University of Ghana http://ugspace.ug.edu.gh

UNIVERSITY OF GHANA

COLLEGE OF HUMANITIES

IMPACT OF TRAINING ON GOOD AGRONOMIC PRACTICES (GAP) ON WAGES, WORKING TIME AND WORKING CONDITIONS OF COCOA FARM WAGE WORKERS IN GHANA

BY

MICHAEL MAWULI AKPE-DOE
(11366286)

THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS IN DEVELOPMENT STUDIES DEGREE

INSTITUTE OF STATISTICAL SOCIAL AND ECONOMIC RESEARCH

APRIL 2025

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

DECLARATION

I, Michael Mawuli Akpe-Doe, hereby declare that the research presented in this dissertation, titled "Impact of Training on Good Agronomic Practices (GAP) on Wages, Working Time and Working Conditions of Cocoa Farm Wage Workers in Ghana" submitted in partial fulfillment of the requirements for the degree of Master of Art in Development Studies at the University of Ghana, is the product of my own original work, except where explicitly stated or acknowledged. I confirm that this work has not been previously submitted, in part or in whole, for any other degree or qualification.

…… Date 02.10.2025

Michael Mawuli Akpe-Doe

(Student)

Soullier

…… Date 02.10.2025

Dr. Guillaume Soullier

(Supervisor)

…… Date 2/OCTOBER/2025

Dr. Ralph N.A. Armah

(Supervisor)

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

DEDICATION

This dissertation is dedicated to my loving and supportive wife, Cynthia and my three beautiful daughters Michelle, Giovanna and Julia, whose unwavering love, support, and encouragement have been my constant source of strength throughout this academic journey. Your belief in me has been the driving force behind my achievements, and I am eternally grateful for your sacrifices and prayers. I also dedicate this work to the cocoa farmers and wage workers in Ghana, whose tireless efforts sustain our nation. May this research contribute to the advancement of sustainable cocoa production practices and the enhancement of their working conditions.

University of Ghana http://ugspace.ug.edu.gh

ACKNOWLEDGMENTS

My first appreciation goes to Almighty God for granting me life, strength, and wisdom throughout this academic journey. His grace has been my source of perseverance and guidance. I am deeply grateful to my family for their unwavering love, prayers, and encouragement. Their support has been the bedrock of my motivation and resilience.

My sincere appreciation goes to my supervisor, Dr. Guillaume Soullier and Dr. Ralph N.A. Armah, for their insightful guidance, constructive feedback, and continuous support throughout this research. I also extend heartfelt thanks to the Institute of Statistical, Social and Economic Research (ISSER) and the University of Ghana for providing the academic environment and resources necessary for the successful completion of this dissertation. Special thanks to the Cocoa for Future (C4F) project for providing the data that made this research possible. Your contribution was critical to the study's success.

I am also thankful to my colleagues at the Research, Monitoring and Evaluation Department of the Ghana Cocoa Board for their encouragement, collaboration, and professional insights which enriched this study.

Finally, I wish to express profound gratitude to the cocoa farm wage workers in Ghana who participated in this research. Their time, openness, and experiences were invaluable in shaping the findings of this work.

To all who contributed in one way or another to this academic milestone, I say thank you.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

ABSTRACT

The cocoa sector plays a critical role in Ghana's economy, yet cocoa farm wage workers continue to face persistent challenges including low wages, irregular working hours, and poor working conditions. While Good Agronomic Practices (GAP) training has been widely promoted to enhance cocoa productivity and environmental sustainability, its implications for labour outcomes remain underexplored. This study examines the impact of GAP training, specifically training in weeding and pruning tasks, on the wages, working time, and working conditions of cocoa farm wage workers in Ghana, with a special focus on gender and youth disparities.

Using secondary data from the Cocoa4Future (C4F) project, the study employs Propensity Score Matching (PSM) to control for selection bias and estimate the causal impact of GAP training on labour outcomes. In addition, a probit regression model is used to examine the determinants of earning above the average wage threshold, incorporating interaction terms to assess the differential effects of GAP training across gender and age groups.

Importantly, the interaction between GAP training and gender yielded a statistically significant and positive effect on wages. This suggests that female workers who received GAP training were more likely to earn above the average wage threshold compared to their male counterparts. Although youth status was marginally associated with higher earnings, the interaction between GAP training and youth was not statistically significant. Moreover, GAP training was associated with a significant increase in daily pruning wages but had no statistically significant effect on daily weeding wages.

In conclusion, while GAP training contributes to labour efficiency, particularly by reducing weeding days, and improves perceived working conditions, its benefits remain uneven and task-specific. Trained workers reported higher perceptions of labour intensity in pruning tasks and increased awareness of health risks in weeding tasks, suggesting that while technical skill

University of Ghana http://ugspace.ug.edu.gh

improved, the physical burden of some tasks may have intensified. These findings highlight the need to ensure that skill acquisition through GAP training translates into equitable compensation, improved working conditions, and enhanced livelihoods for all cocoa farm workers. This calls for the design of more gender- and youth-responsive training programs, coupled with stronger labour protection measures and targeted incentives that reward productivity and protect worker welfare in Ghana's cocoa sector.

University of Ghana http://ugspace.ug.edu.gh

TABLE OF CONTENTS

Contents

DECLARATION i
DEDICATION ii
ACKNOWLEDGMENTS iii
ABSTRACT iv
TABLE OF CONTENTS vi
LIST OF ABBREVIATIONS ix
LIST OF TABLES x
CHAPTER ONE 1
INTRODUCTION 1
1.1 Research Background 1
1.2 Research Problem 3
1.3 Purpose of the Study 6
1.4 Research Objectives 6
1.5 Research Questions 6
1.6 Significance of the Study 6
1.7 Scope of the Study 7
CHAPTER TWO 8
LITERATURE REVIEW 8
2. Chapter Overview 8
2.1 History of Cocoa in Ghana 8
2.2 Importance of Cocoa to Ghana's Economy 9
2.3 The Cocoa Value Chain in Ghana 11
2.4 Labour and Work Arrangements in Cocoa Production 12
2.4.1 Family Labour 12
2.4.2 Wage Labour 12
2.4.3 Noboa System 13
2.4.4 Migrant Labour 13
2.5 Task-Specific Wage Contributions 13
2.6 Good Agronomic Practices (GAP) in Cocoa Production 15
2.6.1 Overview of GAP training programs in Ghana 17
2.7 Impact of Good Agronomic Practices Training Programs 19

University of Ghana http://ugspace.ug.edu.gh

2.8 Challenges for the Adoption of GAP In Ghana 20
2.9 Policy Framework and Institutional Support for GAP Training 21
2.10 Role of Certification Schemes in Promoting GAP 22
2.11 Theoretical Framework 23
2.11.1 Human Capital Theory 23
2.12 Conceptual Framework 27
CHAPTER THREE 30
METHODOLOGY 30
3.1 Introduction 30
3.2 Research Design 30
3.3 Method of Data Collection 31
3.3.1 Source of Data 31
3.3.2 Data Collection procedure 31
3.3.3 Sampling Procedure and Sample Size 32
3.4 Method of Data Analysis 33
3.4.1 GAP Training Impact Analysis 34
3.4.2 Propensity Score Matching (PSM) Procedure 34
3.4.3 Analysing GAP Training's Impact on Wage Gaps 37
3.4.4 Probit Regression Model 37
3.5 Ethical Consideration 38
3.6 Limitations of the Study 39
CHAPTER FOUR 41
RESULTS AND DISCUSSION 41
4.1 Introduction to the Chapter 41
4.2 Socio-Economic and Household Characteristics of Cocoa Farm Wage Workers 41
4.3 Impact of GAP Training on Labour Outcomes of Cocoa Wage Workers 46
4.3.1 Estimation of Propensity Scores Using Probit Regression 47
4.3.2 Effect of GAP Training on Daily Wages 49
4.3.3 Effect of GAP Training on Working Time 50
4.3.4 Effect of GAP Training on Perceived Working Conditions 51
4.4 Covariate Balance Test 54
4.5 Propensity Score Distribution 56
4.6 Rosenbaum Bounds Sensitivity Analysis 58
4.7 Wage Disparities Among Cocoa Farm Workers: A Focus on Gender and Age 60

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FIVE 63
SUMMARY, CONCLUSIONS, AND RECOMMEDATIONS 63
5.1 Introduction to Chapter 63
5.3 Conclusions 65
5.4 Recommendations 66
REFERENCES 68

University of Ghana http://ugspace.ug.edu.gh

LIST OF ABBREVIATIONS

Abbreviation	Meaning
C4F	Cocoa4Future Project
COCOBOD	Ghana Cocoa Board
FAO	Food and Agriculture Organization
FASDEP	Food and Agriculture Sector Development Policy
GAP	Good Agronomic Practices
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
ILO	International Labour Organization
IPM	Integrated Pest Management
LBCs	Licensed Buying Companies
NCRP	National Cocoa Rehabilitation Programme
NGOs	Non-Governmental Organizations
NNM	Nearest Neighbor Matching
PFJ	Planting for Food and Jobs
PPE	Personal Protective Equipment
PSM	Propensity Score Matching
SMD	Standardized Mean Difference
USD	United States Dollar

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

LIST OF TABLES

Table 3.1: A Priori Expectations for Wage Threshold Model 38
Table 4.2: Socio-Economic and Labour Outcome Characteristics 42
Table4.3: Probit Regression on Determinants of GAP Training Participation 47
Table 4.4: PSM Estimates of GAP Training on Daily Wages (GHS/day) 50
Table 4.5: PSM Estimates of GAP Training on Daily Working Time (days) 51
Table 4.6: PSM Estimates of GAP Training on Working Conditions (workers' perception) ..53
Table 4.7: Rosenbaum Bounds Sensitivity Analysis for Weeding and Pruning Wages 60
Table 4.8: Probit Regression on Wage Threshold Among Cocoa Farm Wage Workers 62

LIST OF FIGURES

Figure 2.1: Conceptual Framework Linking GAP Training to Labour Outcomes 299
Figure 4.1: Unmatched and matched standardized % bias across covariates……..56

Figure 4.2: Distribution of Propensity Scores and Common Support Region.....588

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

CHAPTER ONE

INTRODUCTION

1.1 Research Background

Cocoa cultivation contributes approximately 20-25% of Ghana's export revenues, employing over 800,000 farmers and millions of agricultural workers (Yusif et al., 2022). As the world's second-largest cocoa producer, following Côte d'Ivoire, Ghana supplies nearly 20% of global cocoa output (FAO, 2022). Despite the sector's economic significance, cocoa farm labourers continue to experience unstable livelihoods, inadequate wages, unpredictable work schedules, and strenuous physical labour requirements (Anang & Apedo, 2023; Gyapong, 2020). These challenges not only affect workers' well-being but also have broader implications for productivity, labour retention, and the sustainability of the cocoa supply chain. Poor working conditions may lead to labour shortages, reduced efficiency, and even perpetuate cycles of poverty and child labour issues that have drawn international scrutiny (ILO, 2021; Barrientos, 2019).

In response to these challenges, attention has increasingly turned to Good Agronomic Practices (GAP), broadly defined as methods that integrate scientific knowledge with practical applications to optimize agricultural productivity while safeguarding environmental sustainability and human health (Varotariya, 2024). According to the Food and Agriculture Organization (FAO), GAP refers to 'the application of available knowledge to the use of natural resources for the production of safe and healthy food, in a manner that is economically viable and socially acceptable' (FAO, 2003).While research has examined the effects of Good Agronomic Practices (GAP) on agricultural productivity and sustainability (Quaye et al., 2021; Suh et al., 2020), its impact on farm labourers' working conditions and employment terms remains underexplored. This gap is critical because GAP interventions often prioritize environmental and yield outcomes while overlooking socio-labour dimensions. For instance,

University of Ghana http://ugspace.ug.edu.gh

improved farming techniques may alter task demands, shift wage structures, or necessitate new skills factors that directly influence labourers' livelihoods.

The adoption of GAP in Ghana for farm workers has been widely promoted to address challenges such as declining soil fertility, pest infestations, and climate change effects on cocoa output (Adesina et al., 2023). GAP techniques, including pruning, shade management, and integrated pest control, have effectively improved soil quality and increased yields (Obeng Adomaa et al., 2022; Petchrompo et al., 2022). For example, farmers implementing GAP achieve an average yield increase of 40% compared to those using traditional methods (Abdul-Rahaman et al., 2021). Government agencies, non-governmental organizations (NGOs), and certification programmes like Rainforest Alliance and Fairtrade have played crucial roles in equipping farmers with the necessary knowledge and skills to apply these practices. For example, between 2015 and 2022, the Modelez Cocoa Life Program and COCOBOD's Productivity Enhancement Program trained approximately 500,000 Ghanaian farmers in GAP techniques (Bosselmann et al., 2023).

While the environmental and economic benefits of GAP training are well documented, its implications for labour conditions remain inadequately studied (Smidt & Jokonya, 2022; Zakaria et al., 2020). Cocoa production in Ghana is labour-intensive, requiring human effort for every stage, from planting, weeding and pruning to harvesting and drying. Many farm labourers work in informal settings with minimal labour protections and earn below USD 2 to USD 3 per day, falling below the international poverty line of USD 2.15 per day (ILO, 2021). Farmworkers also face job insecurity and limited access to essential social protections such as healthcare and pensions (López-Calva & Ortiz-Juarez, 2023).

Farms that use GAP often require workers to adhere to stricter schedules and perform additional tasks, potentially increasing their workload without a corresponding wage increase. This raises

University of Ghana http://ugspace.ug.edu.gh

critical concerns about the distribution of productivity gains between farm owners and workers. Women constitute approximately 45% of Ghana's cocoa labour force but earn less than their male counterparts and have limited decision-making power on farms (Yaro et al., 2024). Young workers also face barriers such as restricted access to training, resources, and land, which limit their participation in the cocoa industry. Despite their significant contribution to cocoa production, women account for only 20–30% of GAP training participants in Ghana, highlighting structural inequities in access to training opportunities (Amponsah-Doku et al., 2022).

Additionally, while GAP protocols improve occupational safety through better pesticide management and handling practices (Boateng et al., 2023), they also introduce new occupational hazards. For example, Integrated pest management under GAP involves pesticide use, which, if not properly managed, may pose significant health risks to the farm workers (Desneux et al., 2022). Furthermore, the physically demanding nature of GAP practices may increase workers' susceptibility to injuries. These factors underscore the need for comprehensive research on GAP's impact on occupational health and safety.

Given that workers are integral to the successful implementation of GAP, discussions on sustainability and production should also consider their working hours and working conditions (Toledo-Hernández et al., 2020). While certification programs and NGOs have introduced social initiatives such as community development and gender empowerment projects, there is limited empirical evidence on their effectiveness in improving labour outcomes in the cocoa industry. This study seeks to address this research gap by evaluating the impact of GAP training on cocoa farmworkers' wages, working time, and working conditions in Ghana.

1.2 Research Problem

Cocoa production is a cornerstone of Ghana's economy, contributing significantly to both household incomes and foreign exchange earnings (Hess, 2022; Teye & Nikoi, 2021). The

University of Ghana http://ugspace.ug.edu.gh

sector supports millions of livelihoods, particularly in rural communities, and remains a key driver of economic development. To enhance productivity and sustainability, various initiatives, including Good Agronomic Practices (GAP) training, have been introduced. GAP refers to the application of available knowledge to the use of natural resources to produce safe and healthy food, in a manner that is economically viable and socially acceptable (FAO, 2003). In Ghana's cocoa sector, GAP refers to a standardized set of recommended farming techniques promoted by institutions such as COCOBOD, sustainability certification bodies (e.g., Rainforest Alliance, Fairtrade), and development programs (e.g., World Bank, IFAD, FAO). These practices typically include pruning, shade management, integrated pest management (IPM), proper fertilizer application, and soil conservation methods (Asare et al., 2020; Aneani & Ofori-Frimpong, 2021). While GAP guidelines are formally outlined by these institutions, their implementation varies depending on farm size, access to extension services, and the specific requirements of certification schemes (Barry & Danso, 2022).

Most existing studies prioritize farm owners, overlooking the perspectives and experiences of the labourers who carry out daily farm operations and ultimately drive the sector's productivity. Farmworkers, who are often hired informally, play a crucial role in implementing GAP techniques, yet there is little understanding of how these requirements influence their earnings, work hours, and job stability.

Although studies confirm that GAP training enhances agricultural efficiency and environmental conservation (Esmaeilian et al., 2020; Cheng & Kong, 2022), they fail to assess its implications for farm workers' economic and social well-being. The introduction of GAP techniques such as hand pollination, precision pruning, and IPM, often requires farm workers to undertake more labour-intensive tasks, which may increase workload and physical demands (Kodom et al., 2022). However, research has not sufficiently examined whether these additional responsibilities result in improved wages, better employment benefits, or increased job security.

University of Ghana http://ugspace.ug.edu.gh

Emerging evidence suggests that GAP training standardizes tasks and increases overall farm productivity (Amponsah-Doku et al., 2022). However, some studies indicate that while GAP enhances labour efficiency, it does not necessarily lead to higher wages or improved working conditions. Instead, it may place greater labour demands on farm workers without corresponding financial compensation, exacerbating economic disparities and worker exploitation (Kodom et al., 2022). Additionally, gender and youth disparities in employment conditions within GAP-trained farms remain largely understudied, despite concerns that women and young workers may face greater job insecurity or wage inequalities (Unnikrishnan et al., 2022).

Furthermore, GAP training has been associated with improvements in workplace safety, particularly in reducing hazardous pesticide use and promoting safer farming techniques. However, some studies suggest that it also introduces new occupational risks, such as increased physical strain, prolonged work hours, and exposure to harsh environmental conditions (Adams et al., 2024; Bayram et al., 2022). While these studies focus on occupational safety measures, they fail to explore how GAP influences broader employment conditions, including job stability, access to benefits, and overall worker satisfaction.

Given these gaps, this study seeks to investigate the impact of GAP training on farm workers' wages, working hours, and overall working conditions in Ghana's cocoa sector. It will examine whether the adoption of GAP practices leads to economic gains for farm workers or contributes to increased labour demands without sufficient compensation. By providing a comprehensive assessment of GAP's labour implications, this research aims to inform policies that promote fair and equitable labour standards in cocoa production. Understanding these dynamics is essential for ensuring that sustainability efforts do not come at the expense of farm workers' livelihoods but instead contribute to inclusive and socially responsible agricultural development.

University of Ghana http://ugspace.ug.edu.gh

1.3 Purpose of the Study

This study seeks to examine the impact of training on Good Agronomic Practices (GAP) on wages, working time and working conditions of cocoa farm workers in Ghana.

1.4 Research Objectives

1) Evaluate the impact of GAP training on the wages, working time and working conditions of cocoa farm wage workers in Ghana.
2) Analyse how GAP training impacts wage disparities among cocoa farm workers in Ghana, focusing on gender and age differences.

1.5 Research Questions

1) What is the impact of GAP training on the wages, working time and working conditions of cocoa farm wage workers in Ghana?
2) How does GAP training impact wage disparities among cocoa farm wage workers in Ghana, particularly across gender and age groups?

1.6 Significance of the Study

Good Agronomic Practices (GAP) training has been widely promoted to boost cocoa productivity and protect the environment. However, little is known about how GAP affects cocoa farm workers' wages, working hours, and conditions. Most studies focus on farm owners and crop yields, ignoring the labourers who carry out the work. This study addresses that gap by looking at how GAP training impacts the livelihoods of farm workers, giving a fuller picture of what sustainable cocoa production really means.

For academics, the study adds a new perspective by focusing on workers, not just farm owners. It contributes to the growing discussion about making agriculture socially sustainable and highlights issues of gender and youth inequality that are often overlooked.

For policymakers, the study provides important evidence for designing better labour policies in the cocoa sector. It shows how GAP training can be linked to fair wages, better working

University of Ghana http://ugspace.ug.edu.gh

conditions, and stronger protections for workers, ensuring that productivity improvements benefit everyone, not just farm owners.

For industry players, including certification bodies, NGOs, and cocoa companies, the research shows why GAP programs must also include fair labour practices, not just focus on environmental standards. It offers practical ideas for building fairer, more inclusive certification schemes and business models.

By putting farm workers at the center of the discussion on sustainable cocoa, this study calls for a more complete approach, one that shares the benefits of sustainability fairly across all those who contribute to cocoa production.

1.7 Scope of the Study

This research examines the experiences of farm workers across various cocoa farms, recognizing that their differences may shape different labour experiences and wage structures. It also considers the perspectives of youth workers, who represent a critical yet often overlooked segment of the agricultural workforce. By incorporating a gender-sensitive and youth-focused lens, this study aims to provide a comprehensive understanding of how GAP training affects different demographics within the cocoa labour force.

In addition to analyzing cocoa farm worker experiences, the study assesses the role of external actors, including government agencies, non-governmental organizations (NGOs), cocoa cooperatives, and certification programs, in shaping labour outcomes. These entities play a crucial role in regulating labour conditions, enforcing fair wages, and implementing workplace safety measures. The research investigates the extent to which these external actors influence policy implementation, wage structures, and access to social protections for farm workers.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER TWO

LITERATURE REVIEW

2. Chapter Overview

This chapter provides a review of the literature in relation to the major concepts around the research topic. According to Xiao and Watson (2019), a literature review identifies what past research has been done, allowing for more focused and insightful inquiries concerning the research problem to be addressed. Therefore, since the study is focused on the impact of training on Goods Agronomic Practices (GAP) on wages, working time and working conditions of cocoa farm workers in Ghana, attempts were taken to identify prior literature and findings on the matter. As a result, the literature review covers the conceptual, empirical, and theoretical literature on Good Agronomic Practices (GAP) on cocoa farm workers. The conceptual review seeks to provide understanding and insights into the key terms identified on the topic which are Good Agronomic Practices, wages, working time, working conditions and cocoa farming in Ghana. Under the theoretical review, the research identifies and explains the main theories that guide the study, and previous studies related to the topic under study are presented under the empirical reviews.

2.1 History of Cocoa in Ghana

Cocoa was introduced to the Gold Coast (now Ghana) from Fernando Po in 1879 and São Tomé in 1886 (Meyer, 2024). By 1891, just 12 years later, cocoa had become an export crop (Kuusaana et al., 2021).

Earlier efforts to cultivate cocoa began in 1857 when Basel missionaries planted seeds from Surinam at Akropong, Eastern Region. However, these attempts failed due to unsuitable agroclimatic conditions, including cooler temperatures, shallow soils, and hilly terrain (Addae-Boadu, 2015). A second attempt in 1858 using seeds from Cape Palmas in Liberia saw limited success, with ten trees initially surviving, but by 1863, only one remained due to pest damage.

University of Ghana http://ugspace.ug.edu.gh

Pods from the surviving tree were distributed to Aburi, Mampong, and Krobo-Odumase, all in the Eastern region, where cultivation proved more successful (Grossman-Greene & Bayer, 2009).

Tetteh Quarshie, a Ga blacksmith from Christiansborg, is credited with successfully introducing cocoa from Fernando Po of Equatorial Guinea to Ghana around 1879. He established a cocoa nursery in Mampong-Akwapim, Eastern region selling seedlings to local farmers (Agyei-Ohemeng et al., 2018), laying the foundation for Ghana's cocoa industry (Grossman-Greene & Bayer, 2009). From Akwapim, cocoa cultivation spread to Ashanti, Brong Ahafo, Central, and Western Regions, and by 1891, Ghana exported its first 80 pounds of cocoa.

By 1910–1911, Ghana had become the world's leading cocoa producer, with annual production reaching approximately 40,000 tonnes (Boateng, 2014). Cocoa farming in Ghana developed primarily through Ghanaian initiatives, with minimal colonial government support (Roape, 2020). Unlike other producing countries, Ghana's cocoa sector remained dominated by smallholder farmers averaging 2 hectares, with no significant presence of expatriate-owned plantations (Grossman-Greene & Bayer, 2009).

To promote cocoa cultivation, the colonial government established model farms, particularly in Ashanti, and offered rewards—including Dane guns and kegs of gunpowder—for planting cocoa trees (Kumeh, 2024; Asibey et al., 2020). These incentives contributed to Ghana's rapid rise, and by 1939, cocoa accounted for approximately 80% of the country's total exports.

2.2 Importance of Cocoa to Ghana's Economy

Cocoa has been a pillar of Ghana's economy for over a century, serving as a major source of income for farmers and a key driver of foreign exchange earnings. Its prominence as a cash crop is largely due to its relatively low cultivation costs compared to alternatives like palm oil, as well as the favorable climatic conditions in Ghana's forest belt regions (Amanor et al., 2021).

University of Ghana http://ugspace.ug.edu.gh

Cocoa is also versatile in cultivation, as it can be grown alongside other crops and continues to produce even when land is left to fallow (Addae-Boadu, 2015). Given its economic significance, concerns arose when swollen shoot viral disease was first detected in 1936, threatening the cocoa industry. In response, the Ghanaian government established the Cocoa Research Institute of Ghana (CRIG) in Tafo, Eastern Region, and introduced various quality control measures, including bean grading, extension services, and enhanced farmer engagement (Addae-Boadu, 2015).

Government support for cocoa production has remained strong, with continuous technical assistance, financial incentives, and subsidies for essential inputs like fertilizers and pesticides. Over the past decade, these interventions have boosted cocoa production, reaching a peak of 740,000 metric tons in the 2015/2016 season (Aryeetey et al., 2018). In 2024, cocoa contributed approximately 7.3% to Ghana's Gross Domestic Product (GDP), making it the second-largest foreign exchange earner, following gold, which overtook cocoa in 1992 (Ghana Cocoa Board, 2024).

Agriculture remains a vital sector in Ghana's economy, contributing 19.7% to GDP, over 30% of export earnings, and providing critical inputs for manufacturing. In 2019, it employed 33.5% of the national labour force. (Israel's Trade and Economic Mission to Ghana, 2020). Within agriculture, cocoa is a dominant sub-sector, contributing GHS 3.1 billion (approximately $533 million) to GDP in 2021, representing over 10% of Ghana's total GDP and 16.5% of agricultural GDP (Ghana Cocoa Board, 2024; Quayson, 2021). Approximately 65% of the agricultural workforce is engaged directly or indirectly in cocoa production, with cocoa farming serving as the primary livelihood for nearly two million rural farmers and their dependents (Eberhard et al., 2022).

University of Ghana http://ugspace.ug.edu.gh

In recent years, cocoa production has experienced fluctuations, rising from 770,694.44 metric tons in the 2019/20 cocoa season to 1,047,384.94 metric tons in 2020/21 season, before declining to 683,268.94 metric tons in the 2021/22 season and further to 584,000 metric tons in the 2023/24 season (Ghana Cocoa Board, 2025). In 2016, cocoa contributed 28% to agricultural growth, up from 19% in 2023 (Statista, 2024). Such growth is particularly noteworthy given the historically low supply elasticity of Ghanaian cocoa producers (Boateng, 2024). Research has consistently shown a strong correlation between producer prices and cocoa supply, with recent price increases playing a key role in maintaining strong production levels (Staritz et al., 2022). However, while yields increased by 22% between 2015 and 2018, growth has slowed in recent years. Despite this, COCOBOD's initiatives including technology adoption, improved access to credit, and partial liberalization of cocoa marketing have helped sustain productivity gains (Vigneri, 2017).

Cocoa remains Ghana's second most important export commodity, with exports more than doubling between 2012 and 2016. In recent years, cocoa beans (24.3%) and processed cocoa products (3.8%) have accounted for 28% of total exports, making it second only to gold and well ahead of forestry products (15%) (Bangmarigu & Qineti, 2018). Cocoa also constitutes nearly half of Ghana's total agricultural exports, including forestry and fishery products. In comparison, the two leading non-traditional agricultural exports, palm oil and fruits collectively account for only about 4% of total agricultural exports.

2.3 The Cocoa Value Chain in Ghana

Cocoa production in Ghana is embedded in a highly structured value chain coordinated by the COCOBOD. This chain includes a wide range of actors and processes, spanning input supply, farm-level production, post-harvest handling, internal marketing, processing, export, and distribution. Each actor adds value along the chain, and the efficiency of these interactions directly impacts farmer income, export earnings, and national development outcomes.

University of Ghana http://ugspace.ug.edu.gh

2.4 Labour and Work Arrangements in Cocoa Production

Labour is a critical input in cocoa production, with over 90% of Ghana's cocoa grown by smallholder farmers who rely on both household and non-household labour (Ghana Cocoa Board, 2024; Barrientos, 2019). Labour in cocoa farming is organised in different ways, depending on farmers' needs and local traditions. The main types of labour arrangements include:

2.4.1 Family Labour

Family labour is traditionally the backbone of cocoa production, especially in smaller farms. Spouses and children often assist with tasks such as pod collection, weeding, pruning, and drying. Family labour is often unpaid and flexible, which makes it a cost-effective arrangement for smallholders. However, this model does not show the true cost of labour and often results in children being involved in potentially dangerous tasks. Reports by international watchdogs and scholars have documented child involvement in agrochemical application, long working hours, and carrying of heavy loads, all of which contravene International Labour Organization (ILO) conventions and Ghana's Children's Act (Barrientos et al., 2008).

2.4.2 Wage Labour

Wage labour plays a growing role in cocoa production, particularly on larger or more commercially oriented farms. Workers may be hired as casual, seasonal, or contract labourers and are often paid daily or per task. Wage labour is used predominantly for tasks requiring physical exertion or specialized skills, such as pruning, spraying, harvesting, and weeding. The labour market in cocoa-growing regions is increasingly monetized due to rural-urban migration, ageing farmer populations, and declining availability of unpaid family labour (Asuming-Brempong et al., 2017). However, the terms of engagement are often informal, with no legal contracts, minimum wage adherence, or social protection, leaving workers economically vulnerable.

University of Ghana http://ugspace.ug.edu.gh

2.4.3 Noboa System

The noboa system is a traditional labour-sharing mechanism in which farmers take turns working on each other's farms without immediate monetary compensation. It promotes social cohesion and labour availability during labour peaks. Noboa is often used for time-sensitive operations like harvesting or land clearing and helps smallholders without cash to access labour. However, its effectiveness depends on mutual availability and trust. With the commercialization of cocoa and declining communal ties, the noboa system is reportedly declining in usage or being combined with partial wage payments (Anim-Somuah et al., 2011).

2.4.4 Migrant Labour

Migrant labour, particularly from northern Ghana and neighbouring countries such as Burkina Faso and Togo, is a major source of agricultural labour in cocoa-growing regions. Migrants are often employed for seasonal or task-specific work and typically reside in farm communities temporarily. These workers are engaged for demanding tasks like weeding, spraying, and harvesting. Although vital to sustaining production, migrant workers often work under exploitative conditions with limited bargaining power, poor housing, and no access to healthcare or insurance (Osei-Asare et al., 2020). They may also be excluded from community decision-making or land access, despite their contributions to the rural economy.

2.5 Task-Specific Wage Contributions

Different farm activities in cocoa production attract varying levels of labour intensity, frequency, specialization, and wages. Wage contributions by task reflect the value placed on time, effort, and skills. Key findings from literature and field-based studies reveal the following:

- **Weeding**

Weeding is the most labour-intensive task and is usually done two to four times in the year. It accounts for the highest proportion of seasonal wage costs due to its scale and repetition. It is mostly carried out using manual labour (cutlasses or hoes) and is often the first task outsourced

University of Ghana http://ugspace.ug.edu.gh

when family labour is insufficient. Despite its intensity, weeding wages are relatively low per day, but the cumulative cost is high (Anim-Somuah et al., 2011).

- **Pruning**

Pruning is a skilled task performed to remove dead or overgrown branches, which promotes plant health and yield. It is typically carried out once annually and requires knowledge of special techniques. As such, pruning commands slightly higher wages than weeding on a per-day basis, but its overall contribution to seasonal wage income is less due to its limited frequency.

- **Spraying**

Spraying involves the application of agrochemicals to control pests and diseases. It is generally considered hazardous and requires protective equipment and some technical knowledge. In Ghana, spraying is often undertaken by trained community-based spraying gangs (CBSGs) or contracted individuals. Due to its health risks and technical demands, spraying is one of the highest-paid tasks per unit time in cocoa farming, even though it is conducted only three to four times per season (Abankwah, Aidoo, & Osei, 2010; Fairtrade International, 2023). Access to spraying tools and chemical inputs also influences its cost and implementation.

- **Harvesting and Pod Breaking**

Harvesting is a labour-demanding activity that involves cutting cocoa pods from trees and transporting them to a central point. This is followed by pod-breaking, which is often done by hand using stones or wooden tools. Both tasks are time-sensitive and tend to require additional hired labour during peak seasons. Although the daily wages may be modest, the volume of labour needed makes harvesting one of the more significant wage-contributing activities. Pod breaking, particularly, has been associated with informal labour arrangements and sometimes involves children, which poses ethical concerns.

University of Ghana http://ugspace.ug.edu.gh

- **Fermentation and Drying**

Post-harvest tasks like fermentation and drying are typically handled by family labour, particularly women and children. These tasks are crucial for bean quality and market grading but attract little or no wage compensation when performed within households. Where hired labour is used (in larger farms), the pay is relatively lower compared to fieldwork tasks.

2.6 Good Agronomic Practices (GAP) in Cocoa Production

Good Agronomic Practices are broadly defined as methods that integrate scientific knowledge with practical applications to optimize agricultural productivity while safeguarding environmental sustainability and human health (Varotariya, 2024).

The adoption of GAP in cocoa farming is guided by four key pillars: economic viability, environmental sustainability, social acceptability, and food safety. Economic viability ensures that cocoa production remains profitable and improves farmers' incomes, while environmental sustainability focuses on the conservation of natural resources such as soil, water, and biodiversity (Al-Shammary et al., 2024). Social acceptability emphasizes practices that uphold fair labour conditions, gender equality, and community welfare, whereas food safety ensures that cocoa production adheres to strict safety standards, minimizing contamination from pesticides, mycotoxins, and heavy metals.

The longevity and productivity of a cocoa farm are closely linked to the effective implementation of Good Agronomic Practices (GAP) (Owusu-Appiah, 2017). Essential agronomic practices that contribute to high cocoa yields include weeding, pruning, thinning, mistletoe removal, infected pod removal, shade management, and spraying. In Ghana, cocoa GAP standards are primarily established by the Ghana Cocoa Board (COCOBOD), the government agency responsible for regulating and overseeing cocoa production. COCOBOD's Cocoa Health and Extension Division (CHED) provides official guidelines on recommended

University of Ghana http://ugspace.ug.edu.gh

farming techniques, which are disseminated through licensed buying companies (LBCs), cooperatives, and government extension officers (Asare et al., 2020). However, sustainability certification programs such as Rainforest Alliance, Fairtrade, and UTZ also impose their own GAP requirements, which may differ slightly in emphasis (e.g., stricter agrochemical restrictions or shade tree thresholds) (Barry & Danso, 2022). While COCOBOD's guidelines are broadly authoritative, LBCs and cooperatives sometimes adapt GAP training to local conditions or buyer-specific demands, leading to minor variations in implementation (Aneani & Ofori-Frimpong, 2021). Legally, COCOBOD's framework takes precedence, but compliance with certification-specific GAP is mandatory for farmers participating in those schemes.

Weeding helps to reduce competition for nutrients and moisture, while pruning and thinning improve air circulation and tree health. Mistletoe removal prevents the spread of parasitic plants, and infected pod removal reduces the risk of disease transmission. Additionally, proper shade management optimizes light exposure to cocoa trees, and spraying ensures effective pest and disease control. The consistent application of these GAP techniques enhances farm productivity and contributes to economic sustainability in cocoa farming.

Despite the benefits of GAP, many cocoa farmers in Ghana face challenges in its implementation, particularly in the establishment and rehabilitation of farms. In setting up new cocoa farms, farmers often clear and burn forests, a practice that leads to deforestation, soil degradation, and loss of biodiversity. This process frequently involves thinning or completely removing overstory trees to make room for cocoa and food crops. However, many farmers fail to adhere to recommended planting arrangements, which negatively impacts farm efficiency and productivity (Owusu-Appiah, 2017).

For aging and low-yielding cocoa farms, farmers must make critical decisions regarding rehabilitation or replanting. A healthy cocoa tree produces at least 25 pods per year, yielding

University of Ghana http://ugspace.ug.edu.gh

approximately one kilogram of dry cocoa beans per tree (Kongor et al., 2024). In contrast, trees that produce ten or fewer pods annually are considered unproductive and should be replaced. Additionally, cocoa trees exceeding 30 years of age experience declining yields, making replanting a more viable option. Proper farm planning is essential during replanting, particularly in selecting high-quality planting materials that ensure better yields and disease resistance.

One of the major concerns in cocoa farm rehabilitation is the quality of planting materials. Many cocoa farms rely on seeds from naturally pollinated pods, where the pollen source is unknown, leading to inconsistent quality and lower productivity (Nyamekye, 2021). Using unverified planting materials can result in weaker cocoa plants, which are more susceptible to diseases and produce lower yields. To ensure successful replanting, it is recommended that farmers obtain certified planting materials from accredited seed producers or the Seed Production Division of COCOBOD.

The adoption of GAP in cocoa farm management not only improves crop yields but also contributes to the long-term sustainability of the cocoa sector. By integrating proper agronomic practices, making informed planting decisions, and following recommended farm management techniques, farmers can maximize productivity while preserving the environment. The implementation of GAP is essential for achieving a sustainable and profitable cocoa industry, benefiting farmers, communities, and the broader economy.

2.6.1 Overview of GAP training programs in Ghana

Ghana has made significant efforts to promote the adoption of Good Agronomic Practices (GAP) among cocoa farmers. Various stakeholders, including the government, non-governmental organizations (NGOs), development partners, and private sector actors, have implemented training programs aimed at enhancing farmers' knowledge and skills in GAP. These initiatives focus on improving farm productivity, ensuring sustainability, and enhancing the quality of cocoa production.

University of Ghana http://ugspace.ug.edu.gh

The Government of Ghana, through the Cocoa Health and Extension Division (CHED) of the Ghana Cocoa Board (COCOBOD), has been at the forefront of GAP promotion (Ghana Cocoa Board, 2021). CHED conducts Farmer Business Schools (FBS) and practical demonstrations to train cocoa farmers on best practices such as pest and disease management, soil fertility improvement, and post-harvest handling. These training sessions are often held at demonstration plots, where farmers can observe firsthand the practical applications and benefits of GAP (Arhin, 2023). Additionally, COCOBOD provides free or subsidized inputs, such as fertilizers and pesticides, to encourage farmers to adopt sustainable agricultural practices.

Beyond government efforts, non-governmental organizations (NGOs) and development partners have played a complementary role in promoting GAP in Ghana. Initiatives such as the Sustainable Cocoa Initiative and the Cocoa Rehabilitation and Intensification Programme (CORIP) focus on building farmer capacity through training and extension services (Frimpong, 2021). These programs primarily target smallholder farmers, who constitute the majority of cocoa producers in Ghana, aiming to improve their access to knowledge, agricultural inputs, and market opportunities. Additionally, NGOs such as Solidaridad and the World Cocoa Foundation have collabourated with COCOBOD to implement sustainability programs that integrate GAP training into broader efforts to support social and environmental responsibility in cocoa farming.

Private sector actors, including multinational chocolate companies and cocoa buyers, have also made significant contributions to GAP training programs. Companies like Mondelez and Nestlé have launched sustainability initiatives that include training farmers on GAP as part of their commitment to responsible cocoa sourcing (Camargo & Nhantumbo, 2016). Many of these programs incorporate certification schemes such as Rainforest Alliance and Fairtrade, which require farmers to adhere to GAP standards. Certification not only ensures compliance with

University of Ghana http://ugspace.ug.edu.gh

sustainability and ethical farming criteria but also allows farmers to receive premium prices for their cocoa, improving their income and livelihood prospects.

The collaborative efforts of the government, NGOs, development agencies, and private sector stakeholders have been instrumental in expanding GAP training programs in Ghana. These initiatives have empowered farmers with the necessary skills and resources to adopt sustainable farming practices, ultimately contributing to the long-term viability of the cocoa sector.

2.7 Impact of Good Agronomic Practices Training Programs

Good Agronomic Practices (GAP) training programs have significantly improved cocoa production in Ghana by enhancing yields, cocoa quality, environmental sustainability, and farmers' socio-economic conditions. GAP equips farmers with skills in optimal planting, integrated pest management (IPM), soil fertility improvement, and sustainable farm management (Frimpong-Manso et al., 2022). Studies show that farmers trained in GAP techniques such as correct pruning and shade management experience yield increases of up to 25% compared to non-trained farmers (Hainmueller et al., 2011).

In terms of labour outcomes, GAP training has been linked to positive changes in wages, working time, and working conditions for farm workers. Evidence suggests that GAP-trained workers, due to their enhanced technical skills, often command higher wages compared to untrained workers (Olayemi et al., 2020; N'Guessan et al., 2021). However, limited empirical data exist for Ghana specifically, highlighting the need for further research (Kodom et al., 2022).

GAP also improves labour efficiency by promoting better work scheduling, mechanization, and the adoption of labour-saving practices such as targeted pest management and structured pruning (Raji et al., 2024; Zhou et al., 2024). These practices reduce peak labour demands and enhance time management across farming seasons.

University of Ghana http://ugspace.ug.edu.gh

Furthermore, GAP training improves working conditions by promoting safe handling of agrochemicals, encouraging the use of personal protective equipment (PPE), and facilitating access to safer tools and technologies (Mushobozi, 2010; Mignouna et al., 2023). Certification schemes aligned with GAP, such as Fairtrade and Rainforest Alliance, also promote investments in sanitation, safe water access, and better workplace infrastructure, improving the overall well-being of farm workers (Bitzer & Francken, 2019).

While GAP training has yielded significant productivity and livelihood benefits, barriers such as limited training access, financial constraints, and farmer literacy challenges remain. Addressing these issues is crucial for ensuring that the benefits of GAP are widely shared and sustained across the cocoa sector.

2.8 Challenges for the Adoption of GAP In Ghana

Despite the numerous benefits of GAP training programs, several challenges hinder their widespread adoption in Ghana. One major barrier is limited access to training, particularly in remote and underserved areas (Antwi-Agyei & Stringer, 2021). Many farmers lack the financial and logistical resources needed to attend training sessions, leading to unequal adoption rates across farming communities. Furthermore, these training programs often focus solely on farmers, overlooking farm workers and hired labourers, who play a crucial role in implementing GAP on cocoa farms. Additionally, insufficient funding significantly restricts the reach and effectiveness of GAP training programs. While government agencies, NGOs, and private sector actors have made notable efforts, financial constraints continue to limit expansion, preventing these programs from scaling up to adequately serve Ghana's large cocoa farming population, including farm workers (Kissi & Herzig, 2024). Addressing these gaps requires greater investment and inclusivity to ensure that all key players in cocoa production receive the necessary training and support.

University of Ghana http://ugspace.ug.edu.gh

Another critical challenge is low literacy levels among farmers, which affects their ability to understand and apply the technical information provided during training sessions. Many farmers struggle to grasp complex agricultural concepts, limiting their ability to fully implement GAP techniques. To address this issue, training programs should adopt innovative approaches, such as using visual aids, conducting practical demonstrations, and delivering content in local languages, to make the information more accessible and understandable. Moreover, providing continuous follow-up support and extension services is essential to reinforce the knowledge gained during training and help farmers address implementation challenges in the field (Antwi-Agyei & Stringer, 2021).

Another obstacle to GAP adoption is the lack of coordination among stakeholders involved in training initiatives. Fragmentation and duplication of efforts often lead to inefficiencies and missed opportunities for collabouration. Establishing stronger partnerships and communication channels among government agencies, NGOs, and private sector actors would improve program efficiency and effectiveness. By fostering better coordination, stakeholders can maximize resources, streamline efforts, and enhance the overall impact of GAP training programs.

2.9 Policy Framework and Institutional Support for GAP Training

The Government of Ghana has made significant progress in formulating policies to promote sustainable agricultural practices, with Good Agronomic Practices (GAP) training being a key focus. Central to these efforts is the Food and Agriculture Sector Development Policy (FASDEP), which prioritizes sustainable farming methods to enhance productivity, ensure food security, and alleviate poverty (Kolavalli et al., 2010). FASDEP highlights the importance of capacity building and extension services to equip farmers with the necessary skills and knowledge for adopting GAP.

Another vital policy is the Ghana Cocoa Board's (COCOBOD) National Cocoa Rehabilitation Programme (NCRP) (Kumeh, 2024), which aims to enhance the productivity and sustainability

University of Ghana http://ugspace.ug.edu.gh

of cocoa farming. As part of this initiative, GAP training is integrated to provide farmers with essential technical knowledge on pest and disease management, soil fertility improvement, and efficient land use. COCOBOD's Cocoa Health and Extension Division (CHED) plays a central role in delivering these training programs, ensuring that farmers at the grassroots level adopt sustainable cocoa farming practices.

Additionally, the Planting for Food and Jobs (PFJ) initiative, launched in 2017, significantly contributes to GAP training. This flagship policy aimed to boost agricultural productivity and food self-sufficiency by providing farmers with subsidized inputs, such as certified seeds and fertilizers, along with training programs to optimize their use (Pauw, 2022). Through PFJ, GAP principles are incorporated into broader agricultural extension services, encouraging farmers to adopt modern yet sustainable farming techniques (Pauw, 2021).

While these policies provide a strong foundation for promoting GAP, their success depends on effective coordination among government agencies, non-governmental organizations (NGOs), and private sector actors. A well aligned approach among these stakeholders ensures that policy objectives are effectively translated into practical training programs that reach farmers and drive sustainable agricultural transformation.

2.10 Role of Certification Schemes in Promoting GAP

Certification schemes, such as Rainforest Alliance and Fairtrade, have emerged as critical tools in promoting both Good Agronomic Practices (GAP) and improved labour standards in cocoa production. These schemes set stringent requirements for sustainable farming and worker welfare, creating incentives for GAP adoption while addressing social equity (Bethge, 2014). Rainforest Alliance's 2020 Certification Standard, for example, mandates not only environmental criteria (e.g., biodiversity conservation, agrochemical reduction) but also explicit labour protections, including minimum wage compliance, prohibition of child and forced labour, and safe working conditions (Rainforest Alliance, 2020; Gather & Wollni, 2022).

University of Ghana http://ugspace.ug.edu.gh

Certified farms must provide workers with contracts, protective equipment, and access to grievance mechanisms though enforcement remains inconsistent in practice (Terstappen et al., 2023).

Similarly, Fairtrade certification integrates labour rights into its GAP requirements, such as fair wages, gender equity, and freedom of association (Makita, 2016). The Fairtrade Premium, paid on top of the minimum price, is often allocated to worker benefits like healthcare, education, or housing (Kimathi, 2017). However, studies note gaps between policy and practice: while certified farms show reduced hazardous child labour, wages often remain below living income benchmarks, and informal labourers (e.g., seasonal migrants) are frequently excluded from protections (Bauch, 2021; Amadu et al., 2022).

Beyond financial incentives, certification schemes provide GAP and labour rights training, aiming to improve both farm productivity and working conditions (Sirdey & Lallau, 2020). Yet challenges persist: certification costs disproportionately burden smallholders, and complex labour standards such as traceability requirements for subcontractors are poorly enforced in Ghana's informal labour market (Okoffo et al., 2021). Strengthening these standards requires collabourative efforts to subsidize audits, simplify compliance for illiterate farmers, and extend protections to informal workers (Barrientos et al., 2023).

2.11 Theoretical Framework

2.11.1 Human Capital Theory

The Human Capital Theory serves as the guiding theoretical framework for this study on the impact of training in Good Agronomic Practices (GAP) on wages, working time, and working conditions of cocoa farm workers in Ghana. This theory provides a lens through which the value of education, training, and skills development can be understood in relation to improved productivity, income, and overall well-being in labour-intensive sectors such as agriculture.

University of Ghana http://ugspace.ug.edu.gh

Human Capital Theory was popularized by economists Theodore Schultz and Gary Becker in the mid-20th century (Bunning, 2020). Schultz introduced the idea in 1961, emphasizing the importance of investing in human resources as a means of increasing productivity and economic growth (Wuttaphan, 2017). Becker expanded on this foundation in his seminal work *Human Capital: A Theoretical and Empirical Analysis* (1964), which provided a detailed exploration of how education, training, and health contribute to the economic value of individuals and societies (Becker, 2009). The theory posits that individuals and organizations can improve productivity by investing in education, training, and other skill-enhancing activities, just as they invest in physical capital like machinery or infrastructure.

According to the Human Capital Theory, training and education increase the stock of human capital, enabling individuals to acquire new skills, knowledge, and competencies that make them more efficient and effective in their work (Wuttaphan, 2017). This improved productivity, in turn, leads to higher wages, better working conditions, and greater economic opportunities. At an aggregate level, investments in human capital contribute to economic development, as a more skilled workforce drives innovation, efficiency, and competitiveness within industries and nations. The theory also assumes a direct relationship between the level of investment in human capital and the economic returns, arguing that higher levels of education and training yield greater financial and social benefits (Leoni, 2025). Human Capital Theory has been extensively discussed and applied in academic literature across diverse fields, including economics, labour studies, and education. In labour economics, for example, the theory has been used to explain wage differentials, emphasizing that workers with higher levels of education or specialized training command higher wages due to their increased productivity (López-Bazo & Motellón, 2012). Becker's work highlighted the importance of both general and specific human capital, distinguishing between skills that are transferable across industries and those that are specific to particular roles or organizations (Becker, 2009). Similarly, Schultz focused on the broader

University of Ghana http://ugspace.ug.edu.gh

societal benefits of human capital investment, such as poverty reduction, economic growth, and improved health outcomes (Schultz, 1972). Critics of the theory, however, argue that it often overlooks structural and contextual factors that influence labour market outcomes (Nyberg & Wright, 2015). For instance, sociologists have pointed out that barriers such as discrimination, unequal access to education, and systemic inequalities can limit the returns on human capital investments for certain groups (Granovetter, 2017). In agriculture, additional complexities arise, including the impact of volatile commodity prices, climate change, and rural infrastructure deficits, which may dilute the anticipated economic benefits of training and skill development.

The application of Human Capital Theory to the agricultural sector has provided valuable insights into how education and training influence productivity and livelihoods in rural areas. Studies in developing countries have shown that farmers who receive training in modern agricultural practices achieve higher yields, greater efficiency, and improved profitability compared to their untrained counterparts (Mgendi et al., 2021; Rasanjali et al., 2021). For example, research on agricultural extension programs has demonstrated that training in sustainable farming techniques not only enhances productivity but also contributes to environmental conservation, health, and resilience to market shocks (Mungai et al., 2024; Raji et al., 2024). These findings align with the central tenets of Human Capital Theory, which emphasize the economic value of investing in knowledge and skills. In the context of cocoa farming in Ghana, the relevance of Human Capital Theory becomes particularly pronounced given the labour-intensive nature of the industry and its importance to the national economy. Ghana is one of the world's leading producers of cocoa, with the sector providing livelihoods for millions of smallholder farmers and farm workers. However, challenges such as low productivity, poor working conditions, and stagnant wages remain prevalent (Olaigbe & Usman, 2025), underscoring the need for interventions that enhance human capital. Training in

University of Ghana http://ugspace.ug.edu.gh

Good Agronomic Practices (GAP) represents one such intervention, aimed at equipping cocoa farmers and farm workers with the skills and knowledge necessary to improve productivity, quality, and sustainability in cocoa production.

GAP training programs in the cocoa sector typically focus on teaching best practices in areas such as pest and disease management, soil fertility enhancement, post-harvest handling, and environmental conservation (Asare & David, 2011). These programs are designed not only to increase cocoa yields but also to promote sustainable farming methods that benefit the environment and long-term productivity. By applying the principles of Human Capital Theory, it can be argued that GAP training represents an investment in the human capital of cocoa farm workers, with the potential to generate economic and social returns for both individuals and the broader industry. The impact of GAP training on wages, working time, and working conditions is a critical area of inquiry. According to Human Capital Theory, the acquisition of new skills and knowledge should lead to increased productivity, which, in turn, should result in higher wages, improved working condition and the efficient use of working time. In the cocoa sector, farm workers who are trained in GAP may be able to perform tasks more efficiently, produce higher-quality cocoa beans, and adopt practices that reduce costs and enhance profitability. These improvements can translate into better financial rewards for workers, whether through direct wage increases or profit-sharing arrangements with farm owners.

2.11.2 Expected Utility Theory

Expected Utility Theory (EUT) provides a normative framework for understanding farmers' decisions under uncertainty: agents are assumed to choose the option that maximizes their expected utility, weighing the probabilities and utilities of possible outcomes (Ruett et al., 2022). Applied to agricultural innovation, EUT implies that the decision to adopt Good Agronomic Practices (GAP) depends not only on the potential productivity gains but also on

University of Ghana http://ugspace.ug.edu.gh

farmers' perceptions of risk, variability of returns, and the costs (monetary, time, and effort) associated with adoption. Empirical research in agriculture shows that risk preferences and expected returns are key determinants of adoption decisions, with more risk-averse farmers less likely to adopt practices that have uncertain short-term payoffs even if long-term benefits exist.

EUT complements Human Capital Theory (HCT) by explaining the choice to invest in training and new practices. While HCT explains how training raises skills and productivity, EUT explains why a farmer or farm manager decides whether to undertake that investment: adoption occurs when the perceived expected utility (net of costs and risks) from adopting GAP exceeds that of the status quo. Integrating EUT with HCT therefore links skill-formation and productivity gains to the behavioural calculus that drives uptake of GAP (Spiegel, 2021; Han & Niles, 2023).

Recent empirical studies testing the role of expected returns and risk preferences find consistent evidence that expected utility considerations matter for adoption of sustainable and climate-smart practices (Ruzzante et al, 2021). For instance, studies synthesizing adoption determinants report that perceived profitability, risk, and uncertainty strongly predict uptake across contexts, and experimental/structural work shows that EUT-based models often explain observed heterogeneity in adoption intensity. These findings indicate that modelling adoption of GAP in cocoa systems should account for both expected economic returns and household-level risk attitudes.

2.12 Conceptual Framework

The conceptual framework presented in Figure 2.1 illustrates the hypothesized causal relationships between Good Agronomic Practices (GAP) training and key labour-related outcomes among cocoa farm wage workers in Ghana. This framework is grounded in human capital theory, which posits that, investments in knowledge and skill acquisition lead to

University of Ghana http://ugspace.ug.edu.gh

enhanced worker productivity, subsequently improving labour market outcomes such as wages and job quality (Becker, 1964).

In the context of cocoa production, GAP training, particularly in critical farm management tasks such as pest management, soil fertility management, shade management, weeding and pruning is designed to improve the technical capacity of workers. These tasks are foundational to the productivity and health of cocoa trees and are frequently carried out by hired labourers. Weeding ensures reduced competition for nutrients, while pruning shapes canopy architecture for optimal sunlight penetration and air circulation, directly affecting yield outcomes (Kolavalli & Vigneri, 2017; Mignouna et al., 2023).

The framework proposes that GAP training enhances human capital, which in turn influences farm labour dynamics through three main outcome pathways:

Higher Wages: By increasing their competence and efficiency in essential tasks, trained workers become more productive and desirable in the labour market. This improved performance is expected to translate into increased daily or seasonal wages, especially where productivity-based or skill-sensitive remuneration is practiced (Vidal et al., 2023).

More Efficient Use of Working Time: Trained workers are likely to complete tasks more swiftly and effectively, reducing wasted time and effort. This efficiency can lead to a higher volume of work accomplished within a fixed period, benefiting both workers and employers (Kuyah et al., 2021).

Improved Working Conditions: GAP training often includes components related to safe work practices, such as correct handling of tools and reduced exposure to health risks. This promotes a safer, healthier, and more dignified working environment (FAO, 2016).

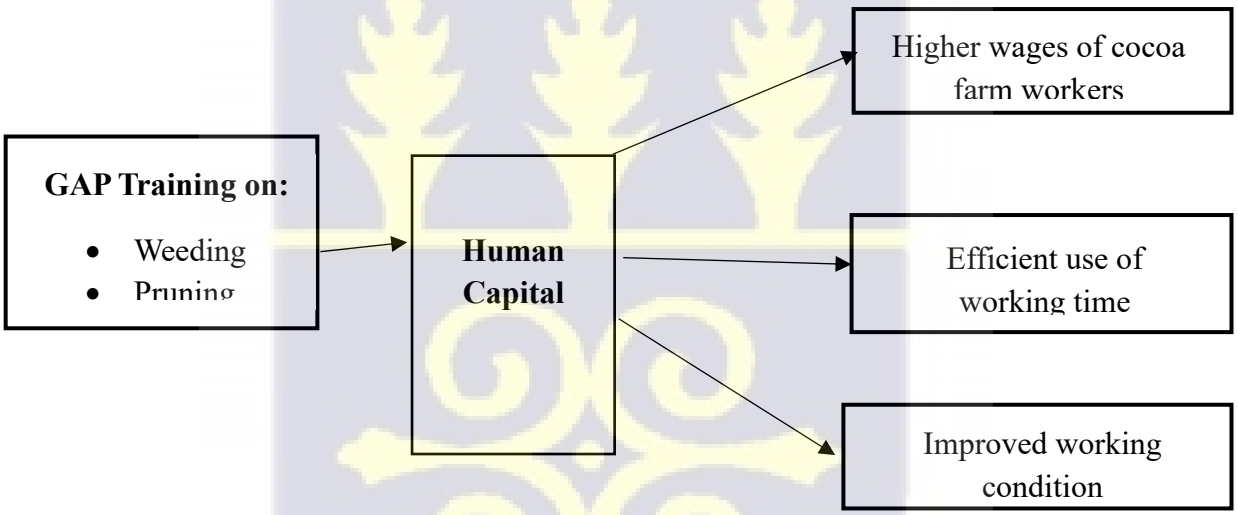
The arrows in the framework diagram indicate direct causal linkages between the acquisition of agronomic skills and these labour outcomes. The central assumption is that enhanced

University of Ghana http://ugspace.ug.edu.gh

technical know-how, specifically in weeding and pruning enables wage workers to deliver higher quality services, which are rewarded with better pay, more effective time use, and improved occupational conditions. In this way, GAP training acts not only as a productivity-enhancing intervention but also as a mechanism for labour empowerment and social upgrading in cocoa farming systems.

This conceptual model provides the theoretical foundation for the empirical analyses conducted in this study. The researcher developed this framework for the study based on ideas from existing studies on GAP, farm labour, and sustainable cocoa production.

Figure 2.1: Conceptual Framework Linking GAP Training to Labour Outcomes



Source: Author's construct (2024)

University of Ghana http://ugspace.ug.edu.gh

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology employed to assess the impact of Good Agronomic Practices (GAP) training on the wages, working time, and working conditions of cocoa farm workers in Ghana. It provides a comprehensive explanation of the research design, study area, target population, sampling strategy, data collection methods, and analytical techniques used in the study.

A quantitative research approach is adopted, utilizing secondary data within a robust analytical framework to assess the impact of GAP training on key socio-economic indicators of cocoa farm workers in Ghana. The chapter outlines the data sources and collection methods, ensuring clarity on how relevant information was obtained. The sampling strategy and participant selection criteria are clearly defined to ensure the representativeness of the study population. The rationale behind sample size determination, selection techniques, and inclusion/exclusion criteria are discussed in detail. Additionally, the limitations of the methodology are acknowledged, providing transparency on potential challenges and the strategies used to mitigate them.

By clearly articulating the research strategies, methodological choices, and analytical techniques, this chapter strengthens the replicability, reliability, and validity of the study, ensuring that the methods used effectively support the study's objectives.

3.2 Research Design

This study adopted a quantitative research approach, as it relies on numerical and statistical analysis to evaluate relationships between variables. A quantitative orientation was appropriate because the study sought to measure the impact of Good Agronomic Practices (GAP) training on the wages, working time, and working conditions of cocoa farm workers in Ghana. This is

University of Ghana http://ugspace.ug.edu.gh

emphasized by Creswell and Creswell (2021), that quantitative research designs allow for the measurement of measurable variables through statistical techniques.

A cross-sectional design was adopted to evaluate the effects of GAP training on cocoa farm workers by collecting data from a diverse sample of farm workers across multiple cocoa farms. This method provides a snapshot analysis of how GAP training influences labour conditions, wage structures, and working hours. Understanding the dynamics of GAP adoption helps in assessing its broader impact on labour practices within the cocoa sector.

The research design incorporates descriptive and inferential statistical techniques to analyze the data. The descriptive component examines wage structures, total work duration, and general workplace conditions among cocoa farm workers in both GAP adoption and non-GAP adoption farms. Additionally, the study records the specific components of GAP training and evaluates their effectiveness in influencing labour outcomes.

3.3 Method of Data Collection

3.3.1 Source of Data

This study relied on secondary data collected within the framework of the Cocoa4Future (C4F) project, funded by the European DeSIRA Initiative under grant agreement No. FOOD/2019/412-132 and the French Development Agency. The C4F project focuses on sustainable cocoa production and farmer livelihoods, providing a reliable dataset for assessing the impact of GAP training on cocoa farmworkers' socio-economic conditions.

3.3.2 Data Collection procedure

This sub-section explains the data collection procedure that was adopted by the C4F project. The data was gathered through a survey administered by a team of nine trained enumerators and one supervisor, all of whom had prior experience with cocoa-related research in the study area. The survey was conducted in Suhum Municipality, located in Ghana's Eastern Region,

University of Ghana http://ugspace.ug.edu.gh

one of the country's top five cocoa-producing regions. The target population consisted of cocoa farm wage workers residing and working within the municipality. A list of cocoa-growing communities was obtained from the local office of the Ghana Cocoa Board (COCOBOD) and used as the sampling frame. From this list, communities were randomly selected, and within each selected community, enumerators used a combination of community guides and household listing to identify eligible cocoa wage worker households. Random sampling was then applied to select respondents from the eligible pool. Prior to each interview, enumerators introduced themselves, explained the purpose of the study, and obtained informed consent from participants.

A structured questionnaire was used as the primary data collection instrument. The questionnaire was designed to ensure consistency and reliability, focusing on demographic characteristics, employment conditions, and workers' perceptions of GAP training. The structured format allowed for systematic data collection and statistical comparison across different respondent groups (Saunders et al., 2023).

3.3.3 Sampling Procedure and Sample Size

The C4F project adopted a multi-stage sampling approach to systematically select respondents. The sampling process involved several steps.

First, the Suhum Municipality in the Eastern Region was purposively selected as the study location. This choice was informed by the area's strong engagement in specialty and organic cocoa production, as well as its significant involvement in cocoa sustainability programs.

Second, two key cocoa-growing communities, Aponoapono and Akote, were purposively selected within Suhum. These communities were chosen due to their diverse categories of cocoa farmers, which offer a variety of on-farm employment opportunities for wage labourers.

University of Ghana http://ugspace.ug.edu.gh

Third, a total of eleven (11) villages were randomly selected from the two communities—six (6) villages from Aponoapono and five (5) villages from Akote.

Finally, based on a sampling frame developed in collaboration with community farmer leaders, 244 farm workers were randomly selected,152 from Aponoapono and 92 from Akote. The sampling frame captured individuals who were actively engaged in cocoa farm work and available in the community at the time of the survey.

However, the final sample size used for analysis reduced from 244 to 170. This reduction was necessary due to several practical constraints encountered during data collection and data cleaning. Specifically:

- Some of the selected respondents provided incomplete or inconsistent responses that could not be used for robust statistical analysis.
- A few interviews had to be excluded due to enumerator errors or recording issues.
- In addition, the survey period coincided with the cocoa harvesting season, leading to labour availability issues as some workers were unavailable or in transit due to the high mobility of migrant labourers.
- The reuse of labour groups by multiple farmers within villages also complicated individual identification and follow-up in some instances.

Therefore, using the final sample of 170 complete and reliable responses ensured that the analysis was based on high-quality data, thereby enhancing the credibility and validity of the study's findings.

3.4 Method of Data Analysis

This section outlines the analytical methods used to achieve the study's objectives, employing Stata 15 for data processing and analysis. The research is grounded in a quantitative methodology, utilizing secondary data to assess the impact of Good Agronomic Practices (GAP)

University of Ghana http://ugspace.ug.edu.gh

training on the socio-economic conditions of cocoa farm workers in Ghana. A cross-sectional approach was implemented to evaluate the effects of GAP training by collecting data from a diverse sample of farm workers across multiple cocoa farms. This approach enables a snapshot analysis of how GAP training influences key labour indicators, including working conditions, wage structures, and working hours. By examining the dynamics of GAP adoption, the study aims to provide insights into its broader implications for labour practices within the cocoa sector. The research design integrates both descriptive and inferential statistical techniques to analyze the data. The descriptive analysis focuses on comparing wage structures, total work duration, and general workplace conditions between farms that have adopted GAP and those that have not. Furthermore, the study documents the specific components of GAP training and assesses their effectiveness in shaping labour outcomes. This comprehensive approach allows for a robust evaluation of the socio-economic impact of GAP training on cocoa farm workers.

3.4.1 GAP Training Impact Analysis

To assess the influence of GAP training on wages, working time, and working conditions, the study employs Propensity Score Matching (PSM). PSM is a statistical technique designed to mitigate selection bias by comparing outcomes between GAP-trained (treated) and non-GAP-trained (control) farmers with similar observable characteristics. This ensures that any observed differences in labour outcomes are attributable to the training rather than pre-existing differences.

3.4.2 Propensity Score Matching (PSM) Procedure

The study employed Propensity Score Matching (PSM) to compare labour outcomes between GAP-trained farmers and non-GAP-trained farmers. PSM serves as a statistical control technique, ensuring that comparisons are made between similar groups based on factors such as age, education, family size, and farming experience (Abdul-Rahaman et al., 2021). PSM

University of Ghana http://ugspace.ug.edu.gh

helps control for selection bias by ensuring that comparisons between treatment (GAP trained) and control (non-GAP trained) groups are made between individuals with similar characteristics. Key control variables included gender, age, educational level, farm size, and farming experience (Abdul-Rahaman et al., 2021). This ensured that differences in labour outcomes between GAP-trained and non-GAP-trained farmers are attributable to training rather than pre-existing differences in individual characteristics (Rosenbaum & Rubin, 1983). PSM involves several critical steps to estimate the causal effect of GAP training, including:

a) **Estimating the Propensity Score:** The first step is to estimate the propensity score, which represents the probability of a farm worker participating in GAP training based on observable characteristics. A logistic regression model is used to estimate this probability, incorporating key covariates such as age, gender, education, farm size, farming experience, household size, and access to extension services (Caliendo & Kopeinig, 2008). Mathematically, the propensity score model is expressed as:

$$P(X) = Pr\ (D_i = 1|X_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{(1)}$$

where P(X) denotes the estimated propensity score, D is a binary variable indicating GAP training participation (1 if trained, 0 otherwise), and X represents the set of covariates.

b) **Matching Treated and Control Groups:** Once the propensity scores are estimated, each GAP-trained farm worker is matched to a non-GAP-trained farm worker with a similar score. Several matching techniques can be applied, including:

- Nearest Neighbor Matching (NNM)
- Kernel Matching
- Radius Matching (Heckman, Ichimura, & Todd, 1998).

University of Ghana http://ugspace.ug.edu.gh

In this study, Nearest Neighbour Matching (NNM) with replacement is preferred to ensure that each treated farmer has a close match from the control group. This method ensures that each GAP-trained worker is paired with a non-trained worker with the closest estimated propensity score, creating a more balanced comparison group.

c) **Assessing the Balance of Covariates:** Following the matching process, the next step is to assess the balance of covariates between the treated (GAP-trained) and control (non-trained) groups. Standardized mean differences (SMDs) and t-tests are used to verify whether the matched samples are statistically similar in terms of observed characteristics. A well-balanced sample ensures that any differences in labour outcomes can be attributed to GAP training rather than pre-existing variations between the groups (Stuart, 2010).

d) **Estimating the Average Treatment Effect on the Treated (ATT):** The core analysis involves estimating the Average Treatment Effect on the Treated (ATT), which measures the difference in labour outcomes (wages, working time, and working conditions) between GAP trained and non-GAP trained workers. The ATT is computed as:

$$ATT = E(Y(1) \mid D=1) - E(Y(0) \mid D=1) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where Y1 represents the outcomes (wages, working time, working conditions) for GAP-trained workers, and Y0 represents the counterfactual outcomes for non-GAP-trained workers. The ATT provides a direct estimate of the impact of GAP training on wages, working time, and working conditions.

e) **Sensitivity Analysis:** Given that PSM relies solely on observable characteristics, sensitivity analysis is conducted to examine the potential influence of unobserved variables. Rosenbaum Bounds Sensitivity Analysis is applied to assess how strongly an unmeasured factor would need to influence training selection to alter the estimated

University of Ghana http://ugspace.ug.edu.gh

effect (Rosenbaum, 2002). This ensures the robustness of the findings and mitigates concerns regarding omitted variable bias.

3.4.3 Analysing GAP Training's Impact on Wage Gaps

To analyse how GAP training influences wage disparities among cocoa farm workers in Ghana, with a particular focus on gender and youth differences, the study employs a Probit regression model. The regression analysis explored whether GAP training had differentiated effects across demographic groups, particularly among women and youth.

3.4.4 Probit Regression Model

Probit regression is widely used in empirical research to model binary dependent variables, as it assumes that the relationship between the independent variables and the probability of a particular outcome follows a cumulative normal distribution (Greene, 2012). Given that wage disparities can be framed as a binary outcome, such as the probability of earning above or below a certain wage threshold, Probit regression is an appropriate econometric technique for modelling such categorical dependent variables (Wooldridge, 2010). This model is particularly suitable for analysing this objective, as it allows us to estimate how GAP training affects the likelihood of cocoa farm workers earning higher wages while accounting for differences in gender and youth status.

The Probit regression equation is given as:

$$W_i = \beta_0 + \beta 1 GAP_i + \beta 2 Gender_i + \beta 3 Youth_i + \beta 4 (GAP_i \times Youth_i) + \sum \beta k_i Xk_i + \varepsilon_i \quad \ldots\ldots \quad \textbf{(3)}$$

where:

- W_i is the latent variable representing the probability that a farm worker earns a wage above a given threshold,

University of Ghana http://ugspace.ug.edu.gh

- GAP_i is a dummy variable indicating whether the worker has participated in GAP training (1 = Yes, 0 = No),
- $Gender_i$ is a dummy variable (1 = Female, 0 = Male),
- $Youth_i$ is a dummy variable (1 = Youth, 0 = Adult),
- $GAP_i \times Youth_i$ are interaction terms to assess how the impact of GAP training varies by youth status,
- Xk_i represents control variables such as education level, farming experience, and farm size,etc
- ε_i is the error term.

The objective is to model an equation and estimate the probability of GAP trained cocoa farm workers earning higher wages with a particular focus on gender and your disparities.

Table 3.1: A Priori Expectations for Wage Threshold Model

Variable	Definition & Measurement	Expected Sign	Justification
GAP (Training Participation)	Dummy variable: 1 = participated in GAP training; 0 = did not participate	+	Skills from GAP (e.g., pruning, IPM) increase productivity and bargaining power.
Gender	Dummy variable: 1 = male; 0 = female	+	Gender discrimination in agricultural wages.
Youth	Dummy variable: 1 = age ≤ 35 years; 0 = age > 35 years	−	Less experience lowers initial productivity.
Education	Years of formal schooling	+	Higher skills → higher productivity
Farming experience	Number of years working in cocoa farming	+	Experience improves efficiency.
Farm size	Hectares of cocoa farm managed	±	Larger farms may pay more (scale) or less (monopsony power).

3.5 Ethical Consideration

The study adhered to ethical standards by ensuring all data is anonymized and participant privacy is protected. As the research is based on secondary data, there was no direct interaction with participants. However, the original data collection process complied with ethical protocols,

University of Ghana http://ugspace.ug.edu.gh

including obtaining informed consent and ensuring voluntary participation. Additionally, the study emphasizes transparency in reporting and acknowledges potential data biases, which are carefully addressed during the analysis to uphold the integrity of the findings.

3.6 Limitations of the Study

Despite the robustness of the research design and analytical methods, this study is subject to several limitations that may influence the interpretation and generalization of its findings. These limitations include:

a) The analysis relies on secondary data collected through the Cocoa4Future (C4F) project, which limited the researcher's control over the scope and framing of the data collection instrument.

b) Although the initial sample size was 244, only 170 observations were used for analysis. This was due to missing responses, data inconsistencies, and issues encountered during data cleaning. While this decision improved the quality and reliability of the dataset, it may have introduced sample bias by excluding certain worker groups, particularly migrant workers who are often mobile during peak farming seasons.

c) The study focused only on a single cocoa-producing district (Suhum Municipality) and two communities (Aponoapono and Akote), which may limit the external validity of the findings. Labour practices and the implementation of GAP training may vary across different cocoa-growing regions in Ghana, influenced by socio-cultural dynamics and institutional support structures.

d) The cross-sectional nature of the data restricts the ability to capture changes over time and establish long-term impacts of GAP training on labour outcomes. A longitudinal design would be more appropriate for assessing sustained changes in wages, working time, and working conditions.

University of Ghana http://ugspace.ug.edu.gh

e) Although the study employed Propensity Score Matching (PSM) to control for selection bias, unobserved heterogeneity may still exist. Factors such as worker motivation, employer preferences, and informal labour arrangements could affect both the likelihood of receiving training and labour outcomes, potentially biasing estimates of treatment effects.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction to the Chapter

This chapter presents the empirical analysis of the socio-economic characteristics of cocoa farm workers and evaluates the impact of Good Agronomic Practices (GAP) training on key outcomes such as wages, working time, and working conditions. The analysis employs three main methodological approaches: Descriptive statistics, Propensity Score Matching (PSM) and Probit Regression. Descriptive statistics is used to describe the demographic and socio-economic statistics of the cocoa farm wage workers. PSM is used to estimate the causal effects of GAP training by comparing treated (trained) and untreated (non-trained) groups, while controlling for observable differences. Probit Regression is applied to examine the determinants of specific outcomes (wages), providing insights into the factors influencing the adoption of GAP practices and their associated effects. Together, these methods offer a comprehensive understanding of the socio-economic dynamics and the effectiveness of GAP training in improving labour outcomes in Ghana's cocoa sector.

4.2 Socio-Economic and Household Characteristics of Cocoa Farm Wage Workers

This section presents a descriptive analysis of the socio-economic characteristics and labour outcomes of cocoa farm wage workers, comparing those who received Good Agricultural Practices (GAP) training with those who did not. The objective is to assess whether GAP training is associated with observable differences in worker demographics, labour patterns, wages, and perceptions of work intensity and health risk. The analysis draws on descriptive statistics and significance testing to highlight meaningful disparities between the two groups. Several statistically significant differences were observed across age, gender, education, household size, and income-related variables, suggesting that GAP training is not only a technical intervention but also linked to broader social and economic dynamics in the cocoa

University of Ghana http://ugspace.ug.edu.gh

labour market. Table 4.1 presents the summary statistics and significance levels for group comparisons.

Table 4.2:Socio-Economic and Labour Outcome Characteristics

	All Workers		GAP-Trained		Non-GAP-Trained			
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	T-Test	
Gender (dummy)	0.9353	0.2467	0.9633	0.1889	0.8852	0.3214	-1.99	***
Age (years)	38.6059	10.9681	40.1193	10.3241	35.9016	11.6357	-2.44	***
Married (dummy)	0.5412	0.4998	0.5780	0.4962	0.4754	0.5035	-1.29	*
House Size (count)	4.4177	2.6839	4.7156	2.7524	3.8853	2.4906	-1.95	**
Experience (years)	12.7118	8.7635	13.1743	8.3841	11.8852	9.4182	-0.92	
Dependents (count)	2.2353	2.2618	2.5229	2.2876	1.7213	2.1380	-2.24	***
Born in Area (dummy)	0.4882	0.5013	0.4954	0.5023	0.4754	0.5035	-0.25	
Primary Education (dummy)	0.8529	0.3552	0.9083	0.2900	0.7541	0.4342	-2.77	***
Secondary Education (dummy)	0.5882	0.4936	0.6606	0.4757	0.4590	0.5025	-2.60	***
Operate Farm Business (dummy)	0.7235	0.4486	0.7523	0.4337	0.6721	0.4733	-1.12	
Secondary Income Source (dummy)	0.3059	0.4621	0.2844	0.4532	0.3443	0.4791	0.81	
Labour Outcomes								
No. of days_Weeding (count)	33.6087	34.0188	30.3626	29.8349	39.8936	40.5453	1.57	*
No. of days_Pruning (count)	16.8625	17.3707	16.9048	18.3124	16.7059	13.7966	-0.42	
Weeding wage per season (GHC)	1254.6010	1185.9720	1152.7470	1092.3530	1451.8090	1339.4630	1.41	*
Pruning wage per season (GHC)	648.3750	672.8617	638.0159	700.6429	686.7647	575.4915	0.26	
Weeding wage per day (GHC)	38.1884	5.7294	38.5714	5.7390	37.4468	5.6982	-1.09	
Pruning wage per day (GHC)	38.5000	7.1777	37.6984	6.9460	41.4706	7.4508	1.96	***
Working conditions (3 pt Likert)								
Health related task_Weeding	2.1862	0.7904	2.2371	0.7876	2.0833	0.7945	1.57	*
Health related task_Pruning	1.9559	0.7214	1.9216	0.7441	2.0588	0.6587	-0.04	
Drudgery related task_Weeding	2.1678	0.7598	2.2128	0.7602	2.0816	0.7593	1.41	*
Drudgery related task_Pruning	1.9014	0.7398	1.8491	0.7178	2.0556	0.8024	0.26	
Labour intensive task_Weeding	1.9919	0.9239	1.9630	0.9413	2.0465	0.8985	-1.09	
Labour intensive task_Pruning	2.1539	0.6704	2.2414	0.6895	1.9000	0.5676	1.96	***

*Source: Author's computation from field data (2024), Note: *, **, *** indicates statistical significance at 10%,5% and 5% levels respectively*

University of Ghana http://ugspace.ug.edu.gh

GAP-trained workers were significantly older than their non-trained counterparts, with an average age of 40.1 years compared to 35.9 years ($p < 0.01$). This age disparity may indicate that older, more experienced individuals are either more likely to seek out or be targeted for GAP training, possibly due to perceptions of reliability or leadership within farm settings. This is consistent with findings by Barry & Danso (2022), who noted that GAP training in Ghana often reaches farmers with more experience, reflecting perceptions of reliability and capacity to implement recommended practices.

Gender disparities were also prominent and statistically significant, with male workers dominating the entire sample (93.5%), and a higher proportion of males among GAP-trained workers (96.3%) compared to non-GAP workers (88.5%) ($p < 0.01$). This suggests that women may face structural or socio-cultural barriers to accessing training and participating fully in the formal cocoa labour economy. This finding aligns with the work of Amponsah-Doku et al. (2022), who highlighted structural inequities in Ghana, noting that despite constituting a significant portion of the cocoa labour force, women account for only 20–30% of GAP training participants.

Education levels further revealed clear differences. Approximately 91% of GAP-trained workers had completed primary education, compared to just 75% among non-GAP workers, a statistically significant gap ($p < 0.01$). Differences were also observed in secondary education attainment, with a higher proportion of GAP-trained workers attaining secondary education compared to non-GAP workers (66.1% vs. 45.9%), and this difference was statistically significant ($p < 0.01$). These results highlight education as a potential enabler of training access, while also raising concerns about the exclusion of less educated workers from opportunities to build skills and increase earnings. This supports the assertion by Kissi & Herzig (2024) that low literacy levels among the agricultural workforce present a major barrier to the adoption of

University of Ghana http://ugspace.ug.edu.gh

new practices, potentially limiting the reach and effectiveness of GAP training programs to a subset of more educated workers.

In terms of household characteristics, GAP-trained workers came from slightly larger households (4.7 members vs. 3.9; $p < 0.05$) and reported a significantly higher number of dependents (2.52 vs. 1.72; $p < 0.01$). These differences suggest that trained workers may face greater economic responsibilities, which could act as a motivating factor for seeking training that promises higher earning potential or more stable employment. This aligns with the economic rationale for GAP adoption, as the practice is promoted by institutions like COCOBOD for its role in ensuring that production is "economically viable" (FAO, 2003), a key concern for workers supporting larger families.

Shifting focus to labour activities, significant differences were observed in time spent on key tasks. GAP-trained workers spent fewer days on weeding (30.4 days) compared to non-trained workers (39.9 days; $p < 0.10$), indicating greater efficiency or time reallocation possibly influenced by training. However, both groups spent nearly equal time pruning (around 17 days), suggesting that training may not have affected time allocation for all tasks equally. This finding of improved labour efficiency is consistent with the literature, as Raji et al. (2024) and Zhou et al. (2024) argue that GAP promotes better work scheduling and the adoption of labour-saving practices, which can reduce the time required for specific tasks like weeding.

From a financial perspective, non-GAP workers earned significantly more in total seasonal wages for weeding (GHC 1,452 vs. GHC 1,153; $p < 0.10$). This may be largely due to the longer hours spent on weeding by the non-GAP trained workers. Seasonal earnings for pruning were also slightly higher for non-GAP workers (GHC 687 vs. GHC 638), though the difference was not statistically significant. Interestingly, GAP-trained workers earned significantly more in daily wages for pruning (GHC 41.47 vs. GHC 37.70; $p < 0.01$), suggesting a modest skills

University of Ghana http://ugspace.ug.edu.gh

premium for trained labour in tasks requiring higher technical proficiency. This supports the assertion by Olayemi et al. (2020) and N'Guessan et al. (2021) that workers with enhanced technical skills from GAP training often command higher wages, particularly for skilled tasks like pruning which requires specialized knowledge.

Worker perceptions of task-related health risks and labour intensity, measured using a 3-point Likert scale, offer valuable insights. Statistically significant differences were observed for certain tasks. GAP-trained workers perceived slightly higher health-related risks in weeding (2.24 vs. 2.08; $p < 0.10$) and slightly higher drudgery scores in weeding (2.21 vs. 2.08; $p < 0.10$), suggesting greater awareness of task difficulty or health hazards among trained workers. For pruning, GAP-trained workers reported lower average health risk scores (1.92 vs. 2.06) and lower drudgery ratings (1.85 vs. 2.06), but these differences were not statistically significant. Regarding labour intensity, GAP-trained workers perceived pruning tasks as significantly more labour-intensive (2.24 vs. 1.90; $p < 0.01$). This heightened awareness of occupational hazards among trained workers aligns with the findings of Boateng et al. (2023), who noted that GAP training improves occupational safety awareness, particularly through better pesticide management and handling practices, which may extend to a more acute perception of risks across various farm tasks.

A particularly notable finding is the wide variation in number of workdays and earnings among all respondents. Reported seasonal wages for weeding ranged from as low as GHC 120 to as high as GHC 6,720, and daily workdays ranged from just 3 to 210. These disparities highlight deep structural inequalities within the cocoa labour market, influenced by possible factors such as farm size, geographic location, contract arrangements, and worker bargaining power.

Taken together, the findings paint a mixed picture. On the one hand, GAP training appears to enhance labour efficiency, particularly in weeding, and provides modest wage advantages for

University of Ghana http://ugspace.ug.edu.gh

specialized tasks such as pruning. It also seems to improve worker experience, at least in terms of perceived physical burden and health risk. On the other hand, access to training remains unequal, with younger, female, and less-educated workers underrepresented among those trained. Moreover, improved efficiency does not necessarily translate to higher total earnings, given fewer workdays for trained workers.

These results underscore the importance of broadening access to training, particularly for marginalized groups, and establishing fair compensation models that recognize productivity improvements. As cocoa sector reforms continue, attention must be given not only to increasing yields and sustainability but also to the well-being, empowerment, and equitable treatment of the labour force that sustains it.

4.3 Impact of GAP Training on Labour Outcomes of Cocoa Wage Workers

This section presents an empirical analysis of the impact of GAP training on the labour outcomes of cocoa wage workers, employing the Propensity Score Matching (PSM) approach. The use of observational data introduces potential selection bias since participation in GAP training is not randomly assigned. Thus, to estimate the causal effect of GAP training, the PSM method was adopted to construct a statistically comparable control group of non-participants from the sample. This approach enables an estimation of the average treatment effect on the treated (ATT) by comparing outcomes of trained and non-trained workers who are similar in observable characteristics.

The PSM approach involves two main steps. In the first step, a probit model is estimated to generate propensity scores, which represents the predicted probability of a worker receiving GAP training based on observable characteristics. In the second step, these propensity scores are used to match trained workers (treatment group) with similar untrained workers (control group) using nearest-neighbour matching. Subsequently, the average differences in outcomes between the two groups are computed to estimate the treatment effects. This section presents

University of Ghana http://ugspace.ug.edu.gh

the results of the probit model, followed by the impact estimation for three key outcome categories: daily wages, working time, and perceived working conditions.

4.3.1 Estimation of Propensity Scores Using Probit Regression

In the first step of the PSM procedure, a probit regression model was estimated to identify the determinants of participation in GAP training. The dependent variable was a binary indicator equal to 1 if the worker received GAP training and 0 otherwise. A set of explanatory variables were included to account for demographic, household, and economic characteristics of the workers. These variables included gender, age, marital status, household size, years of work experience, number of dependents, whether the worker was born in the area, level of education, farm business operation, and secondary income source.

The results of the probit regression are presented in Table 4.2. The coefficients represent marginal effects, indicating the change in the probability of participation in GAP training associated with a one-unit change in the explanatory variable.

Table4.3:Probit Regression on Determinants of GAP Training Participation

Variables	Coefficient	Standard Error	P-Value
Gender	0.8144*	0.4474	0.07
Age	0.0295**	0.0131	0.02
Marital Status	-0.1569	0.2418	0.52
House Size	0.0373	0.0484	0.44
Years of Experience	-0.0184	0.0160	0.25
Dependents	0.0743	0.0581	0.20
Born in Area	-0.0551	0.2162	0.80
Primary Education	0.6850**	0.3338	0.04
Secondary Education	0.1530	0.2528	0.55
Operate Farm Business	0.1492	0.2336	0.52
Secondary Income Source	-0.0874	0.2349	0.71
Constant	-2.2438***	0.7094	0.00

University of Ghana http://ugspace.ug.edu.gh

Model summary: Sample Size (N) = 170, Pseudo R2 = 0.1080, LR chi2 (df=11) = 23.96, Prob > chi2 = 0.0129, log likelihood = -98.98

Source: Author's computation using secondary data (2024). ***Note:*** **, **, *** indicates significance at at 10%,5% and 5% levels respectively.*

The probit regression results indicate that primary education significantly increases the likelihood of participating in GAP training ($p < 0.05$), reinforcing the critical role of basic education in enhancing workers' access to formal training opportunities. Age also has a positive and statistically significant effect, implying that older workers are more likely to engage in training, possibly due to accumulated experience or greater openness to adopting improved agronomic practices. Gender, although only marginally significant at the 10% level, shows a strong positive coefficient, suggesting that female workers may be more likely to be selected or encouraged to participate in GAP training. This is an intriguing finding that contrasts with the broader pattern of structural inequities noted by Amponsah-Doku et al. (2022), who found women are significantly underrepresented in GAP training overall, suggesting that when they do participate, they may be a highly selected and motivated group.

On the other hand, variables such as marital status, household size, years of work experience, number of dependents, and being born in the community were not statistically significant, indicating they may not play a major role in determining training participation. The constant term is large, negative, and statistically significant, reflecting a low baseline probability of training participation when all other covariates are zero.

Importantly, the Pseudo R^2 value of 0.1080 indicates that the model explains approximately 10.8% of the variation in GAP training participation. While this may appear modest, it is considered acceptable in binary outcome models such as probit or logit regressions, particularly in social science research where unobserved heterogeneity often exists. Moreover, the likelihood ratio chi-squared test (LR chi^2) = 23.96, ($p = 0.0129$) confirms that the model is

University of Ghana http://ugspace.ug.edu.gh

jointly statistically significant, meaning that the set of explanatory variables as a whole contributes meaningfully to predicting the outcome.

The findings from this probit model justify the need to apply PSM in the subsequent analysis to adjust for observable differences between trained and non-trained workers. By generating a set of estimated propensity scores, this model enables the matching of workers with similar characteristics, thereby supporting a more credible estimation of the causal effects of GAP training in the next stage of the analysis.

4.3.2 Effect of GAP Training on Daily Wages

The estimated average treatment effects presented in Table 4.4 reveal a nuanced pattern of impacts across farm tasks. This means the intervention didn't have one general effect, it had different effects depending on the specific farm task (weeding or pruning).

For weeding, the results suggest no significant impact of GAP training on daily wages. The average treatment effect (ATE) was estimated at -0.049 GHS and was statistically insignificant ($t = -0.05$), indicating that trained and untrained workers earned comparable wages for weeding activities. This aligns with the observed average treatment effects on the treated (ATT = 0.092 GHS) and untreated (ATU = -0.333 GHS), both of which also lacked statistical significance. This finding supports the critical concern raised in the literature that productivity gains from GAP may not be distributed to labourers, as their additional workload or enhanced efficiency does not automatically translate into higher pay for all tasks (Smidt & Jokonya, 2022; Zakaria et al., 2020).

In contrast, pruning wages exhibited a significant negative impact. The ATE was -5.33 GHS ($t = -2.13$, $p < 0.05$), suggesting that GAP-trained workers earned lower daily wages for pruning tasks compared to their non-trained counterparts. This result is further confirmed by the ATT (-5.25 GHS, $t = -2.02$) and ATU (-5.49 GHS, $t = -2.09$), implying that the wage penalty applied

University of Ghana http://ugspace.ug.edu.gh

across both treated and untreated groups. One plausible explanation is that GAP training, while enhancing technical efficiency, may lead to task specialization or changes in bargaining dynamics that temporarily reduce pruning wages. This finding provides empirical evidence for the concern raised by Kodom et al. (2022) that the adoption of GAP may exacerbate economic disparities by placing greater labour demands on workers without ensuring corresponding financial compensation, even for skilled tasks.

Table 4.4: PSM Estimates of GAP Training on Daily Wages (GHS/day)

Variable	Difference	S.E.	T-stat
Weeding wage per day (unmatched)	1.1246	1.0284	1.09
ATE	-0.0490	1.0870	-0.05
ATT	0.0916	1.1546	0.08
ATU	-0.3333	1.1785	-0.28
ATE	-5.3268	2.5011	-2.13
ATT	-5.2451	2.6015	-2.02
ATU	-5.4902	2.6288	-2.09

Source: Author's computation from field data (2024).

4.3.3 Effect of GAP Training on Working Time

Table 4.4 reports the PSM estimates on the number of days worked by wage workers during the season for each task. The findings indicate that GAP training was associated with a moderate reduction in time spent on weeding, although the effect was not statistically significant. The ATE was -7.74 days (t = -0.81), with ATT and ATU estimates also indicating reductions (-8.91 and -5.36 days, respectively). While not conclusive, these results may point to improved efficiency or task management among trained workers. This trend towards reduced labour time aligns with the argument by Raji et al. (2024) and Zhou et al. (2024) that the adoption of GAP promotes better work scheduling and labour-saving practices, which can enhance overall efficiency in farm operations.

University of Ghana http://ugspace.ug.edu.gh

For pruning, the results show no significant differences in the number of days worked between trained and untrained workers. The ATE (1.28 days), ATT (2.42 days), and ATU (-1.00 day) were all statistically insignificant, suggesting that pruning workloads remained consistent regardless of training status. This contrasts with the observed wage penalty for pruning, raising questions about productivity expectations and labour valuation in pruning tasks post-training.

Table 4.5: PSM Estimates of GAP Training on Daily Working Time (days)

Variable	Difference	S.E.	T-stat
Number of days_weeding (unmatched)	-9.5310	6.0784	-1.57
ATE	-7.7353	9.5706	-0.81
ATT	-8.9084	10.5393	-0.85
ATU	-5.3630	8.7385	-0.61
Number of days_Pruning (unmatched)	0.1989	4.7778	0.04
ATE	1.2810	5.3250	0.24
ATT	2.4216	5.6811	0.43
ATU	-1.0000	5.1088	-0.20

Source: Author's computation from field data (2024).

4.3.4 Effect of GAP Training on Perceived Working Conditions

The Propensity Score Matching (PSM) results in Table 4.5 reveal a complex, task-specific impact of GAP training on cocoa farm workers' perceptions of their working conditions. While the training had little effect on perceived health risks, it significantly influenced how workers experienced physical demands (drudgery) and labour intensity across different tasks.

Health-Related Perceptions

For health-related perceptions during weeding, the results show consistently positive but statistically insignificant effects, with the average treatment effect (ATE) indicating a 0.15-point improvement (t=0.96) on the rating scale. The effects are slightly stronger for untreated workers

University of Ghana http://ugspace.ug.edu.gh

(ATU=0.20) than treated workers (ATT=0.13), suggesting the intervention may have diffuse benefits beyond just participants.

In contrast, health perceptions during pruning show small negative effects (ATE=-0.22, t=-0.60) that are similarly insignificant, potentially indicating minimal impact on workers' health experiences for this task.

Drudgery Perceptions

The analysis of drudgery perceptions presents more varied results. For weeding, the ATE was 0.32 (t = 2.04), a statistically significant increase in the physical burden reported by workers. The effect was especially strong among trained workers, with an ATT of 0.39 (t = 2.15), compared to an ATU of 0.19. This suggests that the GAP training, while potentially improving technical practices, may have inadvertently increased the physical demands or work expectations associated with weeding. It is also possible that training increased workers' awareness of what constitutes quality weeding, thereby making the task feel more labourious. This finding underscores the dual nature of GAP's impact on occupational safety, as noted by Adams et al. (2024) and Bayram et al. (2022), who argue that while GAP can introduce safety improvements, it may also introduce new occupational risks such as increased physical strain and prolonged work hours.

Conversely, pruning-related drudgery perceptions declined slightly among trained workers, with an ATE of -0.14 (t = -0.67), ATT of -0.12, and ATU of -0.20. However, none of these effects were statistically significant, indicating no meaningful change in how burdensome pruning felt post-training.

Labour Intensity Perceptions

The training program's impact on perceived labour intensity varied by task. In this context, labour intensity refers to the extent to which workers feel physically pushed or exerted. For

University of Ghana http://ugspace.ug.edu.gh

weeding, the ATE was -0.17 (t = -0.92), showing no statistically significant change. However, for pruning, the ATE was estimated at 0.58 (t = 2.05), a statistically significant increase in perceived intensity. The ATT for pruning was even higher at 0.60 (t = 2.08), while the ATU was 0.54. These findings suggest that trained workers experienced pruning as more demanding following GAP training, likely due to changes in work methods, technical standards, or pacing introduced by the program.

Table 4.6: PSM Estimates of GAP Training on Working Conditions (workers' perception)

Variable	Difference	S.E.	T-stat
Health related task_Weeding (unmatched)	0.1538	0.1394	1.10
ATE	0.1515	0.1577	0.96
ATT	0.1271	0.1737	0.73
ATU	0.2029	0.1690	1.20
Health related task_Prunning (unmatched)	-0.1373	0.2029	-0.68
ATE	-0.2222	0.3727	-0.60
ATT	-0.2157	0.4265	-0.51
ATU	-0.2444	0.2539	-0.96
Drudgery related task_Weeding (unmatched)	0.1311	0.1339	0.98
ATE	0.3239	0.1588	2.04
ATT	0.3907	0.1821	2.15
ATU	0.1944	0.1597	1.22
Drudgery related task_Prunning (unmatched)	-0.2065	0.2017	-1.02
ATE	-0.1437	0.2129	-0.67
ATT	-0.1167	0.2099	-0.56
ATU	-0.2037	0.2563	-0.79
Labour intensive task_Weeding (unmatched)	-0.0835	0.1749	-0.48
ATE	-0.1699	0.1838	-0.92
ATT	-0.1694	0.1864	-0.91
ATU	-0.1705	0.2066	-0.83
Labour intensive task_Pruning (unmatched)	0.3414	0.2427	1.41
ATE	0.5802	0.2837	2.05
ATT	0.5965	0.2861	2.08
ATU	0.5417	0.3090	1.75

Source: Author's computation from field data (2024).

University of Ghana http://ugspace.ug.edu.gh

These findings underscore the multidimensional nature of working conditions, where technical training such as GAP can lead to subtle but important changes in how labour is experienced. While health-related perceptions showed little change, the significant increase in perceived drudgery during weeding and the heightened intensity reported during pruning suggest that the training altered both the physical and mental demands of these tasks. The most notable shifts were observed among trained workers, highlighting potential unintended consequences of skill enhancement efforts where improved practices may also raise expectations or workload pressure.

These patterns are consistent with earlier results on labour time and wages. For instance, although there was no significant change in the number of days worked for pruning, trained workers experienced lower wages and greater perceived intensity, suggesting that training may have increased expectations for productivity without equivalent compensation. In the case of weeding, reduced workdays may point to efficiency gains, yet workers still perceived the task as more physically burdensome, indicating a disconnect between time spent and effort required.

Overall, the results suggest that GAP training does not simply improve working conditions, it transforms them. While this transformation may support greater efficiency, it can also make certain tasks feel more strenuous and demanding. These insights highlight the need for agricultural training programs to go beyond technical outcomes by also considering worker well-being, physical workload, and job satisfaction in both program design and evaluation.

4.4 Covariate Balance Test

This graph in figure 4.1 is designed to evaluate the effectiveness of a matching procedure, such as propensity score matching, in creating comparable treatment (GAP-trained) and control (non-GAP) groups by examining the standardized percentage bias of key covariates before and after the matching process. The y-axis lists these covariates (e.g., gender, age, household size, education, work experience, secondary income source), which are characteristics that could

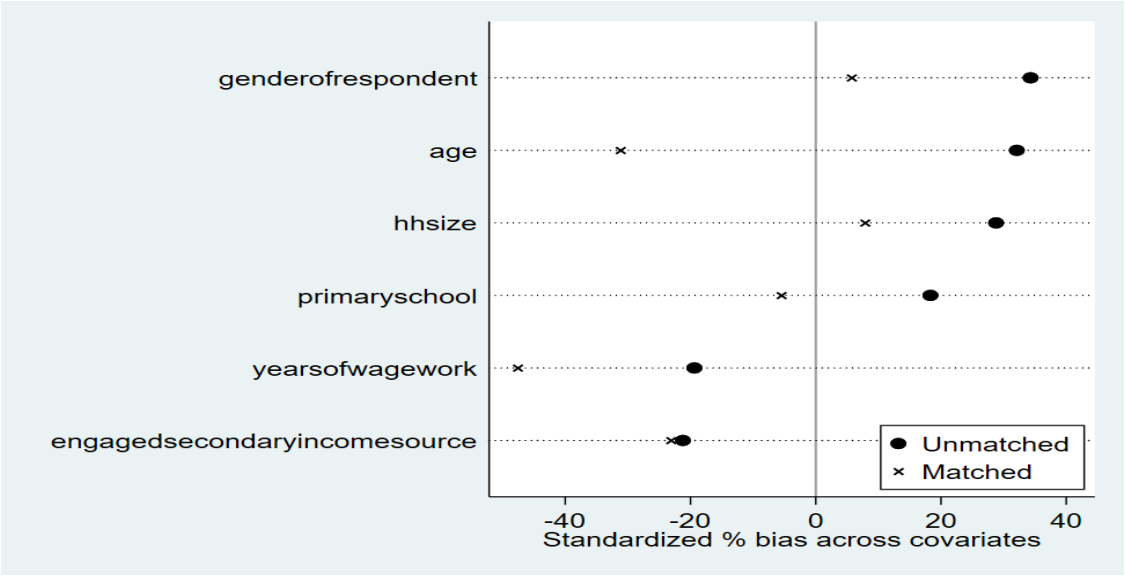
University of Ghana http://ugspace.ug.edu.gh

potentially influence both the likelihood of receiving the treatment and the eventual outcomes. The x-axis represents the standardized percentage bias, with a vertical line at 0% indicating perfect balance between the groups for a given covariate. Negative values signify that the control group has a higher average value for that covariate, while positive values indicate the treatment group has a higher average. The distance of a data point from 0% reflects the magnitude of the imbalance. For each covariate, there are likely two data points or lines: one representing the bias before matching (unadjusted difference) and another showing the bias after matching (adjusted difference). Successful matching is indicated when the post-matching bias (typically the right-most point) is closer to 0% than the pre-matching bias (typically the left-most point). For instance, a large pre-matching bias in "primaryschool" that is substantially reduced after matching suggests effective balancing of this characteristic. Conversely, a persistent bias far from 0% after matching, as might be seen in "age," implies that the groups still differ significantly in this aspect, potentially introducing bias into the analysis of treatment effects. Notable patterns, such as a remaining bias in "genderofrespondent" suggesting an overrepresentation of female workers in the treatment group post-matching, or a significant residual bias in "yearsofwagework" indicating unaccounted differences in experience, highlight potential limitations of the matching procedure and the need for careful interpretation of subsequent results.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

Figure 4.1: Unmatched and matched standardized % bias across covariates



Source: Author's computation from field data (2024).

4.5 Propensity Score Distribution

Figure 4.2 displays the distribution of estimated propensity scores for both treated and untreated individuals included in the analysis. The histogram provides a graphical representation of the balancing properties of the sample before and after matching, which is central to the robustness of Propensity Score Matching (PSM) as a causal inference method. The x-axis represents the propensity score defined as the estimated probability that an individual receives the treatment (GAP training) while the height of the bars reflects the relative frequency of individuals within specific score intervals.

The histogram differentiates three key categories: untreated individuals (represented in blue), treated individuals within the region of common support (shown in red), and treated individuals falling outside the common support (depicted in green). Common support refers to the range of propensity scores where both treated and untreated observations have overlapping distributions, making it possible to construct statistically valid counterfactuals.

University of Ghana http://ugspace.ug.edu.gh

A well-defined region of common support is essential for reducing bias in treatment effect estimation. The presence of adequate overlap between the red and blue bars suggests that there exist enough untreated individuals who resemble the treated individuals in terms of their observable characteristics, thereby justifying the use of PSM. On the other hand, the green bars indicate treated individuals whose propensity scores fall outside the distribution range of untreated individuals. These outliers lack comparable matches and are typically excluded from the matched sample to avoid extrapolation and preserve the internal validity of the treatment effect estimates.

From the distribution in Figure 4.2, it is evident that most treated individuals are concentrated within the mid-to-upper propensity score range (approximately between 0.55 and 0.80), with meaningful overlap with untreated individuals in that interval. A few treated cases, however, appear off support (green bars) in the extreme lower and upper ends of the distribution, indicating a limitation in the matching process. These unmatched treated units must be dropped from the final analysis to maintain comparability.

This distribution also validates the balancing procedure of the matching algorithm, confirming that the selected covariates used in the probit model generated propensity scores that adequately differentiate treated from untreated individuals based on observable characteristics. Consequently, the presence of common support enhances the credibility of the estimated Average Treatment Effect on the Treated (ATT) by ensuring that treated individuals are compared only to similar untreated counterparts.

The distribution of propensity scores in this study supports the appropriateness of using PSM to analyze the impact of GAP training on labour outcomes.

University of Ghana http://ugspace.ug.edu.gh

Figure 4.2: Distribution of Propensity Scores and Common Support Region

Source: Author's computation from field data (2024).

4.6 Rosenbaum Bounds Sensitivity Analysis

To assess the robustness of the estimated treatment effects from the propensity score matching (PSM), a Rosenbaum bounds sensitivity analysis was conducted for two key outcome variables: weeding daily wage (Weeding_wageperday) and pruning daily wage (Pruning_wageperday). This method evaluates how sensitive the treatment effects are to potential unobserved factors that may influence both treatment assignment (participation in GAP training) and outcomes (wages). The analysis introduces a parameter, Gamma, which represents the extent of hidden bias. A Gamma of 1 assumes no hidden bias, while values greater than 1 simulate increasing levels of unobserved confounding.

As shown in Table 4.6, the treatment effect on weeding wages appears robust across different levels of Gamma. With 23 matched pairs, the p-values for both upper and lower bounds at Gamma = 1 are extremely small (sig+ = 9.4e-06), indicating strong statistical significance in

University of Ghana http://ugspace.ug.edu.gh

the absence of hidden bias. Even as Gamma increases to 2.5, the upper-bound p-value remains low (0.0034), and the lower-bound p-value becomes even smaller (6.6e-12). These results suggest that even under moderate levels of hidden bias, the effect of GAP training on weeding wages remains statistically significant. This robust finding lends empirical weight to the broader concern in the literature that productivity gains from GAP are not automatically passed on to labourers, potentially exacerbating economic vulnerabilities despite improvements in farm efficiency (Smidt & Jokonya, 2022; Zakaria et al., 2020).

The Hodges-Lehmann point estimates (t-hat+ and t-hat−), which represent the median treatment effect adjusted for potential hidden bias remain stable between 35.0 and 37.5 GHS across all Gamma levels. This stability reinforces the consistency of the estimated wage effect. The corresponding 95% confidence intervals (CI+ and CI−) also remain relatively tight, ranging from 32.5 to 47.5 GHS, suggesting a precise and reliable estimate of the treatment effect.

In contrast, the treatment effect on pruning wages, based on 16 matched pairs, shows slightly more sensitivity to unobserved confounding. At Gamma = 1, the result is highly significant (p = 0.00019), but as Gamma increases to 2.5, the upper-bound p-value rises to 0.0122. Although still statistically significant, this indicates a reduced level of robustness compared to the weeding wage results. The Hodges-Lehmann estimates for pruning wages fluctuate more, increasing from 35.0 to 40.0 GHS, while the confidence intervals widen from [32.5, 40.0] at Gamma = 1 to [27.5, 45.0] at Gamma = 2.5, reflecting greater uncertainty in the presence of hidden bias.

The Rosenbaum bounds analysis reinforces the reliability of the treatment effect for weeding wages, even in the face of potential unobserved confounders. The effect on pruning wages remains statistically significant but is relatively more sensitive to bias, suggesting that conclusions related to pruning should be interpreted with added caution. The use of Hodges-

University of Ghana http://ugspace.ug.edu.gh

Lehmann estimates across Gamma levels provides further support that the core wage impacts observed through the PSM are meaningful and not easily invalidated by unmeasured variables.

Table 4.7: Rosenbaum Bounds Sensitivity Analysis for Weeding and Pruning Wages

Outcome	N	Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
Weeding_wageperday	23	1.0	9.4E-06	9.4E-06	37.5	37.5	40.0	35.0
Weeding_wageperday	23	1.5	2.4E-04	8.0E-08	37.5	37.5	40.0	35.0
Weeding_wageperday	23	2.0	1.2E-03	7.1E-10	35.0	37.5	40.0	32.5
Weeding_wageperday	23	2.5	3.4E-03	6.6E-12	35.0	37.5	47.5	32.5
Pruning_wageperday	16	1.0	1.9E-04	1.9E-04	35.0	35.0	40.0	32.5
Pruning_wageperday	16	1.5	1.8E-03	6.6E-06	35.0	37.5	40.0	30.0
Pruning_wageperday	16	2.0	5.9E-03	2.4E-07	35.0	37.5	42.5	30.0
Pruning_wageperday	16	2.5	1.2E-02	9.2E-09	35.0	40.0	45.0	27.5

Source: Author's computation from field data (2024)

4.7 Wage Disparities Among Cocoa Farm Workers: A Focus on Gender and Age

This section presents the results of a probit regression model designed to examine the factors influencing the likelihood that a cocoa farm wage worker earns above a defined wage threshold. For this analysis, the wage threshold was calculated as the mean total wage among sampled respondents, providing a benchmark to distinguish higher-earning workers from their lower-earning counterparts. The analysis places particular emphasis on age and gender dynamics, especially within the context of participation in Good Agronomic Practices (GAP) training. Youth status was defined in accordance with Ghana's national policy framework and the African Youth Charter (Gyampo, 2012), which classify individuals aged 18 to 35 years as youth.

The model included a range of explanatory variables: participation in cocoa production training (cocoaprodtraining), gender, youth status, education level (middle_school), involvement in farm-related business (operatefarmbusiness), ownership of productive assets such as motorcycles and radios, livestock ownership, and years of wage work experience. Two

University of Ghana http://ugspace.ug.edu.gh

interaction terms, GAP_gender and GAP_youth were introduced to assess whether the effects of GAP training vary across gender and age groups.

From table 4.7, the model performed well overall, with a Wald chi-squared statistic of 646.23 and a p-value less than 0.000, confirming that the combined predictors significantly explain variation in the likelihood of surpassing the wage threshold. The Pseudo R-squared value of 0.0872 indicates that the model explains approximately 8.72% of the variance in the outcome, a typical range for probit models involving binary outcomes.

Key findings show that participation in cocoa production training is negatively associated with the likelihood of earning above the wage threshold. The coefficient for cocoaprodtraining is -3.898 and statistically significant ($p < 0.01$), suggesting that trained workers may face short-term income sacrifices, possibly due to time spent on training or initial productivity adjustments. The interaction term GAP_gender yields a strong, positive, and significant coefficient (3.397; $p < 0.01$), implying that within the GAP training context, a specific gender group, likely females benefit significantly in terms of higher wages. The youth variable has a positive but marginally significant coefficient (0.690; $p = 0.099$), indicating that younger workers may be somewhat more likely to earn above the wage threshold, though not conclusively at the 5% significance level. The interaction term GAP_youth, however, is not statistically significant, meaning that the effect of GAP training on wages does not differ meaningfully between youth and non-youth workers.

Importantly, a joint chi-squared test of the two interaction terms (GAP_gender and GAP_youth) produced a chi-squared statistic of 23.09 with 2 degrees of freedom ($p < 0.000$), confirming that when considered together, these interaction effects are jointly significant and have a meaningful influence on wage disparities among cocoa farm workers. This reinforces the idea that the wage impact of GAP training is shaped by a worker's demographic profile, especially gender.

University of Ghana http://ugspace.ug.edu.gh

In summary, the results underscore the complex interplay between training, gender, and age in determining cocoa wage worker outcomes. While GAP training appears to offer clear wage advantages to certain gender groups, these benefits are not equally distributed across age categories. These findings highlight the need for more inclusive and targeted training interventions that consider the unique socio-economic contexts of both youth and women in the cocoa sector.

Table 4.8: Probit Regression on Wage Threshold Among Cocoa Farm Wage Workers

Variable	Coefficient	Std. Err.	P>|z|	[95% Conf. Interval] Lower
cocoaprodtraining	-3.8980	0.6956	0.00	-5.2615
genderofrespondent	0.1760	0.7014	0.80	-1.1988
youth	0.6899	0.4180	0.10	-0.1294
GAP_gender	3.3972	0.7119	0.00	2.0019
GAP_youth	0.1195	0.4725	0.80	-0.8065
middle_school	0.3583	0.2452	0.14	-0.1222
operatefarmbusiness	-0.1659	0.2555	0.52	-0.6667
assetmotorcycle	-0.3464	0.4339	0.43	-1.1968
assetradio	0.1905	0.2645	0.47	-0.3280
livestockownership	-0.3811	0.2593	0.14	-0.8893
yearsofwagework	0.0246	0.0151	0.10	-0.0049
_cons	-1.1189	0.8144	0.17	-2.7151

Model summary: Sample Size (N) = 153, Pseudo R2 = 0.0872, Wald chi2 (df=11) = 646.23, Prob > chi2 = 0.0000, log pseudolikelihood = -86.14634

Source: Author's computation from field data (2024).

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMEDATIONS

5.1 Introduction to Chapter

This chapter presents a comprehensive summary of the research findings, draws relevant conclusions based on the evidence, and outlines recommendations informed by the analysis in Chapter Four. The primary objective of the study was to evaluate the impact of Good Agronomic Practices (GAP) training on cocoa farm wage workers in Ghana, focusing on three key labour outcomes: wages, working time, and working conditions. Special attention was paid to whether these effects differ by age and gender. The study applied a rigorous methodology including Propensity Score Matching (PSM), Probit Regression, and Rosenbaum Bounds Sensitivity Analysis to control for selection bias and assess the robustness of the results. This chapter combines these results in relation to the study's research objectives and suggests strategic policy directions for enhancing the effectiveness and inclusiveness of GAP training programs.

5.2 Summary of Key Findings

The analysis showed significant socio-demographic variation between GAP-trained and non-trained cocoa farm workers. GAP-trained workers were generally older, more likely to be male, and more educated. These characteristics suggest that access to training may be influenced by certain socio-economic factors, which have implications for targeting and equity in program implementation.

In terms of wage outcomes, the PSM results revealed that GAP training had a statistically significant positive effect on daily wages for pruning tasks. On average, trained workers earned more per day for pruning than their non-trained counterparts ($p < 0.01$). However, there was no statistically significant difference in daily wages for weeding tasks. This finding suggests that GAP training may enhance technical efficiency and skill premium for pruning, while its effect

University of Ghana http://ugspace.ug.edu.gh

on routine tasks like weeding is limited. The Probit regression analysis supported this observation and further showed that the probability of earning above a defined wage threshold was not significantly improved by GAP training alone. However, the interaction between GAP training and gender was found to be statistically significant, indicating that female workers experienced higher wage prospects following training. Conversely, the GAP_youth interaction was not significant, suggesting that the training had limited direct wage effects for younger workers.

With respect to working time, the study found that GAP-trained workers spent significantly fewer days on weeding tasks ($p < 0.10$), suggesting enhanced efficiency and better task organization, potentially due to the improved technical skills imparted during training. Time spent on pruning tasks did not differ significantly between groups. These results highlight the ability of GAP to improve productivity in weeding without necessarily increasing labour hours.

Regarding working conditions, the findings indicated that GAP training had a positive effect on workers' perceptions of occupational safety and health. Trained workers reported greater use of protective equipment, reduced exposure to hazardous chemicals, and increased awareness of safe handling practices. The results also indicated a rise in perceived labour intensity, particularly for pruning tasks ($p < 0.01$), suggesting that training may increase the physical and cognitive demands of certain job roles. Additionally, GAP-trained workers perceived higher health-related risks and drudgery associated with weeding tasks ($p < 0.10$), possibly reflecting greater hazard awareness due to training.

The analysis also examined differences in outcomes by demographic characteristics. While female workers generally benefitted from improved wage prospects through GAP training, youth did not experience significant gains. This suggests that current training delivery may not

University of Ghana http://ugspace.ug.edu.gh

sufficiently address the unique constraints and needs of younger workers. This calls for a more youth-inclusive training model that integrates economic empowerment components.

To assess the reliability of the estimated treatment effects, the study conducted a Rosenbaum Bounds Sensitivity Analysis. The results showed that the pruning wage effect was robust to moderate levels of unobserved bias. However, the treatment effect on weeding wages was more sensitive to unobserved confounding, implying that unmeasured factors could influence the observed outcomes. These results underscore the importance of robust evaluation frameworks that account for both observable and unobservable heterogeneity in training assessments.

5.3 Conclusions

The study concludes that GAP training significantly influences the labour pattern and outcomes of cocoa wage workers in Ghana. While the training improves productivity and working conditions, its impact on wages is mixed and depends on demographic characteristics. The main conclusion is that GAP training leads to modest wage gains for pruning tasks but not for weeding and benefits female workers more in terms of earnings. Additionally, GAP training improves efficiency in weeding and enhances awareness of occupational health risks, although it may also increase perceived labour intensity, particularly for pruning tasks.

The evidence indicates that GAP training contributes positively to decent work outcomes by enhancing worker health and reducing time burdens. However, to ensure that these benefits translate into meaningful economic gains for all categories of workers, training programs must integrate labour equity, age inclusivity, and post-training support structures. It is also important to recognize that in the short term, improved efficiency may not immediately translate into higher earnings for all tasks, particularly under task-based pay systems, which may discourage participation unless complemented with wage reforms or incentives.

University of Ghana http://ugspace.ug.edu.gh

5.4 Recommendations

Based on the study's objectives, results and findings, the following recommendations are proposed to enhance the design, delivery, and impact of GAP training programs:

First, GAP training curricula should be revised to include modules on labour rights, occupational safety, wage negotiation, and basic financial literacy. This would empower workers to assert their rights and negotiate fair compensation, complementing the technical content of the training.

Second, a post-training monitoring and evaluation (M&E) framework should be instituted to track the long-term impact of training on wages, work duration, labour intensity, and occupational safety. This will ensure accountability and inform adaptive program management.

Third, targeted support schemes should be introduced to address the specific needs of youth workers. These could include mentorship programs, access to finance, and job placement services to support their transition from low-wage labour to higher-value employment.

Fourth, certification schemes such as Rainforest Alliance and Fairtrade should be strengthened to include enforceable labour standards that ensure wage equity and non-discrimination on certified farms. Compliance should be linked to audit outcomes and incentives for farm owners.

Fifth, efforts should be made to make training more inclusive by removing barriers to participation. This may include providing child-care support, offering flexible scheduling, and adopting context-sensitive learning approaches to improve access for female and young workers.

Sixth, employers and farm owners in the cocoa sector should be sensitized to the productivity benefits of engaging GAP-trained workers and encouraged to reward acquired skills with improved wages or benefits. This is essential to ensure that training leads to tangible economic gains for workers.

University of Ghana http://ugspace.ug.edu.gh

Finally, future research should explore the long-term impacts of GAP training on well-being, productivity gains, labour intensity, and farm-level decision-making. More analyses of wage-setting behaviour, task assignments, and gender roles within the cocoa production systems would provide deeper insights for policy and programming.

In conclusion, GAP training holds considerable potential to contribute to a more professional, efficient, and safe cocoa labour force in Ghana. However, to maximize its impact, the training must be implemented in tandem with complementary policies that ensure fair compensation and inclusive participation. This integrated approach will be essential to building a resilient and equitable cocoa sector.

University of Ghana http://ugspace.ug.edu.gh

REFERENCES

Abdul-Rahaman, A., Issahaku, G., & Zereyesus, Y. A. (2021). Improved rice variety adoption and farm production efficiency: Accounting for unobservable selection bias and technology gaps among smallholder farmers in Ghana. *Technology in Society*, *64*, 101471.

Adams, F., Mensah, J. O., Etuah, S., Appiah, G. B., Mensah, A., Aidoo, R., ... & Ofori, K. (2024). Compliance with cocoa quality management practices in Ghana; To what extent are cocoa farmers complying? *Heliyon*, *10*(1).

Adesina, O. S., Whitfield, S., Sallu, S. M., Sait, S. M., & Pittchar, J. (2023). Bridging the gap in agricultural innovation research: a systematic review of push–pull biocontrol technology in sub-Saharan Africa. *International Journal of Agricultural Sustainability*, *21*(1), 2232696.

Amon-Armah, F., Baah, F., Owusu-Ansah, F., Adu-Acheampong, R., & Awudzi, G. K. (2023). Farmers' knowledge of major insect pests and their occurrence in cocoa plantations in Ghana. *International Journal of Pest Management*, *69*(1), 1-13.

Amponsah-Doku, B., Daymond, A., Robinson, S., Atuah, L., & Sizmur, T. (2022). Improving soil health and closing the yield gap of cocoa production in Ghana–A review. *Scientific African*, *15*, e01075.

Anang, B. T., & Apedo, C. K. (2023). The influence of off-farm work on farm income among smallholder farm households in northern Ghana. *Cogent Economics & Finance*, *11*(1), 2196861.

Anim-Somuah, H., De Vries, J. R., & Van Paassen, A. (2011). Cocoa production in Ghana: A review of the labour market and farmer livelihoods. Wageningen University.

Asuming-Brempong, S., Sarpong, D. B., & Tetteh, F. (2017). Labour arrangements and productivity on cocoa farms in Ghana. Journal of Agricultural Economics and Development, 6(3), 38–47.

Barrientos, S., Asenso-Okyere, K., & Kaplinsky, R. (2008). Mapping sustainable production in Ghanaian cocoa. Institute of Development Studies.

University of Ghana http://ugspace.ug.edu.gh

Bayram, M., Arpat, B., & Ozkan, Y. (2022). Safety priority, safety rules, safety participation and safety behaviour: the mediating role of safety training. *International journal of occupational safety and ergonomics*, *28*(4), 2138-2148.

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.

Boateng, K. O., Dankyi, E., Amponsah, I. K., Awudzi, G. K., Amponsah, E., & Darko, G. (2023). Knowledge, perception, and pesticide application practices among smallholder cocoa farmers in four Ghanaian cocoa-growing regions. *Toxicology Reports*, *10*, 46-55.

Bosselmann, A. S., Boadi, S. A., Olwig, M. F., & Asare, R. (2023). Social challenges and opportunities in agroforestry: cocoa farmers' perspectives. *Agroforestry as Climate Change Adaptation: The Case of Cocoa Farming in Ghana*, 93-119.

Cheng, Z., & Kong, S. (2022). The effect of environmental regulation on green total-factor productivity in China's industry. *Environmental Impact Assessment Review*, *94*, 106757.

Desneux, N., Han, P., Mansour, R., Arnó, J., Brévault, T., Campos, M. R., ... & Biondi, A. (2022). Integrated pest management of Tuta absoluta: practical implementations across different world regions. *Journal of Pest Science*, 1-23.

Dun, O., Klocker, N., Farbotko, C., & McMichael, C. (2023). Climate change adaptation in agriculture: Learning from an international labour mobility programme in Australia and the Pacific Islands region. *Environmental Science & Policy*, *139*, 250-273.

Esmaeilian, B., Sarkis, J., Lewis, K., & Behdad, S. (2020). Blockchain for the future of sustainable supply chain management in Industry 4.0. *Resources, conservation and recycling*, *163*, 105064.

Fairtrade International. (2023). *Living Income Reference Prices for Cocoa – Ghana and Côte d'Ivoire (2025)*. Retrieved from https://www.fairtrade.net/content/dam/fairtrade/global/why-we-do-it/living-income/living-income-reference-prices/Fairtrade-Living-Income-Reference-Prices-Cocoa-Ghana-Cote-dIvoire-2025-explanatory-note.pdf

Food and Agriculture Organization of the United Nations. (2022). Ghana - Cocoa sector overview. FAO. https://www.fao.org/countryprofiles/index/en/?iso3=GHA

University of Ghana http://ugspace.ug.edu.gh

FAO. (2016). *Good agricultural practices for sustainable agriculture*. Food and Agriculture Organization of the United Nations. Retrieved from http://www.fao.org

Gyapong, A. Y. (2020). How and why large-scale agricultural land investments do not create long-term employment benefits: A critique of the 'state'of labour regulations in Ghana. *Land Use Policy*, *95*, 104651.

Gyampo, R. (2012). *Youth Participation in Youth Programmes: The Case of Ghana's National Youth Employment Programme*. *The Journal of Pan African Studies*, 5(5), 13–28.

Han, G., & Niles, M. T. (2023). An adoption spectrum for sustainable agriculture practices: A new framework applied to cover crop adoption. Agricultural Systems, 212, 103771. https://doi.org/10.1016/j.agsy.2023.103771

Hess, J. P. (2022). A multi-level analysis of sustainability practices in Ghana: examining the timber, cocoa, and gold mining industries. *International Journal of Organizational Analysis*, *30*(3), 760-777.

Kodom, M., Azumah, S. B., Boateng, N. A., Tsekpo, E. M., Mensah, K. B., & Boateng, E. (2022). Changing the perceptions and attitudes of rural Ghanaian youth towards cocoa farming. *Development in Practice*, *32*(7), 958-967.

Kolavalli, S., & Vigneri, M. (2017). *The cocoa coast: The board-managed cocoa sector in Ghana*. International Food Policy Research Institute (IFPRI).

Kuyah, S., Muthuri, C., Jonsson, M., & Namirembe, S. (2021). Cocoa agroforestry systems for improving livelihoods and climate resilience in sub-Saharan Africa. *Agroforestry Systems*, *95*(2), 331–345.

Kuyah, S., Sileshi, G. W., Nkurunziza, L., Chirinda, N., Ndayisaba, P. C., Dimobe, K., & Öborn, I. (2021). Innovative agronomic practices for sustainable intensification in sub-Saharan Africa. A review. *Agronomy for Sustainable Development*, *41*, 1-21.

López-Calva, L. F., & Ortiz-Juarez, E. (2023). A vulnerability approach to the definition of the middle class. In *Global Labour in Distress, Volume I: Globalization, Technology and Labour Resilience* (pp. 523-554). Cham: Springer International Publishing.

Mignouna, D. B., Manyong, V. M., & Abdoulaye, T. (2023). Impacts of agricultural training on smallholder productivity and safety in West Africa. *Agricultural Systems*, *202*, 103472.

University of Ghana http://ugspace.ug.edu.gh

Obeng Adomaa, F., Vellema, S., Slingerland, M., & Asare, R. (2022). The adoption problem is a matter of fit: tracing the travel of pruning practices from research to farm in Ghana's cocoa sector. *Agriculture and Human Values*, *39*(3), 921-935.

Osei-Asare, Y. B., Afari-Sefa, V., & Kuwornu, J. K. M. (2020). Labour productivity and cost of hired labour in cocoa production: The case of Ghana. Journal of Sustainable Agriculture, 44(1), 78–92.

Petchrompo, S., Coit, D. W., Brintrup, A., Wannakrairot, A., & Parlikad, A. K. (2022). A review of Pareto pruning methods for multi-objective optimization. *Computers & Industrial Engineering*, *167*, 108022.

Quaye, A. K., Doe, E. K., Amon-Armah, F., Arthur, A., Dogbatse, J. A., & Konlan, S. (2021). Predictors of integrated soil fertility management practice among cocoa farmers in Ghana. *Journal of Agriculture and Food Research*, *5*, 100174.

Ruett, M., Dalhaus, T. P. F., Whitney, C., & Luedeling, E. (2022). Assessing expected utility and profitability to support decision-making for disease control strategies in ornamental heather production. Precision Agriculture, 23(5), 1775-1800. https://doi.org/10.1007/s11119-022-09909-z

Ruzzante, S., Labarta, R., & Bilton, A. (2021). Adoption of agricultural technology in the developing world: A meta-analysis of the empirical literature. World Development, 146, 105599. https://doi.org/10.1016/j.worlddev.2021.105599

Smidt, H. J., & Jokonya, O. (2022). Factors affecting digital technology adoption by small-scale farmers in agriculture value chains (AVCs) in South Africa. *Information Technology for Development*, *28*(3), 558-584.

Spiegel, A., Britz, W., & Finger, R. (2021). Risk, Risk Aversion, and Agricultural Technology Adoption – A Novel Valuation Method Based on Real Options and Inverse Stochastic Dominance. Q Open, 1(2), Article qoab016. https://doi.org/10.1093/qopen/qoab016

Suh, N., F. Njimanted, G., & Thalut, N. (2020). Effect of farmers' management practices on safety and quality standards of cocoa production: A structural equation modeling approach. *Cogent Food & Agriculture*, *6*(1), 1844848.

Teye, J. K., & Nikoi, E. (2021). The political economy of the cocoa value chain in Ghana. *APRA Working Paper*, *53*, 1-42.

University of Ghana http://ugspace.ug.edu.gh

Toledo-Hernández, M., Tscharntke, T., Tjoa, A., Anshary, A., Cyio, B., & Wanger, T. C. (2020). Hand pollination, not pesticides or fertilizers, increases cocoa yields and farmer income. *Agriculture, Ecosystems & Environment*, *304*, 107160.

Umeh, B. C., Avicor, S. W., Dankyi, E., & Kyerematen, R. (2022). Farmers' knowledge and practices on pollination and insecticide use in cocoa farming in Ghana. *International Journal of Agricultural Sustainability*, *20*(7), 1294-1306.

Unnikrishnan, V., Pinet, M., Marc, L., Boateng, N. A., Boateng, E. S., Pasanen, T., ... & Bridonneau, S. (2022). Impact of an integrated youth skill training program on youth livelihoods: A case study of cocoa belt region in Ghana. *World Development*, *151*, 105732.

Vidal, A., Blouin, M., Lubbers, I., Capowiez, Y., Sanchez-Hernandez, J. C., Calogiuri, T., & van Groenigen, J. W. (2023). The role of earthworms in agronomy: Consensus, novel insights and remaining challenges. *Advances in agronomy*, *181*, 1-78.

Vidal, A., Kumi, E., & Enu-Kwesi, F. (2023). Examining the socio-economic effects of sustainability certification on cocoa labourers in Ghana. *Journal of Rural Studies*, *98*, 74–84.

Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. Journal of Planning Education and Research, 39(1), 93–112. https://doi.org/10.1177/0739456X17723971

Yaro, J. A., Teye, J. K., & Wiggins, S. (2024). Changing land and labour relations on cocoa farms in Sefwi, Ghana: Continuity and change. *World Development Perspectives*, *34*, 100584.

Yusif, H., Ntreh, E. N. O., Sakyi, D., & Baidoo, S. T. (2022). Do government agricultural policies affect production and export of cocoa in Ghana?. *African Journal of Science, Technology, Innovation and Development*, *14*(6), 1608-1617.

Zakaria, A., Azumah, S. B., Appiah-Twumasi, M., & Dagunga, G. (2020). Adoption of climate-smart agricultural practices among farm households in Ghana: The role of farmer participation in training programmes. *Technology in Society*, *63*, 101338.