020)

Farmers View of Private Farm Management Schemes

Given the labour challenges faced by cocoa farmers in the Volta Cocoa Region, cocoa farmers' perspectives on engaging private farm management schemes in farm management were sought. Farmers have differing opinions about private farm management schemes. Farmers indicate that their participation in private farm management schemes will be determined by the nature and scope of the scheme. Sharecroppers believe that because they do not own the lands, this scheme will not be in their best interests and may force them out of work. Cocoa farmers wonder how such an agreement will be reached with landowners on private farm management schemes to ensure sharecroppers receive their shares.

Farmers also reiterated that cocoa farming is their primary source of income, hence questioned what employment activities they would be engaged if they gave their farms to private farm management schemes, concluding that such schemes would be extremely problematic. Aged farmers were enthusiastic about the scheme and expressed willingness to participate if it were implemented. Farmers also anticipate that the companies may face financial difficulties, that others may fail to perform as expected, and that trust issues in the sharing of produce may impede the scheme.

Farmers believe that the only thing keeping them from participating in such schemes is the non-availability of such companies to provide the service. According to farmers, the use of cocoa farm management is new to them, and most farmers may not know the outcome; it is difficult to change farmers' perceptions, they concluded. Other farmers indicate their participation will depend on the quality of work to be performed by the scheme as *'I have my farm and if they can do it according to Cocoa Abrabopa Association standard, I will participate' (FGD Kute, 22nd January 2020).* Farmers were also enthusiastic about the scheme as they intend to give their farms to COCOBOD because their caretakers were not taking good care of them, as well as in the event that the caretaker passes away.

Due to trust issues, farmers prefer to use a family member instead. Also, cocoa farmers ascertained the usefulness and benefits of the private farm management scheme as well as what percentage of cocoa produce will be given to them. Cocoa farmers are also concerned about the likelihood of the private farm management companies taking over their cocoa farmers from them. Farm management services are required, even if some farmers are skeptical of their value. Farm management organisations must therefore find solutions to potential challenges associated with engagement of private farm management services in order to attract farmers and sustain the cocoa farming sector in the Volta Cocoa Region of Ghana. The role of extension providers in facilitating the activities of farm management services critical in achieving this objective.

Chapter Summary

The socio-demographic and economic factors responsible for cocoa farming with implications for extension delivery are presented and discussed in this chapter. Both quantitative and qualitative results on this objective were presented and discussed in this chapter. The age, sex, marital status, ethnicity, nativity of community, experience in cocoa farming, farm size, cocoa farm class, leadership position held, group participation, were discussed. Access to government interventions such as free seedlings, FBS, hand pollination, inputs, mass spraying and to government COCOBOD scholarships and awards have also been discussed in this chapter. Land and labour issues affecting cocoa farming which has implications for extension delivery have been discussed in this chapter. Particularly aspect of land such as availability and fertility, mode of land acquisition for cocoa farming, tenure security, farm inheritance; and labour issues such as labour organisation, availability, role of women and group work (*fidodo*) have been presented and discussed in this chapter.

CHAPTER SIX

CHALLENGES FACED BY COCOA FARMERS IN THE VOLTA COCOA REGION

Introduction

This chapter discusses the results of objective three which examined cocoa production, marketing and extension delivery challenges faced by cocoa farmers in the Volta Cocoa Region as analysed using the Garrett ranking technique. Chapter six ends with a section on summary.

Production Challenges Faced by Cocoa Farmers in the Volta Cocoa Region

The cocoa production challenges identified and ranked by cocoa farmers in the Volta Cocoa Region is presented in Table 57.

Table 57: Production challenges faced by cocoa farmers in the Volta Cocoa Region.

Production Constraint	Mean score	Rank
Access to credit	54.2	1
Prolonged drought	51.3	2
Labour unavailability	51.2	3
Late input supply	51.0	4
Pest and disease constraints	49.2	5
Soil infertility	47.6	6
Flooding	47.0	7
Fire outbreaks	46.4	8
High labour cost	46.3	9
High cost of inputs	46.3	9
High land cost	46.1	11
Low access to farm inputs	46.0	12
Land tenure insecurity	44.7	13
Theft	41.0	14
Lumbering	37.3	15

Source: Field survey, Agyeman (2020)

The most pressing production challenge for cocoa farmers in the Volta Cocoa Region is access to credit. Due to credit constraints, cocoa farmers are unable to purchase farm inputs and hire labour to adopt cocoa farming innovations. Asare and Sonii (2011) and Begna, Yami, Lemma, Solomom and Etana (2015) emphasized the importance of cocoa farmers having access to credit in order to increase farm productivity.

Prolonged drought is the second most pressing production constraint faced by cocoa farmers in the Volta Cocoa Region as a result of climate change. Drought is most severe in the Jasikan and Papase districts. The FGD revealed the severity of droughts which dry up banana and plantain crops used as temporary shades, resulting in scorching of cocoa seedlings. Issues of drought have implications on agricultural extension efforts particularly with regards to lack of rainfall among cocoa farmers as similarly found by Alemu (2017). Some cocoa farmers in the Volta Cocoa Region have adopted indigenous innovations such as placing filled perforated water bottles (Figure 28) by cocoa seedlings to irrigate them during these periods of droughts.

Figure 28: Cocoa seedling watered with bottled water during drought periods.
Source: Field survey, Agyeman (2020)

When the bottles are empty after few days, they were usually refilled. It is critical that such indigenous innovations are improved in order to raise cocoa seedlings on permanent fields in order to sustain the economy of the Volta Cocoa Region. COCOBOD is expected to provide adaptation strategies as well as drought resistant cocoa seedlings to improve cocoa yields in the Volta Cocoa Region (Wiah & Twumasi-Ankrah, 2017). Farmers' experience in land use, interactions with other farmers, government extension agents, and cocoa buyers will all have implications on cocoa agroforestry practices in the Volta Cocoa region (Ameyaw et al., 2018).

Unavailability of labour is the third most pressing constraint faced by cocoa farmers in the Volta Cocoa Region. This has implications for the timely adoption of cocoa innovations shared with cocoa farmers. The fourth critical constraint is late input supply. Farmers claim that COCOBOD and private extension organisation provided inputs were not delivered on time. Granular fertilizer, for example, is expected to be applied at the start of the rainy season in March-April, and other insecticides and fungicides from June onwards. However, inputs were supplied as late as June and July. According to farmers, late supply of inputs leads to late application, which results in disease and pest infestation, retarded plant growth, and low yield. Asare and Sonii (2011) emphasised the importance of applying approved fertilizers, fungicides, and insecticides in the recommended dosage at the appropriate time, and that these inputs be readily available and accessible at the community level.

Cocoa farmers in the Volta Cocoa Region ranked pest and disease challenges as the fifth most pressing constraint. Pests and diseases such as mirids and blackpod disease are common problems, especially in poorly maintained farms (Figure 29). Farms were found to be infested with algae, which covered the flower cushions, reducing flowering and yield. Farmers believe that the agrochemicals provided by the government to cocoa farmers in the Volta Cocoa Region are of lower quality than those provided to cocoa farmers in other regions. This assertion is not the case the provided inputs are same as provided to other farmers in other cocoa regions of Ghana. This believes required further education by COCOBOD to change the minds of farmers towards applying the provided inputs on their farms.

Figure 29: A weedy cocoa farm observed in the Papase CHED district.
Source: Field Survey, Agyeman (2020)

CAA farmers report receiving high-quality inputs on credit, but experiences delay in delivery. Figure 30 portrays examples of disease outbreaks on cocoa farms in the Volta region. The image on the left side of Figure 30 shows cocoa pod malformations whilst the image on the right indicates green fungal (*apotobibire* in Twi) growth on cocoa trees. Particularly, the fungal conditions stem from poor sunlight penetration. The fungal growth tends to cover flower cushions resulting in poor flowering culminating in reduced yield of the cocoa farm. These diseases can be controlled by farm maintenance including pruning and application of insecticides (both organic and inorganic) CHED and WCF, 2016).

Figure 30: Diseased cocoa pods (left) and a diseased cocoa tree (right)

Source: Field Survey, Agyeman (2020)

Soil fertility is ranked sixth among production constraints. Cocoa farmers claim that continuous cropping on the same piece of land has rendered their land infertile. This could be remedied by applying fertilizer (granular and foliar). Flooding and fire outbreaks are ranked seventh and eighth in terms of production constraints. Perennial floods impacted farmers who farmed near rivers. The flood washed away fertilizer that had been applied, depriving cocoa trees of nutrients. Flooding also promotes the spread of diseases such as blackpod. Farmers also express their inability to attend to their farming activities on time, as they had to wait for the floods to capsize to allow for farming activities to be undertaken. Farmers, particularly in the Papase district, are unable to cross the Tsei river, which regularly overflows its banks. Due to the lack of major bridges (Figure 31) on the river, farmers must take longer routes to access their farms, which can take up to two hours or more to complete a distance that they normally covered in less than 20 minutes.

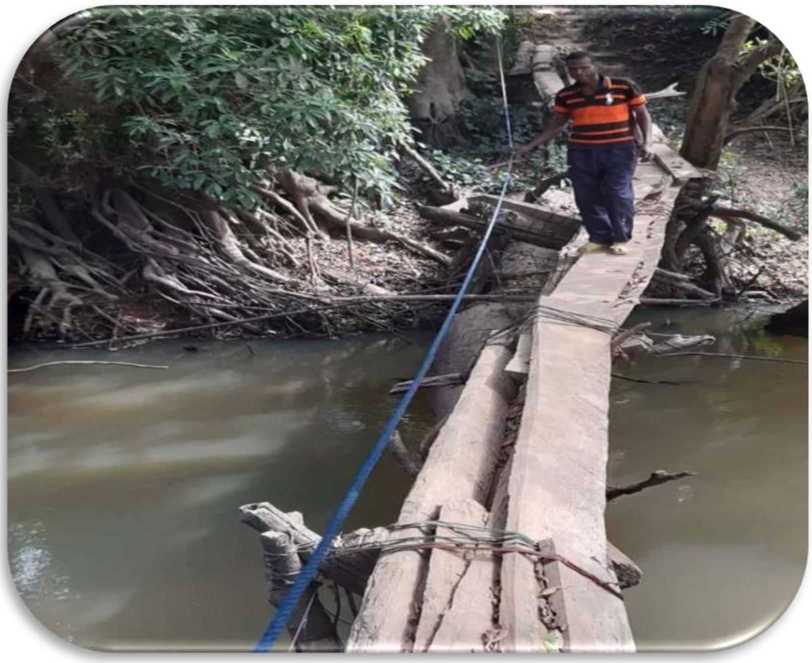


Figure 31: Nature of bridge on River Tsei to cocoa farms at Panku Akura and surrounding communities.

Source: Field Survey, Agyeman (2020)

Fire outbreaks are a common problem for cocoa farmers in the Volta Cocoa Region. Farmers have lost parts of or entire farms as a result of this. The cause of these fire outbreaks was linked to prolonged drought as well as the activities of hunters who set fire to catch grasscutters, rats, and squirrels, among other things. Despite the fact that firebelt innovations were shared with cocoa farmers, some farmers were unable to put them into practice. This was attributed to some farmers' farms being surrounded by other farms with no clear boundaries. Farmers are also doubtful of the effectiveness of fire outbreaks due to the region's persistence of fire outbreaks. Cocoa farmers have attempted to control the fire outbreak threat by spending nights and days on their farms, attempting to control any fire outbreaks that may occur on their farms or nearby farms. COCOBOD and other extension providers and Ghana National Fire Service office in the region have used mass media and face-to-face trainings to educate farmers on how to prevent and control fire outbreaks on their farms.

High labour and input costs, as well as high land costs, are ranked as the eighth and ninth constraints respectively by farmers in the region. Due to labour shortages and rising demand for labour, farmers claim that labour costs are too high and unaffordable. Input and land costs for cocoa farming are also considered high. Limited access to farm inputs is ranked by farmers in the region as the eleventh most pressing production constraint. Farmers report being unable to obtain high-quality inputs and equipment such as knapsacks and motorized sprayers. Farmers require such services in order to effectively adopt innovations that have been shared with them. Land tenure security also remains an issue in the cocoa farming industry which require attention. Land tenure insecurity is the thirteenth pressing problem faced by cocoa farmers in the Volta Cocoa Region. Farmers not having legal titles to their land as required by customary land tenure are prone to land tenure insecurity challenges (Odhiambo, 2015). The challenge of land tenure insecurity faced by particularly sharecroppers in particular, discourages migrants and young people from participating in cocoa farming in the region.

Theft is the fourteenth most pressing production constraint faced by Volta cocoa farmers. Cocoa pods and fermented cocoa beans are stolen and sold to smugglers who buy fresh beans. Farmers have attempted to serve as watchdogs on their farms in order to deter thieves. Lumbering was ranked fifteenth and had the least impact on cocoa farmers in the Volta Cocoa Region. Because the trees on the farms are owned by the government or landowners, they are felled at their convenience. Cocoa trees are usually destroyed by felled trees (Figure 32). Chainsaw and sawmill operators were responsible for cutting down such trees and usually show government permits. They also do not pay compensation to cocoa farmers for destroyed cocoa trees/farms. Lumbering therefore has a negative impact on cocoa yield and income, hence the need to address situation in the Volta Cocoa Region.

Figure 32: Effects of lumbering activities on cocoa farms at Kpando-Kofe community

Source: Field survey, Agyeman (2020)

Marketing Challenges Faced by Cocoa Farmers in the Volta Cocoa Region

The cocoa marketing challenges faced by cocoa farmers in the Volta Cocoa Region is presented in Table 58. Price incentive is the foremost marketing constraint faced by cocoa farmers in the Volta Cocoa Region. Farmers considered the per bag price of cocoa at GH¢475 to be low, given their financial commitments as producers and the price of cocoa in neigbouring republic of Togo (which is higher than pertaining to Ghana).

Table 58: Marketing challenges faced by cocoa farmers in the Volta Cocoa Region

Marketing challenges	Mean Score	Rank
Price incentives	62.4	1
Poor road network	58.8	2
Low premium price	49.6	3
High transportation cost	48.6	4
Scale adjustment	46.2	5
Delays in purchases	44.9	6
Low number of LBCs	43.4	7
Late payment of purchased cocoa	40.2	8
Shortage of cocoa sacks and threads	38.0	9
Long periods between closure and opening of new cocoa season	37.5	10

Source: Field survey, Agyeman (2020)

As a consequence, cocoa farmers smuggle cocoa to neigbouring Togo because of the perceived low price of similar bag/kg of cocoa beans in Ghana. Regarding this phenomenon, farmers indicate through FGD and in-depth interview that need for CFA currency to purchase cheaper (e.g., clothing, cows etc.) needs in Togo, contributes largely to smuggling of cocoa beans to Togo beside the price incentive. Though the government continue to keep a close eye on its borders as a measure to deal with cocoa smuggling to Togo, farmers believe that an increase in cocoa prices in Ghana is the best means of addressing the problem.

Cocoa farmers in the Volta Cocoa Region rank poor road network as the second most pressing marketing challenge faced. Cocoa farmers indicate that the roads leading to their farms are impassable. Due to poor nature of the roads, cocoa farmers are pushed into carting their fermented and dried beans by head to the nearest road for transport to homes for drying and sales to PCs for sale.

Better roads are required to increase cocoa farmers' access to benefits such as diversification opportunities in their communities in the Volta Cocoa Region as similarly emphasised by Barrientos & Asenso-Okyere (2012).

Low premium was the third most pressing constraint faced by farmers involved in certification. CAA pays a GH¢17 premium for a bag of cocoa beans to certification beneficiaries. Farmers believe the premium paid is insufficient in light of the efforts they put in to meet certification standards to realise the required high-quality cocoa beans required by the buyers. The result buttresses findings by Ingram et al. (2013) that farmers under certification complain regarding the cost associated with producing certified cocoa as the cost is not fully covered by the benefits received particularly though premiums. The price premium is the most important incentive for certified cocoa farmers despite other benefits or incentives such as quality cocoa inputs and transportation (Ruf, 2013) hence the need for CAA to raise the premium amount paid to cocoa farmers under the scheme.

High transportation costs and scale adjustment are respectively the fourth and fifth marketing constraints ranked by cocoa farmers in the Volta Cocoa Region. Cocoa farmers transport goods and products to and from their farms using vehicles, tricycles (*Aboboya)* and human labour. According to the farmers, the cost of transportation to and from the farm is extremely expensive. Appropriate means such as labour availability, tricycle ownership, and good roads could all contribute to transportation price reductions.

Scale adjustment (sixth ranked marketing constraint) is a major issue that farmers face when it comes to cocoa marketing. Farmers have perceived and proven claims that purchasing clerks adjust scales to 'cheat' them. Despite the fact that COCOBOD have provided testing stones to help farmers detect scale adjustments, farmers rarely use them. This is due to purchasing clerks failing to provide testing stones or threatening them to discourage them from testing their scales.

Farmers claim that if scale adjustment is detected, they stop selling to a particular purchasing clerk if there is an alternative. Farmers participating in certification schemes agree on the use of ‘free scale’ (unadjusted scales) in purchasing their cocoa produce. Farmers instead agree on kilograms of cocoa to give “Collector” (Purchasing Clerks) to make their work easier and to account for short weights. The improper drying of cocoa beans by cocoa farmers contributes to the adjustment of scales, according to purchasing clerks. PCs have claimed that they require additional cocoa beans in order to cover the costs of additional drying and labour for loading trucks. These costs are usually not covered by LBCs in the form of commission received by the PC. Scale adjustment thus compensates for the additional cost of operation faced by PCs as concluded by Baah et al. (2012).

Delays in cocoa purchases by LBCs is the sixth constraint faced by cocoa farmers in the Volta Cocoa Region. Farmers identified number of times when cocoa beans are ready but are not primary evacuated by LBCs. According to the farmers, this, as well as the issue of late purchase, is due to the low number of LBCs (Seventh ranked constraint) currently operating in the region: Produce Buying Company (PBC), Royal Commodities Limited (ROCO) and Adwumapa buyers. Cocoa farmers report instances where beans were purchased by LBCs and later paid for which negatively affects their financial position in addressing household needs. The eighth most pressing marketing constraint was late payment for purchased cocoa beans. Farmers suffer as a result of late payments because they are unable to pay for credited labour services, inputs, and household needs on time. The ninth constraint is the scarcity of cocoa sacks and threads. To prevent mold contamination, cocoa beans are expected to be stored in COCOBOD-recommended jute sacks (CHED and WCF, 2016). Farmers resort to storing cocoa beans in poly-sacks due to unavailability of the recommended sacks. It is critical that LBCs make sacks available to PCs in a timely manner to avoid contamination of the cocoa beans.

Long periods between closure and reopening of the new season are the least of the marketing constraints faced by cocoa farmers in the Volta Cocoa Region. COCOBOD usually begins the new season in early October. Farmers who gather beans keep them when there is a long gap between the end of the season and the start of the new season because LBCs will not buy them. Spoilage of cocoa beans was cited by cocoa farmers common during such periods, especially among farmers who were unable to properly store cocoa beans during these times. Spoiled beans have a negative financial effect on farmers because the phenomenon reduces the amount of cocoa beans available for sale.

Extension Delivery Challenges Faced by Cocoa Farmers in the Volta Cocoa Region.

Cocoa farmers' rankings of the extension delivery constraints faced in the Volta Cocoa Region of Ghana is presented in Table 59. The most pressing extension delivery challenge faced by cocoa farmers in the Volta Cocoa Region was the low activity of cocoa farmer associations and extension organisations. Farmers sought to question why associations and organisations that exist in other regions do not exist in the Volta Cocoa Region, as they believe that the presence of many of these organisations in the region will raise cocoa production levels through the cocoa farming supports, they provide farmers.

Table 59: Extension delivery challenges faced by cocoa farmers in the Volta Cocoa Region.

Extension Constraints	Mean score	Rank
Low activities of cocoa farmer associations and extension organisations	69.9	1
Low extension staff contact	65.1	2
Low use of training materials	58.2	3
Language barriers	55.5	4
Low feedback rate from extension officers	55.4	5
Cost of mobile phones	49.1	6
Poor telecommunication network coverage	47.4	7
Inappropriate extension methods	43.9	8
Cost of participating in private extension	42.7	9
Cost of mobile phone talk time and data bundles	42.7	9
Poor television waves	36.9	11
Poor radio waves	35.6	12

Source: Field survey, Agyeman (2020)

The second most pressing constraint affecting cocoa farmers in the Volta Cocoa Region is the perceived low extension contacts from extension officers and their organisations. Cocoa farmers indicate respective CHED, and private technical officers need to improve on the attention provided them which is critical for dealing with their cocoa farming problems.

The third cocoa extension delivery constraint faced is the low use of training materials. Farmers indicate that they had inadequate access to training materials to help them understand innovations shared with them. Training aids were identified as important in extension delivery by Babasanya et al. (2013). Cocoa newspapers, cropping calendars, and radio programmes must be used frequently to improve farmers' cocoa farming competencies. Private organisations have tried to provide more training materials than public extension delivery organisations by this study. CHED must also leverage on mass media and other trainings materials in extension delivery. The fourth constraint ranked is language barriers from technical officers who do not understand the native languages (Ewe and Twi). Language barriers have been mentioned as a barrier to direct communication between farmers and field officers unless they are interpreted. The fifth extension constraint faced by cocoa farmers in the Volta Cocoa Region is low feedback rate. Farmers anticipate receiving feedback on issues raised with technical officers. According to farmers, this rarely occurs because they are rarely provided with feedback on the reported issues, and when they are, the feedback is deemed unsatisfactory. It is necessary to have systems in place to directly receive problems from cocoa farmers and address them as soon as possible.

The sixth and seventh extension delivery constraints faced by cocoa farmers in the Volta Cocoa Region were respectively identified as the cost of mobile phones and a poor telecommunication network. According to the study, the majority of farmers use non-smart phones rather than smart phones. This is due to the farmers' perceived high cost and complexity of use of Smart phones. It is critical that farmers have access to low-cost smart phones in order to facilitate electronic extension delivery for instance to be able to use applications such as cocoalink and other internet-based information on cocoa farming innovations and news. Poor community telecommunications network was found to have hampered effective and timely communication through mobile phones for some communities. That is for some of these communities, telecommunication networks were not available, or could only be found at specific locations in the communities. Farmers are thus limited in their use of mobile phones for talk time, data services and mobile money transactions.

Inappropriate extension methods are ranked eighth among extension delivery challenges. Farmers believe that technical officers do not share some cocoa innovations with them using the appropriate extension method. Cocoa farmers indicate for example, for some of the innovations that require demonstration on the farm, technical officers were hesitant train them practically on the farm; instead, they hold meetings, which do not help them understand their shared innovations. The cost of participating in private extension and the cost of mobile phone network talk time and data are ranked ninth. Farmers believe registration fees, the cost of PPE, and the transportation costs of participating in rallies, among other things were deemed expensive. Farmers propose that such costs be reduced so that they can fully participate in private extension activities.

Poor television and radio networks are the eleventh and twelfth constraints faced by cocoa farmers in the Volta Cocoa Region. Cocoa farmers stated that they are unable to watch television unless they owned a digital box. Moreover, cocoa farmers also indicated poor radio reception for some of the communities, making it difficult for them to listen to cocoa related radio programmes.

Chapter Summary

The challenges pertaining to the production, marketing and extension delivery faced by cocoa farmers in the Volta Cocoa Region have been discussed in this chapter. The five main pressing production challenges ranked were access to credit, prolonged drought, labour availability, late input supply and pest and disease were discussed. The marketing challenges faced include price incentives, poor road networks, low premium, high transportation cost and scale adjustment. The pressing extension delivery challenges faced were found to be low activities of farmer associations and extension organisations, low extension contacts, low use of extension materials, language barriers and low feedback rate from extension providers. All these challenges hence require extension efforts to deal with them.

CHAPTER SEVEN

EFFECTS OF EXTENSION DELIVERY ON COCOA FARMERS IN THE VOLTA COCOA REGION

Introduction

This chapter presents results on objective four which examined the effects of extension delivery on cocoa farmers in the Volta Cocoa Region of Ghana. The result on the competencies, innovation Adoption level, cocoa yield, and income of cocoa farmers under cocoa extension delivery system in the Volta Cocoa Region are discussed in this chapter. The Chapter concludes with a summary.

Competency of Cocoa Farmers in Cocoa Farming in the Volta Cocoa Region

In this section, the results (Tables 60, 61, 62 and 63) of cocoa farmers' competencies related to their knowledge, attitudes, skills, and aspirations in cocoa farming are presented and discussed. The results (means and standard deviations) of knowledge(statements) competency cocoa farmers have in cocoa farming in the Volta Cocoa Region is presented in Table 60.

Table 60: Knowledge of Cocoa Farmers in Cocoa Farming in the Volta Cocoa Region

Knowledge statements	Mean	SD
I know the importance of using nursed cocoa seedlings in cocoa farming	4.0	0.9
I know the importance of accurately determining my cocoa farm or land size	3.9	0.9
I know the importance of selecting a good site for cocoa farming	4.0	0.9
I know the planting distance for planting cocoa seedlings	4.0	0.9
I know the importance of providing temporary shade to transplanted cocoa seedlings	4.0	0.8
I know the importance of providing permanent shade trees on the cocoa farm	4.0	0.9
I know the importance regularly pruning cocoa farm	4.0	0.9
I know the importance of controlling pests and diseases on cocoa farm	4.0	0.9
I know the importance of hand pollinating cocoa trees	4.0	0.9

Table 60 continued

I know the need to set fire belts around my cocoa farm	4.0	0.9
I know the importance of controlling weeds on a farm	4.1	0.9
I know the importance of applying various granular fertilizers in cocoa farms	4.1	0.8
I know the importance of using foliar fertilizers in cocoa farming	4.1	0.8
I know the importance of managing drainage conditions on cocoa farms	4.1	0.8
I know the importance of harvesting ripen cocoa pods for fermentation	4.1	0.8
I know the effects unripen and diseased cocoa beans have on chocolate flavour in cocoa beans	4.0	0.8
I know the importance of breaking cocoa pods between 2-3 days after harvesting	4.1	0.8
I know the importance of fermenting cocoa beans for six days	4.0	0.8
I know the importance of drying fermented cocoa beans to right moisture level or feeling a 'cracking sound'	4.1	0.8
I know the importance of storing dried cocoa beans in jute sacks	4.0	0.8
I know the importance of wearing PPE when undertaking farm operations	4.0	0.8
I know the importance of observing pre-harvest and re-entry interval periods	3.9	0.8

Source: Field survey, Agyeman (2020). Mean calculated from a scale of 4.45-5.0 (Strongly Agree), 3.45-4.44 (Agree), 2.45-3.44 (Moderately Agree), 1.45-2.44 **(**Lowly agree) and 1-1.44 (Very Lowly Agree).

The findings of the research (Table 60) show cocoa farmers in the Volta Cocoa Region of Ghana generally have high level of knowledge in cocoa farming with means ranging from 3.9 to 4.1. On mean rankings the Cocoa farmers are expected to improve their competencies of their knowledge on farm size determination (mean:3.9 and SD: 0.9) and observation of pre-harvest and re-entry periods (Mean:3.9 and SD:0.8) as they were found to be the least amongst the statements making up the knowledge competency construct. The results show some level of gaps in knowledge in cocoa farming since cocoa farmers could not attain the maximum mean value of five. Asamoah et al. (2017) similarly found discrepancies between farmers' knowledge in terms of recommended practices. Extension efforts through training are required to sustain and improve the knowledge base of cocoa farmers in cocoa farming in the Volta Cocoa Region of Ghana.

The results (Table 61) indicated cocoa farmers generally have fair to high attitudes (Mean range of 3.1 to 4.2) towards cocoa farming.

Table 61: Mean Attitude of Cocoa Farmers to Cocoa Farming in the Volta Cocoa Region

Attitude statements	Mean	SD
I believe adopting recommended cocoa innovations shared with me results in increasing my cocoa yields	4.2	0.7
I believe that fermenting unripe and diseased cocoa beans will affect the chocolate flavour of cocoa beans	3.9	0.8
I believe that observing re-entry period is important for prolonging my health in cocoa farming	4.0	0.8
I believe observing pre-harvest period is important for preventing agrochemical residues in cocoa beans	4.0	0.8
I believe that participating in cocoa farmer group activities increases my knowledge and skills in cocoa farming	4.0	0.8
I believe that storing agrochemicals in stores will keep me and my family safe and healthy	4.0	0.8
I believe undertaking cocoa farming activities at the right time improves yield and incomes	4.0	0.8
I believe rehabilitating my aged and diseased cocoa farm helps to reduce diseases and sustains my cocoa farming enterprise	4.0	0.8
I believe paying back my cocoa loans and input credit on time helps accessing such facilities in future	3.9	0.8
I believe that investing in my cocoa farming activities helps to increase productivity of my farm and income	3.7	0.9
I believe having a registered farm plan from the lands commission helps to own my cocoa farm	3.1	1.1

Source: Field survey, Agyeman (2020). Mean calculated from a scale of 4.45-5.0 (Strongly Agree), 3.45-4.44 (Agree), 2.45-3.44 (Moderately Agree), 1.45-2.44 **(**Lowly agree) and 1-1.44 (Very Lowly Agree).

The results show cocoa farmers have fair attitude towards ‘having a registered farm plan from the lands commission helps to own my cocoa farm’ (Mean:3.1 and SD:1.1). Cocoa farmers efforts to map their farms are critical, as only those involved in private extension typically were found to have farm plans. However, Cocoa farmers in the Volta Cocoa Region were found to have high attitude (Mean:4.2 and SD:0.7) towards the statement ‘believing adopting recommended cocoa innovations shared with me results in increasing my cocoa yields'. It is critical that farmers who own their cocoa lands/farms improve their level of attitude registration of their lands with the lands commissions in order to properly own them. Rockwell & Bennet (2004) summarises the attitudes of farmers pertaining to their beliefs, feelings, and opinions. Extension efforts are required by providers (CHED and private) to increase farmers level of attitudes towards cocoa farming in the Volta Cocoa Region of Ghana. Possession of the individual mental and physical abilities (skills) by cocoa farmers has positive implications on adoption of innovations (Rockwell & Bennet, 2004).

Table 62 presents results (Means and standard deviations) on the skill levels possessed by cocoa farmers in cocoa farming in the Volta Cocoa Region of Ghana. Cocoa farmers in the Volta Cocoa Region were found to have fair skills levels in usage of Personal Protective Equipment (Mean :3.1 and SD: 1.3), transplanting seedlings (Mean 3.1 and SD 1.4), providing both temporary (Mean:3.1 and SD:1.2) and permanent shades (Mean :3.1 and SD:1.2) as well as repairing spraying machines (Knapsack and Motorized) (Mean:2.8 and SD:1.2). Extension providers must train technical or field officers on basic machine repairs in order to attend to faults on machines as they arise on the field.

Table 62: Skills of Cocoa Farmers in Cocoa Farming in the Volta Cocoa Region

Skills statements	Mean	SD
I am able to nurse cocoa seedlings in polybags or beds correctly	4.0	0.9
I am able to accurately determine my cocoa farm or land size	3.4	1.1
I am able select a good site for cocoa farming	4.3	0.9
I am able to determine accurate planting distance for cocoa	3.9	0.9
I am able to transplant nursed cocoa seedlings correctly	3.1	1.4
I provide temporary shade trees to transplanted cocoa seedlings	3.1	1.2
I provide adequate permanent shade trees on my cocoa farm	3.1	1.2
I am able to correctly and regularly prune my cocoa farm	3.7	0.8
I am able to control weeds on my cocoa farm	3.8	0.8
I am able to apply various granular fertilizers on cocoa farm	3.7	0.9
I am able to apply foliar fertilizers using sprayers	3.7	1.0
I am able to manage drainage conditions on my cocoa farm	3.5	1.2
I am able to identify ripen cocoa pods	4.3	0.9
I am able to harvest ripen cocoa pods without damaging the flower cushions	4.2	0.9
I am able to control pests and diseases on cocoa farm	3.9	1.2
I am able to set fire belts around my cocoa farm	3.0	1.3
I break cocoa pods only after 2-3 days after harvesting	4.0	1.0
I break harvested cocoa pods with clubs (sticks) to prevent damaging the beans	4.1	0.9
I am able to ferment cocoa beans for the recommended 6 days	4.2	0.9
I am able dry fermented cocoa beans to right moisture level or to a point of feeling a cracking sound	4.1	3.9
I am able to store dried cocoa beans in jute sacks and from contaminants	3.9	1.0
I wear personal protective equipment in undertaking cocoa farming activities	3.1	1.3
I am able to observe re-entry interval periods for cocoa agrochemicals	3.7	0.1
I am able to observe pre-harvest intervals for various agrochemicals	3.6	1.0
I am able to repair my sprayers	2.8	1.2

Source: Field survey, Agyeman (2020). Mean calculated from a scale of 4.45-5.0 (Strongly Agree), 3.45-4.44 (Agree), 2.45-3.44 (Moderately Agree), 1.45-2.44 (Lowly agree) and 1-1.44 (Very Lowly Agree).

Conversely, on the mean rankings of the high skills levels possessed, cocoa farmers abilities to 'select a good site for cocoa farming (Mean: 4.3 and SD: 0.9) and identification of ripen cocoa pods' (Mean: 4.3 and SD: 0.9) were found to be the highest. Cocoa farmers were however found to have high skill level in 'Harvesting of ripen cocoa pods without damaging the flower cushions (Mean:4.2 and SD:0.9) and 'Fermentation of ripen cocoa pods' (Mean 4.2 and SD:0.9). The results further indicate cocoa farmers in the Volta Cocoa Region have fair skills (Mean:3.0 and SD:1.3) in setting fire belts around their cocoa farms' which is the least competency possessed amongst the skill competency statements. Due to the prevalence of fire outbreaks situation in the Volta Cocoa Region with its associated negative effects on cocoa farmers, it is critical that cocoa farmers' skills in fire control are improved by COCOBOD CHED in partnership with the National fire service in order to save farms from such fire outbreaks effects.

Cocoa farmers' aspirations towards cocoa farming in the Volta Cocoa Region of Ghana is presented in Table 63.

Table 63: Aspiration Levels of Cocoa Farmers to Cocoa Farming in the Volta Cocoa Region

Aspiration statements	Mean	SD
I desire to expand my cocoa farm(s)	3.8	1.3
I desire to use my cocoa farming business to increase my total household income	4.0	1.0
I desire for cocoa farming related information on radio, television, and the social media	4.1	0.9
I desire to have access to more training materials on cocoa farming	4.1	0.9
I desire to have access to government's free cocoa inputs	4.4	0.8
I desire to have access to cocoa input credits	4.1	1.0
I desire to have access to reliable and affordable cocoa labour services	4.3	0.9
I desire to contribute towards my pension using my cocoa income	3.8	1.2
I desire to insure my cocoa farm against risks (e.g., weather, fire, pests, and diseases)	3.6	1.3
I desire to encourage my children and dependent(s) to engage in cocoa farming as a business	3.5	1.2
I desire to win best cocoa farmer awards	3.7	1.1

Source: Field survey, Agyeman (2020). Mean calculated from a Scale: 4.45-5.0 (Strongly Agree), 3.45-4.44 (Agree), 2.45-3.44 (Moderately Agree), 1.45-2.44 (Lowly agree) and 1-1.44 (Very Lowly Agree).

Cocoa farmers were found to have fair to high (mean value range of 3.5 to 4.1) levels of aspiration competency in cocoa farming. The mean raking of Cocoa farmers desire to have access to free government cocoa farming inputs (Mean:4.4 and SD:0.8) was ranked highest amongst the highly rated aspiration competency statements. This level of aspiration require government to improve provision of such free inputs to cocoa farmers in the Volta Cocoa Region of

Ghana. Moreover, Cocoa farmers also ranked high the aspiration competency regarding their 'desire to encourage their wards or dependents to go into cocoa farming (Mean:3.5 and SD: 1.2) which is crucial in supporting more youth into cocoa farming in the Volta Cocoa Region of Ghana. Provision of the requisite training and incentives to the youth to commence and remain in cocoa farming are important in achieving this objective.

Table 64 presents the overall mean competency levels of cocoa farmers in cocoa farming in the Volta Cocoa Region of Ghana.

Table 64: Mean Competency Level of Cocoa Farmers in Cocoa Farming

Competencies	Mean	SD
Knowledge	4.0	0.8
Attitude	3.9	0.6
Skills	3.8	0.6
Aspirations	4.0	0.8
Competency	**3.9**	**0.50**

Source: Field survey, Agyeman (2020). Mean calculated from a scale of 4.45-5.0 (Strongly Agree), 3.45-4.44 (Agree), 2.45-3.44 (Moderately Agree), 1.45-2.44 **(**Lowly agree) and 1-1.44 (Very Lowly Agree).

The results indicate cocoa farmers have high competencies levels in knowledge (Mean:4.0 and SD:0.7), attitude (Mean:3.9 and SD:0.6), skills (Mean:3.8 and SD:0.6), and aspirations (Mean:4.0 and SD:0.8) in cocoa farming. On a scale of ranking the skills in cocoa farming were found to be the least competency indicator with their knowledge in cocoa farming being the highest cocoa farming competency indicator for cocoa farmers in the Volta Cocoa Region.

Cocoa farmers overall competency in cocoa farming was found to be high (Mean: 3.9 and SD:0.5). Training, farm inputs and incentive are required to sustain and further improve the competency of cocoa farmers in the Volta Cocoa Region. Particularly, Cocoa farmers in the Volta Cocoa Region require continuous improvement in their cocoa farming skills by extension providers through training and provision of the right tools and equipment as well as supports (financial, inputs etc.) to result in higher adoption levels of cocoa innovations in the Volta Cocoa Region of Ghana.

Table 65 shows the results of the Friedman test used to assess significant differences in the mean rankings of competency indicators among cocoa farmers in the Volta Cocoa Region of Ghana.

Table 65: Friedman Rank Tests for Competency Indices used for Classifying Cocoa Farmers Under Cocoa Extension System

Friedman Test Statistics	**Knowledge**	**Attitude**	**Skill**	**Aspiration**
Mean	4.0	3.9	3.8	4.0
St Dev	0.8	0.6	0.6	0.8
Mean Rank	2.9	2.5	2.1	2.5
Total Observation				420
Chi square				86.3
Degree of freedom				3.0
Asymptotic Significance				0.0

Wilcoxon Signed Ranks Test Statistics

	Attitude - Knowledge	Skills-Knowledge	Aspirations-Knowledge	Skills - Attitude	Aspiration - Attitude	Aspirations - Skills
Z	-4.747^{b}	-9.666^{b}	-1.322^{b}	-6.127^{b}	$-.897^{c}$	-4.287^{c}
Asymp. Sig. (2-tailed)	0 .000	0.000	.186	.000	.370	.000

Based on positive ranks

Source: Field Survey, Agyeman (2020)

The Friedman test results show a statistical significance difference $\chi^2(3) = 86.320$, $p = 0.000$ in the competency indices (Knowledge, Skills, Attitude, and Aspirations) of cocoa farmers in the Volta Cocoa Region. Post-hoc analysis with Wilcoxon signed-rank test conducted to determine where the significant differences exist among the competency indices indicate significant differences in attitude and knowledge (Z =-4.747, p =0.000); skills and knowledge (Z = -9.666, p =0.000); skills and attitude (Z = -6,127 p = 0.000), and aspirations and skills (Z = -4.287, p =0.000) of the cocoa farmers in the Volta Cocoa Region.

Adoption of Cocoa Innovations in the Volta Cocoa Region

This section discusses cocoa innovation adoption rates and levels by cocoa farmers in the Volta Cocoa Region of Ghana. GAPs, certification, farmer-level purchases, and farm enterprise management innovations are particularly presented (with illustrations) and discussed in this chapter. The rate of adoption of Good Agricultural Practices is presented in Table 66.

Table 66: Rate of Adoption of GAP Innovations in the Volta Cocoa Region

Good Agricultural Practices (GAP)	Number of Adopters	Percent Rate of adoption
Raising cocoa seedlings in poly bags	358	85.2
Raising cocoa seedlings on beds	227	54.0
Selecting a good site for cocoa farming	369	87.9
Demarcation of cocoa farm/land	248	59.0
Preparing permanent land for cocoa farming	393	93.6
Transplanting nursed seedlings	392	93.3
Planting cocoa seedlings in lines	286	68.1
Planting cocoa seedlings using recommended spacing	222	52.9
Providing temporary shades	366	87.1
Regular pruning of cocoa trees	377	89.8
Application of granular cocoa fertilizer using broadcasting method	332	79.0
Application of foliar fertilizers using sprayers	324	77.1
Application of organic manure in cocoa farm	233	55.5
Blackpod disease control	371	88.3
Cocoa Mirids pest control	388	92.4

Table 66 continued

Observing re-entering for applied chemicals	365	86.9
Erosion and drainage control	326	77.6
Regular weed control on the farm	350	83.3
Creating fire belts around cocoa farms	177	42.1
Identification of ripened cocoa pods	391	93.1
Observing pre-harvest interval (Waiting for days after spraying before harvesting ripen pods)	378	90.0
Harvesting ripen cocoa pods without damaging the flower cushions	410	97.6
Breaking cocoa pods at 2-3 days after harvesting	400	95.2
Breaking cocoa pods without cutting through the beans	405	96.4
Fermentation of cocoa beans for six days	406	96.7
Drying fermented cocoa beans to the right moisture level	406	96.7
Storage of dry cocoa beans in recommended jute bags	383	91.2

Source: Field survey, Agyeman (2020)

The findings (Table 66) indicate cocoa farmers general rate of adoption of GAPs innovations range from 42.1 to 97.6 percent. The findings show GAPs innovations such as ‘harvesting ripen pods without destroying flower cushions (97.6 percent); ‘fermentation of cocoa beans for six days’ (96.7 percent); ‘drying cocoa beans to the proper moisture (96.7 percent); ‘Waiting for 2-3 days before breaking pods’ (95.2 percent); ‘breaking pods without cutting through beans’ (95.2 percent), and ‘storage of dry cocoa beans in recommended jute bags’(91.2 percent) have a an appreciable rates of adoption amongst cocoa farmers in the Volta Cocoa Region. Organic manure application in cocoa farms, creation of fire belts, planting cocoa trees with recommended spacing, and proper demarcation of cocoa lands rank low among cocoa farmers, falling below 60 percent adoption. Adoption of granular and foliar fertilizer use rates was also found to be 79 and 77.1 percent respectively. Fertilizer use has been found to be profitable in cocoa farming as fertilizer-treated fields produce higher yields. Fertilizer use has been found to be low due to high prices if not subsidized (Kolavalli et al., 2016). This could account for the level of observed rate of adoption. Examples of cocoa seedlings raised in polybags and drying of beans innovations in the Volta Cocoa Region are shown in Figures 33 and 34 respectively.

Figure 33: Nursed cocoa seedlings using polybag method at the Ketepii community
Source: Field survey, Agyeman (2020)

Figure 34: Farmer drying cocoa beans to the right moisture level at the Togormey community.

Source: Field survey, Agyeman (2020)

Oomes et al. (2016) finds that smaller farms result in farmers less likelihood of investing in new farm technologies culminating in lower returns on investment. Factors such as weather, pests, late availability of inputs, price fluctuations, and land tenure issues are risks and uncertainties associated with technology use. Moreover, the education level of cocoa farmers and their farm size positively correlate with innovation adoption rates (Oomes et al., 2016) which require extension supports from providers in the Volta Cocoa Region of Ghana. The rate of adoption of certification innovations is presented in Table 67.

Table 67: Rate of Adoption of Certification Innovations in the Volta Cocoa Region.

Certification innovations (n=10)	Number of Adopters	Percent Rate of adoption
Planting the required shade trees in cocoa farms	39	60.9
Practicing non-use of children to undertake hazardous work in cocoa farming	48	75.0
Observing good treatment of workers engaged in cocoa farming	45	70.3
Practicing protection of wildlife (other plants and animals in cocoa farms and the environment	46	71.9
Creating buffer zones between cocoa farms and water bodies	43	67.2
practicing good sanitation in the farm, home, and community	48	75.0
Registering mapped farmland to own a farm plan	35	54.7
Wearing personal protective equipment when undertaking cocoa farming activities	50	78.1
Storing agrochemicals in storage rooms and from food substances	48	75.0
Disposing off by collecting and gathering used agrochemical bags, bottles, sachets	38	59.4

Source: Field survey, Agyeman (2020)

The results (Table 67) indicate certification innovations adoption rates range from 54.7 to 78.1 percent. Certification innovations such as ‘not using children to perform hazardous work’ (75 percent), ‘good treatment of workers’

(70.3 percent), 'protecting wildlife' (71.9 percent), and 'properly disposing off agrochemical sachets and bottles' (59.4 percent) were widely adopted, with adoption rates exceeding 55 percent in the Volta Cocoa Region of Ghana. Also 'registering mapped farmland to own a farm plan' was found to have the lowest level adoption rate (54.7 percent) amongst the farmers. 'Planting of the required type and number of shade trees in cocoa farms (Kaba, Otu-Nyanteh, & Abunyewa, 2020) require improvement as 60.9 percent of certification beneficiary Cocoa farmers adopted the innovation. Figure 35 depicts farmers in the Volta Cocoa Region observing buffer zones and storing agrochemicals as a certification requirement.

Figure 35: Observation of certification standards by keeping buffer zones (left)-Akpafu-Odomi and group agrochemicals and tools storeroom (right) at Kute.

Source: Field survey, Agyeman (2020)

Shade trees are essential for maintaining a balance of shade and sunlight on the cocoa farm, as well as disease management such as Blackpod. Findings of the study indicate COCOBOD provides cocoa farmers with shade trees (e.g., Ofram) to plant in their cocoa farmers. The study however found that while some people received these shade tree seedlings, they did not plant them. Farmers cite late supply of shade trees after rainy seasons as one of the reasons for not planting seedlings. Moreover, farmers indicate during the focused group discussions that initially *"We were informed the trees don't help the cocoa to grow well, so we felled the trees. But we are now planting the trees" (FGD Kute, 17th January 2020*). This level of discrepancies in knowledge on the relevance of shade trees to the sustainability of cocoa farms and the environment need to be corrected by extension efforts. Moreover, the study found trees in the sharecropping systems do not belong to the sharecropper, but rather to the farm owners. Also, existing trees on sharecropping lands were found to be owned by either the landowner or the sharecropper, depending on the terms of the agreement.

The rate of adoption of farmer level purchase innovations in the Volta Cocoa Region is presented in Table 68.

Table 68: Rate of Adoption of Farmer Level Purchase Innovations in the Volta Cocoa Region

Farmer level purchase innovations	Number of Adopters	Percent rate adoption
Properly conveying bagged cocoa beans to cocoa sheds without contamination	408	97.1
Selling all cocoa beans to COCOBOD LBCs in Ghana	403	96.0
Regularly using testing stones and/or body weight to detect scale adjustments	226	53.8
Ensuring cocoa sales are recorded in COCOBOD passbook	389	92.6
Promptly paying advanced loans from LBCs in cocoa or cash	178	42.4

Source: Field survey, Agyeman (2020)

The results (Table 68) show the cocoa Farmer level purchases adoption rate to range from 42.4 to 97.1 percent. 'Proper conveyance of bagged cocoa beans to sheds' (97.1 percent), 'selling all cocoa beans to COCOBOD LBCs in Ghana' (96 percent), and 'ensuring cocoa sales are recorded in COCOBOD passbooks' (92.6 percent) innovations had high rates of adoption among cocoa farmers in the Volta Cocoa Region exceeding 90 percent rate of adoption. However, 'using testing stones and/or body weight to detect scale adjustment' (53.8 percent) and 'promptly paying advanced loans by LBCs' (42.4 percent) were the least adopted FLP innovations in the Volta Cocoa Region. Though cocoa farmers rates of adoption of Ghana COCOBOD directive on sale of all cocoa beans to Ghanaian registered LBCs was found at 96.0 percent adoption rates, the gap of 4 percent need to be bridged. This suggests that some farmers smuggle cocoa into Togo which necessitates focusing on dealing with the problem. The types of Scales used in cocoa purchases in the Volta Cocoa Region is shown in Figure 36.

Figure 36: Electronic scale (left) and manual scale (Right) types used in the Volta Cocoa Region
Source: Field survey, Agyeman (2020)

Figure 37: Cocoa farmer emptying cocoa beans in nylon sacks into jute sacks at a cocoa shed in the Volta Cocoa Region

Source: Field survey, Agyeman (2020)

The study found that PCs in the Volta Cocoa Region used both electronic and manual scales (Figure 36) to purchase cocoa beans. When compared to manual scales, farmers believe electronic scales are not adjusted. Figure 37 shows some farmers store their beans for sale in polythene bags. Though it is recommended that COCOBOD jute sacks be used at all times, purchasing clerks claim that diversion of beans by farmers to other LBCs resulting in loss of provided jute bag, account for not giving out sacks to farmers. However, credible, or loyal farmers of PCs were indicated to be given jute sacks to store cocoa beans produced. It is critical that COCOBOD provides farmers with sacks primarily for storing cocoa beans in smaller quantities.

Table 69 shows the rate of adoption of farm enterprise management innovations by cocoa farmers in the Volta Cocoa Region.

Table 69: Rate of Adoption of Farm Enterprise Management Innovations in the Volta Cocoa Region

Farm Enterprise Management (FEM)	Number of Adopters	Percent rate of adoption
Budgeting for cocoa farming activities	146	34.8
Keeping records on cocoa farming activities	173	41.2
Contracting labour to undertake activities on cocoa farm on time	275	65.5
Supervising contracted labour in undertaking cocoa farming activities	294	70.0
Mobilizing financial and material resources (e.g., inputs, equipment etc.) for cocoa farming	276	65.7
Paying for received cocoa inputs and service credits on time	216	51.4
Saving cocoa income in banks and other financial organisations	229	54.5
Regularly participating in cocoa related meetings and trainings	273	65.0
Estimating expenditure incurred in cocoa farming	159	37.9
Diversifying farming enterprises	333	79.3
Estimating profit realized from cocoa farming	153	36.4
Investing cocoa incomes in cocoa farming and other enterprises	315	75.0

Source: Field survey, Agyeman (2020)

The rate of FEM innovation adoption was found to range from 34.8 to 79.3 percent (Table 69). Particularly, the results show 'diversification of farming enterprises' (79.3 percent) and 'investing cocoa incomes in cocoa farming cocoa and other enterprises' (75 percent) had higher adoption rates by the cocoa farmers in the Volta Cocoa Region of Ghana. Whereas 'budgeting for cocoa farming activities' (34.8 percent), 'Estimation of expenditure incurred in cocoa farming' (37.8 percent) and 'estimation of profit realized from cocoa farming' (36.4 percent) were the least adopted FEM innovations among cocoa farmers in the Volta Cocoa Region falling below 40 percent. The Cocoa farmers in the Volta Cocoa Region generally expressed dissatisfaction observed from estimating expenditure and profits because they frequently found that they are not making profits after such estimates. Record keeping is crucial for farm development yet, the results show 41.2 percent adoption rate. It is critical that farmers are constantly encouraged and supported by CHED CEA's and private extension Technical Officers to keep records on their cocoa farming activities. This will generally assist cocoa farmers to estimate their expenditure and profits to keep their cocoa farming as a viable business enterprise.

Figure 38: Cocoa farmer diversification into coconut farming at the Kpando-kofe community

Source: Field Survey, Agyeman (2020).

Tables 70 and 71 respectively show the overall frequency and mean level of adoption of Good Agricultural Practices, Certification, Farmer Level Purchases, and Farm Management Innovations. The level of adoption of innovations is shown in Table 70.

Table 70: Level of Adoption of Cocoa Innovations in the Volta Cocoa Region

Level of Adoption	GAPs		CERT		FLP		FEM	
	f	percent	f	percent	f	percent	f	percent
Very High	260	61.9	20	31.3	106	25.2	119	28.3
High	141	33.6	12	18.8	154	36.7	119	28.3
Moderate	16	3.8	22	34.4	144	34.3	48	11.4
Low	3	0.7	9	14.1	14	3.3	66	15.7
Very Low	-	-	1	1.6	2	0.5	68	16.2
Total	420	100	64	100	420	100	420	100

Source: Field survey, Agyeman (2020). Mean calculated from a scale of 4.45-5.0 (Very High adoption), 3.45-4.44 (High adoption), 2.45-3.44 (Moderate adoption), 1.45-2.44 **(**Low adoption agree) and 1-1.44 (Very low adoption).

Generally, there is a very high frequency (61.9 percent) of GAPs innovation adoption amongst cocoa farmers whilst certification and farmer level purchase innovations respectively had moderate and high frequencies of adoption levels. Farm enterprise management innovations adoptions were found to have high and very high frequencies of adoption among cocoa farmers in the Volta Cocoa Region of Ghana. The level of cocoa innovation adoption is presented Table 71.

Table 71: Mean Innovation Adoption Levels of Cocoa Farmers in the Volta Cocoa Region

Innovations Adoption Level (IAL)	Mean	SD
GAPs	4.6	0.6
CERT	3.6	1.1
FLP	3.8	0.8
FEM	3.4	1.4
Total	3.9	1.0

Source: Field survey, Agyeman, (2020). Mean calculated from a scale of 4.45-5.0(Very High adoption), 3.45-4.44 (High adoption), 2.45-3.44 (Moderate adoption), 1.45-2.44 **(**Low adoption agree) and 1-1.44 (Very low adoption)

Generally (Table 71), the results show high level of GAPs (Mean 4.6, SD 0.6), Certification (Mean 3.6, SD 1.1), and Farmer level purchase (Mean 3.8, SD 0.8) innovation amongst cocoa farmers in the Volta Cocoa Region, whereas a moderate (Mean 3.4, SD 1.4) level of adoption was found for FEM innovations. Overall, the results show cocoa farmers in the Volta Cocoa Region have a high (Mean 3.9 and SD 1.1) level of cocoa innovation adoption.

According to Aneani et al. (2012), credit, the number of cocoa farms owned by the farmer, gender, the age of the cocoa farm, migration, cocoa farm size, and cocoa yield obtained all influence cocoa farmers' adoption decisions regarding CRIG-recommended innovations. These issues require concerted efforts by government and private organizations to fully deal with them to ensure very high levels of adoption amongst cocoa farmers in the Volta Cocoa Region of Ghana.

The results of the Friedman rank test used to test differences in adoption indices (GAPs, CERT, FLP and FEM) are shown in Table 72.

Table 72: Friedman Rank Tests for Innovation Adoption Indices Used for Classifying Cocoa Farmers into Cocoa Extension System.

Friedman Test Statistics for the mean ranks	GAPS	CERT	FLP	FEM
Mean	4.6	3.6	3.8	3.4
St Dev	0.60	1.12	.86	1.44
Mean Rank	3.02	1.98	2.75	2.24
Total Observation				64
Chi square				36.4
Degree of freedom				3.00
Asymptotic Significance				0.000

Wilcoxon Signed Ranks Test Statistics

	FEM-GAPS	FLP - GAPS	CERT-GAPS	FLP-FEM	CERT-FEM	CERT-FLP
Z	-13.589[b]	-12.163[b]	-5.058[b]	-5.943[c]	-.958[b]	-4.005[b]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.338	.000

Based on positive Ranks.
Source: Field survey, Agyeman (2020).

The Friedman test (Table 72) results show a statistical significance difference $\chi^2(3) = 36.446$, p = 0.000 in the level of adoption of Good Agricultural Practices (GAPS), Certification (CERT), Farmer Level Purchases (FLP), and Farm Enterprise (FEM) innovations indices amongst cocoa farmers in the Volta Cocoa Region. The post-hoc analysis with Wilcoxon signed-rank test conducted to determine where these significant differences exist among level of adoption indices revealed significant differences in the FEM and GAPs (Z =-13.589, p =0.000), FLP and GAPs (Z =-12.163, p=0.000), CERT and GAPs (Z = -5.058 p = 0.000), and FLP and FEM (Z = -5.943, p =0.000) and CERT and FLP (Z = -4.005, p =0.000) of cocoa farmers in the Volta Cocoa Region of Ghana.

The results indicate the importance of adoption of GAPS, CERT, FLP and FEM innovations to raise cocoa yield in the Volta Cocoa Region of Ghana. Cocoa farmers therefore require the necessary inputs and supports in this direction.

Yield of Cocoa Farmers in the Volta Cocoa Region

Cocoa farmers' yield represents the dried cocoa beans obtained from all cocoa farmers' farms. Table 73 shows the cocoa yield (kg/ha) obtained by cocoa farmers in the Volta Cocoa Region over the year period (2018/2019 cocoa season).

Table 73: Yield of Cocoa Farmers in the Volta Cocoa Region

Yield	Mean	SD
Bags (Weight)	65.0	1.1
Yield (Kg/ha)	793.5	987.1
Yield(bags/ha)	12.2	15.2

Source: Field survey, Agyeman (2020)

The results show that the average weight per bag of cocoa is 65kg. Farmers groups under each collector (same as purchasing clerk) agree to give the collector a volume of cocoa ranging from 1-3 kilos to cover his/her expenses and short weights under the CAA system. Moreover, the study found that in the 2018/2019 season, cocoa farmers in the Volta Cocoa Region obtained a mean yield of 793.5kg/ha with SD: 987.1kg/ha which equates to 12 bags/ha. It is important cocoa farmers work towards and beyond this yield level. The yield obtained by cocoa farmers in the Volta Cocoa Region is lower than the experimental and farmer yield potentials of 1891.3kg/ha (30 bags) and 1875.1kg/ha (29 bags) per hectare, but higher than the 333.7kg/ha (5.3 bags/ha) national average yield found by Aneani and Ofori-Frimpong (2013). According to related research by Asamoah, Owusu-Ansah, Brannor, Ofori, and Darkwa

(2013), Ghana's average yield is 400-500 kg/ha and 1400 kg/ha for 10 percent of cocoa farmers, while Kumi and Daymond (2015) and Donovan, Stoian, Foundjem, and Degrande (2016) reported mean cocoa yields of 400 kg/ha and 400-530 kg/ha, respectively. According to Asare and Sonii (2011), in order to sustain the cocoa farming sector, cocoa farmers must produce 1000kg/ha of cocoa.

Income of Cocoa Farmers in the Volta Cocoa Region

Cocoa income includes the sale of cocoa beans as well as the receipt of premiums for participation in a certification scheme, both of which are expressed in Ghana cedis. This section presents the farm, cocoa income, and non-farm income shares in the Volta Cocoa Region. The cocoa farmers' cocoa income in the Volta Cocoa Region was calculated using the COCOBOD 2018/2019 season producer price of GH¢475.00 and a premium of GH¢17.0 per bag (received only by CAA farmers). Table 74 presents results on the farm and non-farm income realised by the cocoa farmers in the Volta Cocoa Region of Ghana.

Table 74: Income sources and Shares of Cocoa Farmers in the Volta Cocoa Region

Income sources	n	Mean (GH¢)	SD (GH¢)	Income Share	Percent Income share
		Farm Income			
Cocoa income	420	5707.5	8270.4	0.632	63.2
Other crops income	302	1875.8	3288.6	0.167	16.7
Livestock income	89	663.3	597.6	0.017	1.7
Natural resources	9	422.2	204.8	0.001	0.1
Farm wages	43	1533.6	1756.3	0.026	2.6
Total (Farm Income)		**7362.7**	**9149.6**	**0.844**	**84.4**
		Non-Farm Income			

Table 74 continued

Self -Employment	119	1874.4	2631.8	0.089	8.9
Non-farm wages	52	4017.9	4562.5	0.038	3.8
Remittance	46	837.6	2121.1	0.014	1.4
Others income sources	28	2826.7	3164.0	0.016	1.6
Total (Non-Farm Income)		**1308.7**	**2889.6**	**0.156**	**15.6**
Total Household income		8671.4	9966.8	1.00	100
Per capita THI		1480.6	1871.0		
Per capita cocoa income		963.0	1529		

Source: Field survey, Agyeman (2020).

The results (Table 74) show total farm income (Mean: 7362.7, SD: 9149.6) earned by cocoa farmers' accounts for 84.4 percent of total household income. That is, cocoa farmers in the Volta Cocoa Region focus their income on cocoa and other crop farming (16.7 percent of THI): maize, yam, cereals such as maize and rice, vegetables, and ginger. The average annual income (Total Household income) for cocoa farmers was also found to be GH¢ 8671 (SD: GH¢ 9966.8) which was higher than the GH¢ 4,596 per year and GH¢ 5,073 per year for Ghana (Asamoah et al., 2013). Kumi and Daymond (2015) however found the average annual cocoa income range for cocoa farmers from 604 to 16,400 cedis.

This research found GH¢ 5707.5 (SD: GH¢ 8270.4) as the mean cocoa income for cocoa farmers in the Volta Cocoa Region, which is much lower than the highest range of income received by Ghanaian cocoa farmers. The findings also show that cocoa farmers receive 63.2 percent of their THI from the sale of cocoa beans and premiums similar to the findings Peprah (2015). The cocoa income share is higher than the national average of 61 percent, but lower than the 66 percent found in cocoa farmers Côte d'Ivoire (Hutz-Adams, Huber, Knoke, Morazán, & Mürlebach, 2016). The findings thus suggest importance of cocoa production to cocoa farmers in the Volta Cocoa Region as it appear to make a substantial contribution to their livelihoods. Livestock farming and natural resource collection (such as hunting and gathering firewood) account for 1.7 percent and 0.1 percent of total household income, respectively. Figure 39 illustrate piggery husbandry managed by a cocoa farmer in the Volta Cocoa Region. Cocoa farmers, as in this example and others, engaged in diversification in the Volta Cocoa Region need much support to expand and improve such additional enterprises.

Figure 39: Cocoa farmer engaged in pig husbandry at Obanda community.

Source: Field survey, Agyeman (2020)

Farm wage income from activities such as weeding, pruning, mass spraying, fetching water for spraying, transporting fermented cocoa to drying mats, and hand pollination, among others, accounts for 2.6 percent of Total Household Income (THI). Furthermore, cocoa farmers were found to divert into non-farm income-generating activities such as self-employment (e.g., trading and oil production,), accounting for 8.9 percent of THI. An example of a cocoa farmer engaged in vehicle fuel (petrol and diesel) business is shown in Figure

40. Such services are critical for providing avenue for other cocoa farmers to purchase fuel to power their motorized sprayers and motorcycles for carting inputs and farm produce as well as transporting farmers to and from farms and markets.

Figure 40: Cocoa farmer engaged in fuel business at Panku-Akura.

Source: Field survey, Agyeman (2020).

Cocoa farmers in the Vota Cocoa Region was also found to engage in non-farm jobs such as teaching and working as purchasing clerks for LBCs, and riding motorcycles and tricycles as a means of getting extra income. This constituted 3.8 percent of THI. Farmers were also found to receive remittances from children and other relatives in order to meet household needs such as school fees, healthcare, and the expansion of their cocoa farms. Other sources of income for farmers such as lotteries and awards, accounted for 1.6 percent of their total household income.

The findings show cocoa farmers receive additional income besides cocoa farming to meet the needs of their households. There is a need to broaden the scope and consistency of the farmer business school for cocoa farmers in Volta Cocoa Region of Ghana. Aneani, Adu-Acheampong & Sakyi-Dawson (2018) indicated low cocoa yields caused by high incidence of pest and diseases, declining soil fertility and use of unapproved planting materials to be associated with low cocoa income. Hence the need to address these challenges facing cocoa farmers to enable them to raise the income earned from their cocoa farming enterprises.

Independent t-test to Establish Differences in the effects of Extension Delivery for CHED and Pluralistic Extension groups.

This section presents the results and discussions of the Levene's homogeneity test and the independent t-test to determine whether there are significant differences in the effects of cocoa extension delivery (competency, innovation adoption level, yield, and income) between cocoa farmers receiving CHED (public) and pluralistic extension as stated in the four-hypotheses underpinning this study.

Levene's Test of Homogeneity of Variance

The Levene's test (Table 75) was used to test for equality of variances between CHED and pluralistic extension groups in the Volta Cocoa Region of Ghana.

Table 75: Levene's Test for Equality of Variance of Effects of extension delivery indices.

Extension Delivery Effects		F	Sig.	t	df	Sig. (2-tailed)
Competency	Equal variances assumed	3.7	.055	2.3	418	.022
	Equal variances not assumed			1.9	105.3	.057
Level of adoption of innovations	Equal variances assumed	7.9	.005	6.2	418	.000
	Equal variances not assumed			7.2	155.6	.000
Yield (kg/Ha)	Equal variances assumed	3.5	.062	2.4	418	.019
	Equal variances not assumed			2.1	108.7	.043
Cocoa income	Equal variances assumed	17.2	.000	2.9	418	.004
	Equal variances not assumed			2.1	94.5	.042

Source: Field Survey, Agyeman (2020)

The null hypothesis (Ho) for the Levene's test indicates there are no differences in the variances between the groups, and the alternative hypothesis (Ha) indicates there are differences. The Levene's test expects the variances between the groups not to differ. If the Levene's test are greater than 0.05, the Levene's test is indicated as not to be significant and hence equal variances assumed. Otherwise, if the significant value is less than 0.05, then equal variance is not assumed.

The Levene's test results (Table 76) indicate that competency (Sig. 0.55) and yield (Sig. 0.062) have significance more than the 0.05 threshold so equal variance is assumed. However, innovation adoption level (sig. 0.05) and income (Sig. 0.00) are respectively same and below the 0.05 value hence equal variances are not assumed between the groups. This result formed the basis for determining the significance of the extension delivery effect indices in the independent t-test results as presented in Table 76.

Table 76: Differences in the Competency, Innovation Adoption Levels, Yield, and Income of Cocoa Farmers Under Public (CHED) and Pluralistic Extension

Extension Delivery Effects	Extension system	n	Mean	SD	Mean diff.	t-Value	df	Sig.
Competency	CHED	337	3.91	.46	0.14	2.29	418	0.02
	Pluralistic	83	4.05	.62				
Innovation Adoption Level	CHED	337	3.80	.69	0.50	7.23	155.63	0.00
	Pluralistic	83	4.30	.53				
Yield	CHED	337	737.64	929.46	282.9	2.35	418	0.02
	Pluralistic	83	1020.50	1172.08				
Cocoa income	CHED	337	5121.44	6934.56	2965.7	2.81	418	0.04
	Pluralistic	83	8087.13	12617.43				

Source: Field survey, Agyeman (2020)

The results (Table 76) revealed significant difference in the level of competencies of farmers in cocoa production who received CHED (M=3.91, SD=0.46) and pluralistic extension (M=4.05, SD=.62, t=2.29, Sig =0.02). Similarly, the independent t-test result shows a significant difference in the level of adoption for CHED (M=3.80, SD=.69) and pluralistic extension receivers (M=4.30, SD=.53), t=7.23, Sig=0.00. Also, there was a significant difference in the cocoa yield (in kg/ha) for CHED (M=737.64, SD=929.46) and pluralistic extension receivers (M=1020.50, SD=1172.08), t= 2.35, Sig=0.02. The result further indicates significant difference in the cocoa income (Ghana cedis) for CHED (M=5121.44, SD=6934.56) and pluralistic extension receivers (M=GH¢8,087.13, SD=GH¢ 12,617.43), t= 2.81, Sig=0.04. The findings buttress the importance of pluralistic extension in improving the competency, adoption, the yield as well as the income of the farmers in the Volta Cocoa Region. Similarly, Muzenda et al. (2018) found pluralistic extension to increase the output, area cultivated, and income of participating cocoa farmers.

Based on these findings, the null hypotheses that there are no significant differences in the competency, innovation adoption levels, yield, and cocoa income of cocoa farmers receiving CHED and pluralistic extension were rejected.

Chapter Summary

This chapter presented and discussed results on the effects of extension delivery on cocoa farmers in the Volta Cocoa Region of Ghana. The knowledge, attitudes, skills, and aspirations and overall competency of cocoa farmers in cocoa farming were found to be high. The innovation adoption levels for GAPs, CERT, FLP and FEM of cocoa farmers in the Volta Cocoa Region of Ghana was also found to be high. The yield (Mean 793.5kg/ha; SD 987.1 kg/ha) and nominal income of the cocoa farmers from cocoa (Mean GH¢5707.5 SD: GH¢8270.4) have also been presented and discussed in this chapter. The cocoa income share accounted for 63.2 percent of total household income of cocoa farmers in the Volta Cocoa Region of Ghana. Farm and non-farm income respectively accounted for 84.4 percent and 15.6 percent of total household income. The null hypotheses for independent t-test were rejected as pluralistic extension was found to significantly improve the competency, innovation adoption levels, yield, and income of cocoa farmers in the Volta Cocoa Region of Ghana.

CHAPTER EIGHT

NEXUS BETWEEN EFFECTS OF COCOA EXTENSION DELIVERY AND THE SOCIO-DEMOGRAPHIC AND ECONOMIC FACTORS OF COCOA FARMERS IN THE VOLTA COCOA REGION

Introduction

This Eighth chapter discusses results of objective five that examined the nexus between the effects of extension delivery (competency, innovation adoption level, yield, and income) indicators from socio-demographic and economic factors of cocoa farmers in the Volta Cocoa Region of Ghana. The multicollinearity diagnostic tests of the independent variables used in the four separate multiple linear regressions are also presented in this chapter.

Multicollinearity Diagnostic Tests

Collinearity or multicollinearity issues in data emanate from two or more independent variables being highly correlated (Sarstedt & Mooi, 2014). This presents a violation in the rules underpinning regression analysis hence the relevance to the check presence of no or little collinearity issues prior to performing regression analysis (Sarstedt & Mooi, 2014). The results of the collinearity diagnostic tests for independent variables used in the four separate multiple linear regressions are presented in Tables 77, 78, 79 and 80. Issues of multicollinearity were ascertained by the tolerance and variance inflation factor (VIF) value thresholds.

Tolerance is the percentage of the variance in a given predictor that cannot be explained by the other predictors. Tolerance close to one indicates little multicollinearity, whereas a value close to zero suggests multicollinearity may be a threat. The VIFs (Tables 77, 78, 79, 80) show the extent of variance of the coefficient estimate which is inflated by issues of multicollinearity. The VIF values beyond ten indicate presence of multicollinearity (Midi et al., 2013).

Table 77: Collinearity Diagnostic Test from the Determining Social, Demographic and Economic Factors of Cocoa Farmers' Competencies

Independent Variable	Variance Inflation factor	Tolerance
Age(X_1)	1.981	.505
Education (X_2)	1.149	.871
Experience in Cocoa farming(X_3)	1.939	.516
FBS Participation(X_4)	1.130	.885
Registered under Certification(X_5)	1.163	.860
Extension Contact(X_6)	1.171	.854
CHED Empathy(X_7)	2.445	.409
Private Communication(X_8)	3.139	.319
Private Empathy(X_9)	3.016	.332
CHED Communication(X_{10})	2.155	.464

Source: Field survey, Agyeman (2020), n=420,

Table 78: Collinearity Diagnostic Test from Determining Social, Demographic and Economic Factors of Cocoa Farmers' Innovation Adoption Level

Independent Variable	Variance Inflation factor	Tolerance
Sex(X_1)	1.103	.907
Age(X_2)	1.488	.672
Education (X_3)	1.082	.924
Experience in Cocoa farming(X_4)	1.983	.504
FBS Participation(X_5)	1.188	.842
Quality of CHED Extension(X_6)	1.457	.687
Knowledge(X_7)	1.976	.506
Aspiration(X_8)	1.287	.777
Skills (X_9)	2.238	.447
Farm size(X_{10})	1.165	.858
Farm age(X_{11})	1.658	.603
Attitude (X_{12})	1.920	.521
Leadership position(X_{13})	1.067	.937

Source: Field survey, Agyeman (2020), n=420

Table 79: Collinearity Diagnostic Test from the Determining Social, Demographic and Economic Factors of Cocoa Farmers' Yield

Independent Variable	Variance Inflation factor	Tolerance
Sex(X_1)	1.096	.913
Age(X_2)	1.511	.662
Education (years) (X_3)	1.085	.922
Experience in Cocoa farming(X_4)	1.967	.508
FBS Participation(X_5)	1.235	.810
Quality of CHED Extension(X_6)	1.504	.665
Knowledge(X_7)	1.755	.570
Aspiration(X_8)	1.308	.764
Skills(X_9)	1.983	.504
Farm size (ha) (X_{10})	1.167	.857
Farm age(X_{11})	1.649	.607
Adopt FEM innovations(X_{12})	1.306	.766
Adopt GAPS innovations(X_{13})	1.236	.809

Source: Field survey, Agyeman (2020), n=420

Table 80: Collinearity Diagnostic Test from the Determining Social, Demographic and Economic Factors of Cocoa Farmers' Income

Independent Variable	Variance Inflation factor	Tolerance
Sex(X_1)	1.097	.911
Age(X_2)	1.496	.668
Education (years) (X_3)	1.105	.905
Experience in Cocoa farming(X_4)	2.076	.482
FBS Participation(X_5)	1.242	.805
Quality of CHED Extension(X_6)	1.477	.677
Knowledge (X_7)	1.754	.570
Aspiration (X_8)	1.293	.773
Skills (X_9)	1.994	.501
Farm size (ha) (X_{10})	1.260	.794
Farm age(X_{11})	1.726	.580
AdoptFLP innovations(X_{12})	1.061	.942
AdoptFEM innovations (X_{13})	1.251	.799
Yield (X_{14})	1.229	.813

Source: Field survey, Agyeman (2020) n=420,

The collinearity diagnostic test results (Tables 77, 78, 79 and 80) indicate no collinearity issues associated with the independent variables used in the four separate regression models (Tables 81, 82, 83 and 84) determining the competencies, innovation adoption levels, yield, and income of cocoa farmers from the social, demographic, and economic factors of cocoa farmers in the Volta Cocoa Region. The regression models were found not be associated with multicollinearity violations and hence the multiple linear regression analysis was performed using the sets of independent variables in each of the multiple linear regressions.

The results of the four separate regressions to establish the determining factors of the competency, innovation adoption levels, yield and income are presented and discussed in the following sections. The results are thus relevant for extension programme design and implementation.

Determinants of Competencies from Socio-Demographic and Economic Factors of Cocoa Farmers in the Volta Cocoa Region.

The regression model (Table 81) revealed significant ($p \leq 0.05$) relationships between the competency of cocoa farmers and socio-demographic and economic factors. According to the model, the independent variables explained 54 percent (R-squared) of the variations in competency (dependent variable). The findings (Table 81) show that education, registration under certification, CHED-empathy, CHED, and private extension communication were positively ($p \leq 0.05$) related to the competency of cocoa farmers in the Volta Cocoa Region of Ghana.

The multiple linear regression model used to determine the factors associated with competency (dependent variable) of the cocoa farmers in the Volta region is indicated as:

Competency=β_0 +β_1(age)+β_2(education)+β_3(experience in cocoa farming) + β_4(participation in FBS) + β_5(registration under certification) +β_6(extension contact) $+\beta_7$(CHED Empathy) $+\beta_8$(private communication) $+\beta_9$(private empathy) + β_{10} (CHED communication) $+\varepsilon$

Table 81: Relationship Between Cocoa Farmers' Competencies and Socio-demographic and Economic Factors of Cocoa Farmers in the Volta Cocoa Region

Independent Variables	Unstandardized Coefficients*		t	Sig.
	B	Std. Error		
(Constant)	2.378	.404	5.892	.000
Age	-.006	.006	-1.149	.254
Education	.022	.012	1.812	.074
Experience in Cocoa farming	.007	.008	.797	.428
FBS Participation	-.075	.114	-.663	.509
Registered under Certification	.246	.108	2.277	.026
Extension Contact	.000	.001	-.543	.589
CHED Empathy	.177	.088	2.006	.049
Private Communication	.377	.101	3.727	.000
Private Empathy	.071	.081	.873	.385
CHED Communication	-.219	.108	-2.034	.046
R-Square	Adjusted R-Square	Standard Error of the Estimate	Durbin-Watson	Sig.
.538	.474	.451	1.710	0.05

Source: Field survey, Agyeman (2020)

Cocoa farmers' improved competencies can be attributed to regular training on GAPs, cocoa purchases, farm enterprise management, and strict adherence to certification standards-Rainforest Alliance, UTZ (CHED and WCF, 2016). Waarts et al. (2014) reiterate this fact that participation in certification programmes results in improved GAPs implementation and cocoa farmer productivity.

According to Jana (2015), empathy is about understanding people from their point of view. Empathy enables extension agents to detect farmers' emotions and communicate mutual understanding and inspiration to them. Empathy is also regarded as a motivator in cocoa farming. As a result, extension methods such as farm and home visits, as well as phone conversations, are expected to be used to strengthen relationships between extension providers in order to improve farmer competencies (Agholor, 2016). CHED and private extension providers' communication practices must be constantly improved, particularly in terms of feedback, in order to deepen cocoa farmers' competencies in cocoa farming. Faqih and Aishyah (2019) support the need for communication in terms of information dissemination as part of the effective extension communication process among cocoa farmers in the Volta Cocoa Region of Ghana.

Determinants of Innovation Adoption Level from Socio-Demographic and Economic Factors of Cocoa Farmers in the Volta Cocoa Region.

The results (Table 82) indicate Participation in farmer business school (FBS), quality of CHED extension, knowledge, attitudes, skills, and aspiration competencies had positive significant ($p \leq 0.05$) relationships with cocoa farmers' innovation adoption levels in the Volta Cocoa Region.

The multiple linear regression model used to determine the factors associated with cocoa farmers innovation adoption levels (dependent variable) and independent variables is expressed as:

Innovation adoption level=β_0 +β_1 (sex)+β_2(age)+β_3 (education)+ β_4 (experience in cocoa farming) + β_5 (participation in FBS) + β_6 (quality of CHED Extension) + β_7 (knowledge)+ β_8 (aspiration)+ β_9 (skills) + β_{10}(farm size) + β_{11} (farm age) + β_{12} (attitude) +β_{13} (leadership position) + ε

Table 82: Relationship Between Cocoa Farmers' Innovation Adoption Level and Socio-demographic and Economic Factors in the Volta Cocoa Region.

Independent Variables	Unstandardized Coefficients*		T	Sig.
	B	Std. Error		
(Constant)	3.136	.320	9.789	.000
Sex	.009	.097	.093	.926
Age	-.005	.003	-1.815	.070
Education (years)	-.016	.008	-1.874	.062
Experience in Cocoa farming	-.002	.005	-.424	.672
FBS Participation	.248	.069	3.615	.000
Quality of CHED Extension	.166	.060	2.766	.006
Knowledge	-.126	.059	-2.145	.033
Aspiration	-.092	.045	-2.041	.042
Skills	.163	.075	2.186	.029
Farm size (ha)	.040	.025	1.596	.111
Farm age	-.001	.005	-.191	.849
Attitude	.189	.070	2.708	.007
Leadership position	-.065	.085	-.758	.449
R-Square	Adjusted R-Square	Standard Error of the Estimate	Durbin-Watson	Sig.
0.165	0.138	0.638	1.517	$p \leq 0.05$

Source: Field Survey, Agyeman (2020).

The model revealed that the independent variables explained 16.5 percent (R-squared) of the variations in the cocoa innovation adoption levels (Dependent variable) of cocoa farmers in the Volta Cocoa Region of Ghana.

The results (Table 82) indicate that whereas knowledge and aspiration competencies were negatively related to cocoa farmers' innovation adoption levels, the skills of cocoa farmers were directly related to the innovation adoption levels ($p \leq 0.05$). Knowledge is crucial for decision making by farmers regarding whether to adopt an innovation or not, what the outcomes are in terms of products, yield, potential environmental benefits, risks, and costs (Seline et al., 2015). However, aspects of the knowledge competency of cocoa farmers led to a reduced adoption of innovations. These required efforts of extension providers to assist farmers to essentially understand how knowledge could be practically applied to cocoa farming. The attitude competency of cocoa farmers to cocoa farming significantly related to the innovation adoption levels of the farmers. The attitude competency of cocoa farmers needs to be sustained through training and provision of related services such as incentives. Skills related to pruning, fertilizer application, harvesting, fermentation and drying are critical for cocoa farm productivity (Asare & Sonii, 2011). Extension needs to focus on improving cocoa farmers' skills in these innovations through demonstrations and use of interactive training materials such as videos and radio programmes.

The aspirations of cocoa farmers are critical for the long-term viability of the cocoa sector of the Volta Cocoa Region. Due to their aspirations for cocoa farming, cocoa farmers are also likely to encourage their dependents to enter the cocoa farming. CHED and private extension efforts are required to sustain cocoa farmers' aspiration competencies in cocoa farming. Participation in farmer business school (FBS) also had a positive relationship ($p \leq 0.05$) with the levels of innovation adoption among cocoa farmers in the Volta Cocoa Region.

The FBS implemented by COCOBOD (GIZ, 2016) remains relevant for the adoption of improved farm enterprise management innovations. To ensure that cocoa farmers in the Volta Cocoa Region engage in cocoa farming as a business, budgeting, record keeping, and profit estimation must be improved. The findings support the recommendation of Asare and Sonii (2011) that farmers engage in cocoa farming as a business or stop growing cocoa if they are unable to do so profitably and sustainably. The results (Table 82) indicate significance relationship between the quality of CHED extension with the innovation adoption levels of cocoa farmers. This is crucial for CHED to sustain the extension contacts and feedback processes in the delivery of extension in the Volta Cocoa Region to improve adoption of shared innovations to cocoa farmers. Mass media including radio and phone conversations can be used to enhance CHED Extension delivery in this direction (GFRAS, 2012).

Determinants of yield from Socio-Demographic and Economic Factors of Cocoa Farmers in the Volta Cocoa Region.

The regression model (Table 83) revealed a significant relationship ($p \leq 0.05$) between cocoa yield and socio-demographic and economic characteristics of cocoa farmers in the Volta Cocoa Region of Ghana.

The regression model used to determine the factors associated with yield (dependent variable) of cocoa farmers in the Volta Cocoa Region is expressed as:

Yield=β_0 + β_1 (sex)+ β_2(age)+ β_3 (education)+ β_4 (experience in cocoa farming) + β_5 (participation in FBS) + β_6 (quality of CHED extension) + β_7 (knowledge)+ β_8 (aspiration)+ β_9 (skills) + β_{10}(farm size) + β_{11} (farm age) + β_{12} (Adopt FEM Innovation) +β_{13} (Adopt GAPs Innovation) + ε

The R-squared of the model (Table 83) indicates that the independent variables explained 18.4 percent of the variation in cocoa yield (dependent variable) of cocoa farmers in the Volta Cocoa Region of Ghana.

Table 83: Relationship Between Yield and the Socio-demographic and Economic Factors of Cocoa Farmers in the Volta Cocoa Region

Independent Variables	Unstandardized Coefficients*		t	Sig.
	B	Std. Error		
(Constant)	-456.898	543.496	-.841	.401
Sex	-21.693	137.160	-.158	.874
Age	-5.450	4.237	-1.287	.199
Education (years)	32.831	11.926	2.753	.006
Experience in Cocoa farming	32.090	6.831	4.697	.000
FBS Participation	106.495	99.206	1.073	.284
Quality of CHED Extension	39.398	86.472	.456	.649
Knowledge	24.310	78.597	.309	.757
Aspiration	12.703	64.294	.198	.843
Skills	221.109	99.777	2.216	.027
Farm size (ha)	-193.169	35.240	-5.482	.000
Farm age	-26.812	6.472	-4.143	.000
AdoptFEM innovations	4.612	34.982	.132	.895
AdoptGAPs innovations	36.495	81.391	.448	.654
R-Square	Adjusted R-Square	Standard Error of the Estimate	Durbin-Watson	Sig.
0.184	0.158	905.985	1.863	$p \leq 0.05$

Source: Field Survey, Agyeman (2020)

The results (Table 83) indicate education, cocoa farming experiences and skills were positively related to cocoa farmer yield, whereas farm age and size negatively related to yield. The findings imply that cocoa farmers with more years of experience, education (Oomes et al., 2016), and skills were able to adopt innovations to achieve the expected higher yields.

This study found the average cocoa farm age for cocoa farmers in the Volta Cocoa Region to be 12 years which is expected to result in increased cocoa yield (Vigneri et al., 2016). Similarly, Asamoah et al. (2017) found a relationship between the age of cocoa farms and the productivity of the farms. The negative relationship between farm age and yields however obtained by the cocoa farmers implies there the need to intensify adoption of GAPs such as fertilizer application, to achieve higher yields (Bymolt et al., 2018a) by the cocoa farmers in the Volta Cocoa Region. The need for fertilizer is also because the hybrid cocoa species vastly cultivated in the Volta Cocoa Region require much more attention and nutrients to result in the expected higher yield (Daniëls et al., 2012).

Determinants of Income from Socio-Demographic and Economic Factors of Cocoa Farmers in the Volta Cocoa Region.

According to the findings (Table 84), cocoa farmers' experiences in cocoa farming, skills, farm size, adoption of farmer level purchase (FLP) innovations, and yield were all significant, and positively related to cocoa farmers' cocoa income ($p \leq 0.05$).

The regression model used to determine the factors associated with the cocoa farmers income in the Volta Cocoa Region is expressed as:

Cocoa income=$\beta_0 + \beta_1$ (sex)+ β_2(age)+ β_3 (education)+ β_4 (experience in cocoa farming) + β_5 (participation in FBS) +β_6(quality of CHED Extension) + β_7 (knowledge)+ β_8 (aspiration)+ β_9 (skills) + β_{10}(farm size)+ β_{11} (farm age) + β_{12} (Adopt FLP innovations) +β_{13} (adopt FEM innovations)+ β_{14} (yield) + ε

Table 84: Relationship Between Income and Socio-demographic and Economic Factors of Cocoa Farmers in the Volta Cocoa Region.

Independent Variables	Unstandardized Coefficients*		t	Sig.
	B	Std. Error		
(Constant)	-11251.510	3656.371	-3.077	.002
Sex	-315.313	1044.803	-.302	.763
Age	-9.853	32.089	-.307	.759
Education (years)	27.051	91.637	.295	.768
Experience in Cocoa farming	146.002	53.423	2.733	.007
FBS Participation	-435.519	757.166	-.575	.565
Quality of CHED Extension	-1054.286	652.261	-1.616	.107
Knowledge	-92.297	598.023	-.154	.877
Aspiration	518.463	486.510	1.066	.287
Skills	1807.564	761.565	2.373	.018
Farm size (ha)	2624.964	278.761	9.417	.000
Farm age	43.755	50.395	.868	.386
Adopt FLP innovations	878.103	402.391	2.182	.030
Adopt FEM innovations	79.436	260.632	.305	.761
Yield (Kg/Ha)	3.117	.378	8.237	.000
R-Square	Adjusted R-Square	Standard Error of the Estimate	Durbin-Watson	Sig.
0.354	0.331	6896.118	1.973	$p \leq 0.05$

Source: Field Survey, Agyeman (2020)

The result (Table 84) indicates that cocoa farmers who have been into cocoa farming for a longer period of time were exposed to more extensive extension services and were drawn to programmes such as the certification scheme for premiums which influenced their income positively. Cocoa farmers' skills in cocoa farming such as their ability to implement GAPs and fermentation and drying of cocoa contributed to the production of high-quality cocoa beans. This resulted in a positive relationship between the cocoa farmers' skills and income.

The findings (Table 84) also suggest that increasing farm size leads to higher incomes. This implies that owning multiple farms translates into larger farmer sizes. This accounts for increased cocoa production (yield). The observed increased income levels are accounted for by the combined cocoa productions of these multiple farmers. Oomes et al. (2016) found that farmers with smaller farm sizes had lower returns. Adoption of farmer level purchase innovations for instance use of testing stones to detect scale adjustments also had a positive relationship with farmers' cocoa income in the Volta Cocoa Region of Ghana.

Furthermore, cocoa yield had a positive relationship with income received by cocoa farmers. COCOBOD set the per-bag price of cocoa at GH¢475, and premiums set by Cocoa Abrabopa Association at GH¢17 for the 2018/2019 cocoa season. As a result, increased cocoa yield and participation in certification programmes for premiums were required to achieve higher income rather than relying on the forces of demand and supply for increased cocoa bean prices. It is critical that cocoa farmers adopt shared cocoa farming innovation to realize higher farm incomes as adopters have been found to be better off than non-adopters in terms of income obtained from cocoa farming. (Hailu, et al., 2014). The finding is supported further by Appelman (2016) who suggests that increasing farm size and productivity per hectare are effective ways of increasing farmer income. Similarly, Assiri et al. (2012) indicate increasing cocoa yields through replanting with recommended planting material, rehabilitation of old farms, and compliance with good agricultural practices contribute to increased cocoa income.

Chapter Summary

The determinants of the effects of extension delivery (Competency, Innovation Adoption levels, yield, and income) from the socio-demographic and economic factors of cocoa farmers in the Volta Cocoa Region of Ghana were presented and discussed in this chapter. The multicollinearity diagnostic test of the variables used in the four separate multiple linear regressions show the Tolerance and Variance Inflation Factors (VIF) values of the independent variables in regression models to be within acceptable limits. The results show that CHED empathy, private and CHED communication and registration under certification schemes determined competency of cocoa farmers whereas quality of CHED communication, participation in FBS, knowledge, attitudes, skills, and aspirations significantly influenced the cocoa innovation adoption levels of cocoa farmers in the Volta Cocoa Region of Ghana. For yield, years of formal education, experience in cocoa farming, farm size and farm age were found to be significant. The cocoa income earned by cocoa farmers was found to be significantly determined by cocoa farmers experiences in cocoa farming, skills, farm size, farm age, adoption of FLP innovations and yield (kg/ha).

CHAPTER NINE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

Despite the prevalence of cocoa extension delivery led by CHED and supplemented by private providers, the Volta Cocoa Region remains the least cocoa producing region in Ghana. This study therefore investigated the factors influencing extension delivery in the Volta Cocoa Region of Ghana to better understand the contributions of extension to the cocoa production levels in the region as well as associated factors that have implications for extension. Specifically, this ninth chapter contains a summary of the study, conclusions, recommendations, contribution to theory and knowledge, and suggestions for further research.

Summary

This study on the factors influencing extension delivery in the Volta Cocoa Region of Ghana was guided by five specific objectives; to describe the nature of extension delivery; describe the socio-demographic, and economic background of cocoa farmers; examine production, marketing, and extension delivery challenges faced by cocoa farmers; estimate the effects of cocoa extension delivery on cocoa farmers in terms of competencies in cocoa farming, level of adoption of cocoa innovations, yield and income; and to determine the nexus between effects of extension delivery from the socio-demographic and economic factors of cocoa farmers in the Volta Cocoa Region of Ghana.

The Bandura's social learning and McClelland's competency theories provided theoretical support for the study. Literature on extension approaches, decentralisation and pluralistic extension, extension methods and materials, challenges of extension delivery, cocoa agronomy, and cocoa innovations were all reviewed. Also, the effects of extension delivery on cocoa farmers' regarding the competencies (knowledge, attitudes, skills, and aspirations), innovation adoption, yield, and income were also examined. Literature on the social, demographic, and economic factors including land and labour issues related to cocoa farming as well as cocoa production challenges affecting cocoa farmers were also reviewed. Literature on mixed methods which was followed in this research was also reviewed.

The study area is the Volta Cocoa Region which covers middle to northern parts of Volta Region and almost entirely the Oti political region of Ghana. COCOBOD divides the Volta Cocoa Region into Hohoe, Jasikan and Papase CHED districts. Over 240 communities and total of 13,528 farmers are into cocoa farming and under the cocoa extension delivery system provided by the public COCOBOD CHED and private organisations such as the Cocoa Abrabopa Association and Solidaridad in the Volta Cocoa Region. The research specific objectives necessitated the use of a mixed-method research approach to integrate qualitative and quantitative research methods in order to fully understand the research problem investigated. The study population included cocoa farmers who had a cocoa farm for at least five years or more and cocoa stakeholders such as lead farmers, chiefs, opinion leaders and staff of COCOBOD and private extension organisations operating in the Volta Cocoa Region. The population of the study was chosen since these farmers and stakeholders particularly have the requisite knowledge and experiences on cocoa farming, extension delivery, and cocoa innovation adoption in the Volta Cocoa Region.

The study employed multi-stage probability and non-probability (purposive, and accidental) sampling techniques. An interview schedule was used to collect quantitative data from 420 sampled cocoa farmers, while the FGD, in-depth interview, and observations guides were used to collect qualitative data from lead/chief farmers, assembly members and staff of CHED and private extension organisations. The FGD and in-depth interviews each had 74 and 13 participants, respectively. The statistical tools—SPSS 25 and NVivo 12 were respectively used to analyse the quantitative and qualitative data. Objectives one and two, which included a description of the nature of the cocoa extension system as well as the social, demographic, and economic background of cocoa farmers were descriptively analysed using, frequencies, means, Standard Deviation and range. The Service Performance (SERVPERF) model in particular, was followed in estimating cocoa farmers' perceptions of the quality of CHED and private extension delivery. The Garrett Ranking Technique was used to rank the identified production, marketing, and extension delivery challenges faced by cocoa farmers in the Volta Cocoa Region.

The effects of cocoa extension: competencies (KASA levels), adoption, yield, and income levels were analysed descriptively. The means and standard deviations were estimated from the 5-point Likert scales of KASA and overall competency as well as the cocoa innovation adoption levels. The yield per hectare and income—Cocoa income (cocoa sales and premium) and total household income (farm and non-farm) were also analysed descriptively. The determinants of the effects of extension delivery (as dependent variables) from socio-demographic and economic (independent variables tested for collinearity) factors of cocoa farmers were identified using four separate multiple linear regressions which were run using the SPSS 25. The findings of the analyses were presented in the form of tables, figures, narratives, and inferences drawn in the discussions.

The results were discussed in relation to the five specific objectives. The findings on the nature of extension delivery by extension providers, the characteristics of shared innovations, frequency of extension methods and effectiveness of extension materials used, as well as the quality of extension delivery were presented and discussed in Chapter four. The findings demonstrate the structure of CHED extension delivery as well as the extension methods used such as farm and field visits, rallies, meetings, and demonstrations, to deliver programmes such as GAPs, Farmer Business School, and so on. A total of 19.8 percent of farmers participated in pluralistic extension receiving extension from the CAA and Solidaridad MASO private extension programmes besides CHED. The CAA programme organizes farmers into groups, train them on certification standards such as UTZ and RA and provides them with cocoa farming inputs (fertilizer, insecticides, fungicides, and sprayers—knapsack and motorized) credits. CAA purchases cocoa using the unadjusted scale (free scale) following the collector cocoa purchases system (member of group chosen to receive group cocoa produce). Beneficiary cocoa farmers received premium as an additional income from the sale of cocoa beans through the CAA system. The MASO programme assists the youth by providing training and group inputs and equipment for demonstration and on-farm use. The programme employed trained facilitators to train the youth. Participating youth and facilitators were assisted by mentors (successful cocoa farmers in the programme communities). In delivering extension to the youth cocoa farmers (including potential individuals) under the Solidaridad-MASO programme, facilitators typically use lecture methods, demonstrations, and meetings, as well as flipcharts, handouts, books as extension methods and training materials.

Cocoa farmers perceived shared GAPs innovations to have very high relative advantage (Mean: 4.9 and SD:0.3), compatibility (Mean:5.0 and SD:0.4), and observability (Mean: 4.6 and SD:0.3), as well as high trialability (Mean: 4.2 and SD:1.0), and complexity (Mean: 3.9 and SD:1.8) characteristic. Certification (CERT) innovations were generally perceived by beneficiary cocoa farmers to similarly have very high relative advantages (Mean:4.8 and SD:0.5), compatibility (Mean:4.5 and SD:0.7), and observability (Mean:4.9 and SD:0.4), with as well as characterized by high trialability (Mean:4.4 and SD:1.8), and fairly possessed complexity (Mean:3.4 and SD:1.4). Characteristics. Also, the Farmer Level Purchases (FLP) innovations were perceived by cocoa farmers in the Volta Cocoa Region to have very high relative advantage (Mean:4.9 and SD:1.1), trialability (Mean:4.5 and SD:0.9), compatibility (Mean:4.9 and SD:0.4), and observability (Mean:4.8 and SD:0.9) with fair possession of the complexity (Mean:2.6 and SD:1.9) characteristics. Also, Cocoa farmers perceived the Farm Enterprise Management innovations to possess high relative advantage (Mean:4.3 and SD:1.7), trialability (Mean:3.6 and SD:1.7), complexity (Mean:3.7 and SD:1.4), compatibility (Mean: 4.3 and SD:2.1), and observability (Mean: 4.4 and SD:1.1), characteristics.

Home visits, farm visits, demonstrations (results and methods), field days, field trips, lectures, office calls, phone calls, meetings, drama, farmer rallies, and E-extension (e.g., Radio, cocoalink etc.) were used to share cocoa innovations in the Volta Cocoa Region of Ghana. All extension methods employed in the extension delivery by extension providers were perceived by cocoa farmers to be somewhat frequently used. The main training materials used in sharing cocoa innovations are books, training guides, folders, newsletters, training manuals, cocoa newspapers, handouts, posters, calendars, flipcharts, PowerPoints, radio, television, and videos. Effective training materials were perceived to be radio, calendar, poster, books, television, and training guide. The quality of CHED extension delivery was perceived as acceptable, while cocoa farmers perceived private extension delivery as good. For CHED and private organisations, the Assurance dimension of extension delivery quality was found to be very high.

Chapter Five described the social, demographic, and economic factors affecting cocoa farmers. The findings show that the average age of cocoa farmers is 49 years, and the average cocoa farm size is 1.4ha, and that the majority (71.6 percent) have B class farms with a mean farm age of 12 years. The results show males dominated cocoa farming in the Volta Cocoa Region, and cocoa farmers had an average of 15 years of experience in cocoa farming (range of 2-51 years). A total of 90.5 percent of farmers have received formal education at the JHS/MSLC, SHS, Tertiary, and postgraduate levels. The mean household size of cocoa farmers was found to be 7 members, with each household having an average of four members under the age of 15. The majority of cocoa farmers (64 percent) were found to be Ewes, with 66.9 percent of all surveyed farmers being natives of the communities in which they lived. Use of own or family land, outright purchase, and sharecropping were identified as means of acquiring land for cocoa farming in the Volta Cocoa Region by the study. Farmers under the CAA certification scheme in particular, owned farm plans as ownership rights over their farmlands.

Non-smart (Feature) phones were found to be used by 69.8 percent out of the 95 percent of farmers who owned mobile phones. The Cocoa farmers in the Volta Cocoa Region were found to have received government (COCOBOD) productivity interventions such as seedlings (71.7 percent), agrochemicals (79.5 percent), hand pollination (44 percent), mass spraying (61.7 percent), participation in FBS (56.9 percent), and farm rehabilitation (13.1 percent). According to the study, 5 percent, and 3 percent of the cocoa farmers respectively in the Volta Cocoa Region had benefited from cocoa-related awards and COCOBOD scholarships for their dependents. The republic of Togo was found to be a major source of labour for cocoa farmers in the Volta Cocoa Region of Ghana. Nnoboa (*Fidodo*) and female participation in cocoa farming activities such as cooking, planting seedlings, fetching water for spraying, and drying cocoa beans were also found.

The sixth chapter discussed the ranked challenges that cocoa farmers in the Volta Cocoa Region face. Access to credit, prolonged drought, labour unavailability, late input supply, and pest and disease problems are the main cocoa production challenges confronting cocoa farmers in the Volta Cocoa Region of Ghana. Price incentives, poor road networks to communities, low premium prices, high transportation costs, scale adjustments, and major marketing constraints confronted Volta Cocoa Region cocoa farmers. The study found extension delivery constraints in descending order of importance as low activities of farmer associations and organisations, low extension staff contacts, low use of training materials, language barriers, and low feedback rate from extension officers to have affected cocoa farmers in the Volta Cocoa Region of Ghana.

The effects of cocoa extension delivery on cocoa farmers in the Volta Cocoa Region were described in Chapter Seven. The competency of cocoa farmers in cocoa farming in the Volta Cocoa Region of Ghana was found to be high (Mean 3.9). Regarding rate of adoption of cocoa innovations, the findings show a range of GAPS (42.1-97.6percent), certification (54.7-78.1 percent), farmer level purchases innovations (42.4.4-97.1 percent), and 34.8-79.3 percent for farm enterprise management Innovations by cocoa farmers in the Volta Cocoa Region of Ghana. The average level of adoption of shared cocoa innovations was found to be very high for GAPs, high for CERT and FLP, and moderate for FEM innovations. The overall level of adoption of cocoa innovations for cocoa farmers in the Volta Cocoa Region was averagely high. The average cocoa farmer yield was found to be 793.5kg/ha whilst cocoa income accounted for 63.2 percent of the total household income of cocoa farmers in the Volta Cocoa Region of Ghana. Cocoa farmers' total farm and non-farm income shares in the Volta Cocoa Region respectively accounted for 84.4 percent and 15.6 percent of THI respectively. The independent sample t-test showed a significant difference in the competencies, level of adoption, yield, and income for CHED and pluralistic extension receiving groups.

The factors associated with the effects of extension delivery, such as cocoa farmers' competencies, level of adoption, yield, and income (from cocoa) were presented and discussed in Chapter Eight. Education, registration under certification, CHED empathy and communication, and private communication were found to be the determining factors of cocoa farmers' competencies in the Volta Cocoa Region of Ghana.

The age of cocoa farmers, education, and participation in FBS, quality of CHED extension delivery, and knowledge, attitude, skills, and aspiration competencies all influenced the level of innovation adoption in the Volta Cocoa Region. Furthermore, cocoa yield per hectare obtained by Volta cocoa farmers was determined by cocoa farming experience, education, skill competency, farm size, and farm age. At five percent significance levels, cocoa farmers' experiences in cocoa farming, skill competency, farm size, adoption of farmer level purchase innovations, and yield in kilogrammes per hectare significantly related to cocoa income of cocoa farmers in the Volta Cocoa Region. Chapters two to eight were concluded with a chapter summary to indicate a summary of the key concepts, issues and findings made.

Conclusions

The conclusions on each of the five specific objectives underpinning this study on the factors influencing extension delivery in the Volta Cocoa Region of Ghana are presented in this section.

Nature of extension delivery in the Volta Cocoa Region

COCOBOD CHED has a decentralized (Regional, district, operational area, and communities) presence in the Volta Cocoa Region of Ghana. COCOBOD CHED and related departments showed responsibility in carrying out their mandate as the COCOBOD (Public) cocoa extension delivery division in the Volta Cocoa Region of Ghana. The Cocoa Abrabopa Association and Solidaridad were found to be the main private extension organisations in the Volta Cocoa Region with a lower number of farmer participation (19.8 percent under pluralistic extension). Cocoa farmers perceived shared GAPs, CERT, FLP innovations to have very high relative advantages whilst FEM innovations were perceived to possess high relative advantage characteristics. Regarding trialability of the shared cocoa innovations, cocoa farmers perceived GAPs and CERT innovations to possess high characteristics whilst FLP and FEM innovations were respectively perceived to have very high and high trialability characteristic. For the complexities of the shared innovations, cocoa farmers perceived GAPs, CERT, FLP and FEM innovations to respectively have very high, fair, very high and high characteristics. The compatibility of shared cocoa innovations to social norms and cultural settings were perceived by cocoa farmers to have very high characteristic for GAPs, CERT, FLP and high characteristics for FEM innovations. The observability characteristics of the innovations were perceived by cocoa farmers to be very high for GAPs, CERT, FLP and high for FEM innovations.

Demonstrations and phone call extension methods were the most commonly used. Radio, posters, calendars, books, and television training materials have all been shown to improve cocoa farmers' understanding and competencies in cocoa farming in the Volta Cocoa Region. Cocoa farmers perceived their experiences with the CHED extension delivery system to be of acceptable quality, whereas beneficiaries (private extension) perceived the quality of the CAA and Solidaridad extension schemes to be of good quality.

Socio-demographic and economic characteristics of cocoa farmers

The Volta Cocoa Region was found to be dominated by an aging, male and Ewe cocoa farmer population. Cocoa farmers in the Volta Cocoa Region were found to be smallholders cultivating an average of 1.4ha landholdings with matured cocoa trees (B-class farms). Land for cocoa farming in the Volta Cocoa Region was found to be acquired through use of family land, inheritance, sharecropping (*Dema*), and outright purchase; and labour was usually organised from the Republic of Togo due to a scarcity of locals to provide cocoa labour services. The nnoboa *(fidodo*) labour system is primarily organised to perform activities such as pod breaking; however, it is not widely used due to challenges such as laziness, envy, food cost, and perceived use of charms on members cocoa farms. Women were found to be owners (minimal farmers involved) and also supported spouses in managing household cocoa enterprises.

Production, Marketing and Extension delivery challenges faced by cocoa farmers in the Volta Cocoa Region.

Access to credit, prolonged drought, and labour scarcity were the most pressing cocoa production challenges faced by cocoa farmers in the Volta Cocoa Region. The most pressing marketing challenges found were price incentives, a poor road network, and low premium price. Low activities of farmer associations and organisations, low contact with extension staff, and low use of training materials were the most pressing extension delivery challenges faced by Cocoa farmers in the Volta Cocoa Region of Ghana.

Effects of extension delivery on cocoa farmers in the Volta Cocoa Region

The research concludes that there are high levels of competency in cocoa farming and the adoption of cocoa farming innovations (GAPs, CERT, FLP, and FEM) by cocoa farmers in the Volta Cocoa Region of Ghana. Cocoa farmers achieved an average cocoa yield of 793.5kg/ha, which is less than the CRIG’s recommended average. Cocoa income accounts for the majority of cocoa farmers' total household income in the Volta Cocoa Region. In addition to cocoa farming, cocoa farmers engaged in income diversification activities and received more than one-third of total household income from non-cocoa farming activities (other crops, livestock, farm wages, natural resource collection) and non-farm income (self-employment, non-farm wages, remittances, and other sources). There is a significant difference between cocoa farmers under CHED and pluralistic extension in terms of their competencies, level of adoption, yield, and income. As a result, participation in pluralistic extension improved cocoa farmers' competencies, level of adoption, yield, and cocoa income in the Volta Cocoa Region of Ghana.

Determinants of effects of extension delivery from the socio-demographic and economic factors of cocoa farmers in the Volta Cocoa Region.

Participation in the certification scheme, CHED-empathy, and the communication dimension of extension quality received from CHED and private extension providers all influenced the competencies of cocoa farmers. The age of cocoa farmers, participation in farmer business school (FBS), quality of CHED extension delivery, as well as the knowledge, attitude, skills, and aspiration competencies of cocoa farmers all determined the innovation adoption level of cocoa farmers. Education, experience in cocoa farming, and skill competency influenced cocoa farmers' yield positively, whereas farm age and farm size influenced farmers' cocoa yield of cocoa farmers negatively. Cocoa farmers' income in the Volta Cocoa Region was determined by their skill level, farm size, level of adoption of farmer level purchase (FLP) innovations, and yield.

Recommendations

The findings of this study on factors influencing extension delivery in Volta Cocoa Region of Ghana offer a number of recommendations to policymakers, COCOBOD, CHED, CRIG, private cocoa extension providers (Farmer Associations/cooperatives, NGOs, and business entities) as well as organised and individual cocoa extension researchers. The following recommendations are provided.

1. CAA and Solidaridad private extension organisations operating in the Volta Cocoa Region are required to widen the scope of their programmes to include several cocoa farmers than currently covered.
2. COCOBOD-CHED at the national and regional levels through partnerships must encourage other private cocoa extension organizations such as Mondellez, Care Ghana etc. to expand their programmes to cocoa farmers in the Volta Cocoa Region.
3. Regarding cocoa farmers perceptions of the characteristics of shared cocoa innovations (GAPs, Certification, Farmer Level Purchases, and FEM), it is recommended CHED and private extension providers continue to intensify dissemination of the cocoa innovations to enable cocoa farmers appreciate their relative advantages, trialability, compatibility, observability as well as overcome the associated perceived complexities of the innovations.
4. Extension providers must address methods of reducing the complexity associated with erosion control which has the potential of increasing disease proliferation and nutrient loss in cocoa farms in the Volta Cocoa Region.

5. It is recommended that radio is used more frequently as a tool for disseminating cocoa innovations to cocoa farmers in the Volta Cocoa Region. CHED community extension agents, private technical officers and facilitators should in addition make more home and farm visits to attend to the individual needs of cocoa farmers.
6. The CRIG must resume publication of the cocoa newspaper and make sufficient quantities available to cocoa farmers in the Volta Cocoa Region.
7. To improve the quality of extension delivery, both CHED and private extension providers must use ICTs such as phone applications, videos, smartphone applications such as WhatsApp, and voice messages to stay in touch with cocoa farmers in the Volta Cocoa Region.
8. The punctuality of extension agents must be improved by CHED and private extension providers. It is important to reduce the coverage area covered by these agents to reduce the farmer agent ratio. Moreover, Motorcycles and fuel must be regularly made available to field staff to enable them efficiently attend to their duties in a timely manner.
9. Cocoa farmers, particularly sharecroppers in the Volta Cocoa Region must ensure the continuous productivity of their lands in order to sustain their farms and avoid problems associated with tenure insecurity including losing their farms to landowners or their successors.
10. Traditional community leaders and chief farmers must ensure land tenure security issues between landowners and sharecroppers are resolved in a way that does not negatively impact cocoa farming in the Volta Cocoa Region

11. To expand cocoa farming and related activities in the Volta Cocoa Region, landowners and family heads must release land to sharecroppers to cultivate.
12. With an effective monitoring system, government agencies such as the Forestry Commission and the Lands Commission must release portions of forest to farmers who live near forest reserves to farm cocoa. This is due to the continued increase in population in such areas, which necessitates additional land for farming in order to avoid illegal entry into forest reserves, unemployment, and food security challenges.
13. Mass spraying, pruning and other cocoa labour activities in the Volta Cocoa Region require increased COCOBOD and private-sector participation.
14. COCOBOD and the Ghana Immigration Service must ensure that labour sought from neigbouring Republic of Togo does not result in child labour issues, as students on vacation were indicated to be commonly used.
15. To reduce problems associated with the *Fidodo* (Nnoboa) labour system, chief farmers must organize and monitor its effectiveness and resolve problems that emanates from its use.
16. Concerning the challenges faced by cocoa farmers, it is recommended that field officers and purchasing clerks encourage cocoa farmers to use testing stones to confirm free scales and prevent scale adjustment issues.
17. The Ghana Standards Authority must conduct spot checks on scales on a regular basis. COCOBOD must also severely punish purchases clerks who engage in scale adjustment to deter others. LBCs represented by

purchasing clerks are expected to refrain from purchasing poor-quality beans. This will prevent scales from being adjusted to care of short weights realised after further drying.

18. COCOBOD must prioritize the construction of a bridge over the Tsei river to enable cocoa farmers attend to their farms during raining seasons where the river overflows its banks. COCOBOD must also dredge the river to prevent flooding of cocoa farms in the surrounding communities, particularly in the Papase CHED district.
19. COCOBOD, private extension organisations and financial institutions must devise long-term financing strategies for cocoa farmers in the Volta Cocoa Region in order to improve farmers' access to credit (finance).
20. The prolonged drought situation in the Volta Cocoa Region can be resolved through afforestation and sustainable irrigation schemes to encourage cocoa farmers to continue farming. This will require the partnership of COCOBOD, NGOs and the Ghana Irrigation Authority.
21. It is recommended that farmers are continually sensitized and supported to plant the required number of shade trees to lessen the effects of prolonged droughts on cocoa farms in the Volta Cocoa Region.
22. Moreover, to address the drought situation, the government cocoa irrigation scheme being piloted by CRIG should prioritise the Volta Cocoa Region.
23. The per bag producer price of cocoa beans must be increased to account for the indicated increasing cost of farm inputs and labour in the Volta Cocoa Region. The CAA premium paid to cocoa farmers under

certification must also be increased from the GH¢ 17.0 currently paid per bag.

24. CHED and private providers must sustain the competencies (knowledge, attitudes, skills, and aspirations) of cocoa farmers through regular training and contact to ensure cocoa farmers adopt shared innovations.
25. Cocoa farmers' skill levels in cocoa farming must be improved through training and the provision of relevant extension training materials, supervision, as well as timely provision and access to inputs by COCOBOD and private financing schemes.
26. COCOBOD and private input providers must provide cocoa farmers with appropriate tools or equipment for making holes for transplanting seedlings to reduce the complexities associated with the adoption of the innovation.
27. Women cocoa farmers in the Volta Cocoa Region are recommended to be provided with ergonomically safe tools and equipment by COCOBOD and private extension providers to enable them perform farm activities such as pruning and agrochemical applications using knapsack and motorized sprayers which are perceived as complex to use.
28. It is critical COCOBOD and private extension providers; NGO’s and District assemblies in the Volta Cocoa Region continue encouraging cocoa farmers to place fire belts around their farms where appropriate in order to prevent fire outbreaks from adversely affecting their cocoa and other farms.

29. It is critical that COCOBOD and community leaders in the Volta Cocoa region with support from the law enforcement agencies sanction cocoa farmers and community members whose actions intentionally cause bushfires leading to destruction of cocoa farms.
30. Manure use among cocoa farmers in the Volta Cocoa Region should be encouraged by Extension providers, particularly on seedlings in the upper parts of Jasikan and the entire Papase CHED districts where drought effects on seedlings have been found to be mostly devastating.
31. CEAs and TCs must assist and encourage cocoa farmers to determine expenditure incurred and profits realized from cocoa farming enterprises in order for cocoa farmers to profitably engage in cocoa farming as a business.
32. The COCOBOD youth in cocoa farming, as well as the Solidaridad youth oriented MASO programme, should be expanded to involve more youth in cocoa farming in order to address the problem of aging cocoa farmers dominating the Volta Cocoa Region of Ghana.
33. To ensure farmers understand the innovations shared, language barriers associated with extension delivery must be reduced. The ability of extension providers, particularly CEAs and TCs to communicate in multiple languages is critical in addressing this challenge.
34. COCOBOD should broaden the scope of the Volta Cocoa Region's hand pollination exercise to include all farms in order to increase productivity.
35. Private extension providers and COCOBOD must provide cocoa farmers with access to land, farm inputs and finance in order to improve

yields, diversify their income sources to increase their overall household income.

36. The FBS programme implemented by COCOBOD should be expanded to include all farmers and also mainstreamed into the regular cocoa farmer training activities in the Volta Cocoa Region.
37. The reliability, responsiveness, assurance, tangibility, communication, and empathy dimensions of CHED and private extension quality require improvement through programme design, policy, human resource strengthening, and infrastructure (telecommunication, road) by COCOBOD, private business entities and government.
38. COCOBOD-CHED must lead and regulate the activities of private extension providers to improve partnerships, ensure private providers provide cocoa extension according to standards, prevent cocoa farmers from being cheated as well as to sustain extension programmes and projects (aspects or wholly) beyond the lifespan of implemented private organisation led cocoa extension projects.
39. Generally, increasing cocoa farm productivity (yield) and income of cocoa farmers must be supported by CHED and private extension organisation through training, diversification, and access to credit to purchase quality farm inputs, access labour and for consumption, savings, and investment.

Contribution to Theory and Knowledge

Extant literature on cocoa production and extension delivery in Ghana are skewed to high cocoa producing regions such as Western North and South, Brong-Ahafo, Central, Eastern and Ashanti regions. This study therefore sought to bridge these knowledge gaps on cocoa extension delivery and related factors for the Volta Cocoa Region. To this end, the social learning and McClelland Competency theories were applied as theoretical frameworks underpinning the study. These theories emphasis observational learning, intrinsic reinforcement, modelling, and competency testing (Bandura, 1971; McClelland, 1973). The findings from the study extended the relevance of the social learning theory to observational learning in cocoa farming through extension delivery particularly involving cocoa extension providers (as models), extension methods and materials (including live models) as well as the quality of the delivery. Moreover, the estimated cocoa farmers competencies regarding knowledge, attitudes, skills, and aspirations in cocoa farming in the Volta Cocoa Region have also contributed to the relevance of the McClelland Competency theory employed in this study.

The findings of the research have bridged knowledge gaps particularly on the shared cocoa innovations, extension methods, materials and quality; socio-demographic and economic factors(e.g. age, sex, level of educational, membership of groups, marital status, ethnicity, nativity of community, access to credit, farm size and age class, ownership of productive assets, mobile phone and money usage etc. as well as on land and labour use issues and practices. Cocoa farmers production, marketing, and extension delivery challenges which have implications for extension delivery have also been indicated for the Volta Cocoa Region of Ghana.

Knowledge on the competencies, innovation Adoption Levels, yield, and income (from cocoa, other farm, and non-farm activities) effects of extension delivery and related determining factors have also been indicated for the Volta Cocoa Region through this study. This provides direction for cocoa extension policy, programmes and project supports for the Volta Cocoa Region which has the potential of contributing immensely to increasing the overall cocoa production volumes of Ghana.

Suggestions for Further Research

Based on the findings of this study on the factors influencing extension delivery in the Volta Cocoa Region of Ghana, the following areas are suggested for further research.

1. Climatic factors influencing cocoa farming and adaptation practices in the Volta Cocoa Region of Ghana.
2. Land and labour issues associated with cocoa farming in the Volta Cocoa Region of Ghana.
3. Factors influencing private extension organisation participation in cocoa extension delivery in the Volta Cocoa Region of Ghana.

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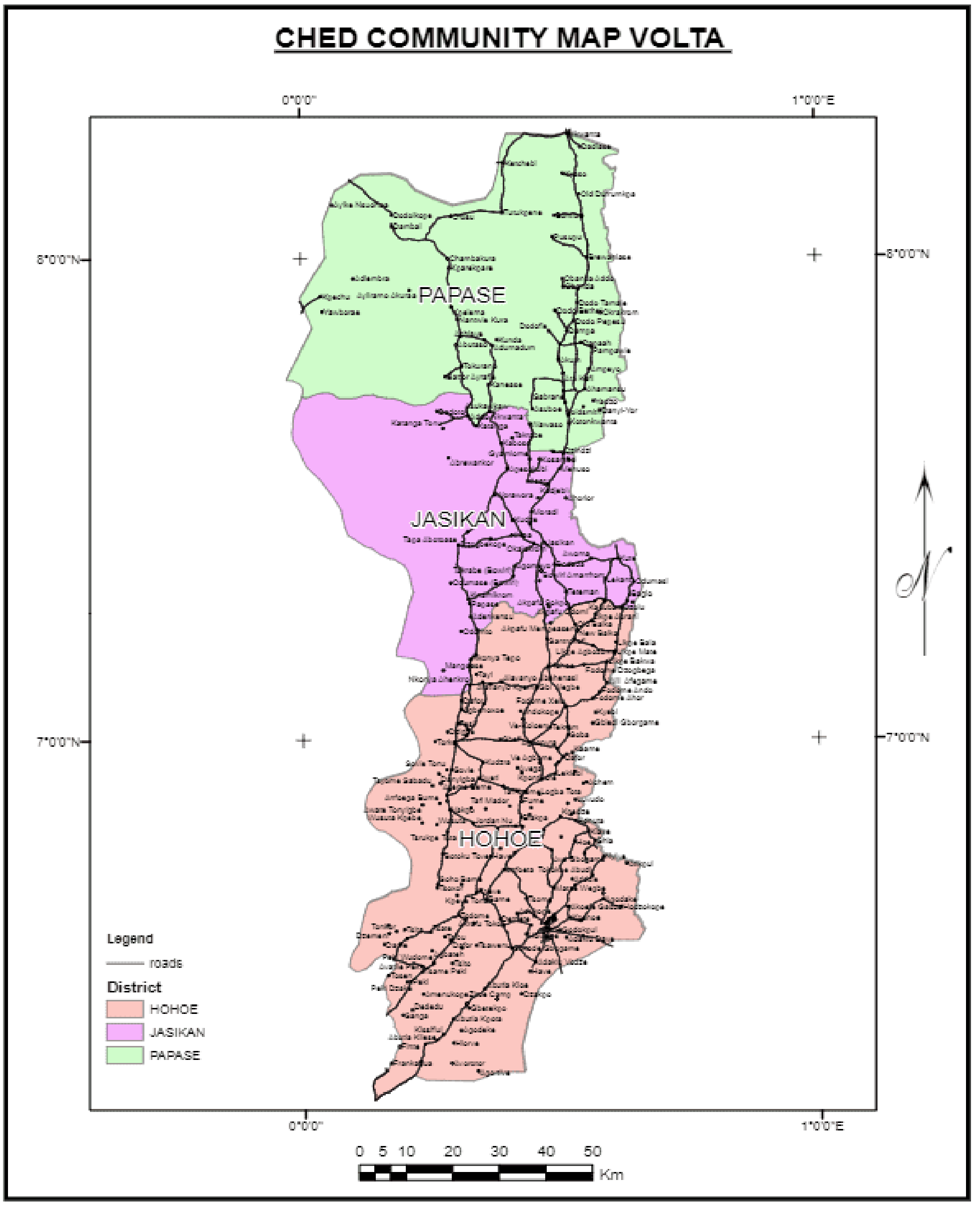
APPENDICES

Appendix A: Volta Cocoa Region CHED Community Map



Source: Volta Regional Cartography Department, COCOBOD

Appendix B: Garret Ranking Conversion Table

GARRETT RANKING CONVERSION TABLE

The conversion of orders of merits into units of amount of "socres"

Percent	Score	Percent	Score	Percent	Score
0.09	99	22.32	65	83.31	31
0.20	98	23.88	64	84.56	30
0.32	97	25.48	63	85.75	29
0.45	96	27.15	62	86.89	28
0.61	95	28.86	61	87.96	27
0.78	94	30.61	60	88.97	26
0.97	93	32.42	59	89.94	25
1.18	92	34.25	58	90.83	24
1.42	91	36.15	57	91.67	23
1.68	90	38.06	56	92.45	22
1.96	89	40.01	55	93.19	21
2.28	88	41.97	54	93.86	20
2.69	87	43.97	53	94.49	19
3.01	86	45.97	52	95.08	18
3.43	85	47.98	51	95.62	17
3.89	84	50.00	50	96.11	16
4.38	83	52.02	49	96.57	15
4.92	82	54.03	48	96.99	14
5.51	81	56.03	47	97.37	13
6.14	80	58.03	46	97.72	12
6.81	79	59.99	45	98.04	11
7.55	78	61.94	44	98.32	10
8.33	77	63.85	43	98.58	9
9.17	76	65.75	42	98.82	8
10.06	75	67.48	41	99.03	7
11.03	74	69.39	40	99.22	6
12.04	73	71.14	39	99.39	5
13.11	72	72.85	38	99.55	4
14.25	71	74.52	37	99.68	3
15.44	70	76.12	36	99.80	2
16.69	69	77.68	35	99.91	1
18.01	68	79.17	34	100.00	0
19.39	67	80.61	33		
20.93	66	81.99	32		

Appendix C: Data Collection Instruments

(a) Interview Schedule for cocoa farmers

This study is being conducted to investigate 'Factors influencing extension delivery in the Volta Cocoa Region of Ghana**.** The study is for purposes of an Agricultural Extension Doctoral Thesis work at the Department of Agricultural Economics and Extension, University of Cape Coast. This questionnaire seeks information on your Socio-Demographic characteristics, cocoa farming activities; land and labour factors associated with cocoa farming, Cocoa extension practices and adoption and challenges confronting cocoa farming in the Volta region. Your responses will be treated strictly confidential. If you have any challenge responding to the questionnaire, kindly contact the student researcher-Bernard A.S. Agyeman on 0243-932044/0203914804; e-mail: agyemanbas@gmail.com. If you accept to respond to this interview schedule, kindly provide your candid responses to the following questions below. However, you may decide to discontinue responding to this questionnaire at any time without any penalty. Thank you

Interview Schedule Number: …… Date………/…………/20…………

COCOBOD CHED District:1. Hohoe [ ] 2. Jasikan [ ] 3. Papase [ ]

Community Name………………………………………………………

SECTION 1: SOCIO- DEMOGRAPHIC CHARACTERISTICS

1. What is your sex? 1. Male [ ] 2. Female [ ]
2. What is your age (years)? ……………………………………
3. (a) What is your main occupation?1. Farming [ ]2. Other (specify)………………………
   (b) Which non-farm income generating enterprises are you engaged if any……………………
4. (a)What is your highest formal educational level attained? 1. None [ ] 2. JHS/MSLC [ ] 3. SSS/SHS [ ] 4. Tertiary [ ] 5. Postgraduate [ ] 6.others………………
5. What is your marital status? 1. Married [ ] 2. Divorced [ ] 3. Widowed [ ] 4. Separated [ ] 5. Never Married [ ]
6. (a) What is your total household size?…………………………..
   (b) What is the total number of persons below 15 years in your household?..........
7. What is your religion? 1. None [ ] 2. Christianity [ ] 3. Islam [ ] 4. Traditional [ ] Others (Specify)………………………
8. What is your ethnicity? 1. Ewe [ ] 2. Guan [ ] 3. Akan [ ]4.Baasare [ ] 5. Others……………………………
9. Are you a native of this community? 1. Yes [ ] 2. No [ ]
10. What cocoa farming related leadership role do you hold?.....................
11. Do you have access to credit? 1. Yes [ ] 2. No [ ]
14. Which Telecommunication network(s) do you have access to in your community? 1. MTN [ ] 2. Vodafone [ ] 3.Airtel/Tigo [ ] 4. Others …
17. (a) Do you own mobile phone(s)? 1. Yes [ ] 2. No [ ]
    (b) If yes, how many mobile phones do you own? ....
    (c) If yes, what type of Mobile phone do you own?1. Smart Phone [ ] 2. Non-Smart Phone [ ]

18. (A) Are you mobile money registered? 1. Yes [ ] 2. No [ ]
(b) If yes, which telephone network(s) are you registered with?.............

SECTION 2: COCOA FARMING ACTIVITIES

19. How many years have you been into farming? .... (years)
20. How many years have you been into cocoa farming? ……… (years)
21. Which other farming enterprises are you engaged in besides cocoa farming?
(a) Crops: ……………………………………………………........
(b) Livestock:…………………………………………………
(c) Aquaculture:……………………………………………
(d) Others (including wage income):……………………………
22. (a) Kindly provide information to complete the table below on your cocoa cropping activities?

No.	Cocoa farm Size (acre)	Age of farm (Years)	Mode of acquiring cocoa farm 1-Own farm. 2-Inheritance 3-Purchase 4. Sharecropping	Yield in last season(kg)
1				
2				
3				
4				
5				
6				
Total				

(a) How many kilograms was cocoa weighed per bag by your Purchasing Clerk/collector in the last season?........................kg

23. Which of the following cocoa farming productive assets do you own? Tick as it applies

Productive Assets owned	Yes	Qty	Productive Assets owned	Yes	Qty
Cutlass			Drying mat		
Knapsack sprayer			Basket		
Mistblower			Bicycle		
Pruner			Motorbike		
Cocoa harvester (knife etc.)			Motorking (*Aboboya etc.)*		
PPE full set (Overall, Hat, wellington boot, Nose mask, gloves, goggles)			Water storage containers (barrels, gallons etc.)		
Shovel/spade			Vehicle/truck		
Tarpaulin			Weighing scale (COCOBOD approved)		
Others (specify)					

24. (a) Do you have access to COCOBOD seedlings? 1. Yes [ ] 2.No [ ]
(b) Do you have access to COCOBOD agrochemicals? 1. Yes [ ] 2. No [ ]

(c) Do you have access to COCOBOD hand pollination? 1. Yes [ ] 2. No [ ]
(d) Do you have access to COCOBOD mass spraying? 1. Yes [ ] 2. No [ ]
(e) Do you participate in Farmer Business School organized by COCOBOD?
1. Yes [ ] 2. No [ ]
(f) Do you have access to COCOBOD cocoa hand pollination?
1. Yes [ ] 2. No [ ]

25. (a) Do you have access to COCOBOD cocoa farm rehabilitation programme(s)? 1.Yes [ ] 2. No [ ]
(b) If Yes, in which year did you rehabilitate your farm?..........................
(c) What was the reason for rehabilitating your farm? ……………………..
(d) How were you compensated for rehabilitation?…………………

26. (a) Do you have a COCOBOD passbook? 1. Yes [ ] 2. No [ ]

27. (a) Has any of your children ever benefitted from COCOBOD Scholarship?
1. Yes [ ] 2. No [ ]
(b) If yes, state number of children who benefited…………………

28. (a) Have you ever won any cocoa farming related award?
1. Yes [ ] 2. No [ ]
(b) If yes, please state type of award won and year of winning?........................

29. Please identify the farm and non-farm activities engaged in and the income (GH¢) realized from them?

	Tick	(a) Farm income activity	Amount received Cash	Premium	Amount in Kind (If applicable)
1		Cocoa			
2		Other crops (food and cash crops)			
3		Livestock			
4		Natural resource collection			
5		Farm wage income			

	Tick	(b) Non-farm income source	Amount received in cash	Amount in Kind
6		Self-employment		
7		Non-farm wage income		
8		Remittances		
9		Other sources		
Total				

SECTION 3: LAND AND LABOUR ISSUES IN COCOA FARMING

30. What sharecropping systems are you engaged in if sharecropper?
1. Abunu [ ] 2. Abusa [ ] 3. Others specify……………………

31. What are the sources of labour used on your cocoa farm? Tick as many as applies. 1. Self [ ] 2. Sharecropper [ ] 3. Caretaker [ ] 4. Family [ ] 5. Group members [ ] 6. Hired [ ] 7. Farm labour services company [ ]
8. Others (Specify)………………

32. Do you use Nnoboa in your cocoa farming activities? 1. Yes [ ] 2. No [ ]
33. Who is likely to inherit your cocoa farm? Tick as many as applies
1. Spouse [ ] 2. Son [ ] 3. Daughter [ ] 4. Nephew [ ]
5. Others (Specify)…………………………………………………………

SECTION 4: COCOA EXTENSION DELIVERY PRACTICES AND ADOPTION

34. (a) Are you registered with any private extension organisation are you registered with? 1. Yes [ ] 2. No [ ]
(b) How many Private cocoa Extension organisation are you registered with if any?...
(c) Name private cocoa extension Organisation (s) registered and receiving extension from if any?..
(d)Why did you register with private cocoa extension organisation if any?..
35. How many cocoa extensions contact (s) did you have with your extension provider in the last cropping year?
(a) Through face to face?1. CHED… ……2. Private provider(s)………
(b) Through electronic?1. CHED …………2. Private provider(s)………
36. (a) Are you under any cocoa certification scheme? 1. Yes [ ] 2. No [ ]
(b) If yes? Name standards ever registered with1. UTZ [ ] 2. Rainforest [ ]
3.Organic [ ] 4. Fairtrade [ ] 5. Others (specify) …………………
(c) How many years have you been into the certification scheme?…….
(e) What benefits have you realized since you joined the certification ………
(f) Which challenges do you face participating in cocoa certification?.......
(g) Are you likely to continue with the certification programme?
1. Yes [ ] 2. No [ ]
37. What is the f of use of Extension methods used in delivering cocoa innovations to you? 5-Very frequent, 4-Frequent, 3-Moderately frequent, 2-lowly frequent and 1-Very lowly frequent, 0-Never

Extension Methods	F of use of Extension Method					
	5	4	3	2	1	0
1.Home visits						
2.Farm Visits						
3.Method Demonstrations						
4.Result Demonstration						
5.Field days						
6.Field trips						
7.Lecture						
8.Office calls						
9.Phone calls						
10. Meetings						
11. Drama						
12. Farmer rallies						

38. What is the level of Effectiveness of the following Extension Training Materials used in training you on cocoa innovations and practices? 5=Very effective, 4=Effective 3=Moderately Effective 2=Lowly effective 1=Very lowly effective 0=Can't Tell

Print Training Materials	**Level of effectiveness**						**Non- Print Training Materials**	**Level of effectiveness**					
	5	**4**	**3**	**2**	**1**	**0**		**5**	**4**	**3**	**2**	**1**	**0**
1.Book							8.Poster						
2.Training guide							9.Calendar						
3.Folder							10.Flip chart						
4.Newsletter							11.Power points						
5.Training Manuals							12.Radio						
6.Cocoa Newspapers							13.Television						
7.Handouts							14.Video						

39. (a) Indicate by ticking if the following cocoa innovations were shared with you?
(b) Indicate by ticking if you adopt the innovations shared with you?
(c) What is your level of agreement of the characteristics of cocoa innovations shared with you? NB: RA-Relative Advantage, TRI-Trialability, CPX-Complexity, COP-Compatibility, OBS-Observability. Kindly indicate for each characteristic as either: 5-Strongly Agree-, 4-Agree, 3-Moderately Agree, 2-Lowly Agree-2, 1-Very Lowly Agree

Cocoa farming innovations	**Is Innovation Shared? (A)** ***(Tick)***	**Do you Adopt? (B)** ***(Tick)***	**Characteristics of Innovation (C)**				
			RA	**TRI**	**CPX**	**COP**	**OBS**
Good Agricultural Practices (GAPs)							
1.Raising cocoa seedlings in poly bags							
2.Raising cocoa seedlings on beds							
3.Selecting a good site for cocoa farming							
4.Demarcation of cocoa farm/land							
5.Preparing permanent land for cocoa farming							
6.Transplanting nursed seedlings							
7.Planting cocoa seedlings in lines							
8.Planting cocoa seedlings on the permanent farm using spacing							
9 Providing temporary shades							
10. Regularly pruning cocoa trees							
11. Application of granular cocoa fertilizer using broadcasting method							
12. Application of foliar fertilizers using sprayers							
13. Application of organic manure in cocoa farm							
14. Blackpod disease control							
15. Common mirid control							
16. Observing re-entry period for applied chemicals							
17. Erosion and drainage control							
18. Regular weed control							
19. Creating fire belts around cocoa farms to prevent fire risks							
20. Identification of ripened cocoa pods							
21. Oberving pre-harvest interval **(**Waiting for the required number of days after spraying before harvesting ripen cocoa pods on my farm)							
22. Harvesting ripened cocoa pods without damaging the flower cushions							

23. Breaking cocoa pods 2-3 days after harvesting pods							
24. Breaking harvested cocoa pods without cutting through the beans							
25. Fermenting cocoa beans for the required six days							
26. Drying fermented cocoa beans to right moisture level							
27.Storage of dried cocoa beans in the recommended jute bags							
Compliance with Sustainability standards							
1.Planting the required type and number of shade trees in cocoa farms							
2. Practicing Non-use of children to undertake hazardous work in cocoa farming							
3. Observing good treatment for workers engaged in cocoa farming							
4. Practicing protection of wildlife (other plants and animals, insects) in cocoa farms and the environment							
5. Creating buffer zones between cocoa farms and water bodies							
6. Practicing good sanitation in the farm, home and community							
7.Registering mapped farmland to own a farm plan							
8. Wearing Personal Protective Equipment when undertaking cocoa farming activities							
9.Storing agrochemicals in storage rooms and from food substances							
10. Disposing-off by burning used agrochemical bags, bottles, sachets etc.							
Purchases Innovations							
1.Properly conveying bagged cocoa beans to cocoa sheds without contamination							
2. Selling all cocoa beans to COCOBOD LBCs in Ghana							
3.Regularly using testing stones and body weight to detect scale adjustments							

4. Ensuring cocoa sales are recorded in COCOBOD Passbook							
5. Promptly paying advanced loans from LBCs in cocoa or cash							
Farm Enterprise Management Innovations							
1.Budgeting for cocoa farming activities							
2.Keeping records on cocoa farming activities							
3.Contracting labour to undertake activities on cocoa on time							
4.Supervising contracted labour in undertaking cocoa farming activities							
5. Mobilizing financial and material resources (e.g., inputs, equipment etc.) for cocoa farming							
6. Paying for received cocoa inputs and service credits on time							
7. Regularly saving cocoa income in banks and other financial Organisations							
8.Regualrly participating in cocoa related meetings and trainings							
9.Accurately estimating expenditure incurred in cocoa farming							
10. Diversifying farming enterprises							
11. Accurately estimating profit realized from cocoa farming							
12. Investing cocoa incomes in cocoa farming and other enterprises							

40. What is your Level of competency in cocoa farming on a scale of Strongly Agree (5) to Very Lowly Agree (1)?

NB: 5=Strongly Agree, 4=Agree, 3=Moderately Agree, 2=Lowly Agree, 1=Very Lowly Agree

No.	Competency in cocoa farming constructs	Level of competency				
		5	**4**	**3**	**2**	**1**
	Knowledge					
1	I know importance of using nursed cocoa seedlings in cocoa farming					
2	I know importance of accurately determining my cocoa farm or land size					
3	I know importance of selecting a good site for cocoa farming					
4	I know the planting distance for planting cocoa seedlings					
5	I know importance of providing temporary shade to transplanted cocoa seedlings					
6	I know importance of providing permanent shade trees on the cocoa farm					
7	I know the importance regularly pruning cocoa farm					
8	I know importance of controlling pests and diseases on cocoa farm					
9	I know importance of hand pollinating cocoa trees					
10	I know the need to set fire belts around my cocoa farm					
11	I know the importance of controlling weeds on a farm					
12	I know importance of applying various granular fertilizers in cocoa farms					
13	I know the importance of using foliar fertilizers in cocoa farming					
14	I know need to manage drainage conditions on cocoa farms					
15	I know importance of harvesting rippen cocoa pods for fermentation					
16	I know the effects unripen and diseased cocoa beans have on chocolate flavour in cocoa beans					
17	I know the importance of breaking harvested cocoa pods between 2-3 days after					
18	I know the importance of fermenting cocoa beans for 6 days					
19	I know the importance of drying fermented cocoa beans to the right moisture level or feeling a ‘cracking sound’					
20	I know the importance of storing dried cocoa beans in Jute sacks and from contaminants					
21	I know the importance of wearing Personal Protective Equipment when undertaking farm operations					
22	I know the importance of observing pre-harvest and re-entry interval periods for cocoa agrochemicals					
	Attitudes	**5**	**4**	**3**	**2**	**1**
1	I believe adopting recommended cocoa innovations shared with me results in increasing my cocoa yields					

2	I believe that fermenting unripen and diseased cocoa beans will affect the chocolate flavour of cocoa beans					
3	I believe that observing re-entry period is important for prolonging my health in cocoa farming					
4	I believe observing pre-harvest period is important for preventing agrochemical residues in cocoa beans					
5	I believe that participating in cocoa farmer group activities increases my knowledge and skills in cocoa farming					
6	I believe that storing agrochemicals in stores will keep me and my family safe					
7	I believe that undertaking cocoa farming activities at the right time improves yield and incomes					
8	I believe rehabilitating my aged and diseased cocoa farm helps to reduce diseases and sustains my cocoa farming enterprise					
9	I believe paying back my cocoa loans and input credit on time helps accessing such facilities in future					
10	I believe that investing in my cocoa farming activities helps to increase productivity of my farm and income					
11	I believe having a registered farm plan from the lands commission helps to own my cocoa farm					
	Skills	**5**	**4**	**3**	**2**	**1**
1	I am to nurse cocoa seedlings in polybags or beds correctly					
2	I am able to accurately determine my cocoa farm or land size					
3	I am able select a good site for cocoa farming					
4	I am able to determine accurate planting distance for cocoa					
5	I am able to transplant nursed cocoa seedlings correctly					
6	I provide temporary shade trees to transplanted cocoa seedlings					
7	I provide adequate permanent shade trees on my cocoa farm					
8	I am able to correctly and regularly prune my cocoa farm					

9	I am able to control weeds on my cocoa farm					
10	I am able to apply various granular fertilizers on cocoa farm					
11	I am to apply foliar fertilizers using sprayers					
12	I am able to manage drainage conditions on my cocoa farm					
13	I am able to identify ripen cocoa pods					
14	I am able to harvest ripen cocoa pods without damaging the flower cushions					
15	I am able to control pests and diseases on cocoa farm					
16	I am able need to set fire belts around my cocoa farm					
17	I break cocoa pods only after 2-3 days after harvesting					
18	I break harvested cocoa pods with clubs (sticks) to prevent damaging the beans					
19	I am able to ferment cocoa beans for the recommended 6 days					
20	I am able dry fermented cocoa beans to right moisture level or to a point of feeling a cracking sound					
21	I am able to store dried cocoa beans in jute sacks and from contaminants					
22	I wear Personal Protective Equipment in undertaking cocoa farming activities					
23	I am able to observe re-entry interval periods for cocoa agrochemicals					
24	I am able to observe pre-harvest intervals for various agrochemicals					
25	I am able to repair my sprayers					
Aspirations		**5**	**4**	**3**	**2**	**1**
1	I desire to expand my cocoa farm(s)					
2	I desire to use my cocoa farming business to increase my total household income					
3	I desire cocoa farming-related information on radio, television, and the social media					
4	I desire to have access to more training materials on cocoa farming					
5	I desire to have access to government free cocoa inputs					

6	I desire to have access to cocoa input credits					
7	I desire to have access to reliable and affordable cocoa labour services					
8	I desire to contribute towards my pension using my cocoa income					
9	I desire to insure my cocoa farm against risks (e.g., weather, fire, pests, and diseases etc.)					
10	I desire to encourage my children and dependent (s) to engage in cocoa farming as a business					
11	I desire to win best cocoa farmer awards					

41. What are your perceived Experiences of cocoa extension delivery on a scale of Strongly Agree to Very Lowly Agree? NB: 5=Strongly agree, 4=Agree, 3=Moderately Agree, 2=Lowly Agree, 1=Very Lowly Agree

	Construct	CHED Experiences					Extension Delivery Quality item (SERVPERF)	Private Extension Experiences				
		5	4	3	2	1		5	4	3	2	1
1	Reliability						My extension provider informs me exactly when to perform cocoa farming activities					
2							My extension provider provides me with services at the time promised					
3							My extension provider provides exact quantity of promised farming inputs					
4							My extension officer is always punctual at meetings/programme					
5	Responsive-ness						My extension officer always responds to me when in need and contacted.					
6							My extension officer shows sincere interests in solving my cocoa farming problems					
7							My extension officer attends to reported issues and problems promptly.					
8							My extension officer is always willing to visit my cocoa farm to advise on problems					
9	Assurance						My extension officer is consistently courteous with me					
10							My extension officer instills confidence in me					
11							My extension officer is always enthusiastic in sharing information/undertaking duties					
12							My extension officer provides scientific information on cocoa innovations					
13	Tangibility						My extension officer wear PPE during field activities and demonstrations					
14							My extension officer uses the appropriate modern training					

							materials (ICTs) share innovations with me					
15							My extension officer conducts him/herself professionally					
16	Communi-cation						My extension officer uses appropriate extension method in training me					
17							My extension officer uses clear and common language during trainings					
18							My extension officer provides me with feedback on my progress and problems shared					
19							My extension provider consistently provides me with training materials					
20	Empathy						My extension officer gives me individual attention					
21							My extension officer has my best interests at heart					
22							My extension officer attends to me at periods that are convenient to me					

SECTION 5: CHALLENGES OF COCOA FARMING

42. Identify and rank the Production, Marketing and Extension delivery challenges you face in cocoa farming?

No.	Challenges	Tick	Rank
Production challenges			
1	Labour unavailability		
2	High labour cost		
3	High land cost		
4	Land tenure insecurity		
5	Low access to farm inputs		
6	Low soil fertility		
7	High cost of inputs		
8	Pests and diseases infestations		
9	Prolonged drought conditions		
10	Late input supply		
11	Access to credit		
12	Fire outbreaks		
13	Theft		
14	Lumbering		
15	Flooding		

Marketing challenges			
1	Low cocoa price incentives		
2	Poor road network		
3	High transportation cost		
4	Scale adjustment		
5	Delays in purchases		
6	Low number of LBCs operating in community		
7	Low premiums paid for engagement in certification		
8	Late payment of purchased cocoa beans by LBC's		
9	Shortage of cocoa sacks and threads		
10	Long periods between closure and opening of new cocoa season		
Extension delivery challenges			
1	Low extension staff contacts		
2	Low use rate of training aids for training		
3	Low activities of cocoa farmer Associations and extension organisations		
4	Low feedback rate from extension officers		
5	Cost of participating in private cocoa extension schemes		
6	Language barriers between farmers and extension officers		
7	Inappropriate extension methods		
8	Cost of mobile phones		
9	Cost of mobile phone talk time and data bundles		
10	Poor radio waves		
11	Poor television waves		
12	Poor internet coverage		

FOCUS GROUP DISCUSSION (FGD) GUIDE
Factors influencing extension delivery in the Volta Cocoa Region of Ghana.

Title of FGD: To examine land, labour, adoption, and challenges issues associated with cocoa farming and extension delivery in the Volta region of Ghana.

District :……………………………………………………………..
Community…………………………………………………………………….
Location: ……………………………………………………………………….
Number of farmers at FGD……………………….……………………………
Date: …………………………………………………………………………
Time: ……………………………………………………………………….

Tape Recording consent: Please be informed that the discussions will be recorded, transcribed, analysed, and used for research purposes. The voice recordings will be destroyed after transcription and at the end of the submission of the final copies of the thesis to the Graduate School and Viva Voce.

Land

1. What cost and processes are associated with land acquisition for cocoa production in the community?
2. How is how is cocoa land mapped and registered in the Volta region?
3. How does owing farm at different distant locations this affect your cocoa farming operations?
4. What land fertility and environmental problems have you faced in cocoa farming?
5. Is land readily available for cocoa farming and expansion in the Volta region?
6. Do you still have uncultivated land? About how many acres if yes?
7. How does land tenure insecurity affect cocoa farming in your community?
8. Are timber/shade trees on your cocoa farm registered in your name?

Labour

9. Is labour readily available for cocoa farming in your community/region?
10. How do you organize and contract labour for cocoa farming in your community?
11. Which activities in cocoa farming that is labour demanding?
12. What positive and negative issues are associated with ‘nnoboa’ in cocoa farming in your community/Volta region?
13. What roles do women play in cocoa farming?
14. What is the cost of undertaking following farming activities your community?

Activity	Cost/acre (GHS)/year/day
Land Clearing	
Transporting of inputs to community	
Transporting of inputs to farm	
Weeding	
Pruning	
Hand Pollination	
Application of fungicides, insecticides etc.	

Fertilizer application	
Pod Breaking	
Transporting fermented cocoa to mat	
Fetching water	
Drying of cocoa beans	
Transporting of dried beans to cocoa storage	
Transporting of bagged beans to shed	
Farm mapping	
Repairs of tools, equipment, and machinery	
Others	

15. What will influence your decision to give out your cocoa farm to cocoa farm management company?

Extension delivery and adoption

16. How is cocoa extension delivered to you in the Volta region?
17. What influences adoption of cocoa innovations in the Volta region?

Challenges of cocoa farming

18. What challenges do cocoa extension officers face in the Volta region?
19. What solutions do you suggest improving cocoa Extension delivery in the Volta region?
20. General questions: Any other question

IN-DEPTH INTERVIEW GUIDE

Factors influencing extension delivery in the Volta Cocoa Region of Ghana.

(Targets: Lead farmers, Extension Mangers, Technical officers, Opinion leaders (e.g., Assembly members)

District…………………………………………………………………..
Community:……………………………………………………………..
Location: ……………………………………………………………….
Title of interviewee: ……………………………………………………
Date: ……………………………………………………………………
Time: ……………………………………………………………………

Tape recording consent: Please be informed that the discussions will be recorded, transcribed, analysed, and used for research purposes. The voice recordings will be destroyed after transcription and at the end of the submission of the final copies of the thesis to the Graduate School and Viva-voce.

Land

1. What cost and process are associated with land acquisition for cocoa production in the community?
2. How is how is cocoa land mapped and registered in the Volta region?
3. How does farms at different locations, how does this affect your cocoa farming activities?
4. What land fertility and environmental problems have you faced in cocoa farming?
5. Is land readily available for cocoa farming and expansion in the Volta region?

6. How does land tenure insecurity affect cocoa farming in your community?
7. Are trees on your cocoa farm registered in your name?
8. Do cocoa farmers in the region have cocoa and other cash crops in other regions within or outside Ghana?

Labour

9. Is labour readily available for cocoa farming in your community/region?
10. How do you organize and contract labour for cocoa farming in your community?
11. Which activities in cocoa farming that is labour demanding?
12. What positive and negative issues are associated with nnoboa in cocoa farming in your community/Volta region?
13. What roles do women play in Cocoa farming?
14. What is the cost of undertaking following farming activities your community?

Activity	**Cost/acre (GHS)/year/day**
Land clearing	
Transporting of inputs to community	
Transporting of inputs to farm	
Weeding	
Pruning	
Hand Pollination	
Application of fungicides, insecticides etc.	
Fertilizer application	
Pod Breaking	
Transporting fermented cocoa to mat	
Fetching water	
Drying of cocoa beans	
Transporting of dried beans to cocoa storage	
Transporting of bagged beans to shed	
Farm mapping	
Repairs of tools, equipment, and machinery	
Others	

15. What influences decision to give out your land to cocoa farm Management Company?

16. What solutions do you suggest to deal with the constraints affecting cocoa farming.

OBSERVATION GUIDE
(Farm, Community, Shed)
How cocoa innovations are adopted in the Volta Cocoa Region

Please be informed that images of the innovations and activities observed at the various entities will be taken with your consent. If at any time you wish to stop the taking of images of any observation, please feel free to inform the researcher to stop.

Entity Observed 1. Farm [ ] 2. Community [ ] 3. Shed [ ]
Date:……… District:……… Community…………………

Observation criteria	Observations	Remarks
What is the general appearance of cocoa farm?		
What cocoa nursery practices are undertaken by farmers?		
What are the cocoa Plant and shade tree populations conditions at the farm?		
What cultural maintenance (weeding, pruning, drainage, mulching, and erosion control) practices are undertaken at the farm.		
How are agrochemicals containers disposed of at the farm and community levels		
What Pest and disease infestations control practices at the farm level?		
Do cocoa farmers own and use PPE?		
How are agrochemicals prepared by farmers?		
How are sprayers used and maintained by farmers?		
Storage of agrochemicals and containers		
How do farmers harvest and gather cocoa pods in their farms?		
How do farmers undertake fermentation of cocoa beans?		
How are fermented beans transported or transferred to homes/ mats		
How do farmers dry fermented cocoa beans and store dried beans?		

What Sanitation exists in cocoa communities?		
What planning aids, training materials and identification systems are available to farmers?		
What records are kept by cocoa farmers?		
How do farmers participation in group activities		
What cocoa purchases processes and issues exists in the community and LBCs?		
General observations		

16. What influences decision to give out your land to cocoa farm Management Company?

Suggested solutions to dealing with constraints affecting cocoa farming.

17. What solutions do you suggest to dealing with challenges confronting cocoa Production, Marketing and Extension Delivery challenges in the Volta Cocoa Region? **Specific questions to target groups**

17. What is the structure and practices of cocoa extension delivery in your Organisation in Volta Cocoa Region? **(Extension staff and manager)**

18. What challenges do cocoa extension officers face in the Volta region? **(Extension Staff)**
19. In what ways should cocoa extension staff be motivated to improve upon their extension delivery performance in the Volta Cocoa Region? **(Extension Staff)**
21. General questions

APPENDIX D: Code Book of Qualitative Analysis

Focus Group Discussions, In-depth interviews Qualitative analysis

Nodes

Nodes\\Adoption

Issues relating to adoption of cocoa innovations

Name	Description	Files	References
Adoption issues	Adoption of cocoa innovations	6	6
solutions required	Solutions to adoption challenges	1	1

Nodes\\Cocoa farming challenges

Challenges of cocoa farming

Name	Description	Files	References
Extension Challenges	Extension delivery challenges of cocoa farming	12	16
Marketing challenges	Marketing challenges of cocoa farming	9	10
Production challenges	Production challenges of cocoa farming	12	21

Nodes\\Extension Delivery

Issues relating to extension delivery

Name	Description	Files	References
Extension practice	Cocoa Extension delivery Practices	6	6
Extension solutions	Solutions to extension problems in cocoa farming	6	6

Nodes\\Labour issues

Labour issues in cocoa farming

Name	Description	Files	References
Child labour issues		1	1
Labour availability	labour availability in cocoa farming	13	13
Labour cost	cost of labour for various activities	13	13
labour demanding	labour demanding activities in cocoa farming	13	14
labour organisation	how farmers organise labour for cocoa farming	13	14
Negatives of Nnoboa(fidodo)	Negatives of Nnoboa(fidodo)	12	13
Nnoboa issues	Issues and importance of Nnoboa	6	7
Positives of Nnoboa	Positives of Nnoboa (fidodo) in cocoa farming	9	9
Private Farm MGT	influencers of participating in private farm management activities	12	12
Women roles	Women roles in cocoa farming	13	13

Nodes\\Land Issues

Land issues in cocoa farming

Name	Description	Files	References
Farm at Different locations	issues with farming at different locations	7	8
Farm outside region or Ghana	Ownership of farm outside Volta region or outside Ghana	6	6
land acquisition	Ways of acquiring land for cocoa farming	13	29
Land availability	Availability of land to expand cocoa farming	13	18
Land fertility	Land fertility issues in cocoa farming	13	13
Shade tree availability	Availability of shade trees in cocoa farming	13	13
Tenure Insecurity	Land tenure insecurity issues in cocoa farming	12	12

APPENDIX E: Ethical Clearance by UCC IRB

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309/ 0244207814
E-MAIL: irb@ucc.edu.gh
C/O Directorate of Research, Innovation and Consultancy

OUR REF: UCC/IRB/A/2016/567
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

27TH NOVEMBER, 2019

Mr. Bernard Archibald Senyo Agyeman

Department of Agricultural Economics and Extension

University of Cape Coast

Dear Mr. Agyeman,

ETHICAL CLEARANCE – ID (UCCIRB/CANS/2019/07)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted **Provisional Approval** for the implementation of your research protocol titled **Factors Associated with Cocoa Extension Delivery and Performance of Cocoa Farmers in the Volta Region Ghana**. This approval is valid from 27th November, 2019 to 26th November, 2020. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

Please note that any modification to the project must be submitted to the UCCIRB for review and approval before its implementation. You are required to submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Samuel Asiedu Owusu, PhD
UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST