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A Tale of Two Trees: A Comparative Study on the Effects of Scale and Biodiversity Efforts in Ghana's Cocoa and Shea Production Networks

By

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Statement of originality

I, Ku'ulei Lewis, confirm that the research included within this thesis is my own work or that where it has been carried out in collaboration with, or supported by others, that this is duly acknowledged below and my contribution indicated. Previously published material is also acknowledged below.

I attest that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge break any UK law, infringe any third party's copyright or other Intellectual Property Right, or contain any confidential material.

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Abstract

This thesis presents two case studies on Ghana's cocoa and shea production networks, focusing on the effects of scale on biodiversity sustainability dissemination. Analysis is done through my unique holistic framework for action-based production network analysis, which provides a robust and multiscalar analysis to answer my main research question *How does scale affect biodiversity sustainability throughout Ghana's cocoa and shea production networks?*

The two case studies focus on Ghana's cocoa and shea production network coordination and the action taken up by different levels of actors within scale, their considerations of, approaches to, and outcomes of biodiversity sustainability dissemination throughout their Ghanaian cocoa production networks. These case studies focus on the history and context of the cocoa and shea sectors as they function within Ghana's agricultural industry, the influencers, and barriers to biodiversity sustainability dissemination throughout the studied production networks, and the effects of scale on this sustainability attainment. My research is support through primary data collected in Ghana and secondary data. The two case studies are then cross-analysed to draw out the commonalities in context, issues faced, and effects of scale on the studied sustainability aspects.

The findings of this research show that in order to achieve biodiversity sustainability, social sustainability must be incorporated into production network coordination and that the level of actors' scale and scalar approach to network coordination significantly impact achievement of biodiversity sustainability dissemination. The results of this thesis are novel in the fact that it combines several streams of analytical consideration into a holistic framework and presents clear and applicable results that can significantly impact the approach to sustainability dissemination throughout global production networks in an equitable manner that is fit to the context within which production takes place.

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Ho'onani I ka Makua Mau.

Abbreviations

GPN(s) – Global Production Network(s)

SSCM – Sustainable Supply Chain Management

GCC – Global Commodity Chain

GVC – Global Value Chain

PN(s) – Production Network(s)

MNC(s) – Multinational Corporation(s)

Co. 1 – Company 1, the studied multinational corporation with cocoa production network in Ghana

Co. 2 – Company 2, the studied multinational corporation with shea production network in Ghana

NGO(s) – Non-Governmental Organisation(s)

KKL – Kuapa Koko Ltd.

GDP – Gross domestic product

GMO – genetically modified organisms

SDGs – UN's Sustainable Development Goals

ABT – Aichi Biodiversity Targets

IPEBS - Intergovernmental Science-Policy Platform on Biodiversity and Ecosystems Services

CFI – Ghana's Cocoa and Forest Initiative

FDI – Foreign Direct Investment

ROI – Return on investment

LBC – Licenced Buying Company

COCOBOD – Ghana's Cocoa Board

SPD – Seed Production Division

CHED – Cocoa Health and Extension Division

CMC – Coca Marketing Company

QCC – Quality Control Company

WB – World Bank

IMF – International Monetary Fund

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Chapter 1 Research Questions and Aims

1.1 The problem: biodiversity loss as a result of agricultural production

Scientific research on the effects of human activity on the Earth's environment shows the substantial risk to the sustainability of the Earth (Crutzen and Stoermer, 2000; Srivastava, 2007; Whiteman, Walker and Perego, 2013; Bowen, 2017). Production impacts on biodiversity can be seen strongly in export-oriented agricultural products such as coffee, palm oil, and chocolate (Clough, Faust and Tscharntke, 2009; Lenzen *et al.*, 2012; Higonnet, Bellantonio and Hurowitz, 2017; WWF, 2020). The production of raw materials such as cocoa, palm oil, and coffee has resulted in global biodiversity degradation, including the extinction of whole species(Higonnet, Bellantonio and Hurowitz, 2017). Biodiversity threats include those species affected by palm oil production in Indonesia, such as the orangutan, Sumatran elephant, rhino, and tiger – all of which are categorised under critical threat due to the intense deforestation to mass produce palm oil, pulp, and paper (WWF, 2020). Further proof is found in cocoa production accounting for 7,000 square km of forest loss in Ghana between 2001-2014, 10% of the country's total forest cover (Nielburg, 2017).

Furthermore, greenhouse gas emissions in hotspot areas, such as the Sumatran rainforest, which currently has the highest greenhouse gas emissions from palm production, can cause significant local and global adverse environmental effects beyond endemic species extinction (WWF, 2020). Research in strategic business management and sustainability mainly focuses on ecological aspects of sustainability, such as biodiversity. Biodiversity sustainability in export-oriented agricultural production is critical to multiple levels within a network scale, from local flora and fauna to global threats, as we are finding in the Anthropocene era. This research seeks to understand the effects of different scale aspects on biodiversity sustainability dissemination in Ghana's cocoa and shea production.

Studies are undertaken by different research streams, analysing at multiple scale levels. Examples across natural science, economic geography, organisational behaviour, value chain and global commodities studies include such work as Achabou,

Dekhili, & Hamdoun, 2017; Bolwig, Ponte, du Toit Riisgaard, Lone, & Halberg, 2010; Daniels, 2006; De Marchi, Maria, & Ponte, 2013; Havice & Campling, 2013; Jeppesen & Hansen, 2004; Khattak, Stringer, Benson-Rea, & Haworth, 2015; Lenzen et al., 2012; Oya, Schaefer, & Skalidou, 2018; Perfecto, Rice, Greenber, & van de Voort, 1996; WWF, 2020. These studies range from micro-firm/actor level, meso-industry, and macro-global levels of analysis. I cannot address all levels or streams of work related to scale and sustainability in this thesis. The main issues being addressed in this research are those concerning biodiversity as a common pool resource (Ostrom, 1990, pp. 1–2), with an emphasis on the interaction between higher-level scale change efforts and nodal-level scale responses (Seuring and Müller, 2008; Ostrom, 2012; Perey, 2014; Touboulic and Walker, 2015). Taking a micro-level approach, this research seeks to understand the power dynamics and driving forces behind two specific agricultural sub-sectors in Ghana, toward or away from the dissemination of biodiversity preservation throughout production networks (PNs) (Henderson, Dicken and Hess, 2002; Coe, Dicken and Hess, 2008; Yeung and Coe, 2015). I will explore the unique effect of a fractal scale approach to viewing how structural changes occur and are instigated at macro-structural and micro-nodal levels (Perey, 2014). This approach may also lend to meaningful, practical implications on the development/dissemination of sustainable production practices at multiple levels of scale.

While this research may speak to the overarching conversation of the relationship between capitalism and the environment, as well as potential answers to questions of who should be held responsible for attaining sustainability, this research is not a theoretical endeavour to offer archetypal theoretical contributions to these conversations. Instead, this research takes a strategic analytical approach grounded in the lived experiences and tangible phenomena in the studied PNs to answer the specific question of how scale affects biodiversity sustainability in the two PNs being studied. This research considers scale as the network's size scale and the power and benefit of the actors participating at different levels within the scale of the production network operation. With this focus, potential insights will be offered to the more extensive theoretical conversations, including but not limited to whether and how

businesses and other powerful actors can address the problems in sustainability for which they are primarily responsible.

The language used in this research is also expressly not 'high academia'. While not a focus of this research, decolonising academia and the use of language as a tool of gatekeeping knowledge is a detriment to achieving equitable sustainability across disciplines and impacts policy, regulation and societal frameworks, which has a significant impact on the contexts within which the actors studied in this thesis operate (Moore, 2007; Matias, Walker and del Hierro, 2019; Jacob-Owens, 2021). I have chosen to write with language that is accessible to anyone, regardless level of western education received. Through intentional consideration of language, this research seeks to add to the growing fight to dismantle colonialism and gatekeeping in academia through accessibility.

This research takes a comparative case study approach and will trace the process of implementing sustainable production practices throughout Ghana's cocoa and shea sectors. The reason for comparing these two commodities in this study is to a) understand the outcomes of specific sustainability initiatives used in Ghana's cocoa PNs, b) understand the current sustainability situation in Ghana's shea PNs and c) uncover the benchmarks, similarities, and differences in issues faced between the two PNs. The purpose of pursuing these research threads is to provide an outlook and potential practical steps that may be taken across both PNs to achieve equitable sustainability for all actors involved. Furthermore, investigating the process and causes that have led to current PN outlooks on sustainability helps us understand through practical means (actions taken and impacts resulting) how the level of actor scale and the scaling up process affects sustainable production. By answering these sub-questions, this research will gain insight into the effects of scale throughout the two sectors by understanding the reasoning behind different approaches at different levels within scale as well as the scale of the actor(s) involved and how this impacts commitment to, and dissemination of biodiversity sustainability throughout the studied PNs.

The importance of studying cocoa is clear from the existing research on cocoa and chocolate production sustainability. Studies highlight the continued fight against unsustainable production and barriers to achieving this goal (examples include Fold, 2002; Franzen & Borgerhoff Mulder, 2007; Higonnet et al., 2017; Wessel & Quist-Wessel, 2015). Shea is a significant PN to study as it is indigenous to and only exists across 23 African nations. Some aspects of shea have recently been studied, and more research is currently being done on the many factors surrounding shea butter production globally. Much of the existing research is focused on understanding the history of shea production, shea as a cocoa butter substitute, the application of global certifications and their potential sustainability outcomes, alternative uses for shea-based timber and charcoal, chemical differences across shea regions, and the gendered nature of the commodity (Chalfin, 1996; Lovett, 2005; Gwali *et al.*, 2012; Francis Alemawor, Jacob K. Agbenorhevi and Adrian K. Poku, 2014; Glew and Lovett, 2014; Adazabra, Viruthagiri and Shanmugam, 2017a; Oya, Schaefer and Skalidou, 2018). This research will focus on the threads of power and scale as they influence the coordination of shea PNs today. Using cocoa as a comparative study for shea will allow an understanding of the overlaps and differences between the two PNs, and how scale and power can impact the studied PNs positively or negatively. Drawing from cocoa's sustainability approaches over time; these results can provide benchmarks and recommendations applicable to both current cocoa PNs and shea PNs in Ghana's context.

There are three main research questions this research will explore:

1) *How does scale affect biodiversity sustainability throughout Ghana's cocoa and shea production networks?*
2) *What forms of governance have been utilised to disseminate biodiversity sustainability in selected aspects throughout the respective production networks?*
3) *How have the studied powerful actors (the two firms researched, Ghana's governmental COCOBOD, and third sector actors) incorporated the proposed integrated framework aspects throughout the production networks?*

These questions are related to one another in that the second and third questions are sub-themes of the first question. The purpose of pursuing these lines of inquiry is to understand the following:

a. The processes that powerful level actors such as firms and governments use to implement/maintain biodiversity sustainability (practices/ policies/ standards) throughout their production networks.
b. The pressure points at which scale, market dominance, profit maximisation and sustainability come into tension, and the factors influencing the priority given to different aspects based on scalar points (i.e. higher level scale actors' focus and influence compared mid-level 3rd sector and low-level farmer.)
c. How different levels of actors deal with these points of tension.
d. The outcomes of approaches taken by powerful actors to address the issues of environmental sustainability along their GPNs amid changing spheres of influence as their network expands and they gain more power in the market. Or conversely, other actors gain influence and power, which is then pressed upon lead firms and their response to such structural changes.
e. How powerful actors address issues of biodiversity sustainability in their cocoa and shea production networks. Related to the pressure points, the cocoa industry has reached a critical state of negative biodiversity implications in cocoa production, and a shift is proposed toward cocoa substitutes. How do these firms 1) choose the substitute material and 2) in the cases where shea is the commonly chosen substitute (Talbot and Slager, 2008 as cited in Glew and Lovett, 2014) how do they intend to maintain biodiversity sustainability in the increased demand of shea for their products?
f. The influencing factors presented by the government, 3rd sector actors and other stakeholders on the firm and its production network, and the influence factors the firm and actors within the production network present to governments and 3rd sector actors.

By understanding these interactions, and the influencing factors behind different approaches to biodiversity sustainability dissemination throughout the studied PNs, this research can add evidence to the conversation on multiscalar governance approaches. This is done by investigating the motivating factors behind different methods and the various methods' outcomes.

This research introduces a new framework for analysis. My holistic framework for action-based production network analysis incorporates Global Production Network (GPN) theory (Yeung and Coe, 2015), Bolwig *et al.*'s (2010) integrated framework, Krauss' (2017) 'constellation of priorities' and a fractal scale (Perey, 2014) approach. Drawing from these theories builds on (Ostrom's (2012) concepts of scalar issues. It is used to understand the interplay of the tools and mechanisms of environmental sustainability efforts throughout PNs – specifically regarding biodiversity. The fractal scale (Perey, 2014) and integrated framework (Bolwig, 2010) for 'value chain action research' approach to analysis help us understand the complete picture of sustainability in the respective sectors within the fluid and interconnected context in which this production takes place. This approach facilitates consideration of the internal and external, direct and indirect drivers toward sustainability or those barriers which prohibit biodiversity sustainability implementation throughout the production networks. This attention to integrated analysis is vital to my research because the motivation for undertaking this study is to provide empirical findings grounded in the reality of lived experience for all actors involved and accessible to all levels of actors, whether involved directly or indirectly in the production network.

An issue with solely macro-level approaches to such topics, as Ostrom (1990, 1999, 2012) and Bowen (2017) have pointed out, includes the breakdown of collaborative action as an issue scales up. This is coupled with the inability to produce a singular global solution and risks of leakages and free riding. Ostrom (2012) calls for efforts to take place at multiple levels of scale, supporting such work as that by Lee (2009) and Seuring & Müller (2008). This research seeks to contribute to the conversation of multi-levelled efforts through a case study of two commodities showing the importance of multiscalar sustainability efforts. Investigating how the studied actors

interact with issues of biodiversity preservation at multiple levels of scale and the multiscalar influences affecting them, this research will aim to answer questions regarding the interplay of structural change from the top-down as well as the impact of multi-nodal shifts that may occur to push structural change from the bottom-up/within the scale. This research seeks to add to the empirical evidence supporting polycentric, multiscalar governance and its holistic sustainability potential, hoping that it can add to educating theoretical frameworks that influence policy and business models.

The studied biodiversity issues are analysed in this research through different lenses – at varying levels of scale – to understand the efficacy and challenges to achieving and maintaining sustainable biodiversity production within the dynamic context in which it is played out. The first lens is that of cocoa and shea farmers/producers; the second lens is the governmental bodies involved in the industries; the third is the view of the lead firms working in Ghana's cocoa and shea production networks; and the fourth and final lens is that of the third sector NGO organisations and international bodies (i.e. IMF and WB) involved. The motivating factors for these four different scalar actors vary according to their intended outcome. The farmers, government bodies and lead firms all seek to capture the highest gains through market involvement, with the imbalance of power and resources tipping these gains in favour of lead firms and government actors. The third sector NGOs, while seeking to maintain operation costs, can have a more direct focus on sustainability outcomes. Resource allocation (be it monetary, farming inputs, or knowledge) is essential to successful market participation for all these actors.

This research applies Krauss's (2017) "constellation of priorities". This "constellation of priorities" refers to the weight given to each priority by each level of actor; consequently, their investment level will vary accordingly. This 'constellation of priorities' helps us understand drivers and barriers of biodiversity sustainability, especially that of financial/access to resources and the varying commitment to and implementation of biodiversity sustainable practices. It is essential to understand the interaction between these priorities and the power that each set of actors holds.

Using this analytical lens in this research will help to map an understanding of the weight each level of the actor scale gives to the studied biodiversity sustainability dissemination methods. This understanding can provide insight into the effects of scale on each level of actor and the outcome of that effect in terms of action taken and commitment to upholding sustainable production practices. With this insight, potential solutions to tackle biodiversity issues may be found and supported.

This research will focus on the power dynamics and driving forces motivating production networks toward or away from the dissemination of biodiversity preservation throughout the production web as it is affected by the scaling-up process and the level of actor scale involved. I will deploy a fractal scale approach to view how structural changes are instigated at multiple scale levels. This research will take a multiscalar approach by analysing the power dynamics between two lead firms, the government body COCOBOD, the third sector through an NGO working in partnership with Co. 2, and with supporting data from interviews with leading researchers at Tamale Technical University Shea Research Department. Due to interview participant confidentiality agreements, I will identify the two companies as Co. 1 refering to the confectionary MNC sourcing cocoa from Ghana and Co. 2 refers to the cosmetics MNC sourcing shea from Ghana. This analysis will also activateGPN's push to consider the contexts of all relevant actors and relationships that come together to achieve production network coordination (Coe, Dicken and Hess, 2008).

The purpose of analysing at multiple levels of actors scale is to capture best the dynamic interactions between each level of actors throughout the production network, examining how the interconnectedness of the network plays each level off each other. My research questions seek to investigate the interwoven tapestry of power dynamics, actor relationships, drivers and barriers to achieving production network sustainability actively. Utilising this multiscalar, multi-lens approach, this research will seek to investigate the causes of effects of biodiversity sustainability in cocoa and shea production in Ghana in a robust and contextually relevant manner.

1.2 Research Questions Aims: Can the Problem be addressed through current sustainability governance approaches in production networks, and can it be scaled up?

To reach the research aim, the proposed research questions are being pursued – 1) How does scale (in this case, the multiscalar level of actors involved or the scale of production operations) affect biodiversity sustainability efforts throughout cocoa and shea production networks in Ghana? 2) What forms of governance have been utilised to disseminate biodiversity sustainability in selected aspects of cocoa and shea production networks? 3) How have the studied powerful actors (the two firms researched, Ghana's governmental COCOBOD, and third sector actors) incorporated proposed integrated framework aspects throughout the production networks?

A causes-of-effects study, the aims are to understand at each level of the production network (farmer, intermediary, lead firm, government) the actors' understanding of

a. biodiversity sustainability in their production practices,
b. the actors' understanding/level of ownership in the responsibility of achieving and maintaining biodiversity sustainability,
c. the tools and resources available for the actors toward these ends,
d. the supply contract, standards, guidelines toward biodiversity sustainability,
e. their experience with the other actors (both directly in contact, i.e. farmers and intermediaries, as well as indirectly, i.e. farmers and 3rd sector actors) within the production network,
f. the power, risk, vulnerability, and return level generated by participating in the production network.
g. the influence behind each level actor's 'constellation of priorities' and the impact on sustainable biodiversity production networks.

By creating a picture from each level of the network – and arguably each level of power in terms of available resources (i.e. financial resources, access, tools) to

respond to shifting market demands and prices, as well as mounting biodiversity implication pressures – the interconnected "roadmap" of cocoa and shea production network in Ghana, is investigated. A robust comparison may be drawn out in terms of forward-thinking action (in the case of shea production, which is not currently in the negative biodiversity impact extreme) and catching-up/rehabilitating action (in the case of cocoa production, which presently presents severe negative biodiversity implications).

1.2.a. Research Question 1: How does scale affect biodiversity sustainability in GPNs?

This research question is aimed at understanding the following sub-foci:

a. The processes that firms/government actors go through concerning implementing/maintaining environmental sustainability [practices/ policies/ standards] throughout a specific production network,
b. The pressure points at which scale/market dominance/profit maximisation and sustainability come into tension, and
c. How firms/government actors deal with these points of tension.

Under this research question, questions of mapping Co. 1 & 2's Ghanaian cocoa and shea production network fall. One aim of this research question is to understand who is responsible for what within the production network, who makes decisions regarding sustainability goals, practices, and standards, and who is being held to account (and by whom) for the implementation/maintenance of biodiversity sustainability throughout the production networks. By mapping out the key points, key actors, and critical places that interact to provide the firms with cocoa and shea, a better understanding of the interplay between different levels of scale interaction (micro farmer, meso lead firm, and macro government) is sought.

This line of inquiry will help investigate where sustainability goals originate (for example, a plan could be to rehabilitate a certain amount of agroforest land per year to achieve a specific rehabilitation area goal) and on whom responsibility for achieving

the goals falls (i.e. who invests the resources necessary to accomplish the rehabilitation – farmers, lead firm, government— to what extent each level of actor is responsible for implementing the sustainability goal).

Concurrently, this research question is to understand the pressure points between profit/procurement of high-quality raw materials and sustainability and how they are addressed by actors at each level of scale and scaling up of operations. For example, this could pertain to chemical fertilisers and pesticides. While these harmful chemicals may increase high-quality cocoa yield in the short term, their use undercuts sustainable production goals due to their negative biodiversity impacts (Donald, 2004; World Bank, 2011; Fairtrade, 2015). This research question will seek to understand how the actors involved in these specific production networks deal with these points of tension, which actors are involved/responsible for addressing these tensions, and the internal and external drivers that may push each level of actor toward a particular course of action.

Related to the pressure points, the cocoa industry has reached a critical state of negative biodiversity implications in cocoa production, and a shift is proposed toward cocoa substitutes. How do these firms 1) choose the substitute material and 2) in the cases where shea is the commonly chosen substitute, such as shea (Talbot and Slager, 2008 as cited in Glew and Lovett, 2014), how do they intend to maintain biodiversity sustainability in the increased demand of shea for their products?

The purpose of this question, "how does scale affect biodiversity sustainability throughout GPNs?" is essential as it is a neglected element in classic GVC analysis. The focus of GVC analysis, as will be discussed in Chapter 2, has been focused on how lead firms coordinate their value chain toward their maximum gain. Little research addresses the effects of that business growth on the lead firm's ability/commitment to maintaining sustainable GPNs, and the subsequent development and increased complexity of a firm's GPN to meet growing demand and continue this growth. While this research will not be able to address these questions in their entirety, it will seek to contribute to the growing conversation on how to understand GPN governance and

coordination in such a way that provides better tools and standards for implementing and maintaining sustainability along GPNs even as they grow in scale and complexity.

The understanding of scale operationalised in this research question is that of the fractal/modular scale discussed in Section 1.1. As businesses grow into multinational corporations, they play on their position of greater power as "lead firms" in the market (Gereffi, Humphrey and Sturgeon, 2005, p. 84). This research will explore the effects that scaling up of two lead firms' operations and the impact of increased power within actor scale has on the biodiversity sustainability of a firm's GPN. This will be explored through interviews with the buying and sustainability managers of the firms and interviews with key suppliers (should access be granted to speak to the suppliers and time permit to travel to their production locations). Additionally, interviews will be conducted with government and 3rd sector bodies involved in facilitating Ghana's cocoa and shea sectors (should access be granted). The firms have been selected, as will be discussed further in Chapter 3, experiencing rapid growth and scaling up of operations in the last 10-15 years and an ever-growing supply network to meet growing demands and biodiversity sustainability goals.

Tracing the scaling-up processes of these firms' GPNs and the changes to sustainability practices that occurred, the causes of the status of the firm's GPN sustainability will be explored. This will be accomplished using process tracing (Bennett and Elman, 2006, p. 459) and further discussed in Chapter 3 – of either building a sustainable GPN from the outset or how they transformed their GVCs from being unsustainable to their current state of sustainability. By understanding the causes that have created the present effect of a firm's PN sustainability, this research will seek to know how that sustainability can be attained and managed amid growth and upscaling operations. By comparing the two case study firms, and the two industries in which they operate, this research will explore the tools and approaches that may be shared in addressing the issue of sustainability and scale. There are different approaches, so I will explore why this is the case and their relative strengths, successes and weaknesses.

1.2.b. Research Question 2: What forms of governance have been utilised to disseminate biodiversity sustainability in selected aspects throughout production networks?

This research question has two purposes. Firstly, at the scale level of the lead firm and government, it is to understand how actors propose they implement biodiversity sustainable production in their Ghanaian cocoa and shea production networks. Secondly, it explores how successful these actors believe their implementation of biodiversity-sustainability practices has been throughout the production network. This seeks to lay out what these two levels of actors claim is happening, what they think the outcomes of these actions are and should be, and how successful the implementation of certain sustainable practices has been at the farmer level.

This line of inquiry will be followed by interviews with cocoa and shea producers (farmers, collectors, and processors according to access and availability). Interviews with producers are vital to the approach of this research, as they incorporate an often-missing piece of the sustainability puzzle – that of the producers of cocoa and shea, who are made to carry out biodiversity-sustainable production practices. It is important to understand the experience of the producers carrying out the demands of the more powerful actors and whether or not the views of those other actors are accurate in the producer's experience. This approach gives a voice to the weakest actor and offers a comparison tool for more powerful actors to gauge the effectiveness of their biodiversity sustainability approaches. While a lead firm or government official might praise a specific aspect of their process for implementing sustainable production, the producer may offer insight into how this approach is ineffective or, in some cases causing further strain they cannot meet. While this research is unable to do large-scale surveys or conduct agroforestry mapping and soil sample testing, it will seek to speak to producers who work directly with the lead firms and government to understand how thoroughly the goals and practices emanating from the meso and macro scale level actors translate out to the micro farm-level actor. This general gauging will be pursued through questions on access to government sustainability programmes, interaction with lead firm sustainability

training and resource provisions, and the farmers' perceived ability to meet the sustainability demands by the government or lead firm actors.

Lead firms operationalise several tools to disseminate environmental sustainability along value chains, such as upgrading, standards, certification requirements, monitoring, and technical collaboration (Jeppesen and Hansen, 2004; Coe, Dicken and Hess, 2008; Seuring and Müller, 2008; Touboulic and Walker, 2015). This research question will ask which tools have been utilised by the case study firms, why actors chose those tools, and the success these mechanisms have had on creating and maintaining a sustainable GPN as their business has grown.

Combined with the process-tracing approach of scalar questions, this research question explores the governance tools utilised by the two firms' current environmental sustainability practices in their GPNs. Furthermore, examining how they disseminated biodiversity sustainability along firm GPNs will highlight within-industry and cross-industries similarities to contribute to GPN and SSCM literature on governance and sustainability.

1.2.c. Research Question 3: How have the selected firms incorporated the proposed integrated framework aspects into their GPN governance and coordination of their GPNs?

This research question aims to understand the following sub-foci:

a. The multidirectional influences within Ghanaian cocoa and shea production networks and their effects on network coordination toward biodiversity sustainability and
b. how inter-scalar influences and interactions affect production network biodiversity sustainability in Ghana’s cocoa and shea sectors.

This research question seeks to understand the motivations for how lead firms set up their production networks in Ghana. The mapping done for research question 1 will inform the structure of the respective production network. This could help to

understand the motivations for powerful actors to express their power to drive their network toward sustainability. For example, if the firms provide eco-friendly fertilisers to fill a possible gap in soil quality, COCOBOD may be exacerbating using chemical fertilisers in their CHED programme. In this sub-focus, we can pursue the understanding of why and how different actors offer different levels of investment and interaction.

Building on the network mapping focused on in research question 1; this research question seeks to explore the different drivers that influence Ghana's cocoa and shea production network coordination. This includes influences presented by the government, 3rd sector actors, lead firms and their production networks, and the impact the firm and actors within the production network present to governments and 3rd sector actors.

1.2.d. Integrated framework of actors' interactive dynamics

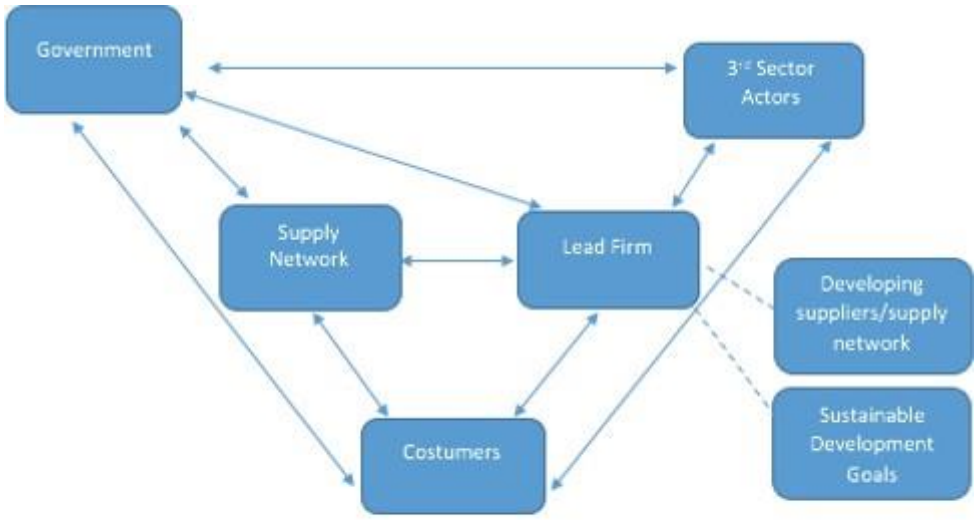

Fig. 1 Integrated Framework (Author, 2017 adapted from Henderson *et al.* 2002; Coe *et al.* 2004)

The dynamic multidirectional interaction and influences, further discussed in Chapter 2, is shown here (Figure 1) as an example of the interaction between the multiple

levels of scale studied in this research. Drivers of network coordination include government requirements for quality assurance checks of cocoa beans, government intervention, 3rd sector drivers through international sanctions and standard setting, and consumer demand for sustainably sourced goods (World Bank, 2011; World Bank Group, 2018). The complexity of network coordination and analysis of phenomena such as the influence of power and actors' lived experiences requires multiscalar and multi-layered research.

A gap in the GVC literature discussed in Chapter 2 is the focus on lead firm actions under the assumption that they are essential and a positive agent of development and in disseminating governance and coordination along the GVC (Bolwig *et al.*, 2010; Campling and Selwyn, 2016). Applying GVC's further iteration for analysis, GPN broadens the focus of the study back toward evaluating phenomena within its played-out context. Using this analytical framework to the above integrated framework provides an avenue to understand the manifestation of the interactions depicted in the integrated framework (Fig. 1). To this end; this research will incorporate the following aspects:

The effect of risk exposure as suppliers enter a GPN and/or their involvement in a GPN evolves (i.e. through investing in upgrading to meet suppliers' standards) (Bolwig et al., 2010).

How the power relations between the supplier and lead firm shape the supplier's action in their local context (i.e. does a lead firm standard come into tension with local/cultural norms, and if so, how does the supplier approach this or how do lead firms address these issues?) How do suppliers respond to lead firms' standards if they go beyond local regulation on social and environmental problems? What is the motivation to meet the suppliers' standards rather than the local norms? What incentives – beyond GPN participation as this is a given incentive – create the drive for adhering to these standards, if any (Bolwig et al., 2010)?

How has the suppliers' approach to environmental sustainability changed through linking up with lead firms? What tools have been provided or gained through this partnership? How have they affected the environment within which the suppliers operate – have they cut a certain amount of GHG emissions or resolved (and if so, to what extent) toxic waste exposure to humans and the environment surrounding their operation (Bolwig et al., 2010)? What (if any) interactions has the firm had with government institutions and 3rd sector actors? To what extent has this interaction involved suppliers, and what was the nature of this interaction? One of the risks in asking this question is that the firm may not provide neutral information. What answers are provided will be fact-checked through 3rd party documentation where possible, as well as a line of inquiry to contact the 3rd sector actors most involved with the lead firm and their suppliers to establish the validity of answers. Another point of fact may come from the differences or similarities in responses between the lead firm and suppliers and between the different tiers of suppliers interviewed, depending on the extent of access gained during the fieldwork phase of this research.

The first two points being considered relate more strongly to the social sustainability of the GPN. These are included in this research as these aspects of livelihood, risk exposure, and participation terms affect a supplier's willingness to undertake environmental upgrading that is sought after by lead firms and governments. By incorporating these elements into this study, this research will seek to understand the context within which environmental sustainability in biodiversity is being pushed. It considers the extent to which weak actors can/are willing to pursue this upgrading, the motivation for this pursuit, and how lead firms have

a. disseminated this sustainability along their production network,
b. the response suppliers have had to this dissemination of environmental standards, and
c. the various approaches that have successfully implemented the biodiversity sustainability sought by the lead firm and the reasons why improvement did not take place or failed.

These questions are a tool to gauge the level of involvement required/offered by the lead firm for their GPN participants to achieve the level of environmental sustainability sought after by the lead firm. It will also explore ways to address the power and benefit asymmetry in GVC operations and analysis(Bolwig *et al.*, 2010; De Marchi, Di Maria and Micelli, 2013; Achabou, Dekhili and Hamdoun, 2017).

The purpose of applying this integrated framework for action-based analysis is to understand the complexity of maintaining biodiversity sustainability as firms scale up their operations and grow to meet demands. The reasons for studying this type of phenomenon and examining the decision-making processes the studied actors go through are: Further understanding of how businesses approach and deal with complexity throughout GPNs concerning environmental and social sustainability. Learn from these firms the unique ways in which scale affects sustainable GPNs Draw insights into creating and maintaining sustainable GPNs that can be transferred to a generalised platform for the understanding and further inquiry of academics, governments, NGOs, and businesses alike.

While this research will not be able to address all these questions in their entirety, it will seek to contribute to the growing conversation of how to understand GPN governance and coordination in such a way that provides better tools and standards for implementing and maintaining sustainability throughout GPNs as they grow in scale and complexity.

Chapter 2 Literature Review

2.1 Introduction

In the countries with main exports such as cocoa and shea, high demand must be negotiated with the regulations in place to protect nature and wildlife from extinction and the people producing these commodities. The higher the demand, the harder it is to find the balance between production and preservation, primarily when the exported products represent the lion's share of the economy (Neimark, 2010). Studies show how the rate of consumption and demand for increasing production of raw materials such as the two studied in this research have a continued and evolving detrimental effect on the planet's ability to sustain natural life(Pimm *et al.*, 1995; Byers, Giovannucci and Liu, 2008; Neimark, 2010; Lenzen *et al.*, 2012). Lenzen et al. (2012) show that the push for increasing yields in agricultural exports pushes smallholder farmers toward degrading habitat, while developed countries such as the USA, the European Union, and Japan have the highest imports of these "biodiversity-implicated products" (p.109).

Discussed further in 2.4 and 2.5, this research applies Global Production Network (GPN) (Yeung and Coe, 2015), integrated action analysis (Bolwig et al., 2010), fractal scale (Perey, 2014), and 'constellation of priorities' (Krauss, 2017) frameworks to analyse the factors that drive production networks toward or away from biodiversity sustainability. The GPN lens facilitates analysis within embedded contexts such as geography and culture. In contrast, Bolwig et al.'s (2010) integrated action analysis incorporates social drivers impacting business and network coordination, aspects often neglected in research and the inclusion of which provides action-oriented analysis facilitating change drivers. Perey's (2014) fractal scale lens is applied to this research to create a dynamic analysis of the complex scale at play in Ghana's cocoa and shea production networks, viewing scalar issues as branched and layered rather than linear and top-down as in conventional chain analysis. Finally, Krauss' (2017) concept 'constellation of priorities' provides a nuanced mapping of shifting priorities over time, scale, and divisions (social, environmental, economic) across the various levels of scale the studied actors operate. Combining these frameworks, I am

introducing a new holistic framework for action-based production network analysis. Doing so, this research applies a unique framework for analysis that considers the multifaceted, interwoven nature of production network coordination, and the resulting social, environmental, and economic impact it has on participating actors.

This approach to researching the effect of scale on Ghana's cocoa and shea production networks delivers a robust insight into the many parts interacting to create the broader picture of network coordination toward biodiversity sustainability. Findings from this approach can contribute to advancing conversations on multiscalar, contextualised, polycentric modes of governance and coordination. Just as important, this approach provides grounded analysis that remains connected to the very human and highly complex web of power, interaction, and influence occurring on multiple levels within the network scale, continuously shifting and adapting to internal and external drivers. This analysis intends to contribute to the growing conversation which incorporates the varying degrees of scale, power and influence different actors have within the context of global production network analysis.

2.2 Understanding the global outlook on commodities' production coordination, and the current landscape of Ghana's cocoa and shea industries

The governance of global cocoa production networks has been characterised as being bi-polar, with multinational corporations (MNCs) holding a significant amount of power disseminated throughout the production chain, while the second pole is held by cocoa producers, whose influence is limited (Fold, 2002; Barrientos, 2016). Motivating factors for each of the four actors (see Chap.1) to be studied varies according to their intended outcome. The farmers, government bodies and lead firms seek to capture the highest gains through market involvement, with the imbalance of power and resources tipping these profits in favour of lead firms and government actors (Barrientos, Gereffi and Rossi, 2011; Barrientos, 2016). The third sector NGOs, while seeking to maintain costs for operation, can have a more direct focus on environmental and social sustainability outcomes. For all these actors, resource allocation and upgrading (be it monetary, farming inputs, or knowledge) are

fundamental to successful market participation (Coe *et al.*, 2004; Neilson, 2014). This research shows how socio-economic and environmental factors, the imbalance of investment, and the return for weak actors are foundational to resolving biodiversity sustainability issues in Ghanaian cocoa and shea production networks. These critical issues are analysed through different lenses to understand the efficacy and challenges to achieving and maintaining biodiversity sustainable production within the dynamic context in which it is played out.

Aside from corporate responsibility, a significant driver for resolving the social and environmental issues in cocoa and shea production is rooted in the desire for farmers to continue meeting the growing global demand for these ingredients (Voice Network, 2015; Barrientos, 2016; Krauss, 2017). The World Cocoa Foundation (2010) has projected global cocoa demand at an estimated 4.5m mt by 2020 with annual average production estimating 3.98m mt as of 2013 (World Cocoa Foundation meeting 2010 as cited in FairTrade, 2011). The gap in supply and demand is further exacerbated by the ageing farmer population, with younger potential farmers abandoning the industry for higher earning, higher status jobs, and Ghanaian smallholder farms only producing 40% of potential farm production (Barrientos, 2016). In the shea industry, Africa produces nearly 1.6m mt of shea from wild-grown trees yearly(Mohammed, Heijndermans and Suglo Mboribuni shea butter processing group, 2013). Ghana produces approximately 600,000 mt annually (Ofosu, 2009). Of the shea collected in Ghana, 60% is used locally, and 25% is exported (Iddrisu, Didia and Abdulai, 2019). Exported shea is mainly in the form of shea kernels; however, demand for shea butter exports has seen a 61.7% increase of shea butter exports between 2009-2010 (GEPA, 2014 as cited in Iddrisu, Didia, & Abdulai, 2019). Achieving biodiversity and socio-economic sustainability in Ghana's cocoa and shea industries is necessary for two main reasons. First, to ensure livelihood for smallholder farmers to continue cultivating the cocoa in ever-increasing demand globally and to ensure the natural habitat where cocoa and shea are grown is viable and yield-producing.

Environmental issues in cocoa and shea production are linked to social sustainability issues, creating an even more complex situation. This can be seen in the link between

contested land rights issues which are rooted in issues of social sustainability, and the environmental issues of sustainable tree husbandry, which is affected by contested land rights (Ubink and Amanor, 2008; Asuming-brempong *et al.*, 2015). Contested land rights are apparent in the dual system of land rights in Ghana between the post-colonial government institution and the traditional chieftaincy-based land tenure arrangements. An intersection within contested land rights is the gender inequality whereby women cocoa farmers and shea producers hold even less authority and fewer rights than men farmers. Farmers may own a certain number of (or all trees) on a plot of farmland, but typically do not own the land itself, instead holding tenancies to cultivate the landowner's land for a percentage of crop profits. At the end of a tenancy, the farmer will be allocated a portion of the land to continue cultivating. At the same time, the rest reverts to the owner's care (two respondents reported that this is typically 20-30% to the farmer and 70-80% to the landowner or chief). This land remains in the care of the tenant until the trees die or they can no longer cultivate their portion of the land. At this point, it is not guaranteed that the land will be signed over to the tenant's eldest son, nor does it protect the inheritance from being stripped at any time in the future (i.e. for sale to developers or immigrant farmers who will cultivate the land for lower wages which were reported to occur more often when the farm was being expanded).

Some areas in Ghana were allowed to be sold through chiefs to anyone they desired. As a result, roughly 64% of landowners today are migrant farmers, further exacerbating land tenure issues as the traditional approach to land rights was that land is owned by the tribal community of an area (Ubink and Amanor, 2008; PETERS, 2010; Asuming-brempong *et al.*, 2015).

Outcomes of this issue for the first lens of actor analysed, farmers, can result in illegal farming in protected forest land, as well as creating a barrier to biodiversity sustainability commitment due to the farmer's lack of long-term investment into the land the trees they own grow on. Supposing the farmer is not secure in maintaining access and ownership of the land they have planted their cocoa trees. In that case, there is no incentive for them to choose more biodiversity-sustainable farming

practices to protect its longevity as they will need to move onto another piece of land, sometimes before their tenure is up, or cannot pass farm ownership to children that may continue reaping the benefits of the parent's investment. Harmful farming practices such as non-shade cultivation further exacerbates the issue as the short-term nature of 'ownership' presses upon the farmer to produce the highest yield possible, knowing they will not be on that piece of land for generations to come and need to capture as much gain from their hard work as possible for the short term of their tenancy (Amanor, 1999; Ubink and Amanor, 2008; Clough, Faust and Tscharntke, 2009; Yaro, 2010; Krauss, 2017; LD3; GHI 49; GHI 70; GHI 72; GHI 73; GHI 74 a&b).

For the second lens of actors being analysed, the government, land rights issues are economic, political, and cultural. Economically, in 2014, cocoa accounted for an estimated 10% of the GDP of Ghana's agricultural industry, with the agricultural industry accounting for 30% of the national GDP (Kolavalli and Vigneri, 2018). With pressure from third-sector actors and lead firms to ensure the traceability and quality of cocoa purchased and meet the ever-increasing demand for higher quantity, land rights issues can significantly impact national economic development. For this reason, the government is motivated to ensure the demands of private and third-sector actors are met and to coordinate widening access to the market for Ghanaian farmers (Amanor, 1999; Yaro, 2010). For shea, the importance of shea butter in local and international markets and the fact that Ghana is the lead exporter of shea in its region present in production security and risk related to access to and care of the savannah land where shea trees grow (Addaquay, 2004; Chalfin, 2004).

The third lens of actors being analysed is that of the firms for whom land rights issues can be detrimental to sourcing cocoa and shea, especially with the growing demand for traceability in origin presented by consumers and supported in some ways by local and international government bodies (LD 1; LD 2: GHI 49; LD 6). International and national government bodies, as well as third-sector actors, can leverage consumer awareness and demands for sustainable sourcing to pressure firms to purchase cocoa and shea from suppliers who have lands institutionally owned following post-colonial government and records, which, due to the dual governance system of land rights,

many farmers and sharecroppers may not have institutionally legal documentation of land ownership, as land customary land ownership is passed through belonging to the community/group under a chief who controls the land, ritual and verbal agreement (Amanor, 1999; Yaro, 2010; Asuming-brempong *et al.*, 2015; GHI 70; GHI 76). This consumer and third-sector action pressures firms to ensure that they source cocoa and shea from suppliers that can prove institutional government documentation of land ownership, cutting out the vast majority of farmers who do not have this documentation. This is a concern not only for the farmers, as mentioned above, but also for the reliability of the quantity and quality of cocoa and shea available for these firms to process into the plethora of ingredients used in consumer industries.

Respondents from the confectionary company being studied in this research (referred to as Co. 1) report that a landscaping project is being undertaken to plot via GPS the farmlands that each member of its cocoa supply network owns, verifying the legal status of ownership. Ghana's government, through COCOBOD, is also undertaking a landscaping project to assign GPS coordinates for plots of land according to government-led surveys of agroforestry lands, demarcating land that has been sold and that which is free to be sold by the local chiefs/community leaders (LD 1; LD 2; GHI 74 a&b).

A concern for both initiatives is ensuring that cocoa sold on the market is accounted for from the point of origin to the processing plant. This is important to private and public sector actors for two reasons beyond land rights affecting the boom and bust cycle of cocoa production in the migration of farmers. A final issue in part resulting from contested land rights is that of smuggling, linked to the desire to capture the most gains from their labour as well as not having that security of land ownership for the long-term (Ubink and Amanor, 2008; World Bank, 2011; Ofosu-Asare, 2018; World Bank Group, 2018).

For shea, while smuggling is not necessarily an issue according to the participants in this research, land rights are a significant issue for the women producing shea butter in Ghana, whereby they have no rights even to the trees that they collect shea fruit

from to produce shea butter (GHI 50; GHI 69; GHI 70; GHI 71; GHI 72; GHI 73; GHG 51-79). Moreover, as discussed in Chapters 6 & 7, women can lose the trees they collect shea fruit from with no remuneration, for reasons from mining activities to family issues, without any say.

The fourth lens of actors being considered, third-sector NGO actors, have economic and social stakes in the resolution of contested land rights in this context. As third-party certifiers of fairtrade, organic, and ethically branded chocolate and cocoa products, certification standards must be met for those products carrying their certification labels. Some of these standards concern social sustainability aspects of production and environmental sustainability. Being that contested land rights, and tree vs land ownership, feeds the social and environmental aspects of cocoa and shea production, it is in the best interest of these actors that these issues be resolved. Just as Nike's brand reputation was scrutinised for social sustainability factors such as inhumane working conditions in factories negatively affecting overall profit (Seuring and Müller, 2008), third-sector actors are also vulnerable to negative consumer response to certified products being found not to uphold the social and environmental standards.

For each level of actor, the social issues of land rights and gender inequality result in adverse environmental sustainability impacts and threaten the livelihood of cocoa and shea producers. If farmers, collectors, and processors are unable to provide for their livelihood, it is evident that the negative outcomes impact the natural environment directly through such practices as non-shade cultivation, smuggling, and forested cultivation. Furthermore, when land tenure security is at risk, this also manifests in poor environmental practices. For these reasons, these social aspects are vital to a robust analysis of the effects of scale on the studied production networks, as they are direct drivers of unsustainable practices.

Global demand for cocoa and shea continues to rise while supply struggles and is forecasted as being unable to keep up (Voice Network, 2015; Barrientos, 2016; Krauss, 2017). Coupled with the overall year-on-year increase in demand for cocoa products,

the popularity of fairtrade certified products provides both a key driver and concern for third-party sustainability certification bodies. Cadbury's 2009 implementation of certifying all cocoa ingredients used in two of their mainstream products, Cadbury Dairy Milk bars and drinking chocolate, has tripled their demand for fairtrade certified cocoa ingredients (Barrientos, Gereffi and Rossi, 2011). Cadbury sources its cocoa for these products from Ghana, contributing further to the gap between demand and sustainable supply. Such issues as farmers being excluded from the market due to sustainability standards not being met and land rights contestation can further intensify the concern over the sustainable supply of cocoa products into the future. Citing Lovett (2004), Naughton, Lovett and Mihelcic, (2015) submit that of the total viable shea trees that could be harvested, only 42% of shea kernels are collected due in large part to access to trees (i.e. trees located in national parklands). This is important as one of the issues in sustainable harvesting of such ingredients as cocoa and shea can become the overharvesting of these crops without proper biodiversity preservation for future yields.

This section shows that the drivers for environmental sustainability in Ghana's cocoa and shea production networks are entwined with social, cultural, political, and global factors. These commodities experience fluctuating demand, but over time the trend in demand is shown to be ever-increasing, consistently increasing the strain put on the environment to meet the increasing demands on land that has to this point potentially not been sustainably cultivated.

2.3 Social sustainability considerations justification: analysing the effect of power and scale in lived experiences of gender, pay, and contested land rights.

The justification for including the social aspect of land rights, gender inequality, and livelihood is seen in the direct impact these social inequalities have on the environmental side of production in Ghana's shea and cocoa sectors.
For the first lens of actor analysed, the farmer, one of the outcomes of this precarious situation is the boom-and-bust cycle of cocoa production, the insecurity of access to land heightening farmers' lack of motivation to practice environmentally sustainable

production (Clough, Faust and Tscharntke, 2009). Demand for annual yield increases for cocoa already applies unwanted incentives toward unsustainable tree husbandry such as non-shade cultivation, resulting in Clough et al.,'s (2009) phenomena titled the 'boom and bust cycle' whereby non-shade cultivation strips the trees or protection and land of sustainable nutrients, causing premature tree death and pushing farmers to move to new (often further into protected lands) areas to create new plantations for more non-shade cultivation, repeating the cycle. With the lifespan and year-on-year cocoa pod yield decreasing, the social dilemma of continued livelihood provision pushes farmers who own only trees and not the land on which the tree is planted to move further into the forest and clear more land to plant new cocoa trees rather than dig up the diseased and dying cocoa trees on existing land and replanting new seedlings, as doing so would negate rights to cultivate on that parcel of land stemming from the approach mentioned above to landownership and cultivation rights granted to sharecroppers and other farmers given access to otherwise owned land (Clough, Faust and Tscharntke, 2009; PETERS, 2010; Sebastian Amanor, 2010; Asuming-brempong *et al.*, 2015).

A further factor to keep in mind for those smallholder farmers who do own the land they are cultivating is the time it takes for the cocoa seedling to grow and produce yield enough to support the farmer. Cocoa seedlings take 7-10 years to mature and produce the number of cocoa pods necessary to sustain farmers financially. This time lag is an added barrier to replacing ageing and diseased trees on legally-owned lands, especially in those cases where farmers only have a hectare or less to cultivate, as do the 800,000 smallholder farmers who average 1-2 hectares of land ownership (Amanor, 2010; Ubink and Amanor, 2008). Since these farmers do not have the physical space for multiple groves of trees as plantation owners do, they cannot rotate the use of fields for cocoa production, thereby allowing for a particular field to be cleared and replanted while the remaining field provides a lesser overall yield during the seedlings' maturation, but enough for the farmer to sustain production and livelihood costs until the new trees are producing at maximum yield.
From the environmental perspective, Clough et al. (2009) show how the rush to capture gains from the high demand for cocoa initiates this cycle with an influx of

cocoa farming and resulting forestland clearing to maximise cocoa pod yield via full-sun exposure cultivation practices. The environmental boom-and-bust is seen in the initial boost in cocoa pod yields from this full-sun exposure, followed by a spiral of decreasing yield year on year due to premature tree ageing caused by the full-sun exposure, and the simultaneous increase and pests and disease outbreaks facilitated by the lack of endemic flora and fauna protection provided by the pre-existing forest species that were cleared for maximised production.

For the second lens of actors, the governments, politically, land rights issues are critical to ensure that access to land is accounted for in tracked records to prove the traceability of cocoa and shea, supporting the economic viability of the two industries. It is also critical to controlling access to agricultural land, ensuring that land is not sold to multiple parties, and that tenure is documented and accounted for to maintain end-of-tenure renewals or selling to new parties.

Culturally, the dual system requires good relations between post-colonial government actors and the tribal kings, head chiefs, and local village community sub-chiefs. Topics of import here are the cultural context within which the post-colonial government sits, with governance holding significant power in the local community and the post-colonial government desiring to work with chieftaincies to facilitate maximum cocoa production market participation.

As discussed above, for the third lens of actors, the lead firms, smuggling and forested cultivation present significant environmental implications embedded in a social sustainability source. Cocoa is often smuggled over shared borders to increase farmer profit (Ubink and Amanor, 2008; World Bank, 2011; Ofosu-Asare, 2018; World Bank Group, 2018). This smuggling is marked not only by the disadvantaged farmers in Côte d'Ivoire seeking to capture higher gains from their product but further intensified by the effects of post-colonial land boundary demarcation. Before the colonisation of the modern-day countries of Ghana and Côte d'Ivoire, the lands that these people inhabit are from the same or neighbouring tribes that have lived side by side through the centuries. This means that the colonial land boundaries between Ghana and Côte

d'Ivoire can be found to run down the middle of land cultivated by the same family or tribe (LD 1; LD 2; LD 3; GHI 49; GHI 70; GHI 71; GHI 76). This creates an added layer of complexity because, while these lands are separate in post-colonial politics, the family/tribal history would see this land to be shared by the same community. Because of this, family located in Côte d'Ivoire may transport their cocoa to their family member who lives on the Ghanaian side of the border to be sold at a higher price. Farmers on the Ghanaian side of the border may also illegally collect cocoa pods from forestland geopolitically marked as Côte d'Ivoire to supplement the cocoa produced on the land they have tribal or post-colonial land rights to.

In shea, contested land rights are found, as discussed above, to be linked to gender inequality, with women not legally owning trees or land rights in the savannah and lacking any authority to protect the trees they have collected from for generations. It is vital to understand the interplay of these two social sustainability aspects in this research as they are clear, direct drivers of unsustainable biodiversity trends and practices.

2.4 Drawing out analytical frameworks for a unique framework for holistic action-based analysis

I have reviewed several streams of research and theoretical frameworks, including Global Value Chain (GVC), Global Commodity Chains (GCC), Sustainable Supply Chain Management (SSCM), Global Production Network (GPN), Bolwig *et al.*'s (2010) integrated action-based value chain, Perey's (2014) fractal scale, and Krauss' (2017) constellation of priorities. As a result, I have created a unique analytical framework for research analysis, pulling from Yeung & Coe's (2015) iteration of GPN, Bolwig *et al.*'s (2010) integrated framework, Perey's (2014) fractal scale, and Krauss' (2017) constellation of priorities to create a holistic analytical framework considering all aspects of cocoa and shea production, and production network coordination as it related to biodiversity sustainability (discussed in detail in section 2.4). The following section will outline the foundational theories activated through my unique holistic framework for action-oriented analysis.

2.4.a. Global Value Chain and Global Production Network Frameworks

GVC literature is broad and diverse, the entirety of which this research cannot address. The concepts of upgrading and governance tools across global locations will be applied to this research as a foundation for the GPN literature activated through the inclusion of context, extended supplier nodes, and varying forms of network dissemination through such tools as flagships and subsidiaries linking network nodes across the globe into the analysis of production coordination and sustainability implementation throughout the studied production networks (Ernst and Kim, 2002; Yeung and Coe, 2015; Alexander, 2018)

As pointed out in Campling and Selwyn, (2016) Campling and Selwyn (2016), Global Commodity Chain (GCC), Global Value Chain (GVC), and Global Production Network (GPN) are streams of the same empirical and analytical framework river. GVC introduces the connected nature or 'chain' of supply of a good from its base material to the end product lifecycle. GVC and especially through works discussing governance, seek to contribute to the discussion on the policy level by understanding how MNCs exert power throughout their supply network to lend insight to policy and institutional frameworks toward the end of facilitating firm/chain 'upgrading' – an essential concept in GVC is the influences that are internal and external to the lead firm being considered in the analysis, a step toward embeddedness and context that GPN further plays out. Gaps include the linear/one-dimensional analysis of supply coordination, power and responsibility, not capturing the interconnected and dynamic nature of supply coordination (a network like a web with nodes, levels and multiscalar influences).

Yeung & Coe's (2015) iteration of GPN fills the previous GVC gap by more directly analysing contexts within which supply or production network coordination is pursued. One weakness of these frameworks is separating social and environmental issues/context (including social sustainability aspects and culture, political and socio-economic factors). The GPN framework explains how these issues are embedded within specific cultural, political and economic contexts (Bair, 2008; Barrientos, 2013;

Yeung and Coe, 2015). Because of this embeddedness, the drivers of environmental issues will differ from country to country and industry to industry. For this research, socio-economic embeddedness draws on Henderson, Dicken and Hess's (2002) contribution to the effects of the socio-economic embeddedness of GPNs.

Utilising Yeung & Coe's (2015) GPN analysis framework reincorporates the contextual embeddedness within which this production network facilitation occurs. It is important to include the geographical, cultural, and political contexts in this research analysis as these factors are integral drivers of production network coordination toward or away from biodiversity sustainability, as shown in section 2.2 and discussed in further detail in chapters 5 and 6.

2.4.b. Including Bolwig et al.'s (2010) 'Integrated framework for action-bases analysis', incorporating social and environmental aspects into the analytical framework for research

In their ground-breaking work, Bolwig *et al.* (2010) introduce an 'integrated framework for action-based analysis' of production networks. This framework is divided into vertical and horizontal aspects, with vertical aspects representing conventional chain analysis considerations such as market integration, upgrading, and chain linkages. The horizontal aspects missing from chain analysis are poverty, gender and the environment. The incorporation of Bolwig et al.'s (2010) integrated framework seeks to fill the weakness of separating social and environmental sustainability analysis. In this research, I refer to analysis as GPN for two reasons, as it is a more recent continuation/iteration of overarching GVC analysis and because the concept of a network as a webbed connection between and across national and international borders and along different levels of scale create a more dynamic picture of the fluid and dynamic nature of the scale of production, power and resulting value and issues (i.e. biodiversity and social sustainability). Bolwig *et al.'s* (2010) framework expand GPN horizons to bring us a step closer to capturing the multifaceted phenomena of production network coordination and the dissemination of biodiversity sustainability throughout the studied networks.

2.4.c. Perey's (2014) fractal scale for organising sustainability efforts

Understanding a webbed network coordinated across multiple locations is grounded in the tangible activity being studied. The GPN framework utilised in this research depicts a top-down relationship of power driving network change similar to the bipolar nature of production coordination reflected in GVC literature, although far improved through the incorporation of the embedded nature of production coordination and the mapping of a webbed network versus a linear chain. Perey (2014) provides an additional layer through a fractal scale lens. Fractals, introduced and coined by Mandelbrot (1982), measure 'roughness' to understand a problem and find practical solutions that are dynamic enough to morph into varying levels and scales (Mandelbrot, 2006). Perey (2014) explains,

"Examples of fractal forms in nature include the branching structure of trees or, at a different scale, the shapes and edges of clouds. Fractals are structures that display self-similarity regardless of scale, and in mathematics the equations that produce fractals have an iterative quality where feedback is an important aspect of generating a new structure at a different level of observation and analysis (Mandelbrot, 1982). Each fractal structure represents a whole within a whole, and while we talk of scale in a linear sense with a linear logic, fractals are anything but linear. All scales of a fractal manifest at the same time: They are coexistent, and it is only the position of the observer in relation to the "fractal network" that changes—fractals are paradoxical (Perey, 2014, p. 216)."

In his work, Perey (2014) argues that approaching systems change analysis with a fractal lens facilitates "working systemically at multiple scales simultaneously (p. 216)." For this research, the scales being considered are the level of power of participating actors, the global and local contexts of cocoa and shea production and consumption, and the scalar complexity of the production network and upgrading efforts within the network. Integrating this concept of the fractal nature of GPN coordination provides a robust framework to analyse the intricacies of scalar impacts on biodiversity sustainability in Ghana's cocoa and shea production networks

simultaneously as a whole as well as maintaining the ability to analyse across multiple scalar levels whilst maintaining the integrity of analysing at each level scale within its unique existence within the whole. This consideration leads to providing analytical momentum studied phenomena capturing the evidence in terms of network coordination toward biodiversity sustainability as a multiscalar, polycentric governance issue (Ostrom, 1990, 1999; Seuring and Müller, 2008; Lee, 2009; Nagendra and Ostrom, 2012; Perey, 2014; Bowen, 2017).

2.4.d. Mapping priorities, tracing motivation and capturing tensions and misalignments through asymmetries of power, scale and value captured across scalar levels through Krauss' (2017) 'constellation of priorities'

The final theoretical framework being drawn from in this research is Krauss' (2017) 'constellation of priorities. According to this framework, the weight given to each priority by each level of actor, and consequently their level of investment, will vary accordingly (Krauss, 2017). Therefore, it is important to understand the interaction between these priorities and the power each set of actors holds (Williamson, 1995; Barrientos, Gereffi and Rossi, 2011). Krauss' (2017) constellation of priorities builds on Raynolds' (2009) tripartite approach, expanding the research focus from Fairtrade certified actors only to include the various firm internal and external standards and certifications, driver and varying priorities based on intended outcomes (whether they be achievables, profit maximisation, etc.). The 'constellation of priorities' identifies three main categories of priority for market participants, "the commercial, environmental, and socio-economic dimensions each encompass four axes symbolising priorities, many of which are interdependent and interconnected, but partly incompatible [. . .] to facilitate systematic (self-)assessments of the 'sustainability' priorities that cocoa stakeholders associate with the concept (Krauss, 2017, p.234)". In my interviews with cocoa farmers, COCOBOD officials, lead firm actors in both cocoa and shea, the shea NGO interviewed, and shea producers Krauss' (2017) 'constellation of priorities' provided a powerful analytical tool for synthesising interview responses into these varying categories and capturing the tensions that

varying priorities and intended outcomes across scalar levels and the resulting interaction based on these tensions and variances.

Understanding the studied actors' constellations of priorities is vital to action-oriented analysis as it captures the capacity and commitment to the aspects of sustainability along the scalar levels of action and power and how these things influence production network coordination toward or away from biodiversity sustainability. Power asymmetries are not confined to lead firm and smallholder farmers. This asymmetry can also be seen in the power relations between the oligopoly of lead firms and the third-sector actors with a misalignment of commercial, social and environmental sustainability goals (Barrientos, 2013). By understanding the causes and effects of these misalignments and asymmetries of power and priorities, potential solutions to tackle the environmental sustainability issue of biodiversity preservation may be found.

The 'constellation of priorities' is essential to this research as it conceptualises the continuum nature of the varied influence of drivers that push different levels of actors. The weight given to each driver reflects in the actors' investing various resources into social and environmental factors — an investment that may shift from firm to firm, country to country, market to market, and year to year. This concept also speaks to the call for multi-stakeholder engagement in social and environmental issues of sustainability as it portrays the overlapping and misalignments of priorities. This approach allows for the mapping of fluctuating priorities for the four levels of actors being analysed in this research, with a particular interest in showing the areas where these priorities may align, deviate, or clash (Krauss, 2017). The constellation of priorities approach to analysis is critical in understanding the motivation behind each level of actors' approach to answering the gaps in Ghana's environmental sustainability in cocoa and shea production, and those factors that remain to be addressed by one or multiple actors. This understanding can provide future research and propositions for filling these gaps, be they social or environmental. In addition, this layer of analysis helps to capture the varying values and understanding that each category of actor assigns to the meaning of social and environmental sustainability.

While the drivers differ, the fundamental end goal for all actors is environmentally and socially sustainable practices disseminated throughout production networks. This is a critical baseline understanding from which to analyse the actors (private, public, and third sector) as these foundational drivers inform the formation and maintenance of production network governance. This orientation of priorities may also indicate the commitment levels of each actor studied in the cocoa and shea markets. For example, while Co. 1 might advertise their socially and environmentally sustainable sourcing and production of cocoa and shea products, the orientation of mission-driven vs market-driven motivators may shed light on the lengths to which these actors may be willing to go to ensure the continued sustainability of their production network practices. For example, when marketed commitment to sustainability and evidenced misalignment in practice can be seen in such firms as Marks & Spencers being associated with the unsafe working environments of Bangladeshi garment factories and the resulting fires and building collapses (KATE ABNETT, 2016) or in the case of Nike and the inhumane working conditions in the Indonesian shoe factories, years after being confronted for the use of child labour in production (Lutz, 2015).

The 'constellation of priorities' approach seeks to expand the traditional GVC buyer-oriented method and expand consideration to include multiple levels of actors within the production scale – buyer, producer, government and non-governmental organisation actors (Krauss, 2017 p.233). By doing so, the analysis of NGO-specific actors can be incorporated as they would not fall under any of the three original categories presented by Raynolds (2009). This is important to this research as the influence of third-sector actors is crucial to understanding the trends and approaches to environmental and social sustainability in cocoa and shea production in Ghana. This is because the Ghanaian cocoa and shea industries are heavily influenced by the multi-stakeholder approach to sustainable governance, as seen in such initiatives as the Cocoa and Forest Initiative, signed by actors from private buying firms, government institutions, and NGOs. Echoing approaches from scholars such as Fold (2002), Gereffi, Humphrey and Sturgeon (2005), Franzen and Borgerhoff Mulder (2007), and Bolwig *et al.*, (2010) and building on these works, as well as her own primary and secondary

data analysis, Krauss proposes starting from a value/outcome-oriented approach to analysis considering:

"a) socio-economic factors including, for example, grower livelihoods
b) environmental aspects on local and global scale (Bolwig et al., 2010)
c) the commercial level, including safeguarding supply, which was a particular concern for stakeholders from the private sector (p.233)."

This research aligns with Krauss's (2017) and many other scholars' (Bolwig et al., 2010; Yeung and Coe, 2015 for example) arguments that call for a more dynamic approach to investigating the many layers and interconnected aspects of drivers behind production network coordination. For example, lead firms can be concerned with both grower livelihood and safeguarding supply – the constellation of priorities approach allows for the weighting of each driver to be represented simultaneously and concerning the various weight of priorities for the other actors in the production network, taking production out the compartmentalised analysis that can be a downfall to such studies as this. Furthermore, giving weight to the presence of multiple socio-economic and environmental factors as having a significant impact on the long-term sustainability of the production network allows for a more realistic and practical analysis of the approaches to environmental sustainability implementation taken up by the actors studied in this research.

The final section of this chapter will present the unique framework for analysis utilised in this research. As shown in the above sections, the four frameworks presented provide integral pieces of a complex puzzle that is fluid and interactive, requiring a holistic and robust framework to capture the unique phenomena at each level of scale and across scalar aspects that come together to create the intricate webbed production networks that are Ghana's cocoa and shea production networks.

2.5 Application of Theoretical Frameworks – Holistic Framework for action-based production network analysis

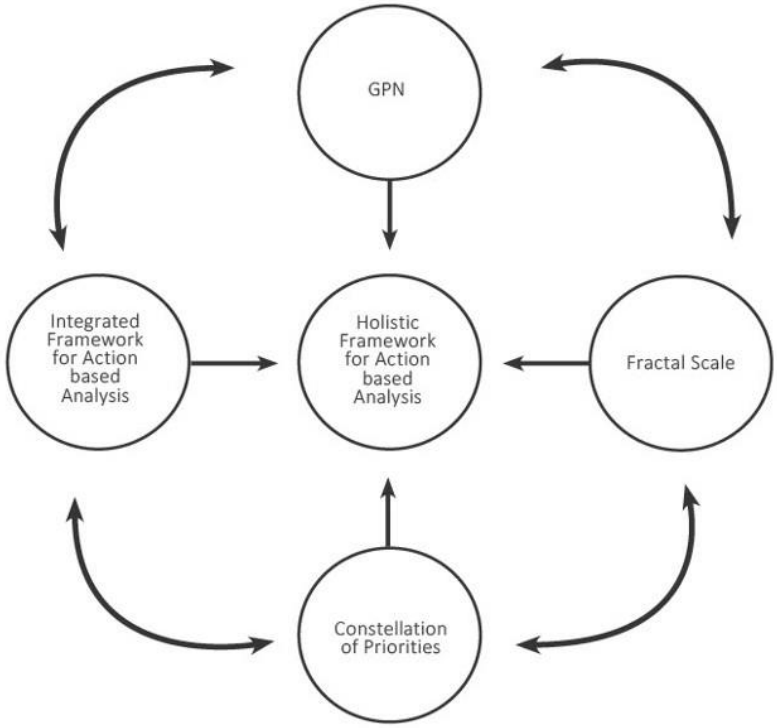

Figure 2. Holistic framework for action-based analysis heritage

The analytical frameworks in Figure 2 is dram drawn from the theories and frameworks discussed above and that combined feed into a multifaceted and dynamic holistic framework for action-based production network analysis. My unique framework seeks to capture the multiscalar aspects of Ghana's cocoa and shea production network coordination, the varying actors and levels of scale and power, and how the internal and external drivers influence the nodes and whole structure toward or away from biodiversity sustainability, whilst capturing all aspects of sustainability that feed into biodiversity sustainability. The proposed holistic framework for analysis considers the embeddedness of network coordination as drawn from GPN literature, and the social and environmental sustainability factors that play out within these contexts as drawn from Bolwig *et al.'s* (2010) integrated framework for action-based analysis, with an active fractal lens to capture the whole of the scalar issues whilst simultaneously analysing individual nodes and retaining

their phenomena occurring within the broader scalar picture. The fractal lens applied to the embedded and multifaceted phenomena of Ghana's cocoa and shea production network coordination toward biodiversity sustainability is further strengthened through the application of Krauss's (2017) 'constellation of priorities' to paint the holistic picture of these phenomena that is 'biodiversity dissemination throughout Ghana's cocoa and shea production networks' and outcomes of these efforts.

The context explored in this research is Ghana's cocoa and shea sectors. Africa contributes 70% of global cocoa and 100% of global shea production. Ghana is the second largest producer of cocoa and, along with Côte d'Ivoire and Nigeria, the third largest producer of shea. Ghana's cocoa industry provides 50% of national employment (Kolavalli & Vigneri, 2018). There are an estimated 800,000 smallholder farmers who rely on cocoa production for 70-100% of their annual income (Anim-Kwapong and Frimpong, 2004) with a survey of 3000 cocoa farmers showing a mean annual average income per household at 716 Ghanaian Cedi (roughly £111) (Hainmueller *et al.*, 2011). In the shea industry, Africa produces 1.76 million tons of shea from wild-grown trees each year (Mohammed, Heijndermans and Suglo Mboribuni shea butter processing group, 2013). Ghana produces approximately 600,000 mt annually (Ofosu, 2009). Of the shea collected in Ghana, 60% is used locally, and 25% is exported (Iddrisu, Didia and Abdulai, 2019). Exported shea is mainly in the form of shea kernels; however, demand for shea butter exports has seen a 61.7% increase of shea butter exports between 2009-2010 (GEPA, 2014 as cited in Iddrisu, Didia, & Abdulai, 2019).
Since these smallholder farmers rely significantly on cocoa sales for their livelihood, market disruptions such as price volatility and barriers to market participation would significantly affect the well-being of these actors. One example of this can be seen in the environmental sustainability issues present in Ghana's cocoa and shea production market.

One reason for assessing these social and environmental sustainability issues from the multiple lenses of actors proposed is the fact that these issues cannot be addressed by a single actor alone (Barrientos, Gereffi and Rossi, 2011). This can be seen in the multi-

stakeholder engagement approaches being pursued to resolve social and environmental sustainability issues in cocoa production networks globally (Bitzer, Glasbergen and Leroy, 2012; Glin, Oosterveer and Mol, 2015; Krauss, 2017; Tampe, 2018; LD1). Lead firms alone cannot ensure that their fragmented production network can invest the necessary resources to achieve and maintain environmentally sustainable production as they operate within the context of local, national, and international government/institutional bodies. Governments/institutions (local, national, and international) alone cannot ensure sustainability in production as they do not hold as much buying power as lead firms do (and in cases of fully liberalised markets, they may hold little to no direct power). NGOs alone cannot ensure sustainability as they hold neither the same level of power as lead firms and governments nor do they have the centralised resources to implement sustainability throughout the fragmented production network without the partnership of lead firms and government actors.

From the three primary foci of socio-economic, environmental, and commercial considerations, the constellation of priorities is heuristic in nature, depicting complex dimensions within each broader category that may coexist in tension. For example, farmer livelihood may be a priority for both the lead firm and the farmer; however, there is a simultaneous priority for the firm to safeguard supply into the future, which may come into direct conflict with the farmer's goal of livelihood maximisation resulting in cutting down shade-trees to increase fruit outputs. This example encompasses issues in all three broad aspects, and differing weights would be assigned to each actor within the constellation. By analysing organisational behaviour through the constellation of priorities, GPN, Bolwig et al.'s (2010) integrated framework, and Perey's (2014) fractal scale lenses, this research can seek to understand in very practical terms, how these varying and sometimes misaligned priorities coexist, and the tipping point for an actor to choose one priority over another (i.e. a farmer choosing to cut down trees giving income a higher priority to environmental sustainability or a lead firm excluding a farmer from the following year's supply group to ensure traceability efforts are upheld and safeguard future supply by investing only in farmers with long-term sustainability potential). In this

way, this research can map the multiple levels of actors throughout the Ghanaian cocoa and shea market and how their varying priorities can tip the industry toward or away from tripartite sustainability – taking social, environmental, and economic factors into consideration. A key aspect of Krauss' (2017) constellation of priorities applied to this research is that it does not seek to map the varying weight assigned to each priority claimed by the actor being researched, only the presence, or lack thereof, of the varying priorities in the practice of the studied production network coordination. It also does not seek to propose a connection between those factors represented by the lines between priorities.

The ability to understand the complex dynamics of cocoa and shea production as each of the four levels of actors experiences and understands it is vital. For example, where the farmers may prioritise "incomes (diversification/increase)" and "food security", government respondents may submit a focus on "carbon sequestration", "protecting forests, soil and water", "traceability", and "high cocoa yield". Firms may prioritise "safeguarding supply", "traceability", and "social/organic certification". In contrast, third-sector actors may prioritise "protecting forests, soil and water", "social certification/farmer organisation", and "incomes (diversification/increase)" (Krauss 2017, p.238). In order to gauge where each level of actors places priorities, interview questions are formed to focus on where time, financial, and input resources are devoted and to what extent these allocations are pursued. For example, a lead firm may invest significant financial and human resources into tracing the origin of cocoa beans purchases at the farm gate and offering farm inputs to suppliers to secure production abilities into the future from that farm.

In contrast, the lead firm may not provide for organic and social certification costs. In this case, the constellation of priorities would represent the environmental and commercial priorities important to this level of actor. Along the same lines, interviews with farmers may uncover actions such as non-shade growth to increase tree yield to address income increases, showing a significant socio-economic priority. The misalignment between the lead firm and farmer level of actors does not inhibit partnership between farmer suppliers and lead firm buyers; however, the tension

between these two priorities must be addressed by both actors. This may be done via a third party, such as an NGO providing socio-economic and environmental assistance to farmers enabling them to remain in the lead firms' production network, thereby adding a third constellation of priorities to the equation.

By mapping the constellation of priorities through the lens of understanding the dynamics of fractal scale phenomena and incorporating the contextual embeddedness and complete aspects of sustainability into analysis for these four levels of actors, there may be offered insight regarding how inevitable tensions are being addressed or could be addressed, by the partnership between the various levels of actors and the use of different scales of power throughout the production network. By asking questions surrounding investment and resource allocation, the constellation of priorities will be uncovered, as the focus of resources will reflect the levels of priority each level of actor gives to each type of priority – environmental, socio-economic, and commercial.

An initial reflection of this approach can be taken from Interview 1, where lead firm participants discussed holding priorities around farmer livelihood, expanding income, and access to knowledge and resources to achieve environmentally sustainable cultivation practices simultaneously and in tension with that of the organisation's for-profit approach to production network coordination. This was reflected in practice in the availability of such inputs as environmentally friendly chemicals for pest and disease control and fertilisers, as well as training and seed pod provision for hybrid trees, but at a cost to the farmer. This cost is often taken as a percentage of the premium price farmers receive for maintaining sustainable cultivation practices and participating in selling to the organisation. Another portion of the premium is also taken from the selling price and allocated to community development projects. The purpose of taking these percentages out of the premium farmers receive is to achieve the profit margin the lead firm is seeking and contribute to developing the broader community in which the farmer lives. While the latter priorities are reached, one tension arises in the former priority of improving farmer livelihood through income security. The use of the proposed 'holistic framework for action-based production

network analysis' allows for the plotting of multiple simultaneous priorities held by each level of the actor in a manner that does not put one priority necessarily above another, allowing for the respondent to provide information and their view of the organisational or personal experience with each priority accurately and without concern for miscommunicating intention to "do good" with practical implications of the various approaches to achieve the various goals set by the actors involved. My analytical framework goes a step further by embedding these multidimensional motivating factors (drivers) within the geographical, cultural, political, environmental and social landscapes within which they take place, seeking to capture each unique node of interaction both independently and within the overarching scalar context. In this way, this research can provide a holistic outlook of the effects of scale on Ghana's cocoa and shea production networks in a robust manner that accounts for these many layers and amplifies the voices and experiences of those actors and sustainability drivers that can often be missed out on by any singular one of the above-introduced frameworks.

Chapter Three Methodology and Case Study Selection

3.1 Introduction

This research is a qualitative inductive case study. Utilising the causes-of-effects analytical approach, it seeks to understand the causes (drivers, barriers, and outcomes) of biodiversity sustainability efforts in Ghana's cocoa and shea production networks (implementation of biodiversity sustainability). This research aims to understand how increased scale, the different drivers from within and without the firm's supply network, as well as different scalar issues of power, resource and influence between the firms, intermediaries, suppliers, government, and NGO bodies push and pull supply networks toward or away from biodiversity sustainability. A case study approach facilitates answering my primary research question, *'How does scale affect biodiversity sustainability throughout Ghana's cocoa and shea production networks'* by investigating specific themes of enquiry with analysis aimed at understanding broader phenomena (biodiversity sustainability in Ghana's cocoa and shea production networks).

This research follows Ghana's cocoa and shea production networks studied through their growth story regarding biodiversity sustainability implementation, utilising primary (interviews with actors at different levels of scale and points throughout Ghana's cocoa and shea production networks) and secondary (literature on drivers barriers, and approaches to implementing biodiversity sustainability issues throughout cocoa and shea production networks both in Ghana and globally) data has been collected and synthesised for this study, with supporting primary data gathered from sources in the industry, government, third sector and academia. By following these two commodities through the supply network to the raw material's point of origin, this research will investigate how different levels of power and interactions with varying actors inside and surrounding the supply network affect the ability and motivation of lead firms, intermediaries, and farmers to create and maintain biodiversity sustainability in cocoa and shea materials production.

This chapter will review the methodology and methods deployed in this research, setting out justifications for each selection. It will finish with an introduction to the global setting of cocoa and shea production within which Ghana's cocoa and shea production networks operate, setting the stage for chapters 4 and 5 case studies of the studied cocoa and shea production networks.

3.2 Research Method and Methodology

This research utilises a case study method. Yin (2003) proposes that the use of a case study approach is due to "the desire to understand complex social phenomena [as it] . . . allows investigators to retain the holistic and meaningful characteristics of real-life events-- such as individual life cycles, organisational and managerial processes, neighbourhood change, international relations, and the maturation of industries (p.2)." By utilising the case study method, this research can contextualise the experiences of specific actors within the phenomenon of scaling up production networks and biodiversity sustainability dissemination throughout these networks. I investigate how this affects holistic sustainability aspects within those networks. As the case study method seeks to understand the phenomenon holistically, analysing contextual factors such as "neighbourhood change," this parallels the analytical focus of the applied holistic framework for action-based analysis, incorporating contextual embeddedness, environmental and social sustainability aspects, the fractal nature of scale, and the studied actors' constellation of priorities into the analysis. Furthermore, the case study approach allows for this research to study the experienced phenomena from each level of the actor involved from the dual viewpoint of the node they operate in directly as well as the larger scalar framework these nodes make up, lending robustness to the research.

For this research, the following criteria can be found:

1. The type of question being asked in this research is a "how" question – How scale affects biodiversity sustainability implementation throughout Ghana's cocoa and shea production networks. The asking of "how" in this study will be

combined with an exploratory approach, with "the goal being to develop pertinent hypotheses and propositions for further inquiry (Yin, 2003, p.6)." While there will be defining elements to this research (explaining how scale affects sustainability throughout Global Production Networks (GPNs) and will not begin with a hypothesis to test), the purpose of asking these how questions will be pursued as the springboard from which to develop new theories and lines of further inquiry. A goal of this research is to move beyond the explanation of what is happening to explore ways to mobilise the elements of sustainability found in the evidence that may produce practical tools to instil environmental and social sustainability throughout GPNs across industries and sectors.

2. The control that I will have as an investigator over "actual behavioural elements" – As this research will be an interview-based exploratory case study, there will be no control that the investigation has over the behavioural elements of respondents. Instead, this research will focus on "presenting the context and experience of respondents". This lack of control but focus on a contemporary phenomenon falls in line with Yin's (2003) proposal of the use of a case study as it examines current events but where "the relevant behaviour cannot be manipulated (p.7)".
3. Focus – This research will focus on contemporary events. This aspect is linked to point B, with the focus on current events and the lack of control over behavioural aspects lending to using the case study approach.

In line with Yin's proposed purpose of the case studies approach, this research seeks to understand the "organisational and managerial processes" of two different sectors within Ghana's agricultural industry at various stages of organisation, where growth is evident, be it over many years or fast and recent growth as is found, and the effects this growth has had on the organisations' efforts to maintain sustainable production networks. This research approach also adheres to the proposed purpose to "understand complex social phenomena [in a way that] . . . retain the holistic and meaningful characteristics of real-life events" (Yin, 2003 p.2).

3.2.a. Establishing Rigour

In their work, Baxter and Eyles (1997) explore the strengths and weaknesses of qualitative researchers' commitment to establishing rigour in the qualitative process and presenting that in their subsequent work. The authors offer a helpful guideline when they write, "questioning how things are done -- an essential component of self-reflection -- allows qualitative research to demonstrate the relevance of the single case (credibility) and to move beyond it (transferability) with a degree of certainty (dependability and confirmability) (p.520)." This approach to rigour is vital to my research as it creates a general guideline by which to hold the research process, method selection, sample selection, formulation, execution, and interpretation of the study accountable to specific standards of rigour. In the following section, I evaluate the design of my case studies (questioning how things are done) and provide the justifications for the applied approaches and case study analysis considerations, with further reflection on the courses taken, data analysed and resulting findings in the findings chapter 7. This leads to the credibility, transferability, dependability, and confirmability that this research seeks to contribute to the conversation surrounding the effects of scale on sustainability dissemination throughout production networks.

3.3 Case Study Design

This section will follow Yin's (2003) criteria for designing a case study, answering the questions proposed to create the framework this study will follow. However, as some of the criteria overlap and will be answered in the first question, only two headings will be given in this section (p.21-27). This is essential as it sets the study's parameters and focus and shows how the information will be acquired, analysed, and interpreted.

Study's Questions – the "who, what, how, and why".

3.3.a. Who will be studied?

This case study will examine two different sectors of Ghana's agricultural industry – cocoa and shea. The examination will be comparative and exploratory in that it will compare intra-industry and inter-industry as well as intra-organisation and inter-organisational decision-making and outcomes. Furthermore, the comparison will be on the effects of scale on biodiversity sustainability implementation through the studied production networks. The reasons for selecting these two commodity's production networks are as follows:

3.3.b. Why cocoa and shea?

The purpose for choosing these two sectors is due to the rising national and global demand for cocoa and shea, alongside the increasing need to achieve biodiversity sustainability throughout production networks to ensure supply access into the future. Being that cocoa is very well studied while shea is making a comeback into research circles and arguably needs significantly more focus in terms of analysis, provide a comparative platform that is dynamic and connected through shea's position as a popular cocoa butter substitute. Comparing the growth and expansion of these two commodities, cocoa provides more academic insight and offers opportunities for new contributions. This is useful in that both sectors' GPNs are quite complex. There is also a similar shift from niche market items to more mainstream markets found in cocoa's broad use in food and cosmetics and shea's transition from a global luxury item to being widely used in food and cosmetics. While these sectors may still be considered to cater to the more affluent customer base in the global north primarily, they both source many of their ingredients from the global south, and the consumer demand for such products in the global south, especially in the cosmetics industry, has a longstanding history. As the cosmetics industry continues to grow, the pressure from scaling up to meet these demands will be pursued in this research. Additionally, shea being pitted as a cocoa substitute for the confectionary industry

while it (and cocoa) are already highly used in cosmetics could push the shea industry into significant unsustainable production practices. This research will seek to use the benchmarks from the growth of these to industries and firms, and the outcomes of scaling up pressures to pursue lines of inquiry around how to prevent shea from becoming as unsustainably sourced as cocoa are, as well as how cocoa might be able to turn its unsustainable feature around to being sustainable once again.

3.3.c. Why these firms?

The organisations chosen for this case study have been selected for various reasons. Both firms have been in operation for at least ten years, with the confectionary firm being in operation much longer than the cosmetics firm. By comparing the journeys of two continually expanding businesses in each industry, there can be an insight into the differences in sustainable GPN coordination approaches, the effectiveness of each method over time, and the different outcomes based on the timelines of these businesses. A commonality these firms share is maintaining an ethical supply of their ingredients/products. They also source materials from across the globe, creating complex and dynamic GPNs that can be examined, mainly focusing on supply from Ghana and interaction with these suppliers concerning environmental and social sustainability.

The two firms' slightly different approach to sustainability is one point of interest. While both firms' current position is to establish and maintain biodiversity sustainable production networks, the cosmetics firm (Co. 2) has taken this stance since its conception. The confectionery firm (Co. 1), much like other multinational corporations (MNCs) operating production networks in the global south, has made its commitment to sustainability explicit over time. This research does not propose that this firm did not focus on sustainability prior to recent years. Instead, the perspective being considered here is explicit versus implicit orientation to sustainability and how this might have had different effects on the firms as they scale up. The shifting prioritisation of direct versus indirect sustainability efforts is mapped utilising Krauss' (2017) constellation of priorities to map the journey of the shifting priorities and

motivating factors behind said changes over time. For the Co. 1 firm, the lack of explicit coordination toward biodiversity sustainability has resulted in the need to work backwards toward sustainability from the current unsustainable state. Much of this deficit can be connected to industry standards to which Co. 1 ascribes not considering such sustainability in any real way. Co. 1 gives a unique perspective as it reflects the experience of many MNCs seeking to work back toward sustainability in other industries that, like the cocoa industry, are plagued with deeply rooted unsustainable production network practices.

3.3.d. Why this study?

This study aims to understand the complexity of maintaining sustainability as various factors evolve (i.e. firm growth, increasing demand, growing environmental impacts, etc.). The reason for studying this type of phenomenon and examining the decision-making processes these firms go through is 1) further understand how various actors throughout different levels of scale and nodes approach and deal with complexity along GPNs concerning environmental and social sustainability, 2) to learn from research participants the unique ways in which scale can help or hinder sustainable GPNs, 3) draw insights into how to create and maintain sustainable GPNs that can be transferred to a generalised platform for the understanding and further inquiry of both academic scholars and business-people alike. The purpose of this case study is to move from academic theory to practical understanding and utilisation of tools and understanding real-life phenomenon in the context in which it takes place, grounding the analysis in actual events and accounts. Furthermore, understanding this interaction and tension between growth and sustainability will further the conversation on how to create and regulate sustainable GPNs. While this study will not have the capacity to offer any theory or regulatory suggestions, the hope is to contribute to the conversation surrounding examples of what works and what doesn't work in terms of achieving biodiversity sustainability throughout GPNs so that future research can form practical and applicable theory and regulation to the benefit of GPNs in their sustainability efforts.

3.3.e. What will be studied?

As the above points (b-d) highlight, the focus of this study will be the interaction of scale and sustainable GPNs, in essence – the effects that different aspects of scale and power have on the biodiversity sustainability of the studied production networks– in the form of focused case study to provide examples of how growth affects sustainability and the responses. This will be done by studying actors' interactions from different level scale within Ghana's cocoa and shea production networks.

3.3.f. How will this be studied?

This case study uses semi-structured group and individual interviews with sustainability managers, buying managers, supply coordinators, government officials in Ghana's agricultural departments, academics, farmers, and producers. The purpose of using semi-structured interviews is to guide the respondent on the topic to be discussed yet maintain their freedom to direct the narrative. The openness of the semi-structured interview is valuable, especially in mapping each interview participant's constellation of priorities, with open-ended questions explicitly asked to create space for the interview participant to expand and explore in their way the aspects that come to mind regarding biodiversity sustainability in the cocoa and shea production networks studied. This provides a more significant opportunity for expansion on ideas and experiences rather than answering narrow questions which may not yield the depth of information necessary to understand the complete picture of what the respondents experience and understand as sustainability, the effects firm growth has had on sustainable GPN maintenance, and the evolving effort by the firm to grow the business as well as a sustainable GPN.

3.3.g. Unit of analysis

The unit of analysis proposed in this study is the studied production network and the various actors participating throughout the different nodes of the network.

3.3.h. Interpreting findings

Two main processes will be utilised to interpret the data collected through interviews, including pattern matching (Yin, 2003, p.27) and process tracing (Bennett and Elman, 2006, pp. 459–460). In using pattern matching, I seek to find patterns of decision-making, action taken, and outcomes resulting to create the holistic analytical picture of the effect of scale on the studied production networks' dissemination of biodiversity sustainability. I also seek to link findings to existing theory, lending to the building of transferability of this work. Process tracing will look at the causes of the current effects of scale on biodiversity sustainability dissemination throughout the production networks being studied, tracing from recent outcomes back to the origin. This will offer insight into the impact that decisions have had.

3.3.i. Establishing Validity and Negating Selection and Research Bias

Drawing from Yin (2003) and Bennett and Elman (2006), this section will discuss how research validity will be established in this research. The types of validities being considered will be those relating to qualitative and case study research methods.

1) Construct validity in this study will be addressed by focusing on the processes and decision-making and their outcomes on the sustainability of the studied production networks (the change being investigated here is the biodiversity sustainability of the GPN). By answering the questions about the decisions made during the expansion and growth of the firm, an understanding of the effects of these decisions as they relate to GPN sustainability can be assessed (Yin, 2003, p.35).
2) External Validity: This will be established during the interpretation and analysis phase of the study, linking findings to current and new theories in the field of sustainability and GPNs, coordination and regulation of GPNs.
3) Reliability will be established using documentation and inquiry audit (Yin, 2003, p.37-8). Therefore, another critical tool to develop reliability in this study

will be using the supervisor-researcher relationship in the form of the inquiry audit (Halpern 1983 as cited in Baxter and Eyles 1997 p.517).

3.3.j. Multiple-case Embedded Flexible Design

This research will be designed as a multiple-case embedded flexible study. The approach of embeddedness is used as this research will focus on the subunits of sustainability management and buying management in the context of the production network and the context(s) of the supply base and suppliers as another subunit of analysis. To negate the warning against tunnel vision, a general framework of the organisation and the interaction between and upon the specific sub-units of study and the larger organisation (and vice versa) will be considered. Flexibility will be in allowing for any natural changes that might occur amid conducting the research based on the findings produced (Yin, 2003, p. 42-55).

3.3.k. Case-Selection Criteria and Selection Bias

Subscribing to Bennett and Elman's (2006) propositions of case study case selection bias negation, especially regarding process tracing and the causes-of-effects approach, this research argues that the selection bias is negated to the extent that it can be under these propositions. This is seen as the firms have been selected based on their meeting the following criteria:

1. Being firms that have witnessed significant growth in the complexity and reach of their GPN.
2. A commitment to sustainability as set forth by the firm.
3. Ability to access respondents within the studied production networks.

3.4 Ontology, Epistemology, Axiology

According to Bennett and Elman (2006), the general ontological framework of qualitative methodologists is "that the social world is complex, characterised by path

dependence, tipping points, interaction effects, strategic interaction, two-directional causality or feedback loops, and equifinality (many different paths to the same outcome) or multifinality (many different outcomes from the same value of an independent variable, depending on context) (p.457)." Drawing on Hall (2003) the authors propose that this view of the world is critical to take into consideration as it how "knowledge statements can be most usefully constructed and verified (p.457)." This research aligns with this ontological framework as the experiences of each level actor are complex, dynamic, and have multi-directional causality. Interaction effects, tipping points, and context are valued in this research as it is the interaction of the actors with these various drivers that are being observed and the process of scaling up and correlated decision-making that is being traced.

Regarding epistemology, this research will take the stance of the causes-of-effects approach in that it seeks to understand how current sustainability (effects) has been achieved and affected by the scalar elements studied throughout the studied production networks (causes). This aligns with Brady's (2003 as cited in Bennett and Elman 2006) causation approach in that this study will focus on the "mechanisms and capacities that lead from causes to an effect (p.457)." Using the causes-of-effects process-tracing method to understand the mechanisms and capacities which have resulted in the current status of the implementation of biodiversity sustainability throughout the studied cocoa and shea production networks in Ghana.

Process tracing in this research is used as it is a tool, they highlight, that can be used for "the discovery and validation of causal mechanisms . . . [through] uncovering traces of a hypothesised causal mechanism within the context of a historical case or cases (p.459)." Falling in line with the process tracing approach, it will follow the Bayesian logic of "diversity of evidence as an important check on causal inferences (p.460)." This is used, as Bennett and Elman (2006) suggest, to protect against confirmation bias and build on causal inferences that can be traced throughout the study.

3.5 Research Methods

A broadened search of ingredients and prospective firms to approach uncovered the connection between the food and cosmetics industry in cocoa and shea products. At the beginning of this research project, an investigation into four firms, two in the organic food industry and two in the cosmetics industry was conducted to determine the feasibility of the study based on the criteria and the research questions. From four baseline firms and four baseline commodities, two (Co. 1 and Co. 2) were chosen based on the procurement of a wide variety of natural ingredients for their products and their history of commitment to biodiversity sustainability in their production networks. The four ingredients researched by these companies were cardamom, turmeric, cocoa butter, and shea butter. While exciting and widely used, cardamom and turmeric production networks are too geographically dispersed to gather an in-depth study in the time given for the PhD. Cocoa and shea procured by Co. 1 and Co. 2, on the other hand, offered a common geographical location of Ghana. Additionally, through a personal network contact, a chocolate company (Co. 1) with a cocoa production network in Ghana and a cosmetics company (Co. 2) with a shea production network in Ghana granted access for interviews.

Cocoa and shea offered interesting and relevant features of biodiversity impact and a complex industry context, with different levels of government and private actor involvement between the two sectors. Studying cocoa and shea offers a good comparison analytically as while cocoa has been studied primarily related to chocolate production, shea is still an understudied field. Furthermore, cocoa and shea share specific environmental and social sustainability issues, allowing multiple comparison levels.

3.5.a. Co. 1 interview process

Initial contact was made via email in the last week of March 2018. A reply to this initial email was received in the second week of April 2018, followed by a Skype conversation with my primary contact at the company taking place in the last week of

April 2018. During this conversation a general idea of the company's organisational structure, market presence, and production network locations was gained, as well as the respondent's own understanding of the company's views and approach to biodiversity sustainability throughout their production network.

I received an initial email in the third week of May with the good news that two potential interview respondents were found from the sustainability division and that an introductory email should be expected by the end of the week.

In July 2018, the first of three virtual interviews was conducted with a North American-base procurement manager and lasted 1 hour. Interview schedules for this and all interviews conducted for this research can be found in Appendix A. From the first interview, connections with buyers, government interns, and potential cooperative organisers who all liaise with the company were made. The primary respondent from interview 1 knowing managers based in procurement in Ghana offering to set up introductions for my time spent on fieldwork in Ghana with the potential to visit buying warehouses as well as processing facilities and headquarter office should the contact they referred me to be willing and available to do this. Following this interview, in the 4th week of July 2018 I received a second introduction to a third respondent. This interview was set and took place with a EU-based supply coordinator and sustainability advisor working on Co. 1's sustainability charters and standards of conduct for their Ghanaian production network suppliers on 5th September 2018 lasting 1 hour and 15 minutes.

During the time between the initial Skype conversation with my primary contact in Co. 1 and the 1st interview in July, the time was spent restructuring my interview schedule and re-writing my interview questions and justifications as they were being adapted to the new material refined in the revised progression document. Between interview 1 and interview 2 I also further revised the interview schedule and questions to pursue new potential lines of inquiry surrounding farmer livelihood and the connection between land and environmental sustainability efforts as a result of the responses received to the interview questions from interview 1.

Commencing the second week of September 2018 through the 4th week of October 2018, my focus was prioritised to the transcription and initial synthesis of the two interviews. During this time, further revisions to the interview schedule were made to focus discussion on the most relevant areas of interest - internal sustainability programmes, public-private initiatives, public actor engagement, land rights and gender inequality (Interview 1, 2). This time was also spent with initial research into literature concerning land rights and the dual governance systems in place in Ghana.

In May 2019 in-person interviews were conducted in Ghana at one of Co. 1's subsidiary headquarters, with the managing director, head of sustainability and sustainable livelihoods manager. Themes from these interviews included biodiversity sustainability implementation throughout the farms supplying cocoa beans to the subsidiary which are then exported by this firm to Co. 1's EU locations for processing. Main themes drawn from these interviews was the high level of government-private partnership including partnership and knowledge sharing for best practices, disseminating training and resources for cocoa farmers in their production network.

Another key aspect from these interviews was the claims by the managing director and head of sustainability on the firm's incorporation of social sustainability issues, particularly farmer livelihood into their efforts to achieve and maintain biodiversity sustainability, the foundational argument being that until the farmer can provide for their livelihood, environmental sustainability cannot be achieved. One discrepancy between the UK/US based respondents and the respondent from the subsidiary is the route of access to the lead firm's sustainability cooperative. According to UK/US respondents, farmers pay an annual few to participate in the cooperative, which allows them to participate in the firm's supply network, either in an advance payment or taken out of the price per kg of cocoa when sold to the subsidiary. According to the subsidiary respondents all farmers in the supply network are incorporated into the cooperative and receive the social and environmental sustainability resources free of charge from Co. 1. For future research, it would be paramount to interview farmers in Co. 1's Ghanaian production network to understand from their experience of participating in this production network.

Further to the interviews with Co. 1 respondents, I interviewed a UK-based academic working with government policy and trade negotiation to find more equitable approaches to Ghana's cocoa industry organisation. This interview lasted 2.5 hours and provided significant insight into the political history of Ghana's cocoa trade coordination and the current (as of 2019) legislation being lobbied for on the national and international stage. Finally, I interviewed with Ghana-based academic teaching and research at a prominent university in Accra. This scholar's work has been cited throughout the cocoa literature and was used in my literature review before the interview. The insights from this interview provided a further understanding of the trial-and-error approach to sustainability in Ghana's cocoa industry. Also, they provided vital insights which informed my later interviews with cocoa farmers, COCOBOD, and shea scholars.

An example of the sustainability of the trial-and-error approach to cocoa production was in the mass planting of eucalyptus trees alongside cocoa trees to promote shade growth practices and provide an alternative revenue stream for cocoa farmers (GHI 76). However, it was later learned that the root systems of eucalyptus trees interfere with cocoa tree root systems, and the eucalyptus tree is more efficient at absorbing and retaining water, stripping the soil of the necessary moisture cocoa trees need to thrive (GHI 76). Therefore, the eucalyptus trees have mainly been replaced with plantain and other local root plant species, which seem to improve soil quality, without the negative implications of eucalyptus (GHI 76). This interview was brought through my discussions with COCOBOD officials, where some confirmed the use of plantain trees to replace eucalyptus due to the plantain tree's ability to retain water and then release water stores into the soil during the dry season or drought (GHI 70, GHI 75).

In May 2019, four group interviews and one individual interview with cocoa farmers were conducted. In these group interviews, I met with about ten farmers each interview, with 25% of respondents being female and the remaining 75% male farmers. These interviews were facilitated, and questions and answers were translated by a COCOBOD officer responsible for the catchment area of farms we

visited. This COCOBOD officer also participated in an individual interview with me and translated for an individual interview with the chairman of one of the two cocoa associations that comprised my group interview respondents. For the farmer interviews, I asked mapping questions such as, 'do you own the land you farm?' and 'how many trees/what types of trees have you planted on your land, and why did you choose these trees?'. The questions in this interview schedule expressly refrain from using such terminology as customary land rights and gender inequality, opting instead to trace the outcomes of responses and reasonings behind the respondents' thoughts and actions back through the process reflected in other interviews with private, public, and third sector actors as well as the literature reviewed to map the causes of the effects that are the respondent's thoughts, actions, and experiences related to cocoa production and sustainability efforts. This was intentionally done to allow all respondents to hear questions in a language that would be familiar to the conversations they may have in general and to provide the space for the respondent to expand into sharing their lived experiences whenever they deemed applicable, avoiding rigid academic language and interview approaches which would create barriers to connecting with the farmers in a way that feels natural to them.

For example, when asked, 'Do you receive any assistance from the government or other businesses who may be buying your cocoa beans to help protect the environment and increase your cocoa tree yields and life span?' The initial response from many respondents was, 'Yes, COCOBOD has given x amount of fertiliser, pesticides, or training', and other respondents, specifically the female respondents, were able to share their struggles in not receiving the same amount of assistance (or in some instances not receiving any assistance). While the original question was framed as a yes/no question, providing the details of what types of interventions I was trying to understand and using language that farmers themselves would use provided the open door for expansive and interactive responses from the group. The data collected during these interviews contributed significant insights into the mapping of actor scale, varying constellations of priorities, and capturing the social and environmental dynamics of sustainability, creating tension within cocoa production networks and biodiversity sustainability dissemination (GHG 1-48; GHI 78).

3.5.b. Co. 2 Interview Process

While arranging and conducting interviews with Co. 1, contact was made with Co. 2 beginning in March 2018. This was done via e-mail and Facebook to my primary contact from 2017. These messages were responded to in the 2nd week of April 2018 with the confirmation of interest in finding buying and sustainability managers within the company that would be willing to speak to me.

In May 2018 my primary contact was scheduled to be at an international conference in July and would further pursue making the appropriate introductions during this time. While waiting for this contact, I focused my energy on the interviews with Co. 1 as they had been more forthcoming with confirming and conducting interviews. In the second week of August 2018, not having heard from my primary contact and the conference they attended having ended, I reached out to check on any progress that had been made during the meeting. My contact responded in the 3rd week of August 2018 saying that they had a couple of potential leads but had not been able to contact them yet, with the assurance that by the end of August, I would hear from them confirming the interviewees' responses. During this follow-up, an informal conversation about Co. 2's procuring shea was discussed. This conversation offered general insights, such as the firm's overarching commitment to the ethical sourcing of products and ingredients and a system of direct buying being utilised to source the ingredients being studied (LD 5). This information was verified by the multiple online resources from the firm discussing sustainability management and buying outlooks.

I widened my search for potential interviews with this company by contacting the headquarters shop located in London for possible access to a local respondent. This message was sent in the 4th week of August 2018 and was received, but no reply was given. As I was finding progress in research from Co. 1's interviews, I focused on finishing the transposition and initial analysis of the first two interviews. I put contact with Co. 2 on hold until the 2nd week of September 2018. As no further response was received from the primary contact, another e-mail was sent to my contact in the first

week of October 2018. While the respondent provided positive feedback, there was no materialisation of a further introduction.

My search for respondents was widened throughout the company and in shops, incorporating contact with other companies that procure the same raw material as Co. 2 for their products to fill this gap. Initially, e-messages and e-mails to the only contact information found online via the company's website, glassdoor, and linked in were made in the 4th week of August, with the incorporation of multiple other platforms and contact information for other managers and the board of director members being added to the contact list beginning in the 1st week of November 2018. These interactions consisted of asking the employee about their knowledge of the sourcing procedures of the firm, with responses reflecting information readily available and already accumulated via online searching. These conversations had the intention of being put into direct contact with a buying or sustainability manager who could participate in a formal interview. However, guidance to contact the general customer service team via phone or e-mail was suggested by employees. Approaching employees in local shops was done bi-weekly from October 2018 through the first week of December 2018. The break in making in-person visits was to accommodate for the significant influx of traffic in the shops and the busy Christmas/new year period. During that time, any conversation or messages sent were either left without a reply or with an answer about the busy time, so contact from December was cut back to not aggravate the contacts I was working on.

Phone calls to the general customer service team were conducted three times with no response or an automated response. A new number was given in the first week of January and contacted on 11th January 2019. Lines of communication with initial contacts were re-opened on 5th January 2019 as the connection had returned from holiday travels. An initial interview with Co. 2 was conducted on 23rd January 2019 (LD 6). This interview was with a procurement specialist overseeing the northwest USA region. While this respondent could not speak to some details of biodiversity sustainability implementation throughout Co. 2's shea production network, they could confirm the name of the primary shea collective partnered with in Ghana to procure

unrefined shea butter. The NGO partnered with and acts as a liaison between the women's cooperative and Co. 2. Through an introduction through this respondent, further interviews were able to be conducted with the managing director of the NGO in Ghana, and a visit and group interviews with a portion of the women's collective supplying Co. 2 was completed in Ghana in May 2019.

Whilst in Ghana in May 2019, I met with the managing director of an NGO facilitating one of the shea cooperatives from which Co. 2 sources their shea butter. I interviewed the managing director, mapping the various levels of actors involved in production network coordination. This mapping shows how the lead firm utilises its partnership with the NGO to facilitate network coordination of the shea cooperatives I visited and interviewed, acting as their feet on the ground, providing training and limited resource allocation to the women in the collectives. The resources distributed by the NGO are primarily sourced from government and fundraising initiatives held by the NGO. The primary collaboration between Co. 2 and the NGO was found to be the buying connection for the collectives, where the NGO was independently securing processing factories, organising individual shea producers into collectives, and liaising on behalf of the collectives with the MNCs seeking to purchase the large quantities of shea kernels and shea butter that each producer could not meet independently of the collective (LD6; GHI 50). According to the NGO respondent, MNCs do not want to go to each producer to collect the amount of shea needed (GHI 50). By organising the women producers into these cooperatives and representing them to the MNCs, the NGO can significantly increase the opportunities for the women in the collective to sell more of their shea at higher prices directly to lead firms rather than through intermediaries which cut into the profit received by the women producers (GHI 50).

The NGO was able to confirm that Co. 2 does have initiatives that are piloting alternative streams of revenue for women producers, such as aloe farming and egg-laying hens; however, of the 26 group interview participants and the individual interview held with a matriarch and founding member of one of the cooperatives, none of the respondents could report any direct interaction with Co. 2 or receiving any of the resources for shea production or alternative streams of revenue. This does

not mean that none of the women in Co. 2's production network receives the claimed assistance. As a second field trip was not possible, it is worth noting that the two villages in the shea-producing region I visited and interviewed at were two of many spread over an extensive geographical location (for example, the villages we did see were an hour or more drive from the processing facilities and NGO offices, some other collectives were much further out requiring overnight travel or stay to accommodate interviews and were in the process of being set up when COVID-19 caused lockdowns and since has not been able to be pursued due to time limitation of the PhD). It would be highly beneficial to meet and learn from more of Co. 2's production network participants in future research as the complete picture of production network coordination toward biodiversity sustainability is not painted here, merely a glimpse of a few areas of Co. 2's network coordination.

In my last two weeks in Ghana, I visited the leading agricultural university for shea research in the shea-producing region of Tamale. I met and interviewed four leading university scholars, including the shea department provost, former dean of agriculture and current sr. manager for COCOBOD's Shea Research Unit, Head of agriculture department, and chair of agriculture research at two leading universities in Ghana with research foci related to cocoa and shea. Of the seven academics interviewed, three had previously held full-time roles in COCOBOD's shea research unit and continue to partner with the COCOBOD shea research unit in current studies on shea tree propagation and other shea-related environmental studies, and one transitioned from academia to become a senior manager in COCOBOD. Common themes in all seven of these interviews were the lack of direct government engagement with the shea industry, lack of resource provision and protection for the women shea producers, and the heavy reliance on third sector and private actors opting in to fill the gaps of need in shea production network coordination (GHI 50; GHI 70; GHI 71; GHI 72; GHI 73; GHI 77; GHI 79). In my final week in Ghana, I had a brief interview with the director of the COCOBOD shea unit based in Accra. This interview confirmed the aim of COCOBOD to collaborate with scholars in Tamale, third-sector NGOs and private actors to meet the needs of the women producers participating in Ghana's shea production networks. In this conversation, it became clear that the majority of

COCOBOD's resources are allocated to the cocoa industry, while in the shea sector, government support is found through the shea research unit facilities in New Tafo Akeym (GHI70; GHI 71; GHI 72; GHI 73; GHI 77). In addition, a shea research office in Tamale was also opened in 2018 that focuses on funding PhDs to research shea propagation and gestation to reduce the traditional 15-20 years gestation down to 3-18 months (GHI 70; GHI 71; GHI 72; GHI 73; GHI 77; *GhanaWeb*, 2018).

3.6 Country Case Selection

3.6.a. Ghana's Cocoa Industry

Ghana's cocoa and shea industries play significant roles in the global cocoa and shea market. Being the second largest exporter of cocoa and the leading exporter of shea in West Africa, these two sub-sectors of the agricultural industry play a significant role in the country's economic development (Addaquay, 2004; World Bank Group, 2018). Due to the significance of both sectors, the effects of sustainable production and the shift toward cocoa substitutes have the potential to greatly affect the economic well-being of the country and its smallholder farmers in both industries.

Cocoa is one of the most significant exports in volume in international trade, second only to petroleum (Donald, 2004). However, while cocoa offers an excellent opportunity for both cultivators' livelihood and agroforestry biodiversity preservation, key detrimental factors hold the industry back from such mutually equitable production. According to their 2009 report, the combination of cocoa's boom and bust cycle with that of ageing farmers, misguided understanding of creating longevity in cocoa production, and the stigma of farming in younger generations prevents the

industry from creating a balance between production and biodiversity preservation that is necessary and potentially attainable (Clough, Faust and Tscharntke, 2009).

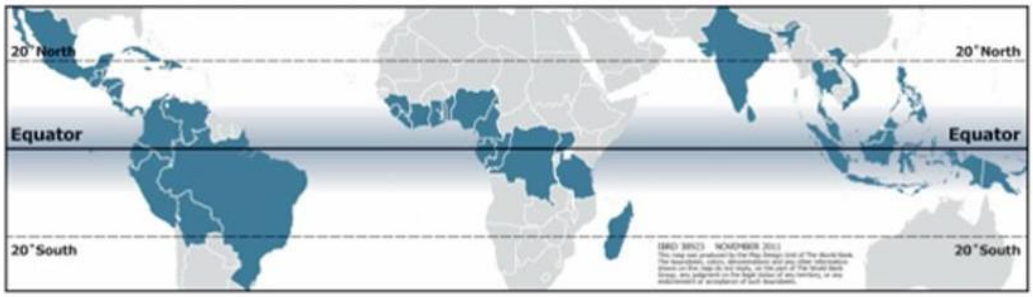

Figure 3 Image from: Supply Chain Risk Assessment Cocoa in Ghana, World Bank, 2011, p.3

Depicted in Figure 3, cocoa trees are cultivated in over 50 countries worldwide, thriving between 15-20^{o} north and south of the equator, where the climate is tropical and humid (World Bank, 2011). Of the top four cocoa-producing countries in West Africa, Ghana is second only to Côte d'Ivoire, with total production from Africa accounting for 70% of world production (World Bank, 2011).

Biodiversity implications in global cocoa production are deforestation, endemic species loss, and natural biodiversity richness loss (Donald, 2004; Hansen *et al.*, 2011; Higonnet, Bellantonio and Hurowitz, 2017). Lack of sustainable cocoa cultivation leads to deforestation as farmers clear new forest ground to plant more cocoa trees when current locations have been depleted of resources and production viability, causing such issues as "forest depletion, environmental degradation and adverse climatic changes (Anim-Kwapong and Frimpong, 2004, p. 29)".

The contemporary agricultural practice uses non-shade cocoa cultivation, which requires clearing land, expanding deforestation and its effects. While shade-produced cocoa trees increase the lifespan of the cocoa tree, part of the reason for non-shade cocoa cultivation is the short-term increase in the trees' pod production (Clough et al., 2009; LD 2; GHI 75). This occurs because cocoa trees perceive increased sun exposure as a threat, thus an increase in pod production improves the likelihood of survivability of the species. On the other hand, lack of shade cover shortens the tree's lifespan and exposes them to more pests and diseases. This is exacerbated without natural pest

control through insects, birds, and other endemic forest species attracted to shade cover or thin forest cultivation. These factors culminate in decreased tree life spans, pushing farmers to clear more land and repeat the cycle (Clough et al., 2009). Other deterrents to shaded cultivation are the decrease in yearly output as a trade-off for the longevity of tree production and a higher level of upkeep in some respects (Clough et al., 2009).

In areas where shade growth is practised, especially near naturally occurring forests, the biodiversity implications of shade-produced cocoa can be significantly positive. The complex shade canopies and proximity to forests encourage dynamic plant and animal diversity (Schroth and Harvey, 2007). Government intervention to rehabilitate viable land for cocoa production is argued to be necessary, as the current trend of cocoa production threatens the long-term sustainability of the biodiversity of agroforestry land and cocoa production if it is not addressed correctly and soon (Clough et al., 2009). The Ghanaian government has taken this course of action in the form of their subsidiary department, Ghana's Cocoa Board (COCOBOD). The implications of such government interventions in the Ghanaian cocoa industry will be discussed below.

Sales from smallholder cocoa farmers account for 70-100% of their annual income (Anim-Kwapong and Frimpong, 2004; Wessel and Quist-Wessel, 2015). Given that smallholder farmers make up most of cocoa production, the effects of both economic fluctuation in the industry and environmental degradation have significant negative implications. Furthermore, the combination of resource/habitat loss due to unsustainable farming practices and the financial limitations of cocoa farmers exacerbates the biodiversity threat that cocoa production has been shown to present (Bos and Sporn, 2012; Berlan and Bergés, 2013).

As evidenced in works such as those studies by Donald (2004), Schroth and Harvey (2007), Anderson Bitty *et al.* (2015), Higonnet, Bellantonio and Hurowitz (2017), and Krauss (2017) and many more, the threats to biodiversity and other environmental sustainability issues in cocoa are a direct result of cultivation practices being utilised in

this sector. This opens an avenue of inquiry regarding the motivations and reasonings behind the specific approach taken by the Ghanaian government regarding the cocoa production sector, as the same for private actors such as lead firms and public actors such as NGOs and cocoa farmers.

Ghana's cocoa industry is crucial to its economy, accounting for more than 9% of the agriculture industry's GDP (Anim-Kwapong and Frimpong, 2004; Bills, 2012). However, while Ghana's cocoa industry saw peak production levels of 1 million tonnes in 2011-12, the average remains significantly less than neighbouring Côte d'Ivoire and significantly below its potential output (World Bank Group, 2018). Moreover, according to a comparison of two World Bank reports (2011 and 2018), the positive outlook for Ghana's cocoa industry projected in 2011, while still maintaining significant potential, has seen little change to achieve its full potential in 2018. Among issues needing to be addressed by the government of Ghana are education and promotion of better tree husbandry, replanting and rehabilitation to promote longevity in farm outputs rather than the historical trend of moving farms to new locations, which has caused a rise in deforestation trends and improper land-use care (Anim-Kwapong & Frimpong, 2004; Asuming-brempong et al., 2015; World Bank, 2011; World Bank Group, 2018).

Sustainability and organic certifications in cocoa producers are present in Ghana, with the chocolate lead firm sourcing some of its cocoa from certified organic and other 3rd sustainability certifications. Fairtrade-accredited cocoa, sold through the Ghanaian cooperative Kuapa Koko Ltd. (KKL), accounted for about 50% of cocoa produced in 2012-13, receiving a Fairtrade premium of 200USD per tonne to be invested in the sustainable cocoa industry's various projects through KKL (Fairtradelabel.org, 2012). While generally understood as a social or ethical standard, Fairtrade demands necessary environmental standards about "soil and water quality, pest management, biodiversity protection, prohibition of genetically modified organisms (GMOs), and harmful chemicals and waste management (Fairtrade, 2015)." As soil quality, pest management, GMOs, harmful chemicals and waste management contribute to biodiversity preservation (Daily, 1999), these are considered in this research.

Understanding farmers' access to the 200USD premium on Fairtrade cocoa is vital for further research. Should farmers receive a higher price for Fairtrade cocoa, it could be investigated whether this increase in product pricing enables farmers to achieve a self-sustained approach to sustainable farming practices. If this premium received by farmers, combined with the COCOBOD and Fairtrade programmes to educate and provide tools/resources to achieve biodiversity, sustainable production of cocoa can be found, the process-tracing from the end of these Fairtrade certified farms back through the means of the sustainable output can provide insight into the various relationships and drivers that provide the motivation and ability for these farmers to achieve such sustainable farming practices.

About 50% of Fairtrade producers are also certified organic producers, this will provide an exciting line of inquiry for the Ghanaian cocoa market as pest and disease control is a significant concern for these farmers. Studies have shown that organically produced crops such as coffee and cocoa positively affect the biodiversity of the forest land used for production, especially when the use of shade-cover cultivation is present (Donald, 2004; Daniels, 2006; Bisseleua, Missoup and Vidal, 2009). Issues concerning organic production and biodiversity in agro-food crops such as cocoa a) the trade-off for farmers to produce organic cocoa is complicated, with organic production requiring higher financial input for farmers to achieve and not being particularly more profitable in return over non-organic production (Bisseleua, Missoup and Vidal, 2009) and b) the most significant impact to biodiversity seems to be the use of shade-cover cultivation, which the felling of trees to produce non-shade cocoa and clearing of new forest land is not strictly considered organic practice (Donald, 2004). A line of inquiry in this arena will be the comparison of organic versus conventional production practices and their effects on the biodiversity of the respective farms. It would be worth noting whether shade cover + organic production practices (particularly non-use of chemical pesticides and harmful fertilisers, which are argued to affect soil and water quality and endemic species longevity negatively (Daniels, 2006)) has a greater positive biodiversity and yield impact than shade cover + conventional production practices as this may lend to understanding another aspect of motivation for using chemical pesticides and fertilisers over organic tree husbandry. Should the latter be

found to have a higher yield for cocoa farmers, a follow-up research inquiry may be how to incentivise farmers to choose the slightly lower yield and theoretically higher positive biodiversity implications of organic farming, such as those government incentive programmes for organic agriculture proposed by Bisseleau, Missoup and Vidal (2009).

3.6.b. Ghana's Shea Industry

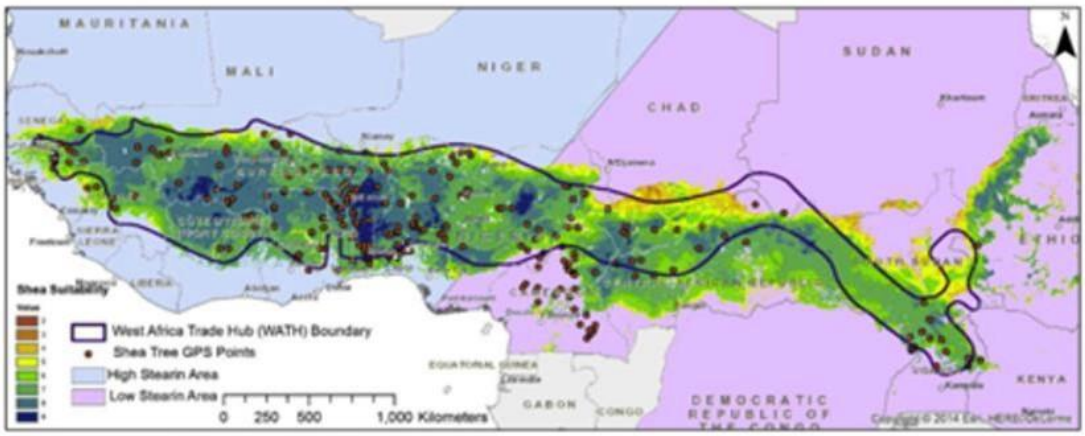

Figure 4 Shea Distribution Map. Taken from Naughton *et al.*, 2015

The shea tree is found only in Africa, growing in West and Central Africa, with a particular concentration in Northeast Ghana (Jibreel *et al.*, 2013). As shown in Figure 4, shea trees can be found in a 500-750km wide area throughout 6000km of 21 countries in Africa. The nuts collection from these trees supports approximately 16.2 million people (Lovett and Haq, 2000a; Lovett, 2005; Glew and Lovett, 2014) . Seven Western African nations – Ghana, Burkina Faso, Benin, Cote d'Ivoire, Nigeria, Mali, and Togo – export 500,000 tonnes of shea nuts annually, some of which are converted to other forms of shea (ex., Shea butter) (Addaquay, 2004). Ghana is essential in the shea nut market, producing 55,000 tonnes of shea nut annually, with exports of 40,000 tonnes, the largest importers of these products or raw materials being Great Britain, the Netherlands, Denmark, North America, and Japan (Addaquay, 2004; Elias and Carney, 2007). While some research has been done on life cycle assessments of shea production regarding carbon footprint and mapping of shea production, taking into consideration such things as land use, precipitation, and soil change, the biodiversity implications of shea production is an area that requires much further

research (Jibreel *et al.*, 2013; Glew and Lovett, 2014; Naughton, Lovett and Mihelcic, 2015). This is especially so as cocoa butter alternatives (CBAs) are sought after, shea being a suitable candidate for CBA due to its high stearin content (Lipp and Anklam, 1998; Talbot and Slager, 2008; Naughton, Lovett and Mihelcic, 2015)

The fact that shea trees are only found in these specific places in Africa shows the importance of biodiversity sustainability. Should the unsustainable management of the environment and the trees cause them to go extinct, there is currently no other place in the world that could provide this raw material. Shea is not presently cultivated but grows wild, and the nuts are collected for processing. Biodiversity issues in the shea tree growing stage are mainly indirect results of other agricultural practices such as bush burning, land clearing and pesticide use. Direct impacts on the environment from shea are found in the processing from nut to butter which traditionally consumes large amounts of fuel wood (resulting in both overconsumption of timber and CO2 emissions) and water, and the waste by-products (Glew & Lovett, 2014; Jibreel et al., 2013).

One area of biodiversity preservation that must be considered for firms such as Co. 2 is waste by-products produced during shea nut processing. Shea nut processing has by-products, "waste brown water and waste black sludge", which harm the soil it is dumped onto as hindering plant germination and growth (Jibreel et al., 2013). Due to such high demand for shea nuts and its various forms, firms have turned to certification to ensure that sustainability goals are being held to in the procurement and processing of shea nuts (Elias & Carney, 2007).

This is another factor that is important to this research for two reasons. Initially, the avenue of inquiry into how firms such as Co. 2 have approached the issue of harmful by-products in processing shea nut is vital as this directly affects the environment at the origin of sourcing shea products. Secondly, it begs the question of what types (if any) of impact the processing of cocoa kernels has on the local environment at the point of origin. This is important to understand as these by-products add another layer of complexity in achieving and maintaining environmental sustainability in

procuring and processing these raw materials for use in confectionery and cosmetics products. In addition, according to some studies, the waste by-product from shea processing can provide an alternate resource for the construction industry being used as a material in clay bricks used in construction (Adazabra, Viruthagiri and Shanmugam, 2017a). Chapter 6 Case Study will pursue this line of inquiry as it may play out on the ground in Ghana, through the interviews and observational data collected.

Shea butter is currently being used as a cocoa substitute to offset the current biodiversity hazard that cocoa production poses (Chalfin, 2004; Elias and Carney, 2007; Jibreel *et al.*, 2013; *Exporting shea butter for cosmetics to Europe*, 2019). One issue pursued in this research is the continued preservation and sustainable cultivation of shea nuts so as to avoid coming up against the same biodiversity threats that cocoa cultivation is facing. One line of inquiry for this research is how Co. 2 approaches the sourcing of this ingredient as compared to cocoa butter which is already under threat. Are there any systems set up to ensure proper maintenance of shea tree viability, protecting against overharvesting or illegally accessing protected areas of shea? Global demand for shea has increased (the American shea market growth rate 1994-2004 documented at 25% (Rousseau, Gautier and Wardell, 2015) and is expected to continue to do so, especially as it is now being sought to be used as a cocoa butter replacement. The current status of shea production having minimal negative biodiversity implications presents this industry with an opportunity to cultivate shea nuts to meet growing demands sustainably without causing the same issues of negative biodiversity implications.

The global push away from cocoa butter and towards such substitutes as shea butter brings new tension points:

1. Maintaining the livelihood of those currently supplying cocoa products while shifting demand away from cocoa and toward shea products.
2. Ensuring sustainable production of shea products will enable the longevity of the trees from which these products are sourced.

3. The level of involvement necessary for the currently threatened habitats of cocoa production sites to rehabilitate these areas and the affected endemic species.

Through the study of a firm such as Co. 2, this research will aim to understand the benchmarks, tools, and network coordination efforts utilised to disseminate a continuation of biodiversity sustainability in shea products amid the growing demand for this product.

As operations for shea cultivation, processing, and transportation scale up in volume and global destinations of shea exports, this provides a look from the front end of sustainability efforts for this research. Where cocoa's sustainability focuses on biodiversity rehabilitation, shea presents a before-picture of sustainability efforts. This can provide insight into how firms are working to ensure that biodiversity impacts of shea production remain positive as the industry grows and more farmers enter the market. Potentially more trees can be used for commercial production. This forward-looking line of study could offer benchmarks for firms, governments, and 3rd sector actors to ensure biodiversity sustainability in producing shea and hopefully prevent such biodiversity issues in this industry as is faced in the cocoa industry.

As shea butter is currently being used as a cocoa substitute to offset the current biodiversity hazard that cocoa production poses, one issue could be the continued preservation and sustainable cultivation of shea nuts to avoid coming up against the same biodiversity threats that cocoa cultivation is facing. One line of inquiry for this research could be how Co. 2 approaches the sourcing of this ingredient compared to cocoa butter which is already under threat. Are there any systems set up to ensure proper maintenance of shea tree viability, protecting against overharvesting or illegally accessing protected areas of shea? Global demand for shea has increased and is expected to continue to do so, especially as it is now being sought to be used as a cocoa butter replacement. The current status of shea production having minimal negative biodiversity implications presents this industry with an opportunity to

cultivate shea nuts to meet growing demands sustainably without causing the same issues of negative biodiversity implications.

This opens an important avenue of exploration for this research. The push away from cocoa butter and towards such substitutes as shea butter brings new tension points:

1. Maintaining the livelihood of those currently supplying cocoa products while shifting demand away from cocoa and toward shea products.
2. Ensuring the sustainable production of shea products will enable the longevity of the trees from which these products are sourced.
3. The level of involvement necessary for the currently threatened habitats of cocoa production sites to rehabilitate these areas and the affected endemic species.

Through the study of Co. 2, this research seeks to understand the benchmarks, tools, and network coordination efforts being utilised to disseminate a continuation of biodiversity sustainability in shea products amidst the growing demand for this product. As operations for shea cultivation, processing, and transportation scale up in terms of volume and global destinations of shea exports, this provides a look from the front end of sustainability efforts for this research. Where cocoa's sustainability focuses on biodiversity rehabilitation, shea presents a before-picture of sustainability efforts. It can provide insight into how firms are working to ensure that biodiversity impacts of shea production remain positive as the industry grows and more farmers enter the market. Potentially more trees can be used for commercial production. This forward-looking line of study could offer benchmarks for firms, governments, and 3rd sector actors to ensure biodiversity sustainability in producing shea and hopefully prevent such biodiversity issues in this industry as is faced in the cocoa industry.

Chapter 4 Historical context of Ghana's cocoa and shea sectors in the global cocoa and shea industry; addressing biodiversity sustainability issues

4.1 Biodiversity sustainability factors in Ghana

Biodiversity sustainability is an issue that is relevant to hard and social sciences, business, and consumers alike as it presents common pool resource extinction issues which affect every person's life (Ostrom, 1990; Crutzen and Stoermer, 2000; Berlan and Bergés, 2013; Robbins, Chhatre and Karanth, 2015; Bowen, 2017). I have reviewed the global outlook of these commodities in Chapter 3. I will focus this chapter on the Ghanaian-specific context and issues that translate from the global stage to the national and local cocoa and shea industries.

The studied biodiversity issues in cocoa directly result from agricultural practices used in Ghana's cocoa sector and climate change (Anim-Kwapong and Frimpong, 2004; Clough, Faust and Tscharntke, 2009; Hainmueller et al., 2011). The biodiversity sustainability issues present in the shea industry are indirect effects of other agricultural production practices (i.e., fertilisers, cross-pollination, and bush burning practices used in different agricultural production), direct results of processing practices and climate change (Goehler *et al.*, no date; Addaquay, 2004; Clough, Faust and Tscharntke, 2009; World Bank, 2011; Glew and Lovett, 2014; GHI 50; GHI 70; GHI 73; GHG 51-68). Ghana's agricultural industry and cocoa and shea sectors have been, and continue to be, influenced by standards, sanctions, and trends originating locally and globally, as will be discussed in sections 4.2.b and 4.2.e.

This consideration of context and coordination, both globally and locally, activates my holistic analytical framework by pursuing lines of enquiry at multiple levels of scale and nodes throughout Ghana's cocoa and shea production networks, mapping the entire structure alongside the individual node analysis of the actors studied. This is done by pursuing lines of inquiry on how day-to-day business functions are set up to

coordinate production, which begins for these two ingredients in the Ghanaian context and continues to the global market. Each of these settings presents specific challenges and opportunities for actors and, I would argue, play off each other (i.e., the international sanctions which affect Ghana-based production). These global and systemic issues must be considered to ensure that the whole picture is considered, creating an accurate and robust study.

This research focuses on the relationships and power dynamics that create the system (or production network) that produces the cocoa and shea utilised across industries and worldwide. The argument here is that it is only in understanding the drivers, motivations, and intended outcomes of these different levels of actors – their 'constellation of priorities' (Krauss, 2017) – within the scale that we can find the causes of the effects of either attaining environmental sustainability or falling short of this goal. In understanding the driving forces, internal and external to the network and actors involved, this research seeks to find evidence for the specific approaches taken up by the actors studied here regarding biodiversity sustainability implementation throughout the production network, evaluate the efficacy of these methods, and offer support for further research which will find mutually equitable solutions for nature, prominent actors, and small alike.

4.1. a. Global drivers toward Ghana's cocoa and shea production network biodiversity sustainability upgrading

Two external drivers seek to push Ghana's cocoa and shea industries toward biodiversity sustainability. Firstly, institutional influencers in the form of sanctions, international agreements and trade laws (i.e. UN Sustainable Development Goals (SDGs). Secondly, consumer demand through organic, Fairtrade and cruelty-free sales trends is rising across cosmetics and confectionary markets. This section examines the approach to implementing global change toward biodiversity sustainability via multiscalar initiatives such as the UN SDGs, the Aichi Biodiversity Targets (ABT), and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystems Services (IPEBS) Global Assessment on Biodiversity and Ecosystem.

These agreements and recommendations are meaningful to this research as they are major external drivers for upgrading Ghana's cocoa and shea production network. They form the foundation from which Ghana's Cocoa and Forest Initiative (CFI) agreement was built. The CFI is a public-private partnership whose purpose is to achieve the goals outlined in the SDGs and aims to achieve targets from ABT (Cocoa and Forest Initiative (CFI), 2017) and will be discussed in section 4.1.4. The CFI is an example of a contextualised agreement between the government of Ghana's COCOBOD and private actors, including Co. 1. This is an example of the fractal scale at work with the global institutions implementing change throughout the network via the nodes and branches of other powerful actors. In the CFI, we also see pushback from the nodes of government and powerful private actors, which play upon the larger framework institutions in its adaptation to meeting standards at a rate and in a manner that potentially holds the most negligible impact on smallholder farmers and the highest potential returns for all actors involved.

Finally, this research seeks to include the nodes of the farmers within the scale of the conversation of achieving biodiversity sustainability. The many small nodal actors of smallholder farmers bring the fractal to life by producing the commodities that are transformed into goods and used in services provided. Therefore, it is necessary to include these actors in considering achieving biodiversity sustainability. Standards, certifications, and sanctions created at the global level inform action taken up at the supplier level, with little practical application taken into consideration in terms of the resources, knowledge, and capacity of the farmer meant to implement these standards and regulations (LD 3; GHI 49; GHI 50; GHI 76). Exacerbated by the price squeeze whilst global demands for these commodities continue to rise, farmers find themselves stuck between the rock of participating in the production network, which requires adherence to these standards (or the appearance thereof), and the hard place of lacking knowledge and resources whereby the farmer is forced to choose between sustainable cultivation practices and meeting livelihood needs (Goehler *et al.*, no date; Perfecto *et al.*, 1996; Rice and Greenberg, 2000; Anderson Bitty *et al.*, 2015a; Glin, Oosterveer and Mol, 2015; Wessel and Quist-Wessel, 2015; Higonnet,

Bellantonio and Hurowitz, 2017). Integrating the main social aspects of livelihood, land rights, and gender inequality that correspond with biodiversity sustainability action taken, or lack thereof, moves this analysis into the holistic framework necessary for action-based research to be effective in real-life terms.

4.1.b. Ghana's biodiversity sustainability initiatives and sanctions

Multiscalar action can be seen in collective action to achieve common objectives and manage common pool resources sustainably (i.e. SDGs, ABT, and CFI). This reflects the macro-and micro-level interactions of strong and weak ties at work socially, culturally, and economically, all affecting the coordination of production networks (Granovetter, 1973; Ostrom, 1990; Ostrom, Gardner and Walker, 1994; Gibson, Ostrom and Ahn, 2000; Bowen, 2017). This research argues that a critical component in the success of multiscalar action is tapping into the agency and resources at those nodes where powerful actors hold significant power and resource which they can distribute throughout their production networks. This allows farmers to upgrade their sustainability efforts and meet growing international, national, and local standards. A result of these external drivers is Ghana's CFI agreement between COCOBOD and several major players in the cocoa industry who have cocoa production networks in Ghana for export (discussed in 4.1.d.).

These powerful actors of government and lead firms (directly) and international bodies (indirectly) impose standards of upgrading on the actors providing the labour and contributions to produce a commodity, such as the 800,000 smallholder cocoa farmers in Ghana. It is the benefit of this multiscalar approach to sustainability implementation by leveraging the power and resources of those actors who have it to upgrade the capabilities and resource access of the weaker actors. By taking the abundance of resources and knowledge from those outer nodes of powerful actors such as lead firms, governments, and NGOs and investing them into the inner nodes of smallholder farmers that, we see process and product upgrading take place throughout the production network, adapting the resources and knowledge from outside the smallholder nodes to fit the needs of those actors and reach in a

contextualised way sustainable cultivation which is mutually beneficial (Humphrey and Schmitz, 2004; Gibbon, 2008; De Marchi, Di Maria and Micelli, 2013; De Marchi, Maria and Ponte, 2013).

Further evidence for the applied holistic framework for analysis in this research is found in the IPBES 2019 assessment. According to this report, issues of biodiversity, climate change, and social inequalities play on each other and feed into the achievement or failure to achieve such goals as the SDGs (Bongaarts, 2019). From this updated report, IPEBS scholars have found that even with the structural change implemented throughout production networks thus far. Despite the external drivers pushing powerful actors to reorient production, Bongaarts (2019) submits that "Current resource mobilisation from all sources is insufficient to achieve the Aichi Biodiversity Targets. In addition, only one in five strategic objectives and goals across six global agreements relating to nature and protecting the global environment is demonstrably on track to be met. For nearly one-third of the goals of these conventions, there has been little to no progress to them, or, instead, movement away from them (p. 15)." This is concerning as public engagement from powerful actors such as the government and lead firms can lead consumers (and other powerful actors such as government, international bodies, and investors) to believe that production is on track to or has achieved biodiversity sustainability (Glasser, 1995; Higonnet, Bellantonio and Hurowitz, 2017).

The biodiversity factors considered in IPBES are "the planet's biodiversity, ecosystems and the contributions they make to people, as well as options and actions to protect and sustainably use these vital natural assets (Bongaarts, 2019, p. 2)". These focus on

nature's contribution to human existence and well-being, and its current state of decline as a result of human action, as well as the unequal access to natural resources and the benefits drawn from nature by different socioeconomic groups direct and indirect drivers of these changes/deterioration of the environment; and the current forecast of achieving 2030 global initiative goals of sustainability based on current trends and trajectories (Bongaarts, 2019).

Specifically, the 2019 IPEBS Assessment found that over the last five decades, agricultural production has continued to increase while the regulation of nature's contribution to this production has decreased across 14 of the 18 categories considered in the assessment (Bongaarts, 2019). IPEBS submit that "since 1970 raw timber harvest has increased by 45% . . . with the forestry industry providing about 13.2 million jobs. However, indicators of regulating contributions, such as soil organic carbon and pollinator diversity, have declined, indicating that gains in material contributions are often not sustainable (Bongaarts, 2019, p. 11)." The fact that the depletion of Ghana's agricultural biodiversity continues to increase while the recuperation of biodiversity contributions continues to decline as linked to the studied environmental and social aspects highlights the necessity of this research.

It is by understanding the power and relationship dynamics at work throughout the actor scale in Ghana's cocoa and shea production that practical solutions to biodiversity sustainability may be found, evidenced by the successful implementation of said efforts throughout a production network and the positive results of these systems for both biodiversity and weak actors (LD1; LD 2; LD 6; GHI 74a; GHI 74b). The 2019 IPEBS assessments highlight the current failure of biodiversity sustainability implementation efforts and support the innovative approaches by Co. 1 & 2, the Ghanaian government, and NGOs through the CFI initiative. This research seeks to understand the multiscalar processes taken in Ghana's cocoa and shea sectors, which can then be reflected at a higher level of scale elsewhere, potentially contributing to a systemic shift closer toward biodiversity sustainability.

The findings of the IPEBS 2019 assessment report reflect the growing concerns which result in such accords as the ABTs and the SDGs in production and resource management. Current efforts must be drastically transformed to achieve sustainability goals, ensuring access to resources for future generations and their ability to achieve health and well-being via nature's contributions (Bongaarts, 2019). This global pressure is seen in the transformation of production networks such as Co. 1's in this study, whereby powerful actors, such as the lead firm and the government, expand their involvement with weaker actors as farmers, and provide the necessary resources

and inputs otherwise inaccessible by farmers, to enable the achievement of sustainability goals (See Chapter 5). Response to international standards like IPEBS, Fairtrade and organic certification is how actors seek to achieve biodiversity sustainability goals. Other answers are found in high-power actors' involvement in providing the training and resources required for weaker actors to achieve environmental upgrading (GHI 74a; GHI 74b).

The indirect drivers of international pressures and potential exclusion from such necessary resources as international funding and assistance press upon government bodies (Anim-Kwapong and Frimpong, 2004; Chalfin, 2004). These, in turn, assert their influence upon other powerful and weak actors of lead firms and farmers. The level of agency held by each level of actors presents levels of pushback or cooperation with these direct and indirect drivers. Considering this complexity and overlapping of push and pull between multiple levels of actors, we can move toward mutually equitable production and access to livelihood and well-being by all actors participating in production networks. To this end, this analysis is focused on understanding how different levels of actor scale influence a given actor's capacity and commitment to achieving biodiversity sustainability in their production practices. Specifically, this research studies the effects of the differences in agency and power at different levels of scale through the lens of three levels of actors operating in Ghana's cocoa production networks: a lead firm (Co.1), the government (via COCOBOD), and farmers. For shea, this study considers four levels of actors operating in Ghana's shea production networks (to varying degrees): a lead firm (CO. 2), the government (via the ministry of agriculture/COCOBOD), NGOs, and collectors/processors.

This study does this by pursuing the following factors:

a) A mapping of Ghana's cocoa and shea production,
b) The lead firms' (Co. 1 and 2 included in this thesis) production network dynamics' influence,
c) The influence of direct and indirect drivers and

d) The subsequent experience and relative success of cocoa farmers who carry out the actions in production practices to meet sustainability goals

In instances where biodiversity sustainability is suffering in the selected studied aspects, there can be significant implications to how classic GPN coordination attempts to achieve biodiversity sustainability.

This analysis argues that the influence of factors external to 'environmental sustainability practices', namely social sustainability issues, is a significant and overlooked aspect of successful GPN coordination toward biodiversity sustainability. The evidence for this claim is found in the themes of powerful actors (lead firms, government bodies, international institutions) seeking to disseminate biodiversity sustainability standards throughout production networks, where weaker actors (cocoa farmers, shea collectors) cannot meet these demands. This study has found that this is primarily due to the preoccupation of a farmer's survival taking precedence over using sustainable practices in production and lack of access to resources. When a farmer is pitted between meeting the basic livelihood needs of themselves and their household whilst meeting growing industry standards, biodiversity sustainability is often undermined, especially in such production networks as cocoa, where there is a high degree of labour-intensive production on the lower levels of actor scale with the least value-added, and a disproportionate gain capture in consumer-end manufacturing which is significantly lower labour and environmental impact (Higonnet, Bellantonio, & Hurowitz, 2017; Voice Network, 2015; GHI 70, 74a, 75, 78).

4.1.c. Fairtrade and organic certification

While Fairtrade, organic, and Rainforest Alliance certified cocoa and shea are sourced from Ghana and potentially sourced by Co 1 and 2, it was unable to be confirmed directly by respondents from both firms whether suppliers providing these certified commodities are in Ghana specifically. As the responses from both Co. 1 and 2 respondents held that they could not confidently say what percentage of Ghanaian-

sourced cocoa and shea is certified, it is not explicitly pursued in this research. However, these certifications are reviewed here as they are present and utilised by both firms to some extent. Further discussion of fairtrade and organic certification can be found in Appendix B.

One example of the use of Fairtrade certification in Ghana is Kuapa Kokoo Ltd. (KKL), a cooperative of cocoa farmers certified Fairtrade in 1995 and seeking to produce ethically sourced cocoa (Kuapa Kokoo, no date; Fairtradelabel.org, 2012). KKL is partnered with government, private and third-sector actors to achieve its objectives: "Provide a medium for the social, economic, and political empowerment of cocoa farmers. Enhance the participation of women in the decision-making process at all levels of operation and organisation. Encourage environmentally sustainable cocoa production processes."

This is a clear example of the multiscalar, inter-network relationships studied in GPN and GVC literature. It can also provide insight into how private and NGO entities can disseminate their power throughout the production network to achieve sustainable cocoa production. In addition, understanding the influence such groups as Fairtrade and KKL have may bring insight into how other private firms such as Co. 1 and 2 may coordinate their networks toward biodiversity sustainability and can provide a benchmark comparison for the effectiveness of models between the firms and such bodies as Fairtrade and KKL, as well as offer any insight to partnerships that the lead firms may have with these groups.

4.1.d. Ghana's application of global initiatives and drivers: Cocoa and Forest Initiative

An actor's level of scale in a production network can significantly affect their agency and ability to increase value capture (Coe *et al.*, 2004; De Marchi, Di Maria and Micelli, 2013). For example, farmers, restricted by a low 6% value capture, cannot achieve the SDGs and IPEBS standards, despite doing the hands-on work to bring the raw material to market, leading firms to capture 35% of value capture (Higonet, Bellantonio, &

Hurowitz, 2017). A response to external drivers such as SDGs and IPEBS recommendations is Ghana's and Côte d'Ivoire's Cocoa and Forest Initiative (CFI).

The CFI agreed in conjunction with each government body, as well as private actors operating in the cocoa industry in these countries, including Co. 1, shows the embodiment of global external drivers such as SDGs and IPEBS translated into the context of the production networks producing this commodity in the respective countries participating. This is a clear example of the external drivers that influence various actors' 'constellation of priorities' (Krauss, 2017) and the linkages between actor scale and capacity for upgrading. This research maintains that multiscalar cooperation in Ghana's cocoa industry is critical to achieving biodiversity sustainability in Ghana's cocoa production networks. Reflecting such scholars' work as Perey (2014) and Ostrom (2012), this approach can capitalise on the varied levels of power operating throughout the actors' scale, lending power to those actors who cannot achieve sustainability independently (Bongaarts, 2019; De Marchi, Di Maria, et al., 2013; De Marchi, Di Maria, & Ponte, 2013).

Ghana's government, through COCOBOD, holds significant power over the coordination of the country's cocoa production networks and expresses this control through such mandates as the CFI, calling for scaling up environmentally sustainable cocoa production through a public-private partnership with those lead firms active in Ghana's cocoa production networks. The mandates outlined in this framework include the following:

a) Updated mapping of Ghana's forest cover and land use.
b) Farmers' socioeconomic standings.
c) Traceability from farm to first purchase.
d) Increased investment from government and private actors toward "provision of improved planting materials, training in good agricultural practices, and development and capacity-building of farmers' organisations.

Sustainable livelihoods and income diversification for cocoa farmers will be accelerated through food crop diversification, agricultural inter-cropping, development of hybrid agro-forestry systems, and other income-generating activities designed to boost and diversify household income while protecting forest (Cocoa and Forest Initiative (CFI), 2017, p. 1-2)."

A goal of the CFI is to increase production output on "less land" (Cocoa and Forest Initiative (CFI), 2017, p4). The CFI proposes that this partnership find innovative ways to utilise the land already growing cocoa in a more sustainable manner that increases yield potential, thereby negating the need to move further into the forest or smuggle from forested areas or neighbouring Côte d'Ivoire.

Lead firms that have signed onto the CFI are to meet the initiative goals, as well as open knowledge and practice sharing, which is taking place between COCOBOD and Co. 1. This partnership is communicated as key to achieving biodiversity sustainability goals in Ghana's cocoa production network (GHI 75; GHI 49; GHI 74 a&b; LDI 1; LDI 3). Of course, neither level of actors can provide all the knowledge and resources necessary for a given production network to achieve sustainability goals; however, the combined expertise and resources of government, lead firm, and NGO- level actors provide a significant opportunity for achievement.

This outlook, reflected in this research's interviews, concurs with scholars' calls for polycentric, multiscalar approaches to governance (Bowen, 2017; De Marchi et al., 2013; Gibson et al., 2000; Nagendra & Ostrom, 2012). This research proposes that, as is seen across multiple industries and levels of issue scale, the larger scale complexity necessitates non-linear approaches to sustainability. This research supports these scholars' findings, confirming that for Ghana's cocoa industry, a multiscalar, polycentric approach being taken shows initial signs of positive implementation and potential for high positive return in achieving biodiversity sustainability throughout Ghana's cocoa production network.

COCOBOD is engaged in providing many of the resources and action points from the CFI and using its influence and position to influence private actors to a) sign up for the initiative and b) invest in their ways to achieve the sustainability goals laid out in the CFI.

Government investments have come in the form of input distribution and training, provided by COCOBOD directly to farmers and through sharing knowledge and allocation inputs for private actors, such as Co. 1, to distribute to their production networks (GHI 74 a&b, 75). This study argues that the government's capacity to move through the industry and its resilience to the volatile nature of both the global cocoa market and increasing global demands for environmentally sustainable production enables this powerful actor to invest the necessary resources (albeit in part funded by international bodies, the government still has access to these funds, unlike many smallholder farmers). The government is influenced by other powerful actors, such as those international funding bodies whose influences catalysed the restructuring of Ghana's agricultural industries in the 1970s-1990s (Mintz, 1985; Jaffee, 1994; McMichael, 1994; Schaffer, 2002; Chalfin, 2004)

4.2 Ghana's agricultural history

4.2.a. Potted History of cocoa in Ghana

Ghana's cocoa sector plays a significant role in the global cocoa industry. Being the second largest exporter of cocoa and top shea exporter, these two sub-sectors of Ghana's agricultural sector play a significant role in the country's economic development (Addaquay, 2004; World Bank, 2018). Ghana's cocoa industry is crucial to its economy, accounting for more than 9% of the agricultural industry's GDP (Anim-Kwapong & Frimpong, 2004; Bills, 2012). Due to the significance of the cocoa industry, the effects of unsustainable production and the shift toward cocoa substitutes can significantly affect the country's economic well-being and its smallholder farmers in both sectors.

A comparison of two reports by the World Bank (2011 and 2018) shows the positive outlook for Ghana's cocoa sector projected in 2011, while still maintaining significant

potential, has seen little change to achieve full potential in 2018. This reflection supports the findings of the 2019 IPEBS assessment at the global level. The interaction of international and local issues is reflected in the market and industry trends toward or away from biodiversity-sustainable production and the national response (CFI) to global mandates (SDGs, ABTs, etc.) (Hanson et al., 2011; Addaquay, 2004; World Bank, 2011; World Bank, 2018; Bongaarts, 2019).

The historically government-led agricultural industry was partially privatised in the 1980s-90s to secure external funding and resources and to stabilise and secure its participation in the global agricultural commodities trade (Chalfin, 2004). This period of public control was followed by a burst of privatisation across the agricultural industry, initially without exception, followed quickly by a recalibration whereby the cocoa sector was brought back under partial government control in 1993 while still meeting external actor demands control and sustainability implementation (Chalfin, 2004; Donald, 2004; Clough, Faust and Tscharntke, 2009; International Cocoa Organisation, 2010).

The privatisation of cocoa directly responded to International Monetary Fund (IMF) and World Bank (WB) stipulations on accessing financial assistance. However, unlike neighbouring countries that accepted full privatisation of their cocoa industries, Ghana adopted the partial-privatisation approach to maintain government control whilst meeting these external demands (Ofosu-Asare, 2018). This multiscalar approach via public-private partnerships and the partial privatisation of the cocoa sector via the introduction of Licenced Buying Companies (LBCs) is being used. This maintains financial aid from global institutions such as the WB and supports the production networks by combining those more powerful actors' knowledge, resources, and agency to enable farmers to achieve biodiversity-sustainable production.

The history of the cocoa sector flip-flops from publicly run to privately held and back to a more publicly semi-privatised state. It is essential to understand that the cocoa sector historically and currently is treated with special attention among Ghana's

agricultural industry sectors (Chalfin, 2004; Addaquay, 2004; Ofosu-Asare, 2018; GHI 50; GHI 70; GHI 73). In contrast, the shea sector suffered significant resource cuts, nearly complete privatisation of the industry, and a hands-off approach to coordinating the shea sector by the Ghanaian government (Chalfin, 2004). From this viewpoint of history, this research situates its analysis, considering key factors that help or inhibit achieving biodiversity sustainability goals. The hands-on approach and incorporation of lead firms into the coordination of the cocoa sector are crucial in attaining biodiversity sustainability between cocoa and shea. This research seeks evidence of how these approaches affect the respective sectors toward achieving biodiversity sustainability in cocoa and shea production.

4.2.b. Biodiversity loss in cocoa and response

Further to biodiversity implications discussed in chapters 2 and 3, specific biodiversity threats for Ghana's cocoa industry are pests and disease, the exacerbation of which is seen in the results of deforestation and non-shade cultivation practices. Three significant issues within pests and diseases affect the biodiversity sustainability of Ghana's cocoa farms resulting from these practices (*Ghana Cocoa Board Official Website*, no date; Ameyaw, Dzahini-Obiatey and Domfeh, 2014; Akrofi *et al.*, 2015).

a) Black pod disease is a fungal disease which can affect every part of the plant (pod, leaf, stem, branches) at every stage of growth (seedling, flowers, cherelles, immature, mature green, and ripe pods) (Akrofi *et al.,* 2015). This disease can cause 100% crop failure if left unchecked, the effects of the disease-causing a 25% (212,500 MT of the 850,000 MT) loss of product in Ghana in 2012 (COOCBOD, 2014 as cited in Akrofi *et al.,* 2015).
b) Mirids/Capsis are second to black pod disease. Mirids are pests that feed on cocoa pods, shoots, and seedlings. Direct damage caused by these insects can result in the dieback of young plants and deformed and shrunken pods in mature plants. Indirect damage is caused by fungal growth of the wounds caused by mirid feeding (Fact sheet - Cocoa mirids (274), nd).

c) Finally, cocoa swollen shoot virus disease (CSSVD) can affect every stage of cocoa plant growth and is spread during the feeding of mealybug species on cocoa plants. This virus can be seen in all plant parts but is noted by stem and root swelling. It can cause up to 70% yield reduction in a plant and cause plant death within 2-3 years from infection (Ameyaw, Dzahini-Obiatey and Domfeh, 2014).

Ghana's government's response to industry coordination is found in the Ghanaian cocoa board, COCOBO. The various divisions and subsidiaries comprising COCOBOD are intended to provide different services to cocoa producers, coordinate cocoa processing from farm to export or manufacturing, provide pest and disease control programmes, education and, farm tools resources and training through its subsidiaries and divisions. As this research cannot evaluate all seven subdivisions of COCOBOD, an in-depth focus will be on the Seed Production Division (SPD) and the Coco Health and Extension Division (CHED), which will be taken up in Chapter 5. These subsidiaries highlight the practical implementation of planned coordination efforts such as the CFI. This is seen in CHED's spraying programme and SPD's seedling distribution, for example. It is important to note here that the selection to pursue CHED and SPD analytically is the focus of tracing the process of implementing biodiversity sustainability throughout Ghana's cocoa production networks.

According to the COCOBOD publication, there are five subsidiaries within the organisation:

1. Cocoa Research Institute of Ghana (CRIG): This subsidiary's objectives are "to provide the farmer with a package of husbandry practices/technology for realising optimal yields and high economic returns under environmentally friendly conditions (COCOBOD, 2018)." CRIG does this through research on pest and disease control, soil fertility and agricultural practices for cocoa, coffee, shea, kola, and cashew.
2. Seed Production Division (SPD): The SPD aim is "to multiply and distribute high-quality cocoa and coffee planting materials most efficiently and cost-

effectively in adequate quantities to farmers (COCOBOD, 2018).” It distributes hybrid, and shade tree seedlings to farmers via 27 cocoa stations and four coffee stations set up throughout cocoa and coffee-growing regions. The seedlings distributed are propagated based on research undertaken by CRIG regarding cocoa trees and an "established bi-clonal seed garden" for coffee (COCOBOD, 2018).

3. Cocoa Health and Extension Division (CHED): CHED provides "the control of cocoa swollen shoot virus disease, rehabilitation of old and unproductive cocoa farms and extension services (COCOBOD, 2018)." CHED does this through surveys, disease treatment, replanting assistance (utilising a disease-resistant hybrid manufactured by SPD), and reinspecting treated and replanted farms.
4. Quality Control Company (QCC): "QCC is responsible for inspection, grading and sealing of cocoa, coffee and sheanut for the local and international markets and also responsible for fumigation and disinfestation of produce (COCOBOD, 2018)." QCC evaluates cocoa against the standards set in the International Cocoa Standards and also evaluates exports of coffee and shea (COCOBOD, 2018).
5. Cocoa Marketing Company (CMC): The CMC, or QCC, "is responsible for inspection, grading and sealing of cocoa, coffee and sheanut for the local and international markets and fumigation and disinfestation of produce." The CMC focuses on the image of Ghana's cocoa sector, setting itself as a global leader in cocoa.

COCOBOD charges tax for exported cocoa, so it would make sense for the board to also ensure that the quality standards of exported cocoa are met. According to COCOBOD (2018) and World Bank (2011, 2018) publications, what margin of profit COCOBOD received is utilised to further COCOBOD's programmes and ability to provide farmers access to knowledge and resources necessary to produce quality cocoa. As better tree husbandry and eradication of pests and disease is part of this effort, this overhead is partially given toward these ends. While this research cannot investigate this claim further, it is a significant factor in understanding the capacity for

upgrading and implementing biodiversity sustainability throughout Ghana's cocoa and shea production networks.

A consideration here is one of the setbacks to achieving biodiversity sustainability, which is low-paid farmers' financial inability to achieve sustainability goals while also realising the highest yield potential from their trees – an economically necessary result if they are to ensure sustainable production practices. This speaks to the importance of understanding the level of effectiveness of such programmes as SPD and CHED to implement sustainable farming practices and the outcomes of such programmes regarding biodiversity impacts on the habitat in which cocoa is cultivated, and yield impacts to cocoa trees and economic implications for farmers to continue sustainable production.

According to some primary and secondary data, the five branches of COCOBOD operate in conjunction with lead firms and NGOs to coordinate the logistical side of delivering the training and resources distributed by the different COCOBOD subsidiaries, exemplifying the multiscalar action this research supports (Asuming-brempong *et al.,* 2015; Glin *et al.,* 2015; LD 1; LD 2; GHI 49). The practical ways these production networks are coordinated, the interaction between lead firm-government, lead firm-farmer, and government-farmer within the different modes of engagement the various actors have with the sectors provide the primary mechanism for understanding the process which, according to the actors interviewed, can lead to a mutually beneficial and biodiversity sustainable cocoa and shea production network within Ghana. These frameworks and programmes may shed light on transferrable approaches utilised in neighbouring countries that share similarities in biodiversity sustainability issues, culture, language, and resource access. They can also feed into the global conversation and provide insight and guidance for other global production networks that share similar environmental issues. The uniqueness of addressing social issues alongside ecological issues provides a multiscalar approach, such as this; the ability to be tailored to a specific context and manage various problems in different settings because of its polycentric approach.

This research will compare the government's perspective and experience in using its power to influence the industry toward sustainability with the knowledge and views of the lead firm in its spheres of influence and the smallholder farmers' experience and perspective of being on the receiving end of the network. This is geared to answer both the theoretical questions of production network coordination regarding the relationships, power and drivers pushing and pulling toward sustainability and the practical implications of achieving biodiversity sustainability for suppliers of firms like Co. 1 & 2. This achieves this research's goal to offer theoretical and practical insight in a multiscalar approach to this examination.

4.2.c. Mapping Ghana's cocoa production network

The complexity of Ghana's cocoa industry is evidenced in the complex interaction at different levels scale that cocoa goes through between public and private nodal actors. The mapping of Ghana's cocoa industry requires multiple sources, as shown above, as each source did not cover all aspects of the network. COCOBOD has inserted itself in the most crucial points of the production network. The first and foremost important player would be argued, by this research, to be the farmer, without whom there would be no material to trade, process, or export. That being said, it seems evident in this document and the readings from this initial research that, like many other industries, the first level of supply (farmers) tends to be the weakest actor and the least compensated for providing the most foundational job (Bolwig *et al.*, 2010; Higonnet, Bellantonio and Hurowitz, 2017).

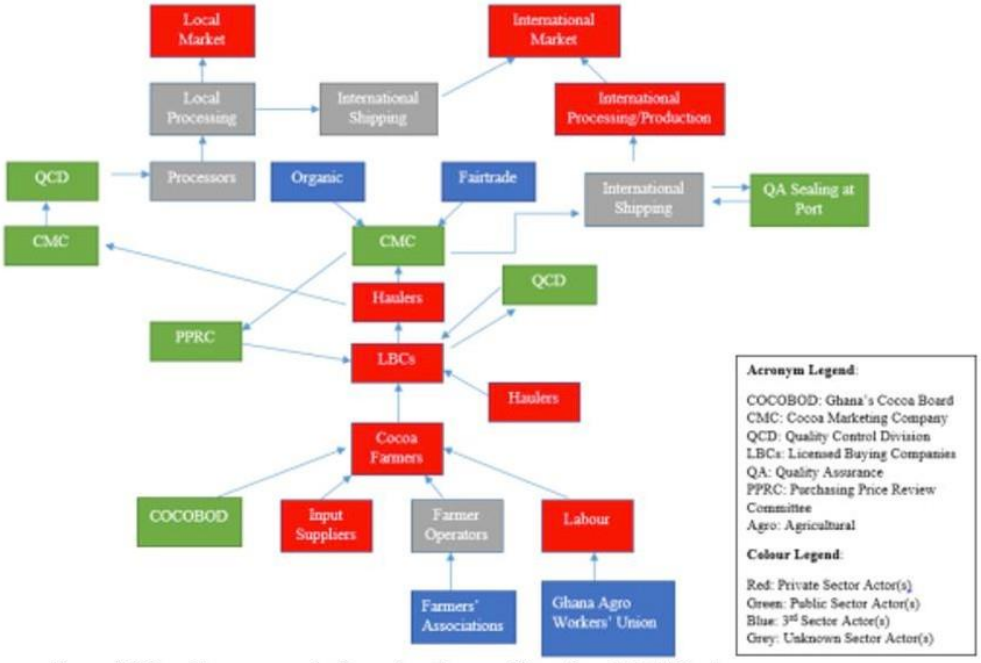

Figure 5. Ghana's cocoa production network map. Taken from World Bank (2011; 2018) and Asuming-Brempong *et al.* (2015)

The inter-network relationships between COCOBOD and farmers, COCOBOD and intermediaries, and COCOBOD and lead firms are evidenced in Figure 5 above as COCOBOD's subdivisions Cocoa Marketing Company (CMC), Quality Control Division (QCD), Purchasing Price Review Committee (PPRC), and Quality Assurance (QA) Sealing at Port that process the cocoa to be sold to processors or shipped internationally between the point of sell to LBCs and either processors or shipping destinations. There is also COCOBOD involvement with farmers through the subdivisions such as SPD and CHED, as discussed in Sections 4.1 & 4.2.

The multiscalar interaction between private, public, and 3rd sector actors is evident in the mapping of Ghana's cocoa sector as shown in the processing of cocoa from LBCs/Haulers through CMC/QCD and back, from Organic/Fairtrade parties through CMC to PPRC, back through LBCS/Hauler, through CMC/QCD again, then on to processors/international shipping. Should local processors and international shipping, which are currently unidentified in ownership structure, be found to belong to Ghana's government as well, this would be an added level of government involvement and another layer of interaction between local and international firms and

certification bodies. This speaks to the integrated conceptual framework and power interplay levels examined in this research.

While the publicised purpose of COCOBOD is aimed at achieving environmental and social sustainability in specific agricultural production sectors, it is essential to remember that the instigation of this public-private approach came from global drivers pressing upon Ghana's government to meet international industry standards (Addaquay, 2004; Chalfin, 2004). This history of Ghana's cocoa sector is connected with and greatly influences the shea sector. During the industry reforms in the 1980s, the shea sector was released fully from government control to meet global pressure to reform the agricultural industry (Chalfin, 2004).

This feeds into the environmental and social issues faced in the shea sector discussed below and exemplifies the structural influence from the outer layers of international bodies upon the national government nodes, who push back to tailor the standards to fit the industrial context, and, finally, the smallholder farmer nodes being most affected via the implementation of these standards which trickle down from the external structure. This is important to my focus on the relationship and power dynamics that move the coordination of the production network and give insight into the issues feeding shea's unsustainable status.

4.2.d. Potted history of shea in Ghana

Ghana is vital in the shea market, producing 55,000 tonnes of shea nut annually, with exports of 40,000 tonnes, the largest importers of these products or raw materials being Great Britain, the Netherlands, Denmark, North America, and Japan (Addaquay, 2004; Elias & Carney, 2007). Co. 2 researched here sources shea from women's cooperatives in Ghana (*Exporting shea butter for cosmetics to Europe*, 2019; LD 5). While this is a significant amount of shea being collected and processed, another study found that in the cohort of female collectors/processors of shea studied, 51% of the shea butter made was used locally (Naughton, Zhang and Mihelcic, 2017). Other studies confirm the high use of shea butter locally, with local shea trade stretching

back thousands of years, with one finding that 45% of shea kernels are processed for local marketing within West Africa (Lovett, 2004). The traditional estimate is between 57% and 41% (Lovett n.d. as cited in Reynolds, 2010)). These facts lend to the shea's national and global importance – with the demand for global shea continuing to increase due to its uses in cosmetics, confectionery, and healthcare. Shea's trade value should equate to the care taken in looking after the environment shea trees grow in and the physical labourers who collect and process the fruit into kernels and butter sold to local and international markets. Without these two foundational actors – the environment and the collector/processor, the shea industry would end, affecting not only the local and national consumers of shea but also the global consumers purchasing health, skin, and dietary items that use shea, as discussed above. This research aims to investigate the action taken to preserve and promote biodiversity sustainability aspects through the studied production network in Ghana, with the consideration of social sustainability aspects taken up to understand more fully the actual state of sustainability of Ghana's shea production network as experienced by the labourers keeping the industry alive.

As a push to decrease carbon emissions through reducing fuel wood consumption continues, shea is left again from considering government intervention. As Chalfin (2004) discusses, government resources and engagement was taken from agricultural sectors such as shea and reallocated to the cocoa sector, a way of the government maintaining the most control over the industry, which was prioritised as the most economically impactful and recalling the interventions from other sectors such as shea to maintain access to international funding from businesses such as IMF and World Bank.

A further study speculates that "with an estimate of 500 million productive trees, an annual production of dry kernel across the whole range of this species may exceed 2.5 million metric tonnes (Lovett, 2005)". As can be seen here, the studies already conducted around different aspects of shea growth, collection, processing, and trade cannot accurately calculate the amount of shea being collected, processed and sold internationally and locally due to a general lack of research on shea. Citing Lovett

(2004), Naughton, Lovett and Mihelcic (2015) submit that of the total viable shea trees that could be harvested, only 42% of shea kernels are collected due, in large part, to access to trees (e.g., those trees located in national parklands). This can be a determining factor in a collector harvesting from protected areas or smuggling shea nuts from other places to compensate for the loss of accessible trees from which to harvest.

This is important as one of the issues in sustainable harvesting of such ingredients as cocoa, and shea can become the overharvesting of these crops without proper biodiversity preservation for future crop and species generations. This gap in the literature was confirmed by academics interviewed in Chapter 6. All respondents spoke of the need for more research to be done in all aspects of shea as an agricultural commodity, with one academic and leading spokesman to the government COCOBOD on issues of shea reporting that not a single study has sought to track the number of shea trees that exist and bear fruit in northwest Ghana, nor how many of these trees are accessed for shea kernel collection (GHI 73). This deficiency highlights the need for research to fill the gaps currently in shea production. While this research cannot fill all the holes in the literature, it seeks to contribute to the growing evidence of the need for such further study and the ever-increasing body of knowledge surrounding shea production.

It is important to note here that, as Ghana's agricultural industry went through its most recent infrastructural changes after cocoa was brought under more government control, the resources and workforce needed to achieve this shift back toward cocoa, were taken from other agricultural sectors, including shea (Chaflin, 2004). This lack of government assistance and coordination has exacerbated the environmental and social issues present in the shea sector. Consequently, this research is considered a leading source of biodiversity loss resulting from shea production (Chalfin, 2004).

Given the fluctuating history of government involvement in this sector, there remain significant gaps in knowledge regarding the extent of the government's current involvement in the industry. Simultaneous to the independent nature of the sector is

the feminisation of the shea industry at a global scale, which is seen in Ghana as well (Chalfin, 2004; Elias & Carney, 2007). Accordingly, the social issues around gender equality, land rights, and access to independent livelihood come into play. Studies show that shea is collected and sold in the form of the kernel and shea butter by women in some regions such as Burkina Faso, a protected right for female access to shea trees (Elias & Carney, 2007; Rousseau et al., 2015). This feminisation of the industry globally, having roots in the historical feminisation of the commodity and the lack of government involvement in the shea sector in Ghana specifically, is crucial to this research as it identifies two unique points of analysis compared to cocoa. First, while cocoa is a male-dominated sector in Ghana, there are female market entrants, and the shifting global gender roles and ideas of equality have become essential in cocoa's context. The comparative analysis of the approach to coordinating a feminised agricultural commodity offers unique insight potential for the cocoa sector and its uptick of female participants.

4.2.e. Biodiversity loss in shea and response

While not as significantly impactful as cocoa production, shea production presents potential threats to biodiversity preservation. Shared issues of land rights, smuggling, and illegal harvesting of shea nuts are issues in this industry, just as they are in the cocoa industry. However, the focus of this study will not include smuggling due to the lack of information available on clear land delineations and shea tree population.

Alongside these comparative issues, there is a unique potential biodiversity threat in shea production found in waste by-products created during processing shea nuts into ingredients such as shea butter sold on the market. These waste by-products include black sludge and wastewater, carbon emissions, and water consumption; all produced while processing a shea fruit into the nut and then further processed into shea butter (Ofosu, 2009; Jibreel et al., 2013).

Harmful chemical inputs used in cultivation and issues of land rights are present in current research on shea production, as they are in cocoa, but are an indirect threat

as these biodiversity issues are enacted upon the land by other agricultural practices which are the domain of men and where women and their work have been considered inferior (Davison, 1988; Chalfin, 2004; Elias and Carney, 2007; Bello-Bravo, Lovett and Pittendrigh, 2015). Bush burning is used to clear land to prepare for planting season and hunting (Chalfin, 2004; The World Bank, 2010; Yaro, 2013). Land clearing is caused by farm expansion, mining activities, and the construction of roads and urban development (Chalfin, 2004; Peters, 2006; Naughton, Lovett and Mihelcic, 2015). Climate changes such as shifting rain patterns, Sub-Saharan desert expansion, and drought also significantly affect shea (Imperatives, 1987; Thomas and Nigam, 2018; Wright, 2018; Chettri *et al.*, 2019a). Unlike in the cocoa sector, the negative impact of indirect unsustainable practices is seen.

Direct impacts on the environment from shea are found in the processing from nut to butter which traditionally consumes large amounts of fuel wood (resulting in both overconsumption of timber and CO2 emissions) and water, and the waste by-products (Glew & Lovett, 2014; Jibreel et al., 2013). Rural shea processing accounts for approximately 50% of rural fuel consumption during shea processing season and produces higher Greenhouse Gas (GHG) emissions than urban processing (Jasaw *et al.*, 2017). Considering that the biodiversity sustainability of shea is an essential line of inquiry as the distinction between cocoa and shea. Many issues pursued in cocoa directly result from cocoa and other agricultural practices. Shea being a receiver of these negative externalities, the action needed to implement biodiversity sustainability in shea might impinge on the implementation of biodiversity sustainability in other agricultural sectors. A significant part of addressing biodiversity sustainability in shea is finding ways to protect habitat and a species that is recipient to unsustainable practices and lacking the necessary protections for shea to balance this out. This research will focus on how CO. 2, the government of Ghana, NGO actors and female producers are addressing these issues alongside the efforts to eradicate the unsustainable practices found in shea processing.

An additional issue introduced in this case study is the effects of the natural cross-pollination of the different indigenous shea tree types and resulting hybrid tree

effects (GHI 72; GHI 73). At the time of the first round of interviews in Ghana, academic respondents discussed the lack of overall research invested into understanding the current state of the shea tree population, including the effects of cross-pollination of shea tree types, precisely the two shea tree types, Vitellaria paradoxa found in West Africa and Vitellaria nilotica found in East Africa (GHI 72; GHI 73). Research has shown that there is some difference in the biological makeup of the fruit produced by paradoxa and its subspecies nilotica, particularly between levels of stearic and oleic acid, although this has been minimal in some studies (Lovett and Haq, 2000a; Gwali *et al.*, 2011, 2012). As industries turn towards such substitutes as shea butter, this brings new tension points:

1. Maintaining the livelihood of those supplying cocoa products while shifting demand away from cocoa and toward shea products.
2. Ensuring the sustainable production of shea products will enable the longevity of the trees from which these products are sourced.
3. The level of involvement necessary for the currently threatened habitats of cocoa production sites to rehabilitate these areas and the affected endemic species.

By studying a firm such as Co. 2, this research will aim to understand the benchmarks, tools, and network coordination efforts utilised to achieve this.

Where the focus for cocoa's sustainability is the rehabilitation of biodiversity, shea presents a before-picture of sustainability efforts and can provide insight as to how firms are working to ensure that biodiversity impacts of shea production remain optimistic as the industry grows, more farmers enter the market, and potentially more trees are used for commercial production. This forward-looking line of study could offer benchmarks for firms, governments, and 3rd sector actors to ensure biodiversity sustainability in producing shea and hopefully prevent such biodiversity issues in this industry as is faced in the cocoa sector.

4.2.f. Mapping Ghana's shea production network

According to Lovett (2014), shea nuts go through 4-5 stages before being delivered as shea butter to cosmetics brands, with a potential for processing kernels to butter either in Africa or internationally once the kernels have been sold to processors. Collectors sell directly in the local market as raw nuts or partially processed nuts. They also sell partially processed nuts to village-based collectors and traders or process themselves to sell as shea butter to processors or in the local market. When sold to traders, shea nut is further processed and passed through fractionators as raw butter, refining and producing the end products consumed on the global market.

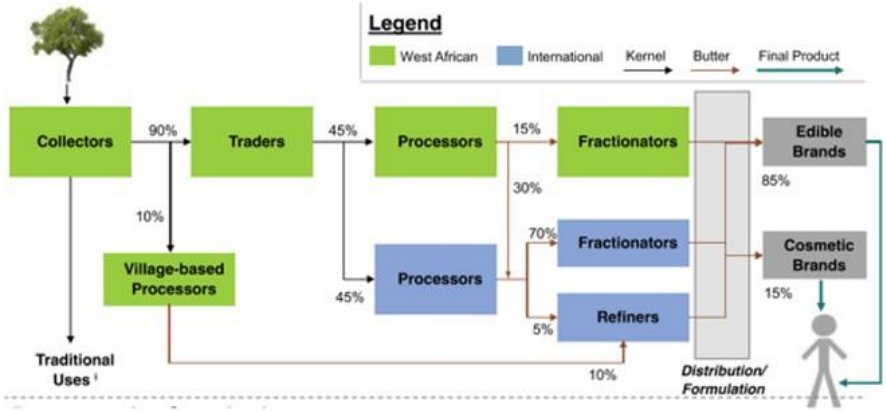

Figure 6. Ghana's shea production network map. Taken from Lovett (2014)

Lovett's (2014) depiction in Figure 6 above of shea production and export processes are like that of cocoa's production, with complex webbed production network frameworks that must be put in place by firms like Co. 2 and Co. 1 in partnership with at least COCOBOD and potentially with other actors, such as NGOs in the case of the shea sector. These firms claim to orient themselves toward sustainable production networks to the weakest actor in the network. However, many production, processing, and export levels magnify these complex relationships. Avenues of inquiry will be focused on which level(s) of production these firms work with, what systems they have in place to ensure that both large and small actors within their production network are treated fairly, and how they disseminate their environmental sustainability standards throughout the entirety of the production network.

It is interesting to note that while Lovett's (2014) value chain shows mass production and exporting for cosmetics brands, Co. 2 may have a different approach as it has marketed itself as a direct buyer in procuring its ingredients, which this research will investigate. One line of inquiry for this study will be the effect direct buying has on the women's cooperative supplying Co. 2 with all their shea butter. Cutting out the middle stages of procurement could impact the level of biodiversity efforts the firm can undertake as it potentially works in direct contact with collectors and processors of these shea kernels. This case study will seek to understand the level of involvement Co. 2, as the lead firm, has with the women's cooperative they source from, whether they invest in education and farming tools that will maintain positive biodiversity implications of shea butter production, how they implement any existing programmes; issues they may encounter implementing new sustainable cultivation and processing practices; and how they address these issues.

4.3. Current state of Ghana's agricultural industry, cocoa, and shea

Historically, the issues plaguing Ghana's cocoa and shea industries are present today. The cocoa sector is still fighting deforestation, pests and disease, premature tree death and decreasing yields. This has been a result of the non-shade cultivation practices used by farmers to increase short-term fruit yield from the cocoa trees, causing a loss of "10% of Ghana's natural forest cover between 2001 – 2014, equating to a loss of 7,000 square km of forestland (Higonnet et al., 2017)".

Some farmers interviewed reported decreasing yields for some of their trees, pointed out by the COCOBOD translator as those respondents working older farms (GHI 11 – 34; GHI 75). According to respondents from COCOBOD, Co. 1 and an academic with a history of cocoa studies, this is partly due to the lack of shade canopy due to tree felling (GHI 75; GHI 76; GHI 49). This reflects the literature, which states that direct exposure to the sun causes the cocoa tree to overproduce pods in its early years and significantly shortens viable production's longevity (Clough et al., 2009).

These issues are further entrenched by institutionalised and customary land rights and the effect this has on farmers' commitment to sustainability. As discussed in Chapter 2, land rights significantly hinder biodiversity sustainability commitment in cocoa and shea. For cocoa, there is no incentive and quite often a more substantial loss to the farmer to implement and maintain biodiversity-sustainable farming practices because they are not able to retain ownership of the land and continue to reap the benefits of the investment to create and preserve the biodiversity sustainability being sought after by powerful actors. What reason would a farmer have to invest their resources and labour for the benefit of a stranger who will rent the land after them and does not need to support the same level of resources but will gain a higher return off the back of the previous farmers' work? The added pressure of hand-to-mouth living situations under which cocoa and shea farmers/collectors live further exacerbates this uneven power and gain distribution that Higonnet et al. (2017) point out. This research seeks to understand the effectiveness of the dual-governance approach in the cocoa industry and also the hands-off approach taken in Ghana's shea industry to understand the effects of these actions on the implementation and maintenance of biodiversity sustainability across these two sectors of Ghana's agricultural industry to further the conversation calling for multi-level governance efforts and a rebalancing of responsibility based on actor power and return on industry participation.

In shea, biodiversity threats' direct and indirect drivers include bush burning, pesticide exposure, construction, mining activities, and process waste by-products. Historically, shea was processed near the home rather than in the fields, degrading the soil around the home's common kitchen area. In contrast, much of the market processing is now done at cooperative processing plants where they are available (GHI 50, 69, 70). In addition, during the home and plant processing confine by-product waste primarily to non-agricultural producing areas, the issues of run-off and pollution of water supplies in towns are present (GHI 50).

4.4. Shared Issues

4.4.a. Environmental: climate change, Sahel expansion, premature tree death

Cocoa and shea share climate change issues, desert expansion, and premature tree death. For cocoa, climate change is observed as directly and indirectly controllable outcomes by farmers in this research. Farmers interviewed believe they are partially responsible for climate change due to environmentally unsustainable practices, especially shade clearing and illegal harvesting of cocoa in protected areas. However, some aspects of climate change, mainly in rainfall patterns and Sahel desert expansion, were seen as more indirect effects of farmer practice and viewed as issues thrust upon the farmer which they need to shoulder (GHI 78; GHG 1-48).

Desert expansion is currently not an issue in shea as the species thrives in the sub-Saharan climate. However, the harsh conditions of a full-blown desert are too extreme for shea. Therefore, the continued expansion of this harsh desert climate will soon become an urgent issue for Ghana's shea sector, lending its applicability to this research.

Finally, as we know, in cocoa, premature tree death is primarily due to full-sun exposure and increased exposure to pests and disease. This premature tree death exacerbates the cocoa sector's boom-and-bust cycle (Clough et al., 2009). This research seeks to understand how the disruption of a multilateral approach to coordination affects the network.

For shea, premature tree death is also heightened by a lack of shade cover for the trees. A unique aspect of shea's premature tree death is that the clearing of shade trees is taken up by male farmers cultivating plots of land for several agricultural purposes and removing shade trees for those crops, as well as resulting from bush burning. Male farmers often take up this practice to control the weed growth around their land before planting crops. Due to the sub-Sahara's extreme heat, the method of bush burning during a dry season, and shea's susceptibility to heat, this is a significant sustainability issue for shea.

4.4.b. Social: land rights, livelihood, gender inequality

Land rights feed into biodiversity sustainability issues because most smallholder farmers (over 80%) cannot customarily own their land. Where they may have institutionalised government permission for their farmland, this can be revoked under customary law or should a shift in institutional government occur (Ubink and Amanor, 2008; Ubink and Quan, 2008; Yaro, 2010; GHI 50; 70 73; 76). This decreases farmer engagement with and commitment to the environmental sustainability of their farmland as they view it as temporary and lacking long-term returns for themselves and their children (Chalfin, 2004; PETERS, 2010).

When a farmer is pitted between meeting the basic livelihood needs of themselves and their household whilst meeting growing industry standards, biodiversity sustainability is often undermined. This is especially true in such production networks as cocoa and shea, where there is high labour-intensive production on the lower levels of actor scale with the most negligible value in return. On the other hand, a disproportionate gain capture in consumer-end manufacturing is significantly lower labour-intensive. Therefore, it can have less environmental impact due to both the resource a higher gain capture brings as well as the nature of the work at this level of the production network (Higonnet, Bellantonio, & Hurowitz, 2017; Voice Network, 2015; GHI 70, 74a, 75, 78).

Gender inequality is considered in this research as it affects participants in Ghana's cocoa and shea sectors. While gender inequality is a more prevalent issue in shea due to the feminisation of this industry, a small percentage of female farmers are present in Ghana's cocoa sector (Elias and Carney, 2007; Tsikata and Yaro, 2014a). The relationship between these issues of livelihood, land rights, and gender inequality are heavily interlinked and feed into one another, as evidenced in the literature and individual and group interviews.

For shea, gender inequality puts female collectors' lives and income at risk, with a lack of resources for protective gear and no land rights as examples. To be discussed

further in Chapter 6, the lack of government involvement and resource allocation to the shea sector results in an under-provisioned sector lacking essential safety gear and medical treatments sometimes needed during fruit collection. While in the global north, there may be questions regarding why female collectors don't provide these materials for themselves, a comparison may be sought to the like of a farmer not owning a tractor to plough their fields. This claim is unfounded in reality, however, especially where the women picking and processing shea fruit into butter are the most underpaid/weakest actor in this production network; nonsensical considering the fundamental role they play both in labour and product knowledge that has been passed down generations to the current women making up Ghana's shea production network. These facts support this research, and many others call for multiscalar approaches to production coordination. This research would argue that it is a necessity to leverage the power and resources from the stronger actors within the production network for the benefit of the entire network because when the 'weakest' actors can achieve both environmental and social sustainability, it will increase the quality, and potentially the yield of shea being sold on the global market.

In cocoa, issues in the distribution of input resources were cited by female farmer respondents. A COCOBOD respondent offered that allocation is based mainly on age, health and size of farmed land, prioritising newer/reconverted farms and bigger farms (GHG 1-10; GHG 11-21; GHI 75). Since female presence in cocoa farming only started recently, the priority to newer farms should allocate them some priority; however, these women's farms were significantly smaller than most of the farmers interviewed. Co. 1 respondents also did not have direct approaches being utilised to address gender inequality in the cocoa sector (GHI 49; GHI 74 a&b; GHI 75). Instead, the average response referred to customary land rights and the complex dual governance system overseen by the Ghanaian government to which the studied lead firm holds its network participants.

While gender inequality is not the focus of this research, it is an issue that affects the ability or motivation of female farmers to achieve and maintain sustainable cultivation practices. Therefore, it is a factor for consideration. The critical points of land rights

security and access to resources alone could resolve the significant hurdles between these female farmers and environmentally sustainable cocoa cultivation.

4.5. Conclusion

This chapter has discussed the global issues within cocoa and shea that translate into Ghana's cocoa and shea sectors. We find that in cocoa, the biodiversity sustainability issues at the international level, which translate down to Ghana, are non-shade cultivation, soil fertility degradation; loss of endemic flora and fauna species; the use of harmful chemicals; climate change in the form of longer and harsher dry seasons followed by higher levels of rain during the rainy season; shifts in rainfall patterns; and desert expansion. For shea, the issues were climate change; desert expansion, non-shade growth; and premature tree death due to non-shade growth and bush burning.

The approach to implementing biodiversity sustainability is taken up differently in each sector in Ghana, with cocoa providing a tumultuous but mainly government-involved sector with primarily high levels of government input. For shea, however, we find an equally fluctuating history but with the marked difference of a lack of government involvement and input. Furthermore, in response to the global demand for biodiversity sustainability in production, Ghana's cocoa sector currently takes a multilateral approach to coordination. In contrast, the shea sector is mainly left to lead firms and NGOs to coordinate and implement sustainable practices.

The analysis pursued in this research seeks to understand the effects of these different approaches on their respective sectors, taking the contextual analysis of each industry and incorporating social issues into the study. This addresses this research proposition that sustainability implementation requires social equality to be effectively implemented and maintained over time.

In Chapter 5, an in-depth look at Ghana's cocoa sector, its actors, and coordination will be taken up. This chapter will focus on the Ghanaian government's approach to implementing biodiversity sustainability throughout its cocoa sector, the reasoning for

their approach, and the current assessment of success and longevity. This analysis considers the power dynamics and intertwined relationships which form Ghana's complex cocoa production networks.

Chapter 5 Scaling up environmental improvements in the cocoa production network: evidence from Ghana. Considering how level of actor scale affects biodiversity efforts in Ghana's cocoa production networks

5.1 Introduction

This chapter analyses the multi-scalar actor relationships in Ghana's cocoa sector, with a line of enquiry being investigated through understanding the approach of a specific multinational corporation (MNC) Co. 1, that sources cocoa from Ghana. This firm has a global production network (GPN) spanning across Europe, North America and Africa. As the Literature Review in Chapter 2 has set out, GPNs are comprised of actors at multiple stages of production, and operating at different levels of actor scale that influence and react to each other as seen in macro-level shifts and micro-nodal responses (Gibson, Ostrom and Ahn, 2000; Henderson, Dicken and Hess, 2002; Coe, Dicken and Hess, 2008; Ostrom, 2012; Perey, 2014; Yeung, 2015; Yeung and Coe, 2015; Krauss, 2017).

The levels within network scale being considered in this research are weak actors of smallholder farmers and powerful actors of government bodies, international institutions, and lead firm. Secondly, scale in this analysis considers the scaling up of biodiversity sustainability goals that have been introduced to Ghana, specifically through the public-private partnership of the Cocoa & Forests Initiative signed by both governments and private actors, including the lead firm analysed here. The key goals of this initiative are to "end deforestation and restore forest areas" highlighting "growing more cocoa on less land (Cocoa and Forest Initiative (CFI), 2017, p. 1)". These national charters reflect the global drivers through such standards as the UN's Sustainable Development Goals (SDGs) and the The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPEBS) Global Assessment on Biodiversity and Ecosystem Services.

This chapter is outlined as follows. Each section analyses the specific level of actors' engagement with biodiversity issues of non-shade cultivation and deforestation, pests and disease control via harmful chemical use and hybrid tree integration. This research studies the implications of the efforts and level of actor-scale on the biodiversity sustainability of the studied cocoa production networks (PNs). The main findings discussed will be the improvement of the studied environmental issues which are being prohibited by the fallout from significant social sustainability issues of livelihood, land insecurity, gender inequality, and market price. This study finds evidence for this in Co. 1's approach of addressing environmental sustainability in conjunction with addressing the social sustainability issue of livelihood showing positive impact on farmer capacity to achieve biodiversity sustainable production practices (GHI 49, 74 a&b). The Ghanaian government's cocoa board (COCOBOD) indirectly addresses livelihood issues through certain interventions (GHI 70, 75, 76), and the farmer respondents' expressing the need to meet basic needs being motivating factors behind certain unsustainable cultivation practices (GHG 1-48). Drawing from the approaches to biodiversity sustainability dissemination taken up by the studied powerful actors, a discussion may be drawn out to understand how the forms of governance approaches and the ways in which then powerful actors have incorporated the integrated framework to gain an insight on how scale affects biodiversity sustainability dissemination throughout the studied PNs.

5.2. Sustainability interventions disseminated by government actors

The history of Ghana's cocoa industry, as discussed in Chapter 4, highlights the need to consider scale and agency when seeking to implement sustainability goals. The level of actor scale in Ghana's cocoa industry has historically influenced capacity and commitment toward biodiversity sustainability. This is evidenced in influential actors of international funding bodies and standards organisations like the World Bank (WB) and International Monetary Fund (IMF) pressuring the next level of powerful actor, the government, to alter its organisation of its agricultural industry to meet globalisation demands and setting biodiversity sustainability standards and goals to be met by cocoa suppliers especially – with cooperation being tied to financial and

resource assistance access (Chalfin, 2004). From their level of power, the government in turn place mandates on farmers, and other production network organisers to implement standards received 'from above' who in turn press upon their PN farmers and local processors to meet these standards. While power and resource access reside in the upper levels scale (government and lead firms), the pressure to carry out sustainability goals and standards falls to the bottom level of the farmer. This level of actor does not have the same resource access. This is where the breakdown in sustainability begins, and an issue which is evermore present in the minds of scholars, development workers, and consumers alike (Higonnet et al., 2017).

Through interviews with farmers, academics, industry leaders, and COCOBOD respondents, this research seeks to better understand dynamics of the give and take of resource provision, standards pressures at different levels, and how they affect different actors in different ways. This chapter also explores how varying levels of actor scale and power manifest in provisions for achieving the biodiversity sustainability justifiably being aimed for. As discussed in Chapter 4, Ghana's government through COCOBOD seems to be very involved in disseminating biodiversity sustainability efforts, providing resources and education for farmers in this regard. This chapter investigates the actions taken on-the-ground and reflects on how these compare to the biodiversity mandates of the IPBES, the Cocoa and Forest Initiative (CFI), and private actor mandates on cocoa farmers' biodiversity sustainability implementation. This approach seeks to answer the research questions by understanding the correlations between level of scale, power and effects of biodiversity sustainability and implementation throughout Ghana's cocoa production networks.

The first level of actor scale considered here is government. The analysis finds that at the government level, the power and agency available is significant, with resources coming in the form of international funding such as that from the IMF and WB coupled with foreign direct investment (FDI). COCOBOD also captures value via port fees and cocoa export revenues, including a fee on privately exported cocoa products. The structure of COCOBOD with its subsidiaries such as the Quality Control Company

and Cocoa Marketing Company also providing streams of revenue through trade and value creating through marketing and controlling cocoa price setting for export. This increases the scale to which government can set biodiversity standards and provide interventions necessary for weaker actors to meet said standards. This is seen in the multiple interventions provided to farmers through the government's cocoa board (COCOBOD) and its seven subsidiaries/subdivisions.

This analysis studies two specific subdivisions, the Seed Production Unit (SPD) and the Cocoa Health and Extension Division (CHED). The reasoning behind choosing to investigate these two subsidiaries is because these branches of COCOBOD feed into the education, resource allocation, and hybrid tree integration for farmers. Access was gained to respondents working in these divisions, providing noteworthy insight during data collection in-country.

Among the initial 2001 investment into the cocoa industry, the government of Ghana focuses on the main areas:

investment in farming knowledge and tools through investment in

a) " improved pest and disease management control
b) replanting and rehabilitation
c) better tree husbandry
d) increased use of fertilizers (p.7)"

The government of Ghana has invested in incentives to fuel FDI through such programmes as zoned tax breaks, and price discounts
infrastructural improvements have been pursued at the two main ports of the country to reduce transaction and transport costs, in an effort to boost ease of international cocoa trade (World Bank, 2011).

COCOBOD's CHED and SPD divisions are aimed to address point a) above, with education and resources provision for farmers through their network of CHED facilitators and in partnership with private actors. SPD's goal to introduce hardy and

higher-yielding cocoa tree hybrids is connected to understanding biodiversity sustainability outlooks for Ghana's cocoa sector as these new tree types may have positive or negative impacts on the current state of biodiversity in Ghana's cocoa producing regions. This intervention is important to this study as it in some ways captures again the effect of power and level of actor scale on capacity to achieve greater and different forms of biodiversity sustainability, speaking to RQ 1. CHED's sector organisation/facilitation speaks to RQ 2 in understanding the mechanism being used by the Ghanaian government and lead firms where partnerships exist such as that between Co. 1 and COCOBOD, being utilised to disseminate biodiversity sustainability throughout the cocoa production networks. Finally, investigating two subsidiaries that have a significant amount of direct contact with multiple levels of actors scale from COCOBOD directors, to lead firms, to farmers and NGOs paints a clearer picture of the relationships and dynamics that intertwine and make up Ghana's cocoa production network organisation.

5.2.a. SPD interventions of hybrid and shade tree seedlings, promoting biodiversity sustainable practices

One issue being addressed by SPD is deforestation due to the clearing of forest for cocoa farming. As established in Chapters 2 and 4, deforestation is high in cocoa producing countries, Ghana included (Donald, 2004; Hansen et al., 2011; Higgonet et al., 2017). The other major issue addressed by SPD are pests and disease that affect the biodiversity sustainability of Ghana's cocoa farms a) black pod disease, b) mirids/capsis, and c) cocoa swollen shoot virus (CSSVD) (*Ghana Cocoa Board Official Website*, no date; Ameyaw, Dzahini-Obiatey and Domfeh, 2014; Akrofi *et al.*, 2015). The increase in these pests and diseases have been linked to land clearing and the loss of shade trees (Donald, 2004; Hansen *et al.,* 2001). For all three issues, decreased yield and increased tree death are ultimate outcomes if left unresolved.

Farmers interviewed report that at least some of their trees are affected by black pod disease or CSSVD, the result rending the cocoa pods unusable, and if overlooked and mixed into the fermenting fruit, can spoil an entire batch of product (GHG 1-10; GHG

11-21; GHG 22-34; GHG 35-48). These farmers reported receiving training for how to spray and treat affected trees with some reporting receiving chemical inputs, hybrid tree seedlings, and shade tree seedlings from COCOBOD.

According to COCOBOD publication and a respondent from COCOBOD in Ghana, SPD is responsible for the production and distribution of hybrid cocoa seed pods for farmers free of charge (COCOBOD, 2017; GHI 75). Hybridisation seeks to address increased pest and disease exposure caused by non-shade cultivation practices (Ameyaw, Dzahini-Obiatey and Domfeh, 2014; *Cocobod -Our Subsidiaries/Divisions*, 2018; Gerber and Lui, 2019). This was confirmed by academic respondent GHI 70, former COCOBOD researcher. The proposed outcome of introducing these hybrid trees being both to address the damage currently suffered from pests and diseases as well as to decrease the use of chemicals for such controls (GHI 70, GHI 75).

While reports and studies submit that land and forest clearing are still heavily practiced (World Bank, 2011; Higonnet, Bellantonio and Hurowitz, 2017; Nielburg, 2017; Chettri *et al.*, 2019a, 2019b), according to a COCOBOD respondent, the land clearing reported by the farmers in group interviews were of farmland, not forestland (GHI 75). The designation between a "forest" and "farmland" seemed important to this respondent as they wanted to ensure understanding that tree clearing was only practiced on farmlands rather than protected forestland. This nuance is something to be explored further, specifically in how it connects with the dual system of colonial/institutionalised law and customary law practiced in Ghana (Amanor, 1999; Chalfin, 2004; PETERS, 2010; Ubink & Quan, 2008). According to some studies, deforestation has occurred illegally on or around protected forest areas, however, according to COCOBOD respondents, as well as farmers, the practice of cultivating cocoa in the forestlands has not been in use for years (GHI 75; GHG 1-48). This could be due to a difference in understanding of what forestland is, being a point of tension with the COCOBOD respondent's information as this actor understands protected areas and forestlands, or a positive outcome of biodiversity sustainability dissemination efforts implemented by COCOBOD.

Questions regarding shade vs non-shade practices revealed potentially interesting points. First, there seems to still be a lack of understanding or connection between non-shade cultivation practices and decrease yield/negative environmental effects. While farmers report receiving training and educational material regarding the effects of deforestation (from another division of COCOBOD), they did not make the connection between this practice and yield effects until prompted by respondent GHI 75. A few farmers offered that they had seen decrease in their yields after clearing more trees for timber or new farmland but did not independently make the connection, contributing decrease yields to climate and increased drought and rainy season extremes (GHG 1-20; GHG 11-21; GHG 22-34). When guided by GHI 75 in a suggestion reminding them of COCOBOD training regarding direct sun exposure, they did agree that this is a factor (GHI 75; GHG 1-20; GHG 11-21).

Farmers also report that customary practices such as intercropping other trees alongside cocoa that could offer shade cover as well as other beneficial produce for the farmer are being returned to (GHG 1-10; GHG 11-21; GHG 22-34). Most of these farmers report purchasing at least a portion of these intercropped trees (GHG 1-20; GHG 11-21; GHG 22-34; GHG 35-48). Some farmers implied that the needs of the family/farm force farmers to cut trees that would otherwise be left to grow or cultivated (GHG 11-21; GHG 22-34; GHI 75).

According to respondent GHI 75, the provision of seedlings is not limited to hybrid trees and can include the distribution of seedlings for shade tree cultivation. This intervention, according to this respondent, and confirmed by respondents GHI 49, 74 a&b, and 76, has a two-fold purpose. It addresses the biodiversity issue of deforestation. Secondly, the reintegration of shade trees can help in addressing the pest and disease issues by reintroducing endemic species associated with tree cover (Donald, 2004; Waldron *et al.*, 2012). An indirect impact of distributing certain types of shade trees can be the provision of an alternative stream of revenue for farmers, in the form of such crops as plantain or mango, as asserted by COCOBOD respondent GHI 75, and confirmed by private sector actors respondents GHI 74 a&b. Plantain in particular is significant as this tree is claimed to retain water and redistributes it to the

soil during the dry season (GH 75). This is important to combat the effects of more frequent and prolonged dry seasons/droughts being reported by farmers.

One issue discussed regarding intercropping is the process of choosing what tree species to introduce. Possible implications to be considered are the effects of the intercropped trees to the soil, root systems, and shade canopy to balance the cocoa. The academic spoken to on this matter expressed concern about the root networks of other tree species, usually those used for timber, and the amount of water required for cultivating some other trees species (GH 76). This concern was echoed in the shea industry, where academics reported the widespread planting of eucalyptus as a shade tree, an alternative income stream, and to replant cleared lands. The issue was that eucalyptus was later found monopolise a large amount of water with root systems that overpowered neighbouring trees and deprived them of water (GHI 70; GHI 73).

Contradictory to the documented practice of non-shade cultivation was the fact that each group of farmers interviewed spoke of customary practices of not cutting down certain trees, or trees around cocoa, and the use of traditional fertilisers and pesticides which were common in the past (GHG 1-10; GHG 11-21; GHG 22-34; GHG 35-48). The reasons for these practices, as mentioned above, were deeply rooted in a spiritual connection to the land and ancestral religious beliefs (GHI 75). Farmers interviewed reported that they had not been practicing shade cultivation purposely, there were trees naturally growing on their land when they started cultivating cocoa, the ones which were not cleared acting as a natural canopy for nearby cocoa trees (GHG 1-10; GHG 11-21; GHG 22-34; GHG 35-48). Farmers also responded that they have planted at least some trees aside from cocoa on their farms, 6 respondents gave specific numbers of trees planted, the largest amount being 350 trees down to 15 trees (GHG 22-48).

As Section 5.5.2 will show, Co. 1 respondents also report providing intercropping trees to the farmers in their network for these same purposes. This multi-scalar action demonstrates improvements that might be observed in Ghana's cocoa industry regarding forest rehabilitation and protection. Further studies need to gauge the

reach of such government and private actor initiatives to provide these shade trees to farmers, and access to such resources.

Responses regarding the relationship between farmers and certain indigenous trees may lead to insight on the effectiveness of slowing one driver of the boom-and-bust cycle, deforestation. The positive association with certain trees and personal accounts of witnessing the differences in shade vs non-shade cultivation over time may also be a positive driver toward implementing the more sustainable shaded cultivation practices being disseminated from the government and lead firms (GHI 75; GHI 78; GHG 1-48). COCOBOD seek to address the lack of farmer education by engaging directly with farmers and farming association in on-the-field training and workshops (GHI 49; GHI 74 a&b; GHI 75). This training is considered to help farmers understand more clearly the role they play in environmental sustainability on the farm, as well as to find innovative ways to increase farmer income through increasing yield per hectare.

This is a goal both public and private actors interviewed in this research believe is achievable in part by implementing certain sustainable practices such as shade-cultivation. Private sector respondents reflect many of the same approaches to dissemination, even going so far as to partner with the government in certain aspects to disseminate training and resources. This shows a multi-scalar governance approach, engaging the public and private sector actors in addressing the issues which hold weak actors captive. The success of such approaches could also lend credibility to those arguments that propose addressing social sustainability as a vital means to addressing environmental sustainability issues.

5.2.b. CHED interventions of spraying programmes, chemical input provision, sustainable cultivation training, promoting biodiversity sustainable practices

The Cocoa Health and Education Division (CHED) of COCOBOD provides training, spraying programmes, and chemical inputs. CHED distributes chemical inputs, including pesticides, spraying programmes, and training on biodiversity sustainable

practices which promote natural pest and disease control such as the hybrid and shade tree seedlings discussed above (COCOBOD, 2018).

A respondent interviewed, being a CHED trainer, could offer insight into how the region they worked in extends COCOBOD training and resources to farmers, via regional catchments (GHI 75). The respondent reported being responsible for a certain geographical area within the region, which holds several villages, associations, and farmers. The respondent is tasked with visiting the farmers' associations in a circuit delivering COCOBOD training, distributing material resources such as chemicals, farming equipment and spraying programmes to combat the aforementioned main cocoa diseases, and maintaining communication lines between COCOBOD and the farming communities (GHI 75). During each visit, they visit individual farms which COCOBOD is working specifically with, for such reasons as CSSVVD eradication, farm rehabilitation or expansion. As the circuit continues, each go-around the respondent will visit different individual farms, thereby visiting all farms in each association in their assigned catchment area over a period (GHI 75).

According to COCOBOD, farmer education is a factor in achieving biodiversity sustainability regarding pest and disease control. This is due to the link between non-shade cultivation/deforestation and increased pests and diseases. Secondly, the ways in which pests and disease are eradicated can be contributing to other biodiversity degradation. For example, COCOBOD provides chemical inputs such as pesticides and insecticides to address black pod disease, insect damage, and cocoa swollen shoot virus disease (CSSVD). Research shows chemicals have a negative impact on soil and the surrounding habitat resulting in decreased soil fertility and tree yield (Saatchi *et al.*, 2001; Whinny, 2001; Siebert, 2002; Hartemink, 2005; Clough, Faust and Tscharntke, 2009; Anderson Bitty *et al.*, 2015a, 2015b; Higonnet, Bellantonio and Hurowitz, 2017). CHED educating farmers in non-chemical solutions, and those actors providing inputs to fight pests and disease, may feed a shift in perception on harmful chemical use. With advancements in sustainable pest and disease control, these harmful chemicals may be replaced with healthier alternatives.

Some dissemination of non-chemical solutions to tree husbandry is seen in the push to reintegrate some customary practices (GHI 75). According to the farmers interviewed, there is a mind-set shift taking place and an openness to use some customary practices in cultivation (GHI 75; 78; GHG 1-48). Two practices being reintroduced by government and private actors are the use of poultry as fertiliser and endemic tea and spice plants for pesticides. Another fertilisation practice/materials re-use being promoted by COCOBOD is the use of cocoa pod husks. According to a respondent, the husk of the cocoa pod contains minerals and nutrients which are very beneficial to the cocoa tree (GHI 75). Typically, the husks are gathered near the location where cocoa bean processing and fermentation takes places, which is away from the cocoa trees. At the end of the season, these husks are left in piles near the processing location and rot, providing no added value to the farmer (GHI 75; 78). COCOBOD has introduced the spreading of these husks back under the cocoa trees to be naturally broken down and the nutrients consumed by the trees (GHI 75; 78). Alternatively, for farmers who have the space and manpower, COCOBOD is training farmers to burn the cocoa husks at the end of the harvest and spread the ashes throughout the fields and under trees, as this is a faster approach to using the husks for fertiliser (GHI 75). Reintroduction of these practices are carried out through COCOBOD extension units through CHED (GHI 75). This was confirmed by many of the farmer respondents reporting higher incorporation of these practices, as well as during my two farm tours where I observed both pod husk distribution around trees and burning piles for the husks the ashed which would be scattered throughout the farm to the same effect (GHG 1-10; GHG 11-21: GHG 22-34; GHG 35-48; GHG 69; GHG 70).

A note on the pesticide shift was that the organic pesticide is not as effective as the chemical one. In cases where more devastating disease such as CSSVD caused by the black pod virus, chemical pesticides are used as they are the only thing that can stem the spread of the disease (GHI 75; GHG 1-48). Further study on the short and long term effects of these chemicals on soil and endemic species surrounding treated cocoa trees would be beneficial, as well as further investment into research

surrounding natural alternatives to the chemical treatments that are currently being used.

As it stands, the farmers interviewed did not seem to have much agency in addressing such issues as these, being reliant upon COCOBOD (or in some reported cases, lead firms such as Co. 1) for the supply of chemicals to fight pests and disease, although some non-chemical practices have been more successful in addressing fertilising and materials re-use (GHG 1-48; GHI 75; GHI 74 a&b). As none of the farmers interviewed had a history of shade-cultivation, this research cannot reflect on the effectiveness of this method in controlling pests and disease directly. While COCOBOD provides chemical inputs, there are no non-chemical input provisions, the responsibility for sourcing these things falling to farmers. For this reason, the farmer respondents in this study reported minimal use of non-chemical solutions due to lack of resources. This example captures the phenomena being studied in this research – the dynamics between power and responsibility/accountability that interact at multiple levels of scale throughout the network influencing the capacity for and commitment to achieving and maintaining biodiversity sustainability throughout the production process. While governments have the financial and physical resources accessible the actors being held to account in the most extreme ways are the farmers (i.e. being excluded from production networks for unsustainable practices that they feel forced into because of their lack of power/resources). While the government through COCOBOD may be able to facilitate some or much of the resource allocation necessary to achieving biodiversity sustainability throughout Ghana's cocoa sector, there are gaps that will always emerge. As will be discussed further in section 5.3, multiscalar organisation seems to provide a more secure access to resources and knowledge for farmers, utilising the lead firm's capacity to distribute resources some of which are provided by COCOBOD.

Another form of training given by CHED tackling CFI's "produce more on less land" goal is to introduce hand-pollination to farmers (Mccoy and de Wit, 2017, p. 4). Dry season has become longer and harsher. As reported by approximately 40 of the 48 respondents, farmers have simultaneously observed changes in rainfall patterns, with

shorter, heavier rains, with the time of arrival of the rains shifting (GHG 1-10; GHG 11-21; GHG 22-34; GHG 45-48). This is an issue as cocoa trees require rain at certain times throughout its gestation, while rain at other specific times can decrease yields (GHI 75). During pollination and early flowering/budding, heavy rains can disburse pollen away from the tree and break or drown flowers and seedlings. Changes in rainfall and prolonged dry seasons are also reported to cause flooding and root rot in some cases according to a COCOBOD respondent (GHI 75; GHG 69). COCOBOD has introduced training, disseminated through CHED as well as via licenced buying companies such as Co. 1 who receive training from COCOBOD to disseminate throughout their networks, to address this yield loss. The hand pollination programme uses simple tools to extract pollen from flowers and pollinate them by hand (GHI 75; GHI 74 a&b). This hand pollination is being piloted and offers avenues of further study.

At the farmer level, the only respondent to discuss the effect of heavy rains during flowering being connected to the decrease in yield was the Assam Cocoa Association's chairman. During his interview, we walked through the farm and the COCOBOD respondent demonstrated how they train farmers to pollinate cocoa flowers by hand. After this demonstration, the chairman offered that due to the rains coming early and destroying the flowers, the hand pollination was helping to recover some lost yield (GHI 75; GHG 69). Recovering potentially lost yield for the farmer, according to COCOBOD respondents, helps provide sustainable livelihood which in turn decrease the need to use unsustainable practices (GHI 75).

As has been shown in this section, Ghana's government, through its arm of COCOBOD is highly involved in the coordination of efforts to address biodiversity sustainability in Ghana's cocoa production networks. These interventions are seen in the research divisions of COCOBOD working on solutions to cocoa tree hybrids and germination of intercropping tree seedlings as taken up by SPD, the distribution of training, resources, seedlings, and various pest and disease control programmes taken up by SPD, CHED, and in partnership with private firms such as Co. 1. This lends to the viability of 'powerful' actors in providing the tools and resources necessary for

'weaker' actors to meet biodiversity sustainability goals while maintaining positive turnover. This supports the proposition of many scholars and this research, arguing for the responsibility of 'powerful' actors to provide the necessary tools and research.

5.3 Sustainability interventions disseminated by private actor Co. 1

The second level of actor studied is the lead firm. Co. 1 is a leader in its industry, providing cocoa products to confectionary manufacturers and gaining direct entry to the Ghanaian cocoa production networks via its subsidiary licensed buying company (LBC). Co. 1 provides a unique insight into the agency that 'powerful' actors such as lead firms hold in Ghana's cocoa industry as it is a signatory of the CFI and heavily involved in its production network's efforts to achieve biodiversity sustainability. While working with the government and receiving certain inputs for redistribution from COCOBOD (GHI 74 a&b), this lead firm provides other resources to farmers which help further the achievement of biodiversity sustainability but are not directly addressing environmental issues (ie social issues). This supports the push for multi-scalar efforts to address sustainability issues, as well as the argument that addressing social sustainability issues must be taken into consideration when seeking to address environmental sustainability. Lead firms participate in providing education and promotion of sustainable cultivation practices through internal charters which provide services and inputs to farmers to work toward sustainable cultivation practices (LD1; 3; GHI 49; 74 a&b). Co. 1's signature on the CFI are examples of another aspect of embeddedness found in this case study, as GPN literature discussed points out (Yeung, 2015).

Specific interventions used by Co. 1 include a supplier contract, gps mapping of farms and periodic checks on farmland. According to UK and US based respondents from Co. 1 gps mapping of farmland propels biodiversity sustainability implementation in two ways. Firstly, it provides a baseline of average annual yield that can be expected from a given farm, if a farmer supplies above or below 10% of the baseline, the firm knows that this is a potential farm in need of assistance or utilising unsustainable practices to boost their yield. Secondly, gps mapping of cocoa producing land is according to these

respondents, the first step in achieving the CFI's goal of 'producing more cocoa on less land (LD 1; LD 2; LD 4; GHI 74 a&b). According to these respondents once an initial mapping of the region is done, the conversation can move forward to designing new ways of cultivating more cocoa (or introducing higher yielding trees) into the current cocoa tree ecosystem in a planned manner and in ways that will not threaten other endemic species.

As mentioned above, Co. 1 distributes a certain amount of provision from COCOBOD to the farmers in their production networks. This provides farmers with access to these government resources as well as assisting COCOBOD in that Co. 1 takes over the training and check-ups that a CHED officer would otherwise be allocated for those regions as Co. 1 is already present on those farms (GHI 49; GHI 74a&b). Additionally, Co. 1 provides further resources and training to meet social sustainability goals for their network participants (GHI 74a&b). This shows again some of the positives of this multiscalar approach and feeds this research's point on levying the 'power' certain actors in different levels of scale to benefit the whole of the production network. In addition to the government's provisions, Co. 1 supplements farmers in their production network with further provisions to aid biodiversity sustainability implementation. An example of these provisions is the carbon positive cookstoves provided to a pilot group of Co. 1 production network participants, with rollout of a full-scale distribution throughout their Ghanaian production network to be complete by 2025 (at the time of interviews in 2019) (GHI 74a). The cookstoves, used in processing cocoa fruit to bean that is sold to Co. 1 require small fraction of fuelwood traditional fires/cookstove do and the technology of the cookstove cleans the smoke being released to create a carbon positive output (GHI 47a). Not only do these cookstove facilitate biodiversity sustainability, they are also used for other household activities, thereby cutting down on the overall fuelwood consumption of the household which is not only a positive biodiversity factor but also a positive social sustainability factor in that the farmers are saving money on purchasing timber and/or not required to cut as many of their own timbre for personal consumption and can sell or use that timbre for other livelihood purposes (GHI 74b).

Another example of achieving biodiversity sustainability goals through meeting social sustainability needs is Co. 1's poultry programme (GHI 49; GHI 74 a&b). In this effort, Co. 1 provides production network participants with egg-laying hens and coops. This meet livelihood needs providing food for the household as well as an alternative stream of revenue through egg/poultry sales. Simultaneously, Co. 1 has trained (more so reminded as this is an indigenous practice) their network participants to supplement chemical fertilisers with hen droppings (GHI 49). The idea behind this programme, alongside the social element is to cut down and eventually replace the use of chemical fertilisers throughout their production networks (GHI 49; GHI 74 a&b). While Co. 1 invests the initial capital to provide such tools as hens, coops, and carbon positive cookstove, they also will reap the benefits of quality cocoa and potentially increased quantities of cocoa being supplied to their firm over time. This is because as farmers struggle less to meet their immediate livelihood needs, they are able to commit more time to sustainable production, extending the lifespan of viable cocoa production on the same piece of farmland (LD 1; GHI 49; GHI 74 a&b).

While there are inevitable complications to organising multiscalar efforts, the benefits in terms of resources and knowledge access for production network participants is clear, showing the potential for environmental upgrading that is being sought after in cocoa, as well as many other agricultural sectors in Ghana and globally. Government and lead firm actors who make up the more 'powerful' levels within the production network scale are capable of bridging gaps unattainable by 'weaker' actors such as farmers and transporters, without losing out on gain capture for themselves.

A logical progression from this phenomenon is the idea that 'powerful' actors can and should hold more responsibility for facilitating equitable achievement of biodiversity sustainability throughout production networks. This answers the research questions through a tangible example of the effects of scale on biodiversity sustainability throughout Ghana's cocoa production network, the tools utilised to implement this sustainability and the effectiveness of these approaches. It is clear through interviews with Co. 1 as compared to interviews with my COCOBOD respondents, that lead firms can capitalise on their higher level of resource and knowledge access to facilitate

environmental upgrading for 'weaker' actors throughout their networks. According to Co. 1 respondents, they are the only lead firm that engages with the government and farmers to achieve biodiversity sustainability, as well as being the industry leader in terms of standards set for supplier participation in the production network (GHI 74 a&b). Co. 1, understanding their level scale do not simply demand such high level of biodiversity sustainability commitment from their network participants without providing the tools and resources inaccessible but necessary to achieve these ends.

Being that Co. 1 remains one of, if not the, largest producers in their industry, the benefits of investing in these provisions for their network participants is clear. Participants in Co. 1's production network benefit from the lead firm's power and capacity through both working toward and/or achieving biodiversity sustainability in their cocoa production, but also in other areas of livelihood such as through the egg hens and carbon positive cookstove. This circles back around to the main barrier to achieving biodiversity sustainability being the lack of social sustainability for the 'weakest' actors in the production network. Through leveraging power at certain levels scale, the entire web of network participant can achieve environmental, economic, and social reciprocity – sustaining a positive outlook for future generations of cocoa suppliers and buyers.

The impetus of international level drivers and government level mandates is coupled with the firm's desire to sustain its supply of cocoa, a goal that Co 1 has tied to the meeting of certain environmental and social sustainability goals (GHI 49, 74 a&b). As the government contributes knowledge and resources to the end of disseminating biodiversity sustainability throughout Ghana's cocoa production network, so does Co. 1 (LD 1, 2, 3, GHI 49, 74 a&b). The lead firm does this through their partnership with the government setting industry standards discussed in Chapter 4, as well as through internal environmental sustainability frameworks and goals. The involvement of lead firms in the process of scaling up environmental sustainability throughout production networks reflect the call for stronger linkages between lead firms and suppliers as found in such works as De Marchi, Maria, & Ponte (2013) and Jeppesen & Hansen (2004) whereby knowledge and innovation are disseminated in partnership between

lead firms and suppliers to meet environmental sustainability goals. In this study, it has been found that the level of upgrading in Ghana's cocoa production network, for Co. 1, is partially through providing physical inputs to facilitate farmer's environmental upgrading. This, in effect, can address the issues of supplier upgrading as found in Khattak *et al.*, (2015).

5.3.a. Lead firm standards and modes of disseminating biodiversity sustainability throughout production networks – framework

The internal standards framework held by Co.1 are comprised of four "pillars" which they propose will disseminate environmentally sustainable cultivation practices successfully throughout their production network (LD 1; LD 6; GHI 49; GHI 74 a&b). These contribute to the physical sustainability of their production network, as well as sustaining the farmer, "the most important player in the whole network because he supplies the cocoa bean that is transformed into the products we sell (GHI 74a)."

The four pillars of Co. 1's framework encompass both environmental and social sustainability issues. As discussed above, the position of the firm is that to address environmental sustainability issues, they must simultaneously address the social issues crippling farmers (GHI 49; GHI 74a&b). The four pillars propose that by 2025, Co. 1's cocoa production network will be completely free from child labour, that production will be fully carbon and forest positive (reflecting one of the main goals of the CFI to not just stop deforestation but also to revitalise forests (Cocoa and Forest Initiative (CFI), 2017)). The third pillar concerns farmer livelihood, with a commitment to "lift our farmers out of poverty" (GHI 74a), because, as four of the six respondents from Co. 1 discussed, if the farmers cannot feed their families and ensure their livelihood, they will not be able to commit to environmentally sustainable cultivation (GHI 49, 74a&b). The fourth pillar is the commitment to source 100% sustainable ingredients.

As one of the pillars of Co. 1 is to ensure that the natural habitat of the cocoa farms is protected, the commitment to said land by the farmers is a key factor in achieving this

sustainability goal. The farmers interviewed in this research were not able to be confirmed as belonging to Co. 1's production network, the question about contested land rights being a potentially integral line of inquiry for future research (Clough et al., 2009; Donald, 2004; Higonnet et al., 2017; PETERS, 2010).

5.3.b. Lead firm actions to disseminate biodiversity sustainability through inputs and training resources distribution

Regarding biodiversity sustainable practices, the main standard which Co. 1 hold its production network participants include "no collecting cocoa pods from the forest, no illegal cultivation on protected lands, stopping deforestation-contributing actions such as cutting down more trees, the replanting of shade trees on cocoa farms, and the use of only approved chemicals on farms (LDI 1, GHI 74a)." The issue of mutual equitability is first confirmed in the preliminary interviews LD1 & LD2 with Co.1 respondents. Respondents presented a commitment to only including farmers registered as having verified sources of cocoa, as well as the integration of biodiversity sustainable inputs and practices, into their production network.

The requirement of farmers to provide their own inputs and pay for resources and training received from Co. 1 is a point of conflict in this study. While European and North American-based respondents from CO. 1 state that farmers pay for at least part of the resources they receive from Co. 1, according to Ghanaian-based respondents, the farmers do not pay for these resources (GHI 74a). This is an important distinction, as the requirement of farmers to pay for the resources received from Co. 1 would in practice limit if not defeat the purpose of the resources. As is proven in the literature and affirmed in this research's interviews across all levels of actor scale. Even if lead firms such as Co. 1 absorbed these costs, the fact that lead firms capture 35% of chocolate sales, as compared to a farmer's 6% value captured (Higonnet et al., 2017) lends to greater capacity for lead firms to incur these costs.

The shared resource distribution and provisions between Co. 1 and COCOBOD was a bit confused. Co. 1 respondents as well as COCOBOD respondents weren't exactly

sure which actor was responsible for what bit (ie cocoa seed pod vs intercropping seedling propagation and distribution), it seemed as though both organisations do a bit of everything (such as running nurseries for seedling propagation, spraying programmes) in tandem. This line of inquiry was not further pursued in this research due to time and access to raw data from Co. 1 being unavailable. This research also does not pursue exactly who is responsible for each individual component because the focus of this research is to understand the working relationships rather than the individual breakdown of each input. In this instance, understanding the whole picture is being pursued. With further research there could be a case made for taking each programme arm and studying the individual components separately, integrating it back into the big picture, to better understand the complexity and layers of interaction in this public-private partnership, including any third sector actors that may be present on the periphery of the industry.

The inputs and other resources reported to be supplied to Co. 1's farmers include the distribution of resources provided by COCOBOD, as well as the distribution of lead firm funded resources such as hybrid tree seedlings, and chemicals (LD 1, 2, GHI 49, 74a&b). Additional resources provided by Co. 1 include the carbon-positive cook stoves and egg laying hens and coops discussed above (GHI 74a&b). The logic behind providing cook stoves, according to respondents GHI 74a&b, is to "firstly reduce carbon emissions to meet our carbon positive goal, these stove clean the air better than it was before it is filter[ed] through this, and it also uses less than 1/3 of the amount of fuelwood typically required in the process of turning cocoa pods to the processed cocoa beans we purchase (GHI 74a&b)." According to GHI 74a, the provision of these cook stoves, "just makes sense because we want to achieve carbon positive production and the farmer here cannot afford this technology which is easy for us to get. It's our part as [the lead firm] to provide this."

Respondent GHI 74a was passionate about the lead firm's approach to addressing environmental sustainability issues via the social sustainability issue of livelihood. All three Ghanaian-based lead firm respondents discussed how the lead firm addresses livelihood issues through their sustainable livelihoods initiative which falls under the

firm's sustainability commitment and makes up one of the four pillars of sustainability that the lead firm builds their ethos around. The three major projects being piloted at the time of my interviews were seedling distribution for both hybrid cocoa trees and intercropping trees, hen coops and egg hens, and carbon-positive cookstoves distribution (GHI 49; GHI 74 a&b). Spraying programmes were said to be taken care of primarily by COCOBOD, as well as seedlings being provided in part by COCOBOD (GHI 74 a&b). Other aspects of this sustainability commitment are those around environmental preservation and rehabilitation, no forced child labour, and creating a sustainable production network of chocolate. The farmer livelihood initiative is enacted through a foundation started by the lead firm, which is an independent non-profit organisation started to implement their sustainable livelihoods programmes (GHI 74 a&b).

The introduction of shade trees with monetary value was found in CO. 1's approach to sustainability, distributing seedlings from SPD as well as providing seedling of their own to farmers, both of hybrid cocoa trees to intercrop as older traditional cocoa trees age, and alternative cash crop tree types (LD2, GHI 49, 74a&b). When asked about the process of choosing what types of trees to distribute for intercropping purposes, Co. 1 respondents were quick to discuss the monetary value of the proposed tree, or the usefulness to the farmer for self-sustenance or other livelihood purposes. These could be things such as construction or cooking materials (GH 49; GH 74 a&b). They were not aware of any long-term environmental implications of tree types being introduced, referring to the collaborative relationship which COCOBOD provides with guidance and supplying seedlings (GHI 49; GHI 74 a&b). After a long pause, GHI 74a hesitantly offered that the trees distributed wouldn't pose any risk of negatively effecting the other crops being cultivated or the long-term soil quality, using vague language without being able to confirm specific studies or information to confirm this fact (GHI 74a). This could be because GHI 74a oversees the organisation of the company, and perhaps an employee working more directly with COCOBOD would have more detailed data on the specifics of how the studied lead firm chooses the trees it distributes to its production network for intercropping. From a biodiversity perspective, it is concerning, however, if this information was not readily available to

the firm, or if there is not significant research on these long-term effects. The negative implications can be seen in the under-researched tree species introduced to shea parklands as well as poorly chosen trees introduced onto cocoa farms in the past (See 5.2.a.).

The same concern can be applied to understanding the long-term effects of such species introduction as timber. Both COCOBOD and Co.1 respondents offered that timber is a common tree species introduced on cocoa farms, and in some cases the creation of timber plots being installed throughout the farm (GHI 49; GHI 74 a&b; GHI 75). While timber is a good alternative stream of revenue and provides material that is widely used in construction of homes as well as household chores such as fuelwood for cookstoves, there are at least two implications of planting timber plots alongside cocoa for the sake of biodiversity recuperation and livelihood management. Firstly, as carbon emission is an environmental issue that needs attention, heavy use of fuelwood such as timber adds to the factors contributing to climate change. To encourage this use of fuel wood through adding more timber plots could have a different negative affect alongside the proposed positive increase in livelihood and resource access. Secondly, these timber plots are using space on farms that could previously have been used to grow sustenance crops for the farmer's family, and space for additional cocoa trees which contributes to 70-100% of the farmer's annual income as it is (Anim-Kwapong and Frimpong, 2004).

There was no information available from COCOBOD or Co.1 on the financial gain to be made by farmers through selling timber, so it could be financially positive. The concern is about the lack of in-depth understanding of potential long-term effects of this promoted practice (GHI 76). Further research into the implication of tree species being introduced on cocoa farms, as well as other practices such as hand pollination for example, need to be pursued.

During our interview, GHI 74a offered that deforestation has stopped in large part due to the firm's presence on farms, conducting regular visits to ensure this standard (among others) is being met. This approach is paired with their training on

environmental sustainability standards, showing why producing more on less land is beneficial to furthering deforestation for the longevity of the industry.

One form of governance practiced by Co. 1 is the use of a Standards and Conduct agreement. This is a further driver for farmers to refrain from felling trees (GHI 74a &b). The organisation maintains a GPS database of the farmland they procure from, and have estimated within 10% above or below, how much cocoa each farm should produce each year (LD 1; LD 2; GHI 74 a&b). Should farmers sell above 10% of the database figure, this flags Co. 1 to investigate further how this farm has managed to produce above the calculated output based on farm size and tree ages (GHI 49; GHI74a). Due to the close relationship and active presence in the farming communities, GHI 74 a&b offered, there has not been any issues of this kind with their farmers (GHI 74 a&b). In the lead firm-supplier relationship here, we see again the mentorship-based and standard-based approaches working in tandem with the more involved and direct relationships between the different actors (De Marchi *et al.,* 2013; Nagendra & Ostrom, 2012). While some of the initiatives and resources being introduced are in their pilot stage, the initial reception of environmentally sustainable practices and the practicalities of achieving these goals can be seen to be mobilised. Providing cook stove, hen coops and hens to farmers are ways in which the firm is scaling up its sustainability efforts (see 5.3), seeking to facilitate farmer commitment and capacity to meet the sustainability standards set forth by the CFI and Co. 1's internal sustainability pillars (GHI 49, 74a&b).

While Co. 1 seems to be exemplary in their hands-on, mixed methods approach to implementing biodiversity sustainability into production networks, they provide a case study which supports other academic findings studying similar approaches(Nagendra and Ostrom, 2012; De Marchi, Di Maria and Micelli, 2013; De Marchi, Maria and Ponte, 2013; Goger, 2013; Khattak *et al.*, 2015). The initial success of these initiatives also supports the call to approach sustainability in a holistic manner, inclusive of both environmental and social sustainability aspects (Daniels, 2006; Schmitt and Schulz, 2016; Chettri *et al.*, 2019b). As Chapter 2 of the 2019 IPEBS (Chettri *et al.*, 2019a) submits, there are both improvements and significant decline in global biodiversity.

One improvement is the decline of deforestation and signs of restorations to tree cover, however, the continued rate of deforestation and forest cover loss has, “gone beyond the precautionary ‘safe limit’ for land-system change proposed in the Planetary Boundaries framework (Steffen et al. 2015b, as cited in Chettri et al., 2019b, p.43).” This shows the potential for positive impacts of such joint enterprises as the public-private approach to biodiversity sustainability in Ghana’s cocoa industry.

Regarding harmful chemical use, Co. 1 took a positive stance to the public-partnership with COCOBOD and the shared research which they believe has offered appropriate chemicals used on cocoa farms (LD1, 2). According to the respondents from Co. 1, there is an approved chemicals list that includes those chemical inputs which meet certain sustainability goals being ascribed to by its organisation, COCOBOD, and several of the big players in Ghana’s cocoa industry (LD 1; 2; GHI 74 a&b). This list was affirmed by the COCOBOD respondent (GHI 75). According to the respondents, the approved chemicals list was made in collaboration between lead firm research, COCOBOD research, and other available scientific data on the specific chemicals that can be introduced to the environment with only short-term impacts. While the chemicals do cause some negative impact on the soil, those on the approved list are said to not bioaccumulate, therefore the respondents report, the negative impacts reduce over time and are not long lasting, nor do they accumulate and spread the negative impacts past the farm (LD 1; 2; GHI 74 a&b; GHI 75).

An area for further mapping and understanding is the division of outreach between public actors COCOBOD and private actors such as Co. 1. While Co. 1 respondents all reported heavy involvement with their network of farmers, the COCOBOD respondent reported little to no private actor involvement at the farm level. Factors considered in this contradiction are the fact that the COCOBOD respondent may be assigned to an area where Co. 1’s farmers are not located and therefore has not encountered those farmers. According to Co. 1 respondents, the level of involvement with their firm executes is an exception to the way many of the other big lead firms coordinate their Ghanaian production networks (GHI 49; 74 a&b). This could mean that the COCOBOD respondents experience reflects a larger portion of Ghana’s cocoa farmers, with Co. 1

providing a benchmark for other key actors, as well as for the shea industry in understanding the effectiveness of a multiscalar approach to sustainability implementation.

5.4 Farmers' experience of scaling up biodiversity sustainability, implications of livelihood, land rights, gender inequality, and education

As demonstrated in sections 5.2 and 5.3, farmer engagement with biodiversity sustainability in cocoa production is catalysed and sustained by the interventions provided through COCOBOD and CO. 1. Two significant factors in farmers' adoption of sustainable practices are seen in the level of farmers connecting practices to negative environmental implications and their access to the tools and resources required to implement biodiversity sustainable practices into their production. According to farmers interviewed, there is a disparity of resources with which they are expected to achieve biodiversity sustainability. As discussed in 5.3, the lack of financial and resource freedom of farmers pushes them to either sacrifice livelihood to follow sustainability standards, or to engage in illicit or unsustainable activity to meet both market and livelihood demands. It was clear in the interviews that, while education and training does influence them to change practices to an extent, the barrier of insufficient resources prohibit farmers from fully adopting practices and disengages them from trying to adopt these practices (GHG 1-48; GHI 70; GHI 74 a&b). In Co. 1's approach, it would be significant to interview farmers in their production network, to investigate the impact that a partnership-based, multiscalar approach to implementing biodiversity sustainability has.

When asked about how often the farmers are visited by COCOBOD's CHED, the response was positive, stating that COCOBOD visits the village and farms frequently, bringing training and inputs to the farmers (GHI 75; GHG 1-48). When asked about their interaction with COCOBOD, the response was again positive for the most part, with the only negative responses showing farmers felt they were not receiving enough resources from COCOBOD to go around the entire association. Some respondents in all four group interviews expressed frustration of not receiving inputs such as

seedlings, fertiliser, pesticides, and insecticides (or in some cases receiving less than others).

Reasons provided for this disparity was the age of the farm, with higher inputs being allocated to younger farms, and the farm size with larger farms receiving more (GHI 75). In a few cases, respondents said it was because when allocation of inputs was being done, they could not attend as soon as other farmers, so they were too late to receive higher inputs(GHG 1-48; GHI 78). Because resources are allocated to farmer's associations and from there distributed to farmers it seems there is put in place a system that allows certain groups of farmers more access to resources than other, typically the smaller farms and/or aging actors. This is significant because of the land rights issue whereby farmers hold temporary rights to farmland in form of a tenancy.

In the individual interview with a cocoa association chairman, it was suggested that as farmers receive inputs, this often determines their level of commitment to biodiversity sustainability practices (GHI 78). This respondent reported that the resistance to changing these practices is founded in the farmer's fear of providing for their families, especially in areas where sustainability on a global scale is defined under absolute terms while in context the mandate may be unfeasible. An example of this, according to GHI 78 and COCOBOD respondent GHI 75, is child labour. While international and industry standards prohibit any use of child labour on farms, there is no consideration for those farms that are run by families, wherein children assist their parents according to their age and abilities, and in a manner that does not interfere with their education. For this particular farmer, they did not have the finances when starting their farm to hire workers, so their children would assist with certain tasks appropriate to their age after school and over school holidays (GHI 78). This approach, being quite common across many agricultural communities in the global north and south, is a key factor in running a smallholder farm. GHI 75 expressed the difficulty to afford school for their children at a point due to the loss of output from their farm when their children were no longer assisting.

This research acknowledges that an issue such as child labour is complex and extremely difficult to implement, with the priority being to protect those who do not have the means to protect themselves. I do not suggest that child labour is or should be acceptable, however there is a sustainable approach to involving family farming. This is an area for further research, to understand how protect the most vulnerable from exploitation without creating further crises which can negatively impact those same children these policies are created to protect.

Farmers' experience of drought and longer, harsher dry seasons was confirmed by Co. 1 respondents (GHI 49; 74 a&b) for those farmers they purchase cocoa beans from, as well as by the farmers interviewed in this research (GHG 1-48). These respondents and COCOBOD respondents offer that one reason this recuperation period has taken longer is the fact that reintroducing intercropping of trees to regain biodiversity has only taken a strong hold in the last few years (GHI 49; GHI 74a; GHI 75). Part of the training provided via COCOBOD and Co. 1 is aimed at connecting the farmer's practices to the environmental outcomes that they are witnessing (GHI 49; GHI 74 a&b; GHI 75; GHI 76). Where farmer incomes are already restrictive, it is difficult to motivate them to potentially sacrifice more of the limited income they receive to strive for sustainable cultivation without any substantially returns (GHI 49; GHI 74 a&b; GHI 75; GHI 76). This is an issue that is shared between the cocoa and shea industries, where sustainable harvesting, processing, and protection of shea parklands is pitted against scraping together a livelihood, deterring low-income actors from higher cost but sustainable practices (GHI 50; GHI 70; GHI 71).

Another effect of climate change is the expansion of the desert regions of the Sahara and the Sahel (GHI 49; GHI 50; GHI 76). This change can be seen more visibly in shea, however the effects of the lengthening dry months and more severe droughts in combination with shifting rain patterns that is being observed to be increasing casts a dark shadow over the sustainability of the environment in which cocoa is cultivated in Ghana (GHI 74 a&b; GHI 75; GHI 70; GHI 72). The effects of this expansion are the drying of savannah lands primarily; however, it is starting to increase in tropical cocoa growing regions (GHI 70; GHI 76). The concern here is the ability to maintain

production as cocoa needs a more humid/tropical environment in which to grow than shea which can survive in the drier savannah climate. Gaps here are the research into how to prevent this expansion or the appropriate response to the expansion which cannot be covered in this thesis. This is an issue that seems newly researched as it is reported to be a more recent environmental development by COCOBOD officials in the cocoa industry as well as academics interviewed in the shea industry (GHI 70; GHI 73). A related area of research is how intercropped tree systems may increase forest resilience, as the removal of these trees indicates a decrease in soil fertility and water retention as well as decreased resilience to drought and rising temperatures (Daniels, 2006; Fischer Lindenmayer D. B. e Manning A. D., 2006).

As discussed above, the biggest human effect reported is deforestation. A potential area one can see this shift in thinking toward shade cultivation is in the farmer responses as mentioned above. Referring to ancient customs being revived and the knowledge/relationship between the people and indigenous trees was key for farmers interviewed in their adopting shade rehabilitation or preservation (GHG 1-48). Supporting the continued deforestation findings of Higonnet, Bellantonio and Hurowitz (2017), all 43 respondents reported clearing trees when planting their cocoa farms. Respondents from one association spoke of many large trees that were or are on their farmland, several having left these trees as shade trees (GHG 11-21). A few of these respondents spoke of the fact that this type of tree was considered sacred or some traditional belief or practice dictating that these trees are not felled (GHG 11-21).

The traditional/superstitious guidance in agriculture was also observed in shea interviews, with an academic discussing at length a superstition surrounding felling or planting certain tree types such as shea and mango bringing about one's death (GHI 70). After receiving training from COCOBOD the added value of providing shade for the cocoa trees has furthered farmers' commitment to maintaining intercropped and naturally occurring shade trees alongside cocoa. One respondent from Association 1 discussed felling a large and very old tree when planting his cocoa, not knowing the implications to shade this would cause, and seeing effects in his younger cocoa trees'

long-term yield (GHG 1-10); this farmer also believed it affected the soil and water retention but was not able to explain why he made this connection, simply that he observed change after felling the tree, particularly during a drought or the rainy season and its different effects felt by his trees and harvests (GHG 1-10).

A major issue affecting efforts to stop deforestation and revitalise forests is land security. While farmers are connecting with COCOBOD and Co. 1 training and being incentivised to replant or retain shade trees via introduction of cash crop shade trees, farmers' commitment to these efforts is undermined by their lack of secure ownership of the land they cultivate, especially female farmers who are not able to own land customarily. In areas where cocoa is cultivated under a shade canopy, the crops benefit from high soil fertility, which in short-term yields, newly converted forestland can see more than 15% yield increase, versus those farms which are on replanted cocoa lands (Matlick as cited in Rice and Greenberg, 2000; Schroth et al., 2007). Shaded growth may also offer some natural pest and disease control, alongside the natural climate control offered by a canopy cover (Beer, Muschler and Somarriba, 1998).

Customary land rights is further discussed in Chapter 4Section 4.6.2. The significance of land ownership in relation to deforestation is seen in the farmer's long-term commitment to sustaining the land. As the literature has shown, when farmers do now own land, or when land ownership terminates at the end of the farmer's lifetime, there is no motivation to sustain the land beyond the current tenant's tenure. When the tenant vacates the farm due to the tenancy being up, land being resold outside of their control, or the farm yields decrease far enough to necessitate replanting, farmers are more likely to simply move to new land where the cycle begins again (Ubink and Quan, 2008; Clough, Faust and Tscharntke, 2009).

Of the 48 farmers attending the group interviews, 23 responded to Q1 "Do you own your land?", with 10 responding "own", 10 responding "sharecropping/tenancy", and 3 responding "family-owned". The COCOBOD translator clarified here that some respondents who replied "own" realistically might not own their land, as customary

land rights and farmers' understanding confuses these issues (GHI 49; GHI 50; GHI 70; GHI 74 b; GHI 75; GHI 76). According to COCOBOD respondent GHI 75, in reality maybe 1 or 2 or the 48 own their land according to institutional government regulations, however customary rights (which can be changed without the current farmer's authorisation or knowledge, see 4.6.2.) may be where they understand ownership of their land.

When discussing environmental issues, farmer respondents from both associations reported similar experiences and understanding. One of the questions asked during the group interviews was, "Over the last 10 years, have you seen cocoa yields increase, decrease, or stay the same; why do you think this is so?". This question was asked to understand how the farmers view the connection between biodiversity sustainability and agroforestry practices. According to respondents from all four group interviews, they have experienced the dry season becoming longer and harsher in the last few decades (GHG 1-10; GHG 11-21; GHG 22-34; GHG 45-48). A few respondents reported that the effects of a major drought which occurred during 2014-2015 were still felt, with a slow uptick in yield and land quality beginning about 2 years ago (GHG 1-10; GHG 22-34). One reason for longer dry seasons, which is a climate related change, could be the expansion of the Sahara Desert which has been tracked in a study analysing data collected between 1902 – 2013 (Thomas and Nigam, 2018). The reasons behind the farmer's experience of longer and harsher dry seasons were not pursued in this study, as the focus is instead on the effects this experience has on the farmer's commitment and ability to achieve sustainability goals.

In interviews, land rights issues were tied to issues of gender equality. In all group interviews, gender disparity was evident, with women making up on average only 25% of respondent samples. All female respondents (11 out of 45 total respondents) cultivated less than 1 hectare of land each (GHG 1-10; GHG 11-21; GHG 22-34; GHG 35-48). Although the women would say they are tenants of their land, according to COCOBOD and lead firm respondents, custom prohibits female land ownership, despite some regions practicing matrilineal inheritance (GHI 75; GHI 49; GHI 74 a&b; GHI 76). The land claimed as the woman's tenancy, according to these lead firm and

government respondents, would legally belong to the male head of household and the female member given permission to cultivate a certain amount of the land (GHI 75; GHI 49; GHI 74 a&b; GHI 76; (Yaro, 2010). This permission does not guarantee children of the woman will inherit the land given her to cultivate, and permission can be taken from the woman should the head of household decide without any legal recourse (GHI 49; GHI 74 a&b; GHI 75; GHI 49; GHI 74 a&b).

As Co. 1 interviews took place after my interviews and conversations with COCOBOD, this aspect of land rights was not able to be pursued further, however when GHI 75 was explaining customary land rights for women, he communicated that once land was formally given to a woman to cultivate, she would hold the land for the duration of the agreement (whether it be a set number of years, stage of farm development, or retirement/death). One possible reason for this could be that GHI 75 seemed to want to provide the most positive picture of Ghana's cocoa farmers and their lives in relation to cocoa production.

During group interviews when issues that could be taken as negative aspects of Ghana's cocoa industry, the GHI 75 sought to explain or justify the reasons for discrepancies or issues. An example for is seen in the discussion around resource allocation of COCOBOD inputs to the farmers. This part of the interview was the liveliest for the first two group interviews, with the farmers from the Assam Cocoa Farmers Association, with a slight break in the interview for a couple of minutes to resolve a complaint being aired by one of the women respondents regarding lack of resource allocation for herself. When this dispute arose, GHI 75 explained that the female respondent was bringing a complaint to the association about her input allocations but that it was a small housekeeping issue that would easily be resolved. He did not, however want to go into detail that the respondent was objecting to the fact that she does not receive inputs when COCOBOD delivers to the association. This information was provided by a personal guide to myself and a translator upon listening to the audio recording of this group interview. At the time, GHI 75 simply assured me that it was a simple housekeeping matter and brought the group back to

the interview topic, asking for other respondents to provide their experience with environmentally sustainable resources (GHI 75).

In this research, COCOBOD was not found to have direct approaches to addressing gender inequality issues in the industry, however according to COCOBOD respondents, women farmers are not prohibited from accessing the same resources as male farmers receive from COCOBOD (GHI 75; GHI 76). Issues in distribution of these resources was cited by women farmer respondents, with COCOBOD respondents offering that allocation is based largely on age, health, and size of farmed land, giving priority to newer/reconverted farms and bigger farms (GHG 1-10; GHG 11-21; GHI 75). As women presence in cocoa farming only started recently, the priority to newer farms should allocate them in some priority, however these women's farms were significantly smaller than most of all farmers interviewed. CO. 1 respondents also did not have direct approaches being utilised to address gender inequality in the cocoa industry (GHI 49; GHI 74 a&b; GHI 75). The average response was referring to customary land rights and the complex dual governance system overseen by the Ghanaian government to which the studied lead firm holds its network participants (LD 1; GHI 49; GHI 74 a&b; GHI 75).

While gender inequality is not the focus of this research, it is an issue that affects the ability or motivation of female farmers to achieve and maintain sustainable cultivation practices, and therefore is a factor for consideration. The key issues of land rights security and access to resources alone could potentially resolve the major hurdles standing between these female farmers and environmentally sustainable cocoa cultivation.

A potential area showing successful sustainability implementation is in Ghana's orientation to harmful chemical use on farms. Many farmer respondents have in the past, or are currently, using a mixed methods approach with both organic and conventional chemicals being used (GHG 1-10; GHG 11-21; GHG 22-34; GHG 35-48). Common among respondents was the explanation that certain organic practices such as animal manure fertiliser, fallen leaves, coconut skins, and cocoa pods offer

substantial fertilising effect and can be used in place of some chemical fertilisers if the trees are yielding well and do not need an extra boost (GHG 1-10; GHG 22-34; GHG 35-48). Another commonality was the substitution of conventional chemicals especially pesticides and fungicides. This was explained that, while there are customary pesticides using local pepper fruits the spicy scent of which deters insects, these organic approaches are only suitable for low or slow affecting issues, and the chemical sprays are required when pests and disease are too high to be combatted by the weaker organic sprays (GH 11-21; GHG 22-34). A respondent reported that use of chemicals up to a certain point in propagation doesn't have long-lasting negative effects, which was echoed by Co. 1 respondents (GHI 75; GHI 49).

Group and individual interviews with farmers was crucial to pursuing RQs 1 and 2. Understanding the farmers' experiences of biodiversity sustainability implications, avenues to promote/implement/maintain this sustainability, and drivers and barriers associated with it show how the level of actor scale clearly affects the commitment and ability to achieve and maintain biodiversity sustainability. This is seen clearly in the varying levels of engagement/commitment that are associated with social issues such as livelihood, land rights, and access to resources. In order to begin answering RQ2 , these interviews were integral in that it could verify the validity of government and private sector actors found in both the literature and respondent correspondence from these two levels of scale. As this section has shown, there is a direct link between biodiversity sustainability implementation throughout Ghana's cocoa production networks and the impact to farmer livelihoods, resource access, and knowledge. It is only in accounting for these multiple aspects that biodiversity sustainability can be achieved.

5.5 Preliminary findings summary

As observed in this research and the literature, environmental issues in cocoa production are complex. The themes found in this research for each level of actors was shared, however the experienced effects of these issues were observably different between the levels of actors. While not exhaustive, this research observed

the intricate tug-of-war between the experience of farmers, in terms of environmental change over time, demand for commodities and on achieving biodiversity standards, and the strain between livelihood, sustainable production, meeting market demands, and the access the resources and goods.

Farmers experience these issues through price squeeze, rising demand, lack of resources to meet growing demand for both increased yield and biodiversity sustainability attainment, and the struggle between meeting demand and securing livelihood. For private actors these issues are experienced in access to production networks and qualifying suppliers, internal and external demands for products and ensuring their production network participants meet biodiversity standards, as well as the effect of environmental degradation on supply. For public actors these are observed as experienced through access to global funding and resources, meeting demands of consumers, and standard-setting institutions regarding biodiversity sustainability in agricultural production, public-private partnership demands, the effects of environmental change on agricultural output.

This preliminary finding supports the use of GPN and fractal scale as it shows the underlying contextual drivers feeding into the complex nature of biodiversity sustainable cocoa production. GPN subscribes to analysis of all actors' contextual application of an issue such as biodiversity sustainability. Fractal scale submits that the changes made by one level (ie lead firms requiring documented traceability records from farmers to participate in their production network or governments requiring tribal and institutional documentation to confirm traceability) affect the other levels of the network. As can be seen in this research, these issues are interconnected in the lived experience of the actors studied. Utilising this approach allows this research to analyse these phenomena both individually and as it sits within the whole of the production network being studied.

As these studied biodiversity sustainability issues of non-shade cultivation, deforestation, and harmful chemical use are linked to social sustainability issues, this has been found to create an even more complex situation. This can be seen in the link

between customary land rights issues which are rooted in issues of social sustainability, and the environmental issues of environmentally sustainable tree husbandry, which are affected by contested land rights issues (Asuming-brempong et al., 2015; Ubink & Amanor, 2008). This can also be seen in the dual system of land rights in Ghana between the postcolonial government institution and the traditional chieftaincy-based land tenure arrangements (PETERS, 2010; Ubink & Amanor, 2008), as well as the group interviews with cocoa farmers, academic interviews, and public and private actor interviews. Finally this can be seen in the connection between commitment to biodiversity sustainability implementation and farmer livelihood demands (LD 3; GHI 49; GHI 74 a&b; GHI 76; GHI 78).

The public-private partnership between firms such as Co. 1 and COCOBOD shows the effectiveness of the multiscalar approach utilising a mix of standards and mentoring-approach to implementing sustainable practices. This approach shows promise of a more mutually beneficial production network for all parties participating. As the mentoring-approach taken up by Co. 1 with such initiatives as input supply, are pilot programmes, as mentioned, there is further research to be done regarding its effect on achieving biodiversity sustainability. The approach of incorporating social and environmental sustainability issues is further evidence supporting those studies that propose that both arenas of sustainability are connected, and one cannot successfully be addressed without the other.

The complexity of biodiversity sustainability proposed in the literature is reflected in the outlook of the different respondents from LD 1, 2, and 4. Coming from different backgrounds of organisational sustainability, biodiversity efforts expert, and academic expert respectively, one underlying issue that was common was that of contested land rights. The effects of this issue and the approach to resolving it was seen differently by some of the respondents, however. While the lead firm respondents put forward that documented land ownership and traceability are cornerstone to ensuring biodiversity sustainable practices are implemented, an academic interviewed argued that in fact forcing institutionalised land ownership disrupts the traditional migratory cultivation framework which has been instated throughout tribal history (GHI 74 a; GHI 76). This

change may present further harmful effects to the 800,000 smallholder farmers who historically have depended on community land and migratory practices to maintain livelihoods for their families while not infringing on tribal law (GHI 76; Yaro, 2002; Amanor, 1999). This critical issue of contested land rights and the public-private partnership to promote traceability in sourcing is one of the questions remaining for this research to investigate further. As the experience of each respondent interviewed thus far has presented different resulting priorities and solutions, future interviews with lead firm correspondents as well as government correspondents will press into the varied outcomes of traceability and institutionalised land ownership versus the traditional communal migratory land ownership.

Chapter 6 Scaling up environmental improvements in the shea production network: evidence from Ghana

6.1 Introduction

A focus of the shea case study is to understand how biodiversity sustainability is understood and disseminated by different actors throughout Ghana's shea production network. It examines the approaches and their effectiveness compared to Ghana's cocoa industry standards and development. This chapter seeks to understand the shifting relationships and power dynamics that promote or deter change within Ghana's shea sector compared to Ghana's cocoa sector.

Local, national, and international relationships play vital roles in achieving biodiversity sustainability or could contribute to the barriers holding the industry back from this sustainability, as is shown in Chapter 4. This chapter analyses the current standing of Ghana's shea industry, building on the historical context laid out in Chapter 4. Empirically, this chapter analyses, "the social processes involved in producing goods and services and reproducing knowledge, capital and labour power (Henderson, Dicken, Hess, et al., 2002, p. 444)." This is necessary, as Henderson et al. (2002) and subsequent GPN scholars have pointed out, to understand the development of Ghana's shea industry relating to biodiversity in both "spaces of places and flows (Henderson et al., 2002, p.437)" that are embedded in the subnational, national and global contexts within which interaction and production coordination take place. The fieldwork conducted for this chapter provides an insight into the short and long-term effects of the various approaches taken by powerful actors in this sector and potential opportunities for improvement and development of this sector's sustainability.

A second focus of the shea case study is to understand the potential implications of rising demand for shea to be used as a cocoa substitute. Some studies claim that shea, along with several other proposed substitutes differentiate too much from cocoa butter, while other studies show a comparable solution to cocoa butter in shea butter, at least as a partial substitute in chocolate. There is not enough research on both the

application of shea butter for cocoa butter in confectionary products as well as the economic and environmental implications of the potential shift toward shea butter as the main cocoa butter substitute over other fatty oils such as palm, mango and illipé (Lipp and Anklam, 1998; Francis Alemawor, Jacob K. Agbenorhevi and Adrian K. Poku, 2014; Glew and Lovett, 2014). Shea is being used in some markets as a cocoa butter substitute, necessitating this investigation. What implications does this have on the sustainability of Ghana's shea industry? As there is not enough research on shea production and the environment, this research seeks to understand the current state of environmental sustainability of Ghana's shea industry, the drivers, and barriers to achieving sustainability for shea, and lines of further research to consider.

This chapter will first discuss current government involvement in Ghana's shea sector, followed by examining the other actors engaged in Ghana's shea sector, specifically NGOs and private firm actors. Third, the lived experience of the actors producing shea butter relating to biodiversity sustainability. Finally, a findings review will cover those topics highlighted in the data collection and further lines of inquiry.

This research utilises primary evidence from interviews with government actors, academic researchers currently employed by or past employees of various agricultural departments within the government or COCOBOD, NGO actors, and women shea producers (including both producers of shea kernels and shea butter for sale to private actors and/or the local market). These interviews were supplemented with tours of shea collecting villages and interviews with two women's cooperatives who often supply the shea butter sold to Co. 2 via the NGO interviewed for this research. This research was unable to interview shea buyers from Co. 2 directly. Alternatively, an interview with a former shop manager and a procurement specialist from Co. 2 was conducted. These interviews are supplemented with the interview findings from the NGO and cooperative women's interviews, offering a glimpse into the organisation of Co. 2's shea production network. The data provides further research into the specific interactions between Co. 2 and the Ghanaian government, NGOs, and the women from the shea collectives themselves.

Due to COVID-19 restrictions, a follow-up field trip for further data collection primarily within Ghana's shea sector was not possible. This follow-up fieldtrip was aimed to pursue in more detail COCOBOD's Shea Research Unit in Tafo-Akim, Co. 2 respondents visiting their Ghanaian suppliers, and further interviews and visits to shea producer over a broader region. This leaves gaps in this research that have been unable to be filled with the current literature on shea production in Ghana. The main insights from this chapter are found in comparing outcomes from the varying levels of powerful actor engagement between Ghana's cocoa and shea sectors and the results of different sustainability and structural approaches to achieving biodiversity sustainability across the two industries, as experienced by shea producers. While both commodities operate within Ghana's agricultural sector, the methods to sustainability between cocoa and shea sectors in Ghana is distinct, as discussed in Chapter 4. The effects of these varying approaches will be further discussed in this chapter, leading to critical areas for further research.

This chapter will discuss biodiversity sustainability in the two steps of shea butter production- collecting shea fruit and processing into either shea kernels or shea butter. There is a third step yet to be pursued, that of selling shea butter to private actors and in the local market. Due to the lack of access to Co.2 buyers and inability to carry out a second fieldtrip, this line of inquiry was not able to be pursued in this research but is a vital next step to understanding the full picture of Ghana's shea production networks. Within the two categories analysed here, several processes take a shea fruit to a kernel, which can then be processed further into shea butter. Further to the actual processing of fruit to butter, there are transport and intermediary dynamics between shea butter producers and MNC buyers. Much of the shea butter produced is sold in smaller quantities to intermediary buyers and then sold to MNCs. They use shea in their various production activities. By considering the steps to take shea from fruit to MNCs, this research aims to capture a holistic picture of biodiversity in this industry.

6.2 Sustainability interventions disseminated by government actors

As Chalfin's (1996) work shows, Ghana's shea sector has experience pendulum swings between high-level government involvement pre-1990s to no government involvement beginning in the early 1990s, back toward proposed government involvement, which is how Ghana's shea sector is said to currently operate. The driving forces behind changes in government involvement in the shea sector are a reaction to globalisation (Schaffer, 2002; Chalfin, 2004), the commodification of shea as a global product pressures from external funding bodies such as the World Bank and the IMF, the transition of shea into a cocoa butter substitute in chocolate, and an uptick in globalised use of shea in the cosmetics industry (Ferguson and Arhin, 1974; Minifie, 1989; Elias and Carney, 2007; Glew and Lovett, 2014). The shifting flows of actor engagement, and levels of autonomy achievable within the shea industry for powerful actors compared to the cocoa industry offer an insight to the multifaceted dynamics that interact within subsectors of the same agricultural industry. Data collected here on actor experiences from NGOs, collectors, processors, and academic researchers reflects this. Respondents from each category report that the government through COCOBOD is meant to implement sustainability throughout Ghana's shea production networks however many are experiencing minimal to no tangible support/interventions on the ground (GHI50; GHI69; GHI70-74b; GHG51-68).

This research's data for government involvement in Ghana's shea production industry was gathered mainly through shea collector and processor interviews, and NGO interviews. These were supplemented with interviews with academic researchers within the field of shea propagation and sustainability within the same region, and an informal discussion with a head of COCOBOD's Shea Unit in Accra. Visits to shea parklands, collection village sites and processing plant locations within Tamale and outlying villages were also carried out. This section considers government involvement in disseminating biodiversity throughout Ghana's shea production networks. There is a difference in the proposed level of involvement and provision to the lived experience reported by the women shea collectors and processors, NGO respondent and academic researchers interviewed. Accra and Tamale are a significant

distance apart, and there are other regions throughout Ghana where shea butter is produced, which may lend to the discrepancy. However, the difference between the government and other interviewed respondents does not match up. It provides different lines of research that should be pursued in greater depth, given more time in the country.

6.2.a. Biodiversity interventions in the shea collection stage

The main issues in this stage of shea butter production, as introduced in Chapter 4, are:

a) shea tree loss – due to premature or natural tree death, tree shock from poor agricultural practices such as bush burning, or illegal tree felling for roads, mining, and timber and charcoal materials,
b) increased drought times and severity as well as savannah expansion creating harsh environments poorly affecting shea trees and fruit yield,
c) neglect from including shea trees in positive agricultural practices such as irrigation systems and fertilising/pest-control methods,
d) cross-pollination and lab-produced hybrid tree introduction effects on shea butter composition, and
e) effects of pilot programmes introducing genetically modified shea tree types with decreased seedling to fruit bearing tree time (Elias and Carney, 2007; Neimark, 2010; Gwali *et al.*, 2011; Jasaw *et al.*, 2017; Abdul-Mumeen *et al.*, 2020;GHI 50; GHI 70-73; GHI 77).

The only government intervention regarding illegal tree felling and shea tree loss found in the fieldwork is the state laws prohibiting the felling of certain tree species, including shea. As is seen in Ghana's cocoa and other agricultural sectors, the issue of land rights in shea is complex with a customary and institutional approach that leaves actors such as farmers, and especially women vulnerable (Chalfin, 2004; Ubink and Amanor, 2008; Yaro, 2012; Tsikata and Yaro, 2014b). Land rights are more accurately tree rights for shea as they are in the cocoa sector, whereby the authority of the land

a tree is planted on remains in the tree and is thereby nullified when the tree dies or is cut down. A customary law and state law prohibits the felling of planted trees (GHI 50; GHI 70-73; GHI 77). While these customary and state laws may be known to farmers, the evidence of the continued deforestation is clear. The Shea Unit manager reported that this law is often misunderstood, as it is not only a law protecting shea trees, but any planted tree within the sub-Saharan parklands in which shea tree are wild-grown (GHI 77).

From their desk in Accra, it was hard for the respondent to answer on the effectiveness of this law or the level of enforcement, offering that regional magistrates and COCOBOD officials oversee the implementation of such institutional law. They did offer that COCOBOD's Shea Research Unit in Tafo-Akim may offer more insight into how this law is implemented in the northern regions of Ghana. Some of the reasons for shea trees being cut down are due to road expansion, mining activities, industrial development of land, and clearing for other agricultural produce (GHI 50; GHI 69; GHi 70; GHI 71; GHI 72; GHI 73; GHI 76; GHG 51-79). Being that some of the incentives for felling shea trees in this region of Ghana are rooted in monetary gain, it is difficult to see the feasibility of laws to protect shea and other indigenous tree types that are not actively implemented.

Bush burning is a long-standing agricultural and hunting practice commonly used to clear weeds from crop farming plots and to hunt in the sub-Saharan parklands (Dapilah, Nielsen and Akongbangre, 2019; GHI 50; GHI70; GHI 72; GHI 73). This custom causes tree shock, resulting in withering of the trees, a significant decrease in shea fruit yield, and over time premature tree death. This practice, coupled with the lack of irrigation systems committed to shea tree areas, results in biodiversity degradation on the trees and other endemic species living in the sub-Saharan parklands surrounding the trees (Elias & Carney, 2007; Jasaw et al., 2017; GHI 50; GHI 70; GHI 72). Drought and the Sahel-savannah zone expansion are macro-level environmental sustainability outcomes that affect shea trees as well, with the same decreased fruit yield and premature tree death resulting (Dapilah et al., 2019; Jasaw et al., 2017; GHI 50; GHI 70-73). As desert expansion continues and the parklands become more severe

climates for the endemic ecosystems, the loss of the flora and fauna surrounding shea trees exposes the trees to the harsher climate effects even more.

As presented in Chapter 4, there is a natural hybridisation occurring in certain shea tree regions between West Africa's *Vitellaria paradoxa* and East Africa's *Vitellaria nilotica*. While some literature contends that there is very little difference between the chemical characterisation of the two sub-species, the lived experience and foundational research of Ghanaian researchers and shea producers shows that *Vitellaria pradoxa* shea produces a thicker, creamier butter while *vitellaria nilotica* produces an oilier more fluid butter (GHI 50; GHI 72; GHI 73; Gwali et al., 2013, 2011; P. N. Lovett & Haq, 2000a). As rain and wind patterns change, as well as given dessert expansion, there is a natural hybridisation occurring between the two tree types (GHI 50; GHI 72; GHI 73). Additionally, lab-produced hybrid and/or genetically modified shea trees are being introduced to parklands. These lab-based shea trees are created to produce higher fruit yield with less water requirement, decrease timespan between seedling to viable fruit yields, and to have higher resistance to extreme temperatures of the parklands, pests, and disease. It is important to further investigate the potentially further change the characteristics of shea butter produced in Ghana through further cross-pollination and natural further hybridisation (GHI 72; GHI 73).

According to some interview respondents, COCOBOD research and seedling facilities distribute seedlings to farmers in the sub-Saharan parklands to encourage the regeneration of shea tree populations (GHI 71; GHI 73; GHI 77). This is done mainly in areas where cash crop farming activities naturally incorporate shea into good husbandry practices such as irrigation systems, fertilising and pest control efforts. Respondents from the women's collectives and the NGO interviewed for this research did not receive these seedlings (GHI 50; GHI 69; GHG 51-68). However, as only one small area within Ghana's vast shea producing lands was researched for this work, it cannot be extrapolated that no parkland regions are receiving hybrid tree seedlings.

Further risks accompanying shea butter production are from hazards during shea fruit collection (Chalfin, 2004). For example, women collectors suffer from snake and other rodent bites while harvesting, as they often pick fruit by hand without any protective gear available to them (GHI 50; GHI 70-73; GHG 51-79). The respondent interviewed from COCOBOD's shea unit reported that resources such as safety gloves, antivenom, and fruit picking tools are regularly distributed to the shea collecting villages across the Savannah and Sahel regions (GHI 77). However, according to the NGO respondent, there was only one time around 2015 when COCOBOD sought to distribute protective gloves and antivenom to collecting villages (GHI 50). Of the 18 collectors interviews, only 3 of these respondents recalled receiving any assistance or physical resource from the government, limited to a few protective gloves (GHG 51-68; GHI 69). One issue with antivenom provision is that the villages surrounding shea parklands often do not have electricity, and antivenom must be kept refrigerated to remain stable (GHI 50). As this research was unable to interview all shea producers in the region, it is not to say that other producers do not receive more frequent resource allocation from COCOBOD. It is concerning, however that such a significant proportion of collectors interviewed, all of whom belong to a large shea association spanning several villages and processing in government-built plants in Tamale, have not received much or any government assistance to access these tools they are unable to access independently.

While not an environmental-specific aspect of government involvement in Ghana's shea production, this resource provision is considered in this research as it is one of the few areas where the government's COCOBOD proposes to be directly involved in the maintenance of the sector. It is also crucial to consider as the lives of the shea producers are essential to preserving the industry to continue producing shea butter. In this factor, it is apparent that the proposed level of government involvement put forth by government actors stand in contrast to the lived experience of the shea collectors.

According to all academics interviewed, the NGO representative and collector respondents, COCOBOD, the overseeing government ministry for cocoa, shea, cola,

and coffee, has not had much involvement in addressing these biodiversity and safety issues affecting the shea sector (GHI 50; GHG 51-68; GHI 69; GHI 70; GHI 72). According to some respondents, COCOBOD has turned a deaf ear to the issues faced by women collectors (GHI 50; GHI 69; GHI 70; GHI 72; GHG 51-79). Some respondents report the impetus to address issues in shea has fallen to academic researchers and NGO actors to provide at minimum training on alternative practices to bush burning, the implementation of anti-tree felling laws, and the provision of minimal safety equipment required by the women collectors (GHI 50; GHI 70; GHI 72). However, other respondents, mainly those employed by COCOBOD, cast a more positive light on COCOBOD's involvement. They propose that while the government doesn't provide many physical resources, a dedicated research unit for shea specifically focused on shea hybridisation and propagation methods (GHI 71; GHI 73; GHI 77).

The respondent interviewed from COCOBOD's shea unit, and the academics employed by COCOBOD reported that the government's initiative to produce hybrid shea trees and new varieties of shea tree species has several desired outcomes (GHI 71; GHI 73; GHI 77). Firstly, these new forms of shea trees are hoped to reach maturity and begin bearing viable shea fruit within 2-5 years, versus the 12-17 year wait for endemic shea tree species (Lovett & Haq, 2000; GHI 50; GHI 70; GHI 73; GHI 77). Second, these new shea trees are designed to produce higher yields, be more resistant to pests and disease, and have a higher drought tolerance, thereby requiring less water to produce shea fruit (GHI 71; GHI 73; GHI 77). The reasoning behind these design features seeks to indirectly address the lack of protection of shea trees from harmful agricultural practices and increase the overall yield of the shea sector without requiring significantly more land, time, and water to achieve (GHI 77). The issue with this approach, this research would argue, is that it neglects directly addressing the harmful practices that have put shea and the parkland ecosystem at risk and created an unsustainable environment for biodiversity in the first place. Rather than implementing the customary and institutionalised laws that seek to protect shea trees from being felled, prohibiting bush burning practices, and addressing the lack of women's rights within this sector. The introduction of hybridised and genetically modified shea trees addresses a symptom rather than the root cause.

According to the data collected for this research, there are seemingly two points to the government's engagement in Ghana's shea sector- a) resource provision through legal statutes implementation, training and safety tools, and b) resource provision through hybrid and new tree subspecies introduction. While producing shea tree hybrids with significantly shorter gestation times could be an independently positive outcome, the lack of addressing the current issues creating the need for such interventions, as well as the neglect for collectors' health and safety is evident.

In the current approach, this research would submit that the government does not address biodiversity sustainability. The adverse effects of unsustainable practices are hoped to be muted by integrating new shea trees into the parklands. What happens, though, when these new tree varieties are inevitably felled or succumb to the increasing environmental degradation of the parklands? Additionally, as with unexplored negative biodiversity impacts of non-indigenous tree types into these lands, there is no way to precisely know the effects of introducing these new shea tree species into the parklands on the indigenous trees already in existence. Finally, the shea butter produced from these new tree types, combined with the natural crossbreeding of endemic and laboratory manufactured tree types, is unknown. These questions must be addressed if preservation of both the indigenous tree species is achieved and the protection of the quality and consistency of produced shea butter.

6.2.b Biodiversity interventions in the shea processing stage

As discussed in Chapter 4, the four main biodiversity concerns in the two stages of processing shea (from fruit to dried kernel, then from kernel to shea butter) are a) water consumption, b) fuelwood consumption, c) carbon emissions, and d) by-product waste produced during the processing stages (Elias and Carney, 2007; Jibreel *et al.*, 2013; Glew and Lovett, 2014; Adazabra, Viruthagiri and Shanmugam, 2017b; Jasaw *et al.*, 2017). While some academic respondents speculated that COCOBOD might be developing or deploying training initiatives to educate processors on safe waste by-product disposal, according to the COCOBOD and NGO respondents and the processing actor respondents, no official enterprises of this nature currently exist (GHI

50: GHI 70; GHI 73; GHG 51-68). Regarding water and fuel-wood consumption and carbon emissions, academic, COCOBOD, and NGO respondents were not aware of government programmes or resources provided to curb these negative biodiversity influences (GHI 50; GHI 70; GHI 71; GHI 72; GHI 73; GHI 77).

The lack of government involvement in environmental sustainability and good tree husbandry practices in shea collecting and processing is a stark contrast to the level of government training and resources dispersed in Ghana's cocoa industry. This reflects findings from scholars such as Chalfin (2004). The reasons for this lack of provision, according to the COCOBOD respondent, were due mainly to lack of personnel and a perceived lack of need (GHI 77). Furthermore, as shea is a wild-growing tree not included in direct agricultural practices, there seems to be a disconnect between the environmental decay of the shea parklands, and shea tree species, and surrounding agricultural practices that impact them.

In this instance, unlike in the cocoa case study, the level of actor scale for the government does not seem to influence active implementation of biodiversity sustainability in Ghana's shea production networks. This is a significant contrast as Ghana's shea sector is substantial to the national market as well as placing Ghana as the top global producer of shea annually (Lovett, 2004; Addaquay. 2004; Elias & Carney, 2007; Reynolds, 2010; Lovett, 2014). As shown above, there is not much in the way of governance used to disseminate biodiversity sustainability throughout Ghana's shea production networks from the government, with a lack of incorporating the proposed integrated framework for sustainability by the government. Being that the government is a powerful actor in the agricultural industry in Ghana, the disparity between engagement between the cocoa and shea sectors is highlighted. Considerations for further research are to further investigate the actual extent of COCOBOD's involvement in the shea sector. Additionally, it could be crucial to understand the value capture by COCOBOD form the shea sector, as it may be argued that due to lack of gains for COCOBOD the lack of incentive to facilitate biodiversity sustainability throughout its shea production network may be a key detrimental factor.

6.3 Sustainability interventions disseminated by NGO and private actors

Most sustainability dissemination efforts in Ghana's shea production industry identified in this research are provided through NGOs and public-private partnerships between NGOs and corporations such as Co. 2. Resources and training are primarily disseminated through NGO's, such as the those provided by the NGO interviewed for this research. This NGO has a partnership with Co. 2 and other MNCs seeking to source shea butter from the regions within and nearby Tamale, where the NGO operates. This research has gained an insight into the dynamics of the relations between public actors such as this NGO, private actors and suppliers working in this region through several interviews with women collectors and processors, the NGO's Managing Director, and discussions with two employees of Co. 2. These interviews are supported by further interviews with academic researchers at the leading agricultural university in Tamale, which specialises in shea propagation and sustainability research. Finally, interviews with shea producers and visits to shea parklands, collection villages, and processing facilities in and surrounding Tamale offer meaningful insight into the experience of these actors receiving/benefitting from NGO-private firm sustainability dissemination.

6.3.a. Biodiversity interventions in the shea collection stage

In terms of biodiversity sustainability effort from NGO and private actors in the collection stage, this research found that the majority of provisions are through education, training, and assistance with organisation of the production network through forming and facilitating cooperatives, as well as acting as an intermediary/advocate for the women producers with private buyers. Respondent GHI 50, Managing Director of the NGO partnered with Co. 2, discussed training workshops they hold on a rotational basis with different women's cooperatives in the region, similar to the rotational and regional training dissemination system carried out in Ghana's cocoa sector. The collectors interviewed confirmed that the training and resources received over the last decade have come from this NGO, with training around how to avoid snake and rodent attacks during collection and how to limit

waste by-products and carbon emissions during the two processing stages (GHI 50; GHI 69; GHG 51-68).

Respondents confirmed common sustainability issues in shea fruit collection as being results of other agronomic practices, especially bush burning, tree felling, land clearing, negative intercropping species choices, and construction/urban development (GHI 50; GHI 70-72). The NGO respondent, two academic respondents, and COCOBOD's Shea research unit respondent suggested that shea trees are protected by law (GHI 50; GHI 70; GHI 77). According to all respondents, however, in shea parklands, shea trees are felled for timber charcoal and to clear land for other food crops reiterating the need for more government involvement to implement policy (GHI 50; GHI 70-73; GHI 77). Regarding poor agricultural practices, there is a reported lack of power to enforce customary or institutional laws prohibiting certain detrimental practices such as bush burning for hunting, cash crop field clearing, and tree felling (GHI 50; GHI 70; GHG 51-68). In addition, the NGO respondent provided the lack of male involvement in shea butter production, specifically in collecting shea fruit and transporting it from the parklands to the village for initial processing, and shea tree husbandry practices such as irrigation (GHI 50). Because shea is not considered a cash crop and is viewed as a woman's remit, male farmers and developers mainly do not participate in collecting or processing activities and therefore do not see the need to attend the NGO's training. Therefore, they lack knowledge, or desire to understand, the harmful effects of these practices and the potential alternative practices that may be introduced to the same product with lower or no adverse environmental implications.

The NGO respondent, however, maintains their engagement with the women in the collectives, providing training resources on how to sustain shea trees through good husbandry practices such as protecting them where possible from bush burning (GHI 50), an effort acknowledged as being directed by NGO actors by academic and government respondents alike (GHI 70-73; GHI 77). An example of potential positive applications in crop farming practices being disseminated by NGO actors is the inclusion of shea trees near cash crop fields in the irrigation and fertilisation systems

used for other crops (GHI 50; GHI 77). They can be integrated into the positive husbandry practices that promote better tree health, increased fruit yield and more protection from premature tree death (GHI 50; GHI 70; GHI 71). The disconnect between collecting and selling shea kernels and unrefined shea butter to processing collectives and MNCs to the positive cash flow into the household creates a barrier to this integration (GHI 50; GHI 70-73). As in the findings from Ghana's cocoa industry discussed in Chapter 5, customary and institutional variances in land rights and gender's influence on land rights are crucial factors in some of the barriers to achieving sustainable agricultural practices, deteriorating biodiversity in both industries (GHI 50; GHI70-73; GHI 77).

This interaction exemplifies the findings from Chapter 5's cocoa case study regarding the effect of scale on biodiversity sustainability implementation throughout Ghana's shea production network. While NGOs are found here to be the most directly involved/present actor in Ghana's shea production network, the NGO studied here shows the interaction of being a 'weaker' actor in terms of production network power and the ability to implemented sustainability throughout the production network. Even with their partnership with Co. 2 the limitations to the resources, tools and other provisions they can provide to shea producers greatly impacts the effectiveness their biodiversity sustainability implementation. A further line of enquiry would be to gain access to more private actor information from Co. 2 and other MNCs purchasing shea kernels and butter from Ghana's shea production networks to see if any of these powerful actors reflect a more involved and effective means of dissemination as was found with Co. 1 in the cocoa sector. Additionally, there would feasibly be a marked difference between the NGO studied here, being a locally founded and run organisation, and international third sector bodies such as the World Bank. Further study of larger international third sector bodies' involvement in Ghana's shea production networks would be strategic to understanding the full weight of level scale on effects of biodiversity implementation throughout Ghana's shea production networks.

The respondents surveyed in the private and public sectors and academics interviewed confirmed a robust NGO presence in the shea industry, with private partnerships alongside or collaborating with NGOs (LDN 6; GHI 50; GHI 70; GHI 71). NGO respondent GHI 50, reported a lack of government involvement. This respondent recalled only one partial survey done with shea producers and one shea processing plant/warehouse that was built by COCOBOD, underutilised due to distance from harvester/processors. This survey was done nearly ten years before this researcher's interview was conducted. No findings were proliferated to the NGO respondent's knowledge of their organisation or the women producers surveyed (GHI 50). This reflects the academic respondents who also reported a gap in government research and surveying of shea tree quantities, health, species, subspecies, and hybrid species types (GHI 70; GHI 71; GHI 72; GHI 73). One academic respondent recalled only one significant survey being conducted in the last 20 years by scholar Lovett, P.N., who has subsequently published seminal works from 2000 – 2018 (GHI 73). This research does not submit that this is the only survey conducted. However, this insight is key to understanding the gap between investment in research. Lack of engagement with the shea industry adds to the barriers to achieving biodiversity sustainability within Ghana's shea production networks. How can individuals or institutions provide practical and appropriate resources and information when a foundational understanding of the state, structure, and lay of shea tree regions is unavailable?

Regarding desert expansion and sever weather conditions, the NGO respondent and academic respondents echo the insight provided by COCOBOD shea respondent. The NGO respondent participating in this research provided photographs of the changes in shea tree population in the same area visited during fieldwork, showing a substantial loss of shea trees in the same location over the last 8-12 years (GHI 50). Regarding cross-pollination and hybrid tree integration, the NGO respondent was aware of these aspects, however due in large part to lack of resources to conduct their own studies, the NGO respondent considered it a misuse of the time and resources for their organisation, choosing instead to focus on the direct work of training, resources provision and advocacy for the women producers with other public and private actors

(GHI 50). Again this links to RQ1 showing the manifestation of varying levels of actor scale on biodiversity sustainability implementation.

As discussed above, one problem stemming from climate change and long-term poor husbandry practices in other agricultural activities has been increased drought and soil barrenness. An issue the NGO is seeking to address is collectors needing to journey further into savannah due to the loss of shea trees and ever decreasing fruit yields from existing trees. This sparks transport issues decreasing yield collected. Due to this increasing distance, in some areas, it is now necessary to attain motorised transportation where hand-push trolleys or hand-carrying would have sufficed to transport shea fruit from the trees to the village for initial processing (GHI 50; GHI 69; GHG 51-68). Some collectors can sometimes secure a vehicle to transport more significant amounts of shea fruit from the fields further out in the parkland. However, this transportation is provided through the men of the village. As discussed previously, shea is not seen as a man's work, and so this assistance is held at the whim of the men in the village and quite often is refused to the women collectors with no recourse on the women's part (GHI 50; GHI 72).

One approach to the lack of shea care offered by the NGO respondent is the education of male farmers on positives to including shea trees into husbandry practices (GHI 50). These practices would consist of contact fertilisation, watering and inclusion in irrigation systems, and pest control. This inclusion would help to increase fruit yield, lengthen tree life, promote tree health, and potentially rejuvenate areas surrounding the shea trees. In turn, providing alternative sources of sustenance and homing for endemic rodents and snakes minimises the risk of attack and harm during fruit collection. One essential step to this process, according to the respondent, is changing the mindset of men in these communities to understand the livelihood gain that is associated with this 'women's work' of collecting and producing shea butter (GHI 50; GHI 70; GHI 71; GHI 72; GHI 73). The lack of connection between shea production and livelihood/community contribution needs to be tackled according to participant respondents (GHI 50; GHI 69; GHI 70; GHI 71; GHG 51-79). As discussed, women bring an alternative income stream through shea kernel and butter sales, and

some of the shea butter made in the villages is retained for household consumption. Moreover, as the uses of shea butter range from food, medical treatments, and hygiene care, it offers a lot more to the wellbeing of men, women, and children that are not currently recognised, lending to the neglect of the trees and land surrounding them (Addaquay, 2004; Chalfin, 2004; Lovett, 2004).

The final issue pursued in this research plaguing the shea collecting stage is the risk of harming the collectors through snake bites and other wild animal bites. These effects are seen in the year-on-year increase of attacks and increased number of snake and rodent sightings around shea trees by women collectors (GHI 50; GHI 69; GHG 51-79). While the NGO respondent did report that their organisation does provide some antivenom assistance, the NGO facility is in the Tamale township near the shea processing facilities. The shea parklands and central areas for shea fruit collection are scattered throughout the villages in the parklands outside of Tamale, sometimes up to an hour's drive or more from Tamale. Intermittent telephones lines/mobile phones and lack of network coverage in the villages and parklands, combined with the distance between the town and the village, can make it impossible for the antivenom to be administered in time to collectors in need (GHI 50; GHI 72). This is compacted by temperature requirements to keep the antivenom viable, with the high temperatures of the savannah making it difficult to keep the antivenoms closer to the villages due to lack of reliable electricity for refrigeration facilities and lack of resources for safe mobile refrigeration systems (GHI 50).

In some areas, NGOs and private firms have partnered to supply antivenom to treat such bites, however not every place has access to these resources. Moreover, where they are available, the resources are limited or, in some cases, have run out without being replenished or are too far to access fast enough to be effective (GHI 50; GHI 71; GHI 72). The NGO has introduced harvesting tools to reduce snakebite incidents for harvesters. The simple fruit pickers can significantly lower this risk factor; however, the issue is funding and distributing enough tools for all collectors (GHI 50).

6.3.b. Biodiversity interventions in the shea processing stage

As discussed in Chapter 4 and above, the main biodiversity issues in shea processing are the disposal of by-product waste, fuelwood and water consumption, and carbon emissions from high volumes of fuelwood burning (Adazabra et al., 2017b; Elias & Carney, 2007; Glew & Lovett, 2014; Jasaw et al., 2017; Jibreel et al., 2013). The NGO respondent discussed by-product waste management approaches to reuse or recycle by-products produced during several processing stages. For a few processing steps, a volume of brown wastewater is produced, which can be reused for other household work or reused in different phases of the processing course, or finally disposed of in dugouts or refuse areas to limit the negative impacts to soil the soil through bioaccumulation (Jibreel et al., 2013; GHI 50; GHI 70; GHI 71; GHI 72). Typically this run-off water is dumped on the bare land (Jibreel et al., 2013; GHI 50; GHI 70; GHI 71). Over time, the bioaccumulation of this brown wastewater changes soil composition, inhibiting seed germination and killing plant growth (GHI 50; GHI 70; GHI 71; GHI 72; GHI 73; Jibreel et al., 2013). Additionally, there is a volume of waste by-products called black sludge at the end of shea butter processing, typically dumped to the same effect. This black sludge by-product has shown potential for alternative use, such as in clay brick making and creating 'fuel cakes' to burn for shea butter processing and other household activities, which decreases fuelwood consumption, and is intermittently practice where knowledge of this application exists (GHI 50; Jibreel et al., 2013; Adazabra, et al., 2017). This is one of the foci of the NGO's training in the shea processing stage, encouraging the recycling of these waste by-products within the production cycle to help minimise direct biodiversity sustainability implication of shea production.

As well as introducing training on types of charcoal/by-product fuel cake to decrease fuel woods and emissions, the NGO is introducing semi-mechanised processing techniques that reduce the amount of water and heating required to process shea into butter (GHI 50). This potential is reflected in scholars' findings of semi-mechanised processing being used more frequently, with minimal trade-offs in terms

of shea butter consistency and quality produced from these methods (Addaquay, 2004; Jibreel et al., 2013).

From the data collected in this research, the NGO, academic and COCOBOD respondents show a glimpse into the barriers to achieving biodiversity sustainability implementation throughout Ghana's she production networks. Displaced responsibility and lack of resource allocation from the more powerful actors is found to have significant negative impacts on these efforts. While the NGO interviewed for this research exemplifies the potentials and current limitations to multi-scalar biodiversity sustainability implementation throughout Ghana's shea production networks, further research of more NGO and private actors is necessary to understand the full current standing and potential of these forms of sustainability implementation.

6.4 Collectors' and Processors' experience of scaling up biodiversity, implications of livelihood, land rights, gender inequality, and education

The data collected in this research shows that shea butter production is layered. It was found in interviews with government, NGO, academic and women shea producer respondents that some women collect shea fruit to process into kernels and then sell on these kernels to shea processing collectives or intermediaries who sell on to MNCs for export. Other women collect shea fruit, process to kernels and then further into the unrefined shea butter. At this point, they sell this unrefined shea butter to processing collectives for further refinement and resell to MNCs and in local markets. Finally, some women collect shea fruit, process it into kernels, and transport it to processing plants. They are also members of the processing collective that transforms the kernel into the refined shea butter or oil sold to MNCs and local markets (GHI 50l GHG 51-68). The data for this section was gathered through three group interviews with four, thirteen, and ten participants respectively, and one individual interview with a matriarch and cooperative leader from one of the collection villages. A visit supported these interviews into the parklands and photo data showing the change in the parkland tree population dating 8-12 years back compared to the visual data seen

as the current state of the parklands in those areas visited, as shown above. This section is divided similarly to those above, focusing on the women's experience in the collecting and then processing phases of shea butter production related to biodiversity. It is essential to note that there is considerable overlap between the two stages in terms of actor engagement. Within each group interview, portions of women are involved in one, several or all steps of shea production. This is important showing the complexity of shea production network organisation and therefore biodiversity sustainability implementation throughout. The overlap of the uses of produces shea from the research participants link back to the necessity of considering the embeddedness of production network organisation as proposed in GPN literature (Coe *et al.,* 2004; Yeung, 2015; Yeung & Coe, 2015).

6.4.a. Women's experience in the shea collection stage

It is interesting to note here that shea collection, and shea tree rights vary across different shea-producing countries. In this research, respondents' experience in shea fruit collection and processing into shea butter reflects Ghana's (and potentially the region of Tamale in particular) interaction with this 'feminised commodity' as being very separate from the male-dominated agricultural industry, while in other countries such as Burkina Faso the feminised nature of the shea industry seems to lend to more security in some aspects for women collectors and processors, and different forms of competition (Chalfin, 2004; Elias & Carney, 2007). In their work, Elias and Carney (2007) found that the feminised shea industry in Burkina Faso has lent to the higher protection of shea trees from being cut down (significantly, shea trees are primarily felled only when they interfere in other male-dominated agricultural production, a similar construct to Ghana's shea production networks), as well as young men entering into the collecting arena as they have understood that high value of shea fruit for export sales, creating competition that the respondents in this research did not experience. A shared experience is found in the fact that like Ghana, male head of households in Burkina Faso often are the authority to grant women access to shea trees, with a slight differentiation between personal and family fields, whereas the Ghanaian respondents in this research reported that they had full access to the trees

within the parkland unless a male head of household prohibited access (Elias & Carney, 2007; GHG 51-79). This shows again the nuance and effect of the varying contexts within which production takes place, speaking to the necessity of a robust GPN theoretical framework that considers the multifaceted aspects of global production networks, within the different contexts and spaces they take place, and considering economic, environmental and social aspects of production and sustainability to create a truly resilient and sustainable global commodities market (Alexander, 2018; Bolwig et al., 2010; De Marchi, Maria, *et al*., 2013a; Krauss, 2017; Yeung & Coe, 2015).

The women's cooperatives interviewed in the shea collecting villages reflected the issues discussed above (tree loss due to unsustainable practices, desert expansion, sever weather changes, drought, neglect from positive agronomic practices) impacting savannah biodiversity and shea tree sustainability and yield (GHI 69; GHG 51-79). This confirms the findings from the academics, government and NGO actors above regarding main biodiversity threats in the shea industry being the result of indirect effects from other poor agricultural practices (GHI 50; GHI 70; GHI 71; GHi 72; GHI 73). As in the cocoa industry, the mentality of the women the shea collectors was a passive one. Reasons for this disengagement were found to be results of being on the receiving end of other actors' actions, specifically cash crop agriculture, and not having the ability to change those practices (i.e. bush burning) to protect shea trees, thereby protecting their livelihood and the resource used by the entire village community (GHG 51-54; GHG 55-68: GHG 69-79; GHI 69).

An example of this disparity experienced by some women interviewed was the recent loss of shea trees (GHG 55-68; GHG 69-79). Trees were felled for gravel mining, road construction, home construction, and timber for fuelwood and charcoal creation, with shea marked as a preferred wood to make charcoal due to its extended burning features (GHG 51-54; GHG 55-68; GHG 69-79; GHI 69). According to some women respondents, an area populated by viable shea trees harvested from their grandmothers' generation or earlier to date were felled to expand international mines and roads to facilitate gravel transportation and other industrial construction. When

asked what recourse they had to stop such actions, some respondents said that the most they could do were to ask their husbands, brothers, or fathers to speak to the businesses to save their tree from being felled with no success as it was these men in their family and the village chiefs who sold access to the land to the corporations operating there now (GHI 69; GHG 51-79). A few respondents said they had gone to the location of their shea tree and physically held onto the trees to try to dissuade its felling and were forcefully removed from the site (GHG 55-68).

Regarding compensation for felled shea trees which wasn't received by any research participants in this study, it would be nearly impossible to provide recourse that would be enough to negate the lifetime revenue lost in removing these shea trees (GHI 50; GHI 70; GHI 71; GHI 72; GHI 73). Many respondents spoke on asking for at least some form of payment which was to that time denied, many reasoning that because they are women and shea is not considered a meaningful stream of revenue, there is no backing to their request for compensation (GHG 55-68; GHG 69-79).

As women do not formally own land, and shea trees are traditionally wild-grown and not propagated, land rights are not present in the institutionalised way of thinking about it. Instead, as seen in the example above, and like tree rights in the cocoa industry, tree ownership in the shea industry is informally held as belonging to the male head of the household working the land on which the shea trees happen to grow. Since shea production is left to women, there is an informal consideration that shea trees are 'for women' (GHI 50; GHI 70-73; GHI 69). However, as is seen in the example above, this does not hold sway over any instances of tree removal in consideration for the women producing the locally used and exported shea butter. The loss of shea trees negatively impacts the livelihood of these actors. It has significant biodiversity implications, especially when considering the conventional time required for a shea tree to mature to produce viable shea fruit made into shea butter. As the introduction of hybrid shea trees has only just begun and only in certain pilot regions, there is insufficient evidence to negate this threat to the shea tree population (GHI 50; GHI 69; GHI 70; GHI 73).

Shown in the interaction of men and women in the studied production network above, gender inequality plays a significant role in the barriers to biodiversity and socially sustainable shea butter production. As it does in the women participating in cocoa production regarding access to education, tools, and resources. Some of these inequalities are seen around access to positive agricultural practices, tree scarcity, lack of tree protection, and distance travelled to find viable shea trees for collection. The women participants in this research operating in this sector feel a lack of power to affect change in the broad-scale aspects of agricultural practice (GHI 50; GHI 69; GHG 51-79). This creates barriers to their conception of the small things they can do to limit environmental degradation (i.e. lower fuelwood consumption by using shea waste by-product). Like cocoa farmers lacking the incentive to invest in good tree husbandry practices due to land rights issues, land ownership is tentative at best in shea and the same disengagement is present. The women operating in the shea collection phase and processing within the village lack incentive to do these smaller sustainable practices considering the overarching unsustainable practices they have no control over (GHI 69; GHI 50; GHI 72: GHG 55-68).

The only education around sustainable shea butter production received by the collectives interviewed was disseminated by the NGO that works in partnership with the women's collectives and other private sector actors such as Co. 2. This reflects both academic and government actor findings showing a lack of engagement in distributing educational resources in this sector (GHI 50; GHI70; GHI 71: GHI 77). Similarly, any training and resources to protect against snake bite and other animal attacks during collection was received from the NGO directly (GHG 55-68). Of the women 28 women interviewed, only four discussed having made inquiries with COCOBOD representatives for receipt of such tools as safety gloves, fruit pickers, and antivenom (GHG 55-68). These women reported not receiving any communications from COCOBOD in response to their requests, and the other women in these groups added that this lack of response was why they too would not go to COCOBOD for assistance (GHG 55-68).

Comparable to the barriers to biodveirsity sustainability implementation in the cocoa sector, the social variables in shea production create significant limitations to the buy-in of women shea producers to biodiversity sustainability. This is yet another confirmation of the integral part social sustainability plays in achieving biodiversity sustainability, and the importance of incorporating social sustainability aspects into activated production network analysis as Bolwig et al., (2010) among others propose.

6.4.b. Women's experience in the shea processing stage

Scaling up biodiversity sustainability efforts in the shea processing stage shows marked differences to the collection stage. One significant difference is that of land/tree rights. Women operating only at this processing stage do not necessarily collect the kernels or unrefined butter being processed, so there is no consideration for land rights here. Livelihood is also less threatened in this stage. Processing plants are not on agricultural land and have been constructed by either NGO-private partnership or, in some cases, by the government. Combined with the fact that shea processing plants don't offer alternative uses to other male-dominated activities in the way shea trees do, they face fewer indirect threats to biodiversity sustainability implementation (GHI 50).

There is a logical increased incentive to utilise sustainable practices in shea processing. Using black sludge waste as an alternative fuel to fuelwood provides an economic stimulus (GHI 50; GHI 70; GHI 71; GHI 72). The women are required to spend less as they need less fuelwood for the heating steps of processing. The ability to potentially sell black sludge cakes for clay brick production can also provide a potential alternative revenue stream for these women (Adazabra, Viruthagiri and Shanmugam, 2017b). The creation of designated brown water waste disposal areas by the NGO within the processing plants visited has also cut down on the environmental impact of this waste product in the town by restricting the area affected to a small portion of the plant's property (GHI 50; GHG 69-79). For black sludge and brown waste water disposal in the village where some shea that is collected is processed for use in the home and to trade or sell within the local economy, the issue of waste

disposal remains an issue, but one with seemingly limited effects. While black sludge cakes are slowly being introduced to cooperative members who mainly collect shea fruit and do the initial processing to shea kernel, it is an avenue that has presented some opposition to the NGO respondent in that the activities within the home for the women can be more controlled by other activities and the head of the household in a way that processors aren't (GHI 50). Secondly, for brown waste water disposal, as shea fruit to kernel processing is down within the homestead and not in or near the agricultural fields, disposing of the waste water is seen as having no negative environmental impact by the collectors/homestead processors. This is because the area of land they dispose on is usually near a footpath that will not be planted on, however through the NGO's training initiatives, this practice is being limited over time to designated disposal areas that can be determined to not be near any running water that may carry the waste to cultivated land (GHI 50; GHG 51-79).

Finally, as above, the education and training for scaling up environmental sustainability in the shea processing stage have been found in this research from the NGO working with the collectives interviewed, with no known initiatives through the government being found in the data collected (GHI 50; GHI 77; GHG 69-79).

6.5 Preliminary Findings

As discussed in Chapter 4, the main environmental issues in the shea sector are indirect effects of other hunting and agricultural practices which affect shea trees. These practices include bush burning, tree felling, and lack of irrigation systems (Elias & Carney, 2007; Dapilah, Nielsen, & Akongbangre, 2019; GHI 50; GHI 69; GHI 70-73; GHI 77). These practices are exacerbated by poverty which drives farmers to fell trees beyond the usual consumption for construction, fuelwood and to sell as timber for alternative income streams. Unsustainable practices and the neglect of shea trees from positive agricultural practices is often rooted in the belief that shea is a) woman's remit and b) is not considered a food crop, despite shea being used in cooking many staple dishes and for medicinal purposes (Chalfin, 2004; Elias & Carney, 2007; GHI 50; GHI 70; GHI 71; GHI 72; GHI 73). These poor husbandry habits,

combined with the fact that shea trees traditionally take ten years to mature and five or more years from maturity to bearing fruit viable for processing into shea butter, have drastically decreased tree populations in sub-Saharan parklands (GHI50; GHI 70; GHI 72). The effect of deforestation in this area has seen endemic tree species wiped out to be replaced by cash crops such as mango, timber, and eucalyptus for a time (GHI 50; GHI 71; GHI 76). The land degradation due to the introduction of harmful foreign tree species leaves many areas once populated by shea and other tree species now barren. The loss of endemic species due to the felling of indigenous trees around shea trees is also a significant factor in the loss of shea tree species. This is due to the disruption of the natural ecosystem that brings wildlife that can act as natural pest (and thereby disease) control. As shea is not considered a food crop, it does not receive the agricultural attention that other trees and crops receive, such as pesticides and fertilising treatments, further destroying the tree population and land.

The main findings in this chapter show that the threats to biodiversity associated with shea butter production in Ghana are primarily indirect results of other unsustainable agricultural practices taking place in the vicinity where shea trees grow. In the processing stage, the direct unsustainable practices, where logic and incentive are presented, change through training and resource provision is being achieved. In contrast, the lack of motivation to the minimal unsustainable direct action in the collection stage creates a barrier to scaling up biodiversity. In both stages of shea butter production, the powerful public and private actors in Ghana rely heavily on NGO intervention to address both social and environmental issues present in the Ghana shea production network. This research cannot say if this is true for every region on Ghana that is active in shea production, however, having visited the largest shea producing region in and near Tamale, the picture painted by the women's collective, academics, and NGO respondents show a clear lack of engagement by the most powerful actors in the network, a vast difference between the shea and cocoa industries.

The most reported issue across the respondent categories outside of the government respondent was the lack of land rights and women's rights which leave the main

actors in collecting and processing shea vulnerable (GHI 50: GHI 69; GHI 71; GHG 51-54; GHI 55-68). This translates to biodiversity sustainability wherein women do not have the power to stop illegal tree cutting, urbanisation/construction without permission or compensation, and tree shock due to unsustainable crop farming and hunting practices (GHI 50; GHI 70). As in the cocoa sector discussed in Chapter 5, social sustainability issues feed biodiversity sustainability issues directly and indirectly and are necessary to address if biodiversity sustainability is hoped to be attained. This supports this researcher's overarching findings in the cocoa sector and supports other scholars' arguments that sustainability cannot be achieved without considering social and environmental aspects (Goger, 2013; Ponte and Cheyns, 2013; Sinkovics, Hoque and Sinkovics, 2016; GHI 49; GHI 74 a&b; GHI 70-73). This further supports many scholars' calls to incorporate the two arms of sustainability and reflect other scholars' work in the contextualisation of GPN framing and research. These direct and indirect factors all feed into the achievement or determent of true sustainability- both biodiversity and social (Henderson, Dicken and Hess, 2002; Salzmann, Ionescu-somers and Steger, 2005; Bolwig *et al.*, 2010; Krauss, 2017; Alexander, 2018). As is discussed in Chapter 2's literature review, even GPN scholars identify the need to expand the GPN framework to avoid being dualistic. The literature seeks to incorporate the multi-faceted nature of power, production, context, culture, and many other socio-economic factors contributing to the global commodities' many-branched tree (Coe et al., 2008; Perey, 2014; Yeung & Coe, 2015; Yeung, 2015).

This research finds the overarching themes of gender inequality, land rights, and livelihood are substantial factors impeding scaling up biodiversity in this industry. The increasing demand for shea butter in global confectionery and cosmetics production adds fuel to the fire burning up this natural resource faster than it can be rehabilitated. Significantly in tandem with the exponential loss or neglect of shea trees being excluded from protections against other agricultural and industrial activities that threaten shea tree population and yield. This again supports this research's argument that social sustainability factors are part and parcel of achieving biodiversity sustainability in Ghana's shea production industry, just as it is in Ghana's cocoa production industry. Again, we see in shea, just as in cocoa, the actors with the least

autonomy and power to affect change being negatively affected by both the ramification of degrading environmental practices and being the 'biggest losers' to these adverse environmental outcomes. These actors are also often burdened with the impetus of reforming negative industry practices and norms, which in itself poses the issue of displaced responsibility to those actors with the least resource to make a change, as well as being the group who will benefit least in terms of financial gain from any changes made (Sinkovics, Hoque and Sinkovics, 2016; Higonnet, Bellantonio and Hurowitz, 2017).

Further research is needed to understand the exact extent of deforestation and shea tree loss. Lovett and Haq's (2000) survey compare shea tree density on "high intensity, medium intensity, and low intensity (or unmanaged woodland) farmland (p.273, 280)" found the highest tree density on low-intensity farmland (84.2 ± 10.0% (2.16 ± 0.57 m2 ha-1) of woody biomass (p.280). The main contributor to the stifling of shea tree population on medium and high-intensity farmland is the felling of shea trees that don't meet specific farmer criteria such as age, size, yield, and spacing. Lovett and Haq's findings are significant in the context of understanding the relationship between farmers, shea producers, shea trees and the land. In addition, it supports the experience of shea collectors and processors who report neglect in good agricultural practices and a lack of protection for shea trees from felling and other harmful practices. The study, however, only surveyed three areas, Jintigi, Mandari, and Bole, within the West Gonja District, Northern Region, Ghana (Lovett and Haq, 2000; p. 275). Before this study, the last large-scale survey found in this research of the shea tree population was conducted in the 1920s (Lovett and Haq, 2000b). The current evidence for shea tree loss is most notably found in the distances women collectors now travel into the parklands to find viable shea trees, with the distance being now in some place over 5-10km away from their homes (GHI 50; GHI 72; GHG 51-68). In the collection of shea fruit, women often travel by foot and handpick shea fruit that has fallen to the ground in the pre-dawn hours. In recent years, with the clearing of more and more land for rural development, cash crop farming, road construction, and gravel mining, women now need to travel to find viable shea trees. Hand carrying the bags of fruit back to the homestead limits the amount of shea that can be harvested

each day, significantly limiting the overall output of shea kernels from collection villages (GHI 50; GHI 70; GHI 71). The physical evidence of bush burning and shocked or withering shea trees to the collecting villages also shows deforestation and tree loss. The significant research gaps in shea tree population, species types, hybridisation effects, and the effects of introducing lab-grown and fully propagated shea trees is another critical barrier to achieving biodiversity sustainability within this industry. Suppose there is no foundational understanding of the actual status of where this industry stands in terms of these things. Then, there is no possibility of creating benchmarks or strategies to achieve sustainability because there is no guide to show how far away from that sustainability the industry truly is.

Chapter 7 Findings and Conclusion: A Cross-study analysis of scaling up environmental improvements in Ghana's Cocoa and Shea production networks

7.1 Introduction

This chapter focuses on my research findings from chapters 5 and 6. I focus here on the interactions between the two case studies, the commonalities, and differences in context, issue, scale, approach, and outcomes. This chapter comparatively analyses the processes taken up by the studied actors at different scale levels, the effect of these approaches, and the long-term sustainability outlook resulting from Ghana's cocoa and shea production networks. In analysing the different approaches to sustainability dissemination throughout the two studied networks and at varying scale levels, I seek to determine the effects of scale on the various actors and strategies studied. Each aspect of scale analysed is done through the four actor lenses (farmer, private actor, government, NGO). These lenses reflect different levels within the scale of the respective production networks and the effects of scale on each level actor. As in the chapters leading up to this, the characteristics of embeddedness, power, and multiscalar interactions are considered. This attention activates my holistic framework for action-based analysis and provides a robust evaluation, contributing to the existing research calling for the analytical inclusion of these factors (Ostrom, 1999; Gibson, Ostrom and Ahn, 2000; Henderson, Dicken and Hess, 2002; Coe, Dicken and Hess, 2008; Bolwig *et al.*, 2010; Nagendra and Ostrom, 2012; Barrientos, 2013).

Specifically, this analysis seeks to contribute to Coe et al.'s (2008) call for GPN analysis that offers a "conceptualisation that operates at the interface of structure and agency, flows and territories, culture and economy (p. 289)." It seeks to provide supportive evidence for Bolwig et al.'s (2010) appeal to incorporate environmental and social aspects of production network analysis toward "practical methods to guide action research in value chains (p. 175)". This analysis reaches these aims using Perey's

(2014) fractal scale framework and Krauss's (2017) 'constellation of priorities'. In my research, I consider the effect of the level of actor scale involved in sustainability dissemination and upgrading throughout the studied networks, the distribution of responsibility for achieving the studied sustainability aspects and the return on investment (ROI) for the weakest level actor involved.

Considering social context (livelihood, land rights, gender inequality) is done to frame analysis grounded in real life and practical application viewpoint. Otherwise, as argued throughout the previous chapters, the study would be inconsequential and detached from reality. Questions asked toward these ends are: How do context and scale (livelihood, land rights, gender inequality, power, access to resources, knowledge, and ROI) affect biodiversity sustainability implementation and upgrading? What transferrable actions exist between the two cases? How do different barriers between the two networks affect the achievement of biodiversity sustainability implementation and upgrading? What are the areas of improvement for each, and what further research needs to take place?

Of the 21 individual interviews, nine were with actors in the shea sector, and eleven were with the cocoa sector. Within the shea sector, my individual interview respondents comprised two private firm actors, one public sector actor, five academics in shea research, and one government actor holding a shea-specific role. Within the cocoa sector, my individual interview respondents consisted of eight private sector actors, two academics in cocoa and economic research, and one government actor holding cocoa-specific capacity; the only sector actor unable to be interviewed in cocoa was one in the public sector, due to time and access restrictions. I also conducted seven group interviews across shea and cocoa-producing private actors. I held three group interviews in shea: Interview set E consisted of three shea producers, interview set F with thirteen shea producers, and interview set G with ten shea producers. In my cocoa case study group interviews, interview set A comprised of ten farmer respondents, interview set B of ten farmers, interview set C with twelve respondents, and interview set D with thirteen farmer respondents. The interview sets E-G respondents were all female, reflecting the female-dominated shea sector in

the literature. In the cocoa case study, interview set A consisted of four female and seven male respondents, Interview set B of two female and eight male respondents, interview set C had two female and eleven male respondents, and interview set D consisted of three female and ten male respondents, reflecting the male-dominated sector found in the literature.

This chapter will first examine the commonalities and differences in the context of Ghana's cocoa and shea production networks as mapped through participant interviews in the data collected. Second, a discussion on the commonalities and differences in biodiversity sustainability issues faced between the two studied networks with the application of the foundational literature that feeds my holistic analytical framework. Third, an examination of the commonalities and differences in approaches to and outcomes of scaling up biodiversity sustainability in Ghana's cocoa and shea production networks. Finally, I will examine the longevity forecast of approaches to scaling up biodiversity and aspects for further research consideration.

7.2 Commonalities and differences in the context of Ghana's cocoa and shea production networks

The considered aspects of scale in this study include: the amounts of the commodity produced for export or local markets, the scale of PN, how many levels of interaction play out in each PN (local, national, global), the scale of biodiversity sustainability dissemination efforts throughout the studied networks, levels of actors scale directly involved (farmer, processor, government bodies and the scale of power of each actor involved), and the scalar nature of each network coordination approach and its outcomes.

In 2014 Ghana produced 900,000 tonnes of cocoa, contributing 20% of all global cocoa exports and 25% of Ghana's total foreign exchange earnings, and an average of 82% of cocoa produced was exported between 1999-2004 (Asuming-brempong et al., 2015; Wessel & Quist-Wessel, 2015; World Bank Group, 2018). The importance of this export commodity is seen in the large percentage of total foreign exchange earnings,

coupled with the strong local and national demand for cocoa butter. There is no doubt that cocoa is vital to this nation. Simultaneously, like many of its neighbouring countries, Ghana possesses multiple streams of significant resources, such as shea butter. The top exporting country of shea globally, Ghanaian producers collect approximately 500,000 tonnes annually. About 270,000 tonnes of raw nuts are exported, while an estimated 230,000 tonnes are processed into about 60,000 of crude shea butter. Of the shea processed into unrefined butter, 28% is sold in local markets. The remaining is exported to the global market, mainly refined for cosmetics and confectionary use (Addaquay, 2004; Glew and Lovett, 2014).

The significance of Ghana's cocoa and shea sectors is not limited to local and national consumption. Both are staples across West Africa and arguably the rest of the continent. Ghana supplies a substantial amount of the global cocoa and shea purchased and further sold in many products across the cosmetics and confectionary industries, with daily consumption and use by millions of consumers worldwide. Moreover, the local market for these products is vital. It has a long history, in shea's case dating back centuries of trade in West Africa and across the continent, which continues today alongside the ever-rising global demand and export of shea nuts and unrefined butter (Addaquay, 2004; Wardell and Fold, 2013; Glew and Lovett, 2014).

It is for these, and the many reasons discussed throughout this research, that preserving and rehabilitating biodiversity throughout the respective PNs in Ghana, and the protection and enhancement of the lives of the integral growers, harvesters, and produces of these two precious commodities, without whom the entire global market for these goods would collapse. Land and the people of the land, with an ancient history and wealth of knowledge of the needs and life breath of the land, cannot be dismissed as it historically has been in western academia and business. Although the necessity for biodiversity and social sustainability is not a new cry, from scholars to policymakers to consumers, the need to create mutual equitability between powerful actors, farmers/producers, and nature is being called for. Without such balance, the outlook for these commodities and their countless lives is bleak for the many 'weak' actors and consumers whose leveraging power is minuscule

compared to the few 'powerful' actors who also capture the highest value from this market participation.

Although both shea and cocoa are large-scale commodities, the scale of PN coordination between the two couldn't be any different. In cocoa, we find at least eight stages cocoa passes through from the farm to its export from Ghana, with further stages taking place across the globe. From the tree, cocoa is first met by the farmer, who processes the sellable beans into the plethora of cocoa-based products people worldwide will enjoy. Then, the farmer sells these beans to Licenced Buying Companies (LBCs), who pass the beans through COCOBOD's Quality Control Division and Purchase Price Review Committee. Finally, the beans return to the LBC, pass to hauliers, and through the Cocoa Marketing Company to the port where the final Quality Assurance sealing at the port stage takes place.

It should be noted that this structure may have fewer or more stages depending on the form in which the cocoa is being exported (i.e. if it is being processed further into cocoa powder for export, there will be additional stages to pass through to get to port) or if it is being processed for sale on the local or national market. Meanwhile, in Ghana's shea PNs, all two or three stages must be passed through to bring shea from savannah to export. First, collectors harvest shea and process it from fruit to nut. Next, the shea nut is sold through such bodies as NGOs to MNCs who export the nuts for further processing and refining abroad. Alternatively, shea may see one additional stage, for the portion of the harvest that is processed into unrefined shea butter and then sold to MNCs for export or on the local market (Glew and Lovett, 2014).

Levels of interaction between different levels of the actors' scale are similarly split. The cocoa sector shows interactions between farmers, government, and private actors through resource provision, training, and standards accountability. In this research, a caveat is that Co.1 claims that it is singular in the level of interaction and support provided to its PN farmers. Further study into the other big players in Ghana's cocoa sector would better understand the overarching engagement level. In shea, the only interaction confirmed in this research was between the women

collectors/producers and the third sector through the NGO interviewed. As Co. 2 respondents were extremely limited, it would be an essential insight for further research to gain access to Co. 2, notably as they are partnered with the NGO participating in this research. In interviews with the women collectors/producers, when asked if they could recall meeting or working directly with Co. 2, they responded that they only worked with or have met the NGO respondent and their staff members (GHG 51-79; GHI 69). With the limited data available for this case study, the conclusion that can be drawn are general and reflect the literature reviewed, where third-sector actors pretty independently coordinate the networks, with no government support and minimal if no interaction with private-level actor MNCs buying the shea nuts and unrefined butter (Chalfin, 2004; Wardell and Fold, 2013). As seen in cocoa's case, and as found in the literature reviewed, polycentric multiscalar approaches to governance can more successfully achieve biodiversity sustainability that does not come at the detriment of the human being attached to the network production, begging the question of what it will take to push the necessary actors involved in Ghana's shea sector toward engagement with these issues and application of said governance (Nagendra and Ostrom, 2012; Ostrom, 2012; Perey, 2014).

As discussed above, cocoa and shea are both subsectors of Ghana's agricultural industry that bring a significant contribution to local, national, and international markets (Addaquay, 2004; Anim-Kwapong and Frimpong, 2004; Chalfin, 2004; Elias and Carney, 2007; World Bank, 2011; Jibreel et al., 2013; Asuming-brempong et al., 2015). Shea's strong presence in the national and international marketplace, being one of the top shea-producing countries in the world, cannot be dismissed (Addaquay, 2004). Ghana is the leading producer of shea in the world, producing approximately 500,000 tonnes of shea nuts, 72% of which is exported annually (Addaquay, 2004). Of the 500,000 tonnes of shea produced annually, an estimated 230,000 tonnes are processed into about 60,000 tonnes of unrefined shea butter, and about 270,000 tonnes of raw nuts are exported (Addaquay, 2004). The remaining 28% of shea produced is sold in local markets, showing the significance of this product both locally and globally (Addaquay, 2004).

Organisationally, as shown in chapters 5 and 6, shea is overshadowed by cocoa's being pushed as one of the nation's most important economic contributors and the second largest producer globally (Chalfin, 2004; Asuming-brempong et al., 2015). In my shea interviews, all levels except the government level actors discussed the disparity of resource and investment between cocoa and shea production networks in Ghana (GHI 79; GHI 50; GHI 69; GHI 70; GHI 71; GHI 72; GHI 73; GHG 51-79). Seven out of ten shea individual interview respondents discussed the lack of government intervention, with the priority and resource being allocated for cocoa production networks instead (GHI 50; GHI 69; GHI 70; GHI 71; GHI 72; GHI 73; GHI 77; GHI 79). Of the three respondents who did not discuss the lack of government intervention, two were US and UK-based respondents from Co. 2 who did not have information on the level of government involvement in the production networks from which Co. 2 procures shea butter (LD 5; LD 6) and one respondent was a head of a shea division within COCOBOD who focused on the research into shea tree propagation when asked questions about government involvement in the network toward biodiversity sustainability dissemination (GHI 77). When asked specific questions about resource provisions for shea producers, the COCOBOD respondent discussed past initiatives to distribute some safety tools such as gloves and antivenom. However, they were unaware of any programmes for this distribution being in current circulation (GHI 77). They were also unaware of or did not want to discuss such topics as research into the implications of hybrid shea trees and transitional soil implications, instead referring back to "the wealth of research" into shea tree propagation, with initial results "show[ing] good outcomes to reduce shea tree propagation down from two decades to a few weeks or months (GHI 77)."

While the presence and influence of women in cocoa are extremely understudied, seminal work such as Barrientos' (2013) study found that women are present and making valuable contributions to global cocoa production, her case study countries including Ghana. As shown in Chapter 4, the experience of these women farmer respondents reflects the disparity between men and women cocoa farmers, with all women respondents in this study responding that they receive less or no resource support through COCOBOD compared to their male counterparts. Issues of land rights in cocoa and shea also affect women more than men, although even cocoa farmer

men are subject to the problems brought about through the dual land rights system in Ghana's cocoa and shea sectors. Just as the women shea producers are at risk of loss of shea trees, women cocoa farmers are also beholden to the males of the community for access to land they may be farming and can lose the little plots of land (less than ½ acre in the case of cocoa farmer women interviewed in this research) without compensation. In the cocoa sector, a small percentage of women cocoa farmer participants report receiving the least amount of assistance, if any, and the least amount of value captured for their network participation (GHI 11-21; GHI 35-48).

Ghana's cocoa PNs are highly male-dominated, with the interplay between customary, institutional, and private governance aspects present. As discussed in chapters 4 & 5, the cultural elements of men versus women- oriented work and the multiscalar approach to biodiversity implementation throughout this PN show significant engagement with environmental upgrading throughout the network. In my group interviews with cocoa farmers, interview set A comprised four female and seven males respondents, interview set B with two female and eight male participants, interview set C two female and eleven male respondents, and interview set D with three female and ten male participants (GHG 1-48). The two individual interviews with the chairpersons of the two cocoa cooperatives participating in my group interviews we both male, and when asked, the COCOBOD respondent facilitating the farmer interviews was not aware of any female chairperson in any of the cooperatives they worked with at that time (GHI 75; GHI 78; GHI 80). Of the interviews conducted with cocoa farmers for this research, 29% of respondents identified as women. Although a tiny portion of the over 800,000 smallholder farmers are active in Ghana's cocoa sector, the sample of interview respondents reflects the primary and secondary data collected regarding women's low participation in this sector (World Bank, 2011; LD 3; GHI 76). During my group interviews, when asked questions regarding whether COCOBOD resources allocation was received and how resources were allocated, the women in all four group interviews raised their hand when asked have you experienced not receiving COCOBOD resources? When asked how resources are allocated, women in each group interview offered various experiences of missing out on resource distribution.

During one group interview, we had to pause the conversation as one of the women became very vocal in response to this question (GHG 22-34). When I asked my COCOBOD respondent, who was acting as my translator and interview facilitator, he said that the woman misunderstood the question and had asked to discuss some 'housekeeping' issues accessing the resources (GHI 75). During the transcription of my interview recordings, I sat with a Ghanaian academic fluent in Twi, the language spoken by my cocoa and shea producer interview participants, who translated that specific part of the audio file, informing me that the woman farmer was angry because she was voicing her experience of being excluded from COCOBOD resource distribution of fertilisers and pesticides, speaking on the fact that the women farmers are not told when COCOBOD would be delivering the inputs. Due to household responsibilities in addition to their cocoa farming work, they are all gone by the time they can reach the warehouse to pick up any inputs. She reported that this had happened to her every delivery over the last several months (GHG 22-34). In another group interview, another woman farmer discussed how she was told that whenever the inputs are delivered but by the time she can attend the warehouse, like the previous group interview respondent, all the inputs would be gone, so she also did not receive any resources from COCOBOD (GHG 35-48). This interaction highlights the effects of scale as experienced through the actor lens of the farmer and the impact of scale on a powerful actor, such as the government, through the desire to limit outsider knowledge of the disparity between resource provision between men and women farmers. The impact of gender inequality at this basic level of resource allocation and reception reflects the need for social and environmental integration applied through my holistic framework for action-based research and speaks to Bolwig et al.'s (2010) integrated framework for action-based analysis. The influence of social aspects of sustainability on the weakest level of the actor scale is seen in the impact on women's ability to meet environmental sustainability goals being impeded due to their social status as a woman. Although the high-power level actor scale of the government is directly involved in the cocoa PN participants interviewed in this research, gender inequality was apparent as a barrier to the affected actors' ability to achieve biodiversity sustainability in their cocoa production practices.

Because this research could not collect responses from farmers that could be confirmed as participating in Co. 1's PN, it is imperative to pursue this line of enquiry further to fill this knowledge gap. With the multiscalar partnership between MNCs such as Co. 1, COCOBOD, and international bodies that influence and feed into Ghana's cocoa sector, is there a difference in the facilitation toward biodiversity dissemination for Co. 1's PN participants? If the efforts of such private actors as Co. 1 can be confirmed, does this intervention address the unequal access to resources due to gender identity found in the public-sector engagement through COCOBOD? This would be important to understand as companies such as Co. 1 received some resources, such as a portion of fertilisers and pesticides from COCOBOD, that they distribute to the farmers in their PN alongside the provisions CO. 1 provides independently. It would be pivotal to understand the impact of the multiscalar efforts played out in CO. 1's PNs compared to the public-sector facilitated cocoa PNs to understand further the effects of scale on biodiversity sustainability dissemination throughout Ghana's cocoa and shea PNs.

Finally, the shea vs cocoa tree husbandry method contradicts the two sectors. Where cocoa is not indigenous and is fully propagated and cultivated for commodity trade, shea is indigenous to Ghana and not bred or cultivated. However, research into shea tree propagation is underway (see Chapters 5 and 6). The differences between regional shea tree types (east vs west tree types potentially showing varying outcomes in the final shea butter or oil) is also a very new line of study currently being carried out by several scholars in Ghana's leading agricultural university for shea studies in Tamale. Even these academic respondents recognise the lack of significant and contemporary research into the shea tree's biodiversity sustainability aspects and echo this research's call for urgent and in-depth studies to be carried out through Ghana and neighbouring countries' shea-producing regions (GHI 50; GHI 70-73).

This section shows a few contextual and organisational commonalities in Ghana's cocoa and shea sectors. Both commodities are highly valued nationally and globally; most tonnes produced in both sectors are exported. Both sectors provide the

potential for sustainable biodiversity production with suitable approaches and investment. And both commodities present significant negative biodiversity sustainability implications with solid potential for positive biodiversity implementation, with the correct application of scale, power and capacity toward those ends. The differences between the two sectors are the different approaches to network coordination with varying levels of direct and indirect influential actor involvement between the two sectors. Shea provides an essential avenue for women market participants, while cocoa is currently much more challenging for women participants. The difference between direct and indirect inclusion into agricultural practices is another considerable difference between the two sectors. This research would argue that the difference between the two sectors, especially in the level of powerful actor engagement, is the fundamental aspect of their different biodiversity sustainability outcomes.

The differences between the two sectors have significant impacts the biodiversity sustainability dissemination. This is evident in the contrasting sector organisational frameworks and the different amounts of engagement from different levels of actors and scales of engagement. Shea is currently a women-dominated labour force, whereas cocoa is male-dominated. While the government prioritises cocoa, it is an introduced and propagated crop, whereas shea's is indigenous to this region and, to date, not propagated. Finally, this research found a chasm of research and knowledge differences between the cocoa and shea case studies. Where cocoa has been heavily researched and engaged with on multiple levels across Ghana and globally, shea is considerably understudied. As reflected in the academic interviews, this research finds a great need for further study and understanding of the biodiversity implications of this sector's practices and the organisational frameworks and their effects on the networks' biodiversity sustainability. Further research into the organisational frameworks of Ghana's shea sector is needed, and arguably other multiscalar efforts are required to invest in any hope of sustaining this vital and indigenous commodity.

7.3 Commonalities and differences in issues faced in Ghana's cocoa and shea production networks

Both PNs present biodiversity sustainability issues, with a marked difference between the two sectors being that for cocoa, the problems in sustainability are mainly direct results of human action (see Chapter 5), while in the shea sector, main sustainability issues are from indirect human activity surrounding other agricultural and cultural practices (see Chapter 6). In addition, both shea and cocoa PNs studied here are being affected by global climate change, with a significant barrier to achieving biodiversity sustainability being rooted in social sustainability issues of livelihood, land rights, and gender inequality for both sectors, as discussed in section 7.2 (i.e. Addaquay, 2004; Chalfin, 2004; Elias and Carney, 2007; Clough, Faust and Tscharntke, 2009; Hainmueller et al., 2011; Asuming-brempong et al., 2015; LD 3; GHI 49; GHI 74 a&b; GHI 76; GHI 78; Ghi 80; GHI 50; GHI 79; GHI 69; GHI 70; GHI 71; GHI 72; GHI 73; GHI 77; GHG 1-79).

For cocoa, the main factors contributing to biodiversity degradation in Ghana's cocoa PNs include deforestation, non-shade growing practices, and harmful chemicals (Clough, Faust and Tscharntke, 2009; World Bank, 2011; Higonnet, Bellantonio and Hurowitz, 2017). Global climate change factors experienced by farmer participants interviewed in this sector include prolonged drought, more severe rainy seasons flooding outcrops, and the resulting loss of endemic flora and fauna due to both direct and indirect biodiversity sustainability factors (Clough, Faust and Tscharntke, 2009; World Bank, 2011; GHG 1-48; LD3; GHI 49; GHI 76; GHI 78). These factors are found in this research to be compounded by the cocoa farmers' inability to meet livelihood needs, the insecurity over land rights creating a lack of stake in the longevity of the land and the negative impacts of gender inequality for some farmers (GHI 78; GHI 80; GHG 1-48). If Co. 1's approach to multiscalar PN coordination and integration of social and biodiversity sustainability goals being addressed through their coordination framework is impactful, it would be beneficial to map the potential implications to Ghana's cocoa sector in future research. Studies specifically comparing the results of Co. 1's organisational approach to other prominent players in Ghana's cocoa sector

and the resulting biodiversity sustainability outcomes of the varying approaches would be significant to creating better standards and benchmarks for this industry in Ghana and potentially in other global cocoa sectors.

Concerning human activity in Ghana's cocoa PNs studied, it was evidenced in the group and individual interviews with farmers, academics, and government officials, that the social issues faced by these actors have a direct connection to their application of and commitment to biodiversity-sustainable practices (LD 2; LD 3; GHI 49; GHI 74a&b; GHI 75; GHI 76; GHI 78; GHI 80; GHG 1-48). Five of the 35 cocoa farmer respondents spoke specifically about not using specific approaches such as shade growing and non-harmful chemical usage due to the negative impact these approaches seem to have on yield (GHG 1-48; GHI 78). While these respondents discussed these reasons specifically, many other respondents in the group offered agreeable nods of comments to the proposed explanation (GHG 1-48; GHI 80). In some instances, there was a sense of guidance from the COCOBOD facilitator acting as my primary translator during the cocoa farmer interviews. When prompted, farmers discussed the positive changes they have been implementing, such as repurposing cocoa husk ash, hand pollination, the use of government-approved (and provided) chemicals, and slow uptake of reintegrating shade trees (provided by the government) onto farms (GHG 1-48; GHI 78; GHI 80). Land rights were the second main barrier to biodiversity sustainability implementation in farmer interviews. Only one of the 35 farmers interviewed discussed feeling fully secure in their land ownership, this respondent being the chairman of one of the associations interviewed (GHI 78). Many of the other respondents reported either being unsure of the status of their land 'ownership' (most respondents renting their farm plots) or being unsure of the details of their tenancy and how the land will be repossessed or tenure extended at the end of their lifetime/agreed term (GHG 1-48; GHI 80).

Finally, as discussed in Chapters 4 and 5, gender inequality is evident in Ghana's PNs studied in this research. This was most evident in some of the women cocoa farmer respondents arguing about not receiving resources such as fertilisers and pesticides due to the men farmers being provided for as a priority (GHG 1-48). Additionally, in

conversation with the COCOBOD respondent acting as my guide and interview translator, they discussed how often resources are prioritised for younger and bigger farm plots, where women only own less than one acre of land on the rare occasion that they enter the cocoa industry at all, they will not be prioritised, regardless of their farm plots potentially being newer (GHI 75).

In contrast, Ghana's shea sector shows growing biodiversity concerns that are rooted mainly in indirect actions, with primary direct causes for environmental degradation found in the processing of shea from fruit to butter (Chalfin, 2004; Tsikata and Yaro, 2014; Jasaw et al., 2017a; Abdul-Mumeen et al., 2020). Indirect causes were found to be unsustainable practices such as bush burning, the exclusion of shea trees from positive agricultural practices such as irrigation systems and fertilisation, and the loss of shea trees without compensation due to mining and industrial activities all combine to create a precarious situation for future shea supplies, and the lives of the women dependant on shea sales for their livelihood (Chalfin, 2004; Tsikata and Yaro, 2014; Asuming-brempong et al., 2015; Barrientos, 2016; Jasaw et al., 2017a; Abdul-Mumeen et al., 2020). Comparable to the cocoa finding, gender inequality is an evident barrier to biodiversity sustainability dissemination in this sector, with little to no government interventions to provide adequate resources to achieve biodiversity sustainability throughout shea PNs and to protect shea regions from other harmful human activities, felt most keenly by the women producers (GHG 51-79; GHI 50; GHI 69; GHI 70; GHI 71; GHI 72; GHI 73; GHI 79).

Unlike the cocoa case study, the trickiest part is that any objection to unsustainable practices affecting shea trees is disregarded in shea. The buy-in from men farmers perpetuating this biodiversity degradation is virtually nonexistent because shea is not considered a cash crop and is ignored as a woman's pastime or chore for the home (LD 3; GHI 50; GHI 69; GHI 76; GHG 51-79). An added layer of complexity could be the fact that this unique stream of income for women is entirely independent of the male household member. Should men farmers key into the immense value of shea and economic potential, would this create a support system for the women who have built shea into the global commodity it is today, or would this create strife and competition

or a takeover of shea production by men cutting women out of market participation and off from revenue streams? As women seem to have little to no authority in terms of market organisation and only the bare minimum in terms of facilitating their market entry, the solution to biodiversity degradation in this stage of shea production may create further turmoil and unsustainability in other areas. This is a tricky balance and a substantial factor in disseminating biodiversity sustainability throughout Ghana's shea PNs.

During the processing of shea into butter, as discussed in Chapters 4 & 6, the leading direct contributing factors toward biodiversity loss are high volumes of fuelwood consumption, carbon emissions in burning fuelwood, and improper disposal of waste by-products (Addaquay, 2004; Elias & Carney, 2007; Glew & Lovett, 2014; Jasaw et al., 2017; Jibreel et al., 2013). Some technological tools could help reduce these negative impacts considering fuelwood consumption and carbon emissions. However, access to these advancements is not attainable for shea producers due to the cost or location of village processing (Jasaw et al., 2017; Glew & Lovett, 2014). Hindrances to fully and semi-mechanised processing systems are not confined to the lack of access. The additional issue of electricity supply is required by semi- and fully-mechanised tools. This is an added cost to the producers, as well as work being stopped during common electrical outages, not to mention the distance between village and town with most villages not being on the electrical grid (Glew & Lovett, 2014; Jibreel et al., 2013; GHI 50; GHI 76). Finally, waste by-product disposal directly impacts biodiversity sustainability (Jibreel et al., 2017; GHI 50; GHI 70; GHI 73; GHI 79). However, the effects of this practice are limited to the immediate area of disposal, typically in the processing factory, near the home, or in a nearby dugout used for refuse (Jibreel et al., 2017; GHI 50; GHI 69; GHG 51-79). Due to the limited impact area, and a lack of connection between waste disposal activity and biodiversity degradation, the women respondents interviewed in the villages reported using the traditional disposal means and showing no interest in creating sustainable disposal systems.
In contrast, women respondents questioned in the processing factory reported receiving training from the NGO staff and allocated disposal systems/areas that reduce negative environmental impacts (GHG 51-79). According to such studies as

Adazabra et al. (2017), spent shea waste provides a potential for recycled use in brick making. Positive evidence is that bricks incorporating this shea waste may be more durable than traditional clay bricks and improve thermal energy insulation. This innovation could provide another income stream from shea production and the many biodiversity sustainability implications it could have for both the shea industry and, potentially, the construction and energy industries. This study shows further potential for the shea industry to maximise production and create a biodiversity-sustainable PN.

While the cocoa and shea case studies in this research show the substantial impact of global warming feeding biodiversity degradation, the shea PN studied here indicates high indirect actions resulting in unsustainable networks. In contrast, direct action is seen in the cocoa case study. Furthermore, pests and disease seem to impact cocoa more than shea, with no discussion of these factors in the shea interviews as being experienced or contributed to shea yield loss compared to the response in the cocoa farmer interviews with pests and disease being widely experienced and reported (GHG 1-79; GHI 50; GHI 70; GHI 71; GHI 72; GHI 73; GHI 69; GHI 79; LD 3; GHI 76). Finally, the critical comparison between these two case studies was found to the difference in impact, resulting from direct human activity in the cocoa study and primarily indirect human activity in the shea case study. As the causes of these effects stem from complex and multifaceted concerns, this research cannot directly prescribe cross-sector implementation in this regard. Nevertheless, it would be worth studying. However, the impact solving three shared issues – those of land rights, gender inequality, and livelihood – may have on the overall biodiversity sustainability dissemination throughout these two integral PNs in Ghana.

7.4 Commonalities and differences in the effects of scale on approaches to biodiversity dissemination and outcomes of scaling up biodiversity in Ghana's cocoa and shea production networks

Echoing the scale and complexity of each PN coordination, the effects of scale on biodiversity sustainability dissemination efforts are also vastly different between

cocoa and shea. While shea presents fewer direct biodiversity implications in the collecting and harvesting, the effects of climate change, alternative agricultural practices impact, and processing impacts, there is work to be done to sustain the savannah and wild growing shea trees before they are lost due to the activities. Moreover, given that the only level actor directly and consistently engaging with shea producers is the third sector NGO, the limitations to resources, funding, authority, and workforce to disseminate biodiversity sustainability practices throughout shea PNs are considerable.

It was observed in the interviews with cocoa farmers, COCOBOD, academic, and private industry respondents that the high level of multiscalar interaction positively affects disseminating biodiversity sustainability throughout the studied cocoa PNs (LD 1-4; GHI 49; GHI 70; GHI 74 a&b; GHI 75; GHI 76). As discussed by academic scholars in the UK and Ghana, there is "a lot of motivation to make the cocoa sector prosper, because it ensures the continued investment by international bodies like the IMF and the World Bank, that hold countries like Ghana captive to their agendas through international sanctions and standardisations, as well as flexing control over even national-level decisionmakers such as annual farmgate pricings being approved in conjunction with the IMF or World Bank and Ghana's government (LD 3)." As stated above, the effect of the scale of power is seen even in the highest levels of scale, with the assumed 'most powerful actor' the government being beholden to the influence of external forces pressing down upon the government toward international agendas using a carrot and stick approach to controlling an entire government system. The external drivers filter out through the production network and are pressed back upon through the multiscalar process to cocoa production network biodiversity sustainability dissemination through the intercountry and interfirm participation (i.e. Ghana and Côte d'Ivoire's Cocoa and Forest Initiative).

The multiscalar efforts in such agreements as the Cocoa and Forest Initiative (CFI) show the effectiveness of involving multiple scalar levels to achieve the expected end of biodiversity-sustainable PNs. With government, MNC, third sector, and international bodies and certification boards co-signing the initiative, it creates

accountability for the different levels of actors' scale and a wealth of resources to achieve its goals. This reflects case studies from other industries, such as De Marchi et al. (2013) and Khattak et al. (2015), identifying the times wherein multiscalar or embedded efforts to achieve environmental upgrading occur and the potential for positive outcomes in these approaches. An interest for further research in Ghana's cocoa PN organisation is to follow up with Co. 1 respondents now two or more years into their sustainability pilot programmes, to attain the level of success in their approach. It would also be highly beneficial to speak to farmers in Co. 1's Ghanaian PN and compare those farmers involved in the pilot programmes versus those not within Co. 1's PN and further comparison of these actors' achievement of biodiversity sustainability as compared to other Ghanaian cocoa farmers who are not within Co. 1's PN. This could give more evidence which can support the call from scholars throughout the last several decades toward multiscalar and complex PN organisation tools and their capacity for positive outcomes (Granovetter, 1973; Ostrom, 1999, 2012; Bengtsson and Kock, 2000; Nagendra and Ostrom, 2012).

Evident in the cocoa case study was the effect of this multiscalar approach, especially the level of private actor involvement taken up by Co. 1, COCOBOD and international institutions. This finding of the impact of multiscalar practice in Ghana's cocoa PNs shows how scale affects biodiversity sustainability in Ghana's cocoa and shea PNs through the comparison between the shea sector's lack of multiscalar and embedded approaches to biodiversity sustainability implementation and the cocoa sector's high level of the multiscalar embedded process. The outcomes from my shea case study showing a lack of biodiversity sustainability achievement and the negative implications on social aspects of sustainability for PN participants versus the results of the opposite context within Ghana's cocoa PNs highlight the effects of scale and power on holistic sustainability achievement. Due to Co. 1's approach of addressing social and environmental sustainability issues throughout their PN, they set a high standard of biodiversity sustainability for their network participants that can be met as they are simultaneously giving their suppliers the tools and resources to meet these standards as well as addressing the social sustainability factors which often hinder commitment to biodiversity sustainability in production practices. As pointed out in

Chapter 5, these elements of standards implementation throughout Co. 1's cocoa PN can provide a basis from which other cocoa PNs in Ghana and globally could attain biodiversity sustainability dissemination throughout PNs that does not come at the detriment of the actors conducting the physical labour of producing the cocoa.

The effects of scale on biodiversity sustainability investment and dissemination throughout the studied production networks are seen clearly in the difference between the approaches to and outcomes of biodiversity sustainability dissemination practised in the cocoa sector compared to the shea sector, evidenced most clearly in my shea network interviews. The fact that the government, one of the highest level actor scale, is disengaged from the sustainability implications of the country's shea sector is evident in the government respondent's focus on research investment into a high-yielding, short-term propagation only and no clear investment in sustaining the current actors participating in shea network production reflects this level actors' constellation of priorities being profit maximisation and international engagement security over the physical needs of shea producers and current environmental impacts felt in shea PNs throughout Ghana (i.e. shea tree population loss and adverse effects of other agricultural practices on shea tree population and yield). A reconnection between the importance of shea producers' sustainability issues (both environmental and social) is lacking in the data collected from the various levels of actor participants. It must be integrated to achieve holistic sustainability throughout Ghana's shea production networks to ensure the longevity of Ghana's shea sector. The fantastic research being done to produce more shea in a shorter amount of time will be for nought should the current PN actors die out due to a lack of addressing the current social and environmental sustainability issues faced by these actors who do not have the power needed to protect themselves and the environment in which shea trees are already naturally growing and producing shea.

The five shea academics interviewed confirmed that all of the research projects underway at the time of data collection that were commissioned under COCOBOD's shea research unit and partnership with the two agricultural universities from which

my respondents came, they were aware were focused solely on this reduction of propagation time and discussed the need for more research.

"Specifically, we need to know how many shea trees are in population today. The last study was taken by scholar Lovett some 20 years ago…he walked through many areas, but to my knowledge, no one has mapped the entire shea regions in Ghana from 1940s research to date, so how can we know really the status of the shea population and the viability of the trees, as well the effects of
the paradoxa and nilotica hybridisation that is happening naturally from east to west African shea trees (GHI 73)." Academic respondents GHI 71-73 and GHI 79 spoke on the research projects they oversaw, which focused on reducing shea tree propagation time. "It's like this," GHI 70 explained, "in the old days, when a farmer plants a mango tree, they tend and care for it for ten years or more, and then they die before this tree bears any fruit for them. Maybe their sons tend the tree for ten more years, and they die before the fruit the tree bears can be eaten. In this fashion, now there is a myth, a belief that if you plant a mango tree, you will die. It is the same for the shea tree. We know that shea is not propagated in the parklands, why? Because it will take up to three generations of shea producers tending to and growing the tree before it produces even one harvest that could be turned into enough amount of shea butter and shea oil for consuming in the home and selling on the market. In this way we say, if you plant shea you will die, like it is a curse, so now shea like the mango is a sacred tree for the women who rely on its fruit for sustenance and income, but this is not the same value for the men, they do not care about shea because they don't tend it or bring in the income from it so they will cut it down, and the women what can they do? So now, we are focusing on the propagation time, in the lab we can reduce the time from 15 years to maybe 18 months before the seedling can produce viable fruit, but this is all in the lab we don't know if it will work in the wild savannah zones (GHI 70)."

The other shea and cocoa scholars interviewed in Ghana also reflected the above sentiment, confirming the focus of COCOBOD's shea investment on propagation research (GHI 71; GHI 72; GHI 73; GHI 76; GHI 79). Lack of government support was found in my interviews with the two academic respondents in the cocoa field, both

discussing how COCOBOD does not acknowledge shea or invest in the sector as heavily as the cocoa sector due to "outside influences (LD 3; GHI 76)" with respondent GHI 76 discussing the heavy hand international bodies such as the "World Bank and IMF pushes COCOBOD investment toward cocoa to secure funding" and respondent LD 3 discussing the influences of market fluctuation and farmgate cocoa prices holding the government's attention over "the people of the country in these sectors". We can see here that external drivers significantly influence powerful level actors such as the government toward specific actions, in this case, the focus on research over resource provision for existing social and biodiversity sustainability issues, influencing the powerful actors' constellation of priorities toward a specific outcome. Would the government's focus shift if international institution demands were not hyper-focused on cocoa production network provisions? What would it look like for Ghana's government to have a more secure relationship with international funding bodies that doesn't result in bullying resources allocation so heavily on one agricultural sector to the neglect of the others?

The NGO and individual interview shea respondents confirmed the lack of government intervention in the shea industry. However, the focus of these respondents was on social sustainability aspects of health and safety, livelihood, and gender inequality rather than propagation time and shea tree population, for the most part (GHI 50; GHI 69). This reflects these actors' priorities on the sustainability of the lives of those actors producing the shea butter and oil consumed and sold in local and international markets. Therefore, it should not come as a surprise that the focus of these actors who navigate PN coordination with the least amount of actualised power are most concerned with social issues of livelihood, income, health, and safety. These interviews also confirm the effects of scale on the actor's ability to implement sustainability throughout the production network, reflected in women collectors' lived experiences of marginalisation and inability to enforce protection of shea tree (primary and sometimes sole means of livelihood) from external forces negatively impacting the trees and the women.

The effect of scale is seen in the NGO's lack of capacity to disseminate sustainability throughout the production network from their level within scale. During my interview with the NGO respondent, they showed me pictures of the shea region we would visit the next day, photos taken in 2014 and 2015, showing a field of several tens of shea trees, more than could be counted and filling the entire frame of the image (GHI 50). The following day, the NGO respondent drove past the same fields shown in the picture en route to the shea village we visited. A handful of trees were left when we stopped to view the fields. I counted 15 in the area I could see. "This is the difference of only 5 to 6 years here, with the bush burning, timber wood harvesting, charcoal harvesting, cement mining, and road building and the like. The trees are disappearing, and the women now travel many, many kilometres each way and sometimes into land they do not have rights to enter to collect enough of the fruits. And the men, we speak to them and try to include them in the trainings on shea tree conservation to teach them about how their actions kills the trees, but they don't come to the trainings, and even after a talk, we can see they don't care about what we say, they just keep doing what they want to keep their crops and selling the land to make money from the mining and construction expansions (GHI 50)." The NGO respondent discussed how the organisation fundraises and lobbies for government provisions "for simple things, like gloves and a fruit picker like this simple ones here (GHI 50)" showing me a tool similar to a reacher-grabber tool which is often advertised in western countries for people who have trouble reaching and grabbing items. GHI went on to explain, "as NGO we can only do so much, even when we want to do more. We have very limited antivenom, but these need to be kept cool so it is kept here in Tamale, but the village may be over one hours drive away and there is no reliable phone service so when something happens it may take too long to get to the shea village to give to the woman, and we cannot keep these antivenom in the village because the electricity is unreliable or there is no electricity in the whole village so it cannot be kept there, we have our hands tied." When asked if she had interacted with people who work for COCOBOD or Co. 2, GHI 69 shook her head no and chuckled, "Only Mr. A comes to see me and my women collective, only Mr. A helps, we need more help." In my group interviews with three, thirteen, and ten respondents each, all women raised their hands when asked if they had suffered injury or near-injury

experiences collecting shea from the parklands, with some calling out, "every day", "in the pre-dawn always I find snakes and rodents trying to bite", "of course this is the life of shea women" (GHG 51-54; GHG 55-68; GHG 69-79). As data could not be collected from the private actors involved in Co. 2's shea procurement efforts, this research cannot speak on the effect of this level of powerful actor's impact on their shea production network participants in one way or the other. It is vital in future research to capture this level of actor scale, as it can add to the evidence of the effect of scale on sustainability dissemination throughout Ghana's shea PNs. According to London and North American-based respondents from CO. 2, the firm implements a dual sustainability standard system, seeking to address environmental sustainability issues alongside social sustainability issues, with both respondents discussing such initiatives as the aloe farming project CO. 2 is implementing throughout their Ghanaian shea PN (LD 5; LD 6). According to these respondents, to address the loss of shea trees and to expand the livelihood security of their shea PN participants, the company provides aloe samplings and training on how to propagate and maintain small aloe allotments within or near the homestead, as a stream of alternative income and for domestic use. The impact of this programme was unknown to the interview respondents, nor were they able to comment on what percentage of Co. 2's shea PN has been provided with this resource and training. This preliminary evidence does speak to the effect of scale on sustainability dissemination in terms of the ability of higher power level scale's ability to achieve sustainability goals from their position of power and resource, mirrored in the cocoa sector through Co. 1's dual sustainability system addressing social and environmental sustainability factors as well (GHI 49; GHI 74a&b).

In line with the work of scholars such as Chalfin (2004) and Elias & Carney (2007), the labour of collecting shea fruits and producing shea butter for sale is the remit of women in Ghana's shea industry; men hold the sector's organisational power. This is supported by the lived experience shared by respondents who participated in this study (see Chapter 6). This is reflected in data collected in both individual and group interviews with shea PN participants, with all shea producer respondents identifying as women, and the men respondents from academia, government and the NGO

confirming nearly nonexistent male participation in shea production (GHI 50; GHI 69; GHI 70; GHI 71; GHI 72; GHI 83; GHI 76; GHI 77; GHI 79; LD 3; GHG 51-79). While the actual production of shea butter, from collecting fruits, processing to nuts, and processing further to butter, is organised and carried out almost exclusively by women, the network coordination of MNC sale/export is held by men. Evidence for the male domination of the shea industry was seen in the following ways in the data collected – the lack of female authority over the direct and indirect agricultural practices which affect shea trees and their natural habitat's biodiversity factors (GHG 51-79; GHI 50; GHI 69; GHI 70; GHI 72; GHI 73); the lack of authority to protect fruit bearing shea trees from being cut down for field or road clearing, or mining and development with no compensations made to the women for the loss of income resulting; and the lack of representation and leverage with government's agricultural board COCOBOD as discussed in Chapter 6 (GHI 50; GHI 77; GHG 51-79).

While men in the shea sector hold the overarching organisational power as it is in Ghana's cocoa sector, a marked difference between Ghana's cocoa and shea sectors is that shea provides a unique opportunity for value capture for women actors collecting and processing shea into butter (Chalfin, 2004; Elias and Carney, 2007). As it is considered a woman's area of work, and in some ways dismissed by men, these women actors receive the monetary value captured from market participation. Also, due to the sector's women-dominated labour, the resources invested in Ghana's shea PNs by such actors as NGOs and MNCs are received by the women within the network (LD 6; GHI 50; Chalfin, 2004). This research found that women are not typically involved in trade with MNCs. These sales are facilitated by the NGO enabling the cooperative (GHI 50; GHG 51-79). The fact that women hold little to no authority in the shea sector, despite providing the backbone to this highly valued commodity, shows a lack of commitment to biodiversity sustainability implementation (GHI 50; GHI 70; GHI 71; GHI 72; GHI 73; GHI 76). This became particularly evident in interviews with women producers who discussed their efforts to stay shea tree felling by physically tying themselves to hold onto the tree, their only course of action against the tree's removal (GHI 69; GHG 51-79). The women who reported having experienced this situation all discussed the unsuccessful protection of the shea tree

and the negative response to the women themselves for their actions (GHI 69; GHG 51-79). "I tried everything to stop them cutting my trees, I begged my husband and brothers, but they don't listen. On the day the men come to dig up the land to build the road, I use the rope to tie myself to the trees, but they come and carry me away, and I have to watch them cut my shea trees down for their roads, and I don't get any payment from this I just lose my [money] from the shea tree (GHG 55-68)." This commonality shows the gender inequality in shea PNs in Ghana, with little recourse for women participants to pursue if necessary.

One of the observed approaches to implementing biodiversity sustainability throughout Ghana's shea PNs is the introduction of proper disposal practices and reusing some aspects of by-product waste materials. The re-incorporation of by-product waste toward the sustainability of the shea sector is also found in cocoa's reuse of pod husks for fertilisation. These initiatives in Ghana's shea and cocoa PNs were introduced by actors outside the direct producers of these commodities, adding to the argument of multiscalar engagement toward the ends of biodiversity-sustainable cocoa and shea production. This research found that the NGO carried out the dissemination of this knowledge and the implementation of more sustainable waste disposal and reuse. This reflects the single-level engagement and network coordination in an efficient manner, providing a tangible example of the limited outcomes achievable without the coordination and engagement of higher-level actors. This is not to say that the NGO lacks the knowledge capacity to roll out a biodiversity sustainability programme; however, as has been discussed, the lack of means to achieve this prohibits the upgrading from taking place.

As discussed in Chapter 6, the lack of engagement and importance in the minds of especially men-dominated agricultural activity is being engaged at the current level of actor involvement. First, however, something must be said about the status of power the third-sector parties hold to influence them. Evidence of this lack of influence is seen in the continued use of harmful practices such as bush burning and shea tree felling and the conversations reported by NGO and women producer respondents regarding men's reaction to NGO training and education on these issues. Therefore, it

would be beneficial to speak directly to men farmers, especially those who have women in their household who are also shea producers, to gain better insight into the mentalities, cultural assumptions, or other aspects that may create the disconnect between the necessity to adjust their actions to preserve shea tree (what to them would be thought as a woman's concern and not related or connected to themselves/their actions) (see Chapter 6).

While the government invests in shea research, interviews with academic respondents at the country's leading agricultural university in the heart of the shea region found minimal government investment, lengthy procedures, and failed attempts to secure further funding. As discussed in Chapter 6, a Shea Research Unit outside of Accra is also funded through COCOBOD. While permission was gained to observe and interview researchers there, this follow-up field trip was not possible due to travel restrictions during COVID-19 lockdowns. Future research would greatly benefit from insight into this unit, their work, and its application to Ghana's shea PNs and biodiversity sustainability dissemination. As shown in Chapters 4, 6, and above, shea provides a prodigious opportunity to apply such frameworks as the polycentric governance found in the cocoa PN studied in this research. There could be potential to engage multiscalar network coordination and integrate all aspects of sustainability into the industry reform that seems to be required to ensure the longevity of this commodity and its producers.

As can be seen in this discussion, there is a correlation between the approach to network coordination and biodiversity sustainability dissemination and outcomes for both the environment and the human actors involved in production. In cocoa's case, we see multiscalar efforts, with engagement across multiple levels of the actors' scale. The outcome of such multiscalar, multi-level coordination is found in this research to create a PN that is not only knowledgeable about biodiversity sustainability and the connections between it and cocoa cultivation practices and access to the resources necessary to implement biodiversity sustainable cocoa cultivation practices throughout the PN. While there is much work yet to do to break down long-held beliefs and assumptions that threaten sustainable production and social issues

needing to be addressed, it would be insightful to understand the effects of the multifaceted approach to cocoa PN coordination by COCOBOD and Co. 1, as well as other MNC actors in Ghana's cocoa sector in a few years to allow integration of the many programmes and tools to take root and produce observable outcomes.

In contrast, this research's shea study finds significant gaps in engagement from more powerful level actors and a nearly complete lack of investment into biodiversity sustainability dissemination throughout shea PNs. The studied shea PNs were, for the most part, one-dimensional, with direct engagement with shea producers being only through the NGO. As evidence for Co. 2's direct involvement with shea producers in their Ghana PN, I cannot comment on this level of the actor's direct engagement from the field data collected in Ghana. According to web reports and UK/US-based interviews with Co. 2, there is a proposed level of direct engagement between the firm and the women producers. However, this claim needs further verification from women who have experienced this engagement, which none of the respondents interviewed in the shea study could provide. The result of this lack of attention across different levels of power, and the lack of resource provision to achieve biodiversity sustainability goals in the shea sector, show a stagnant (at best) sector with signs of decline. While shea is not under quite the same level of threat as cocoa regarding sustainability and longevity, without proper adjustments, this sector may soon face severe consequences from the sustained biodiversity degradation in the region.

In summary, in the literature review and fieldwork data, I have found that Ghana's cocoa sector receives the focus of government and private actor intervention, assistance, and investment (Chalfin, 2004; LD3; GHI 75; GHI 76). The evidence from Co. 1, Co. 2 and other actor respondents in Ghana's cocoa and shea PNs answer the question 'How does scale affect biodiversity sustainability dissemination?' being that scale affects commitment and capacity to achieve biodiversity sustainability throughout the studied PNs, especially regarding how the addressing of social sustainability issues of land rights, livelihood, and gender inequality as significant barriers to implementing biodiversity sustainability. As reflected in the literature, this research shows that multiscalar and holistic approaches to sustainability

dissemination throughout PNs that work within the embedded context of the geography, cultural and socioeconomic landscape are more successful in achieving biodiversity sustainability dissemination throughout the studied PNs. As discussed in detail in chapter 5, the multiscalar PN organisation, while complex, lend Ghana's cocoa sector capacity to reaching biodiversity goals set out in the CFI and other global biodiversity sustainability goals. In the shea sector, this research found that a high level of NGO direct involvement is played out on the ground, with an ever-widening gap between the demands placed on shea producers and the resources provided to meet the needs. The only government-backed involvement found in this research in the shea sector was the research into and experimentation with hybrid shea tree types, with no confirmed rollout of hybrid tree seedling distribution at the time of the data collection (Chalfin, 2004; Wardell and Fold, 2013); GHI 50; GHI 69; GHI 70; GHI 72; GHI 73; GHG 51-79; GHI 77).

Regarding biodiversity sustainability upgrading in the shea sector, private actors, using NGOs such as the organisation participating in this research, offer mainly education and training to women shea producers. In addition, some provisions of fruit picking tools and snake bite antivenom are supplied through the NGO. However, these provisions are difficult to come by and distribute, as discussed in Chapter 6 (GHI 50).

As Co. 2's Ghana procurement team was unavailable for an interview during data collection, the complete picture of Co. 2's direct involvement is unclear and worth further investigation. In the cocoa sector, the direct participation of Co. 1 with cocoa farmers in its PN through its Ghanaian-based subsidiary provided significant opportunities for environmental and social sustainability upgrading for its network participants. A line of further enquiry would be to gain a complete picture of Co. 2's direct and indirect interaction with shea producers in their Ghanaian PNs. As discussed in Chapter 5, the direct involvement in Co. 1's Ghanaian PN but the MNC have seen such upgrading as the provision of carbon-positive cook stoves, egg-laying hens, biodiversity sustainability training and the like. According to Co. 2's website, the firm is directly involved in training and facilitating alternative streams of income via aloe farming programmes. However, this claim could not be substantiated in the data

collection, as the women collectors participating in the interviews for this research had not directly interacted with Co. 2 to date, nor had they received any resources or training through the NGO toward such ends as aloe farming. This does not mean that this initiative is not being rolled out, as not every woman participant in the Jojoba Collective was able to be interviewed due to the time and distance to each of the villages incorporated in the collective.

7.6 Longevity outlook of approaches to scaling up biodiversity in Ghana's cocoa and shea production networks

As shown above, the cocoa study found that the threat to the commodity is great, with severe biodiversity degradation and systems of unsustainable production practices that need to be transformed. Simultaneously, this study found direct engagement across levels of scale and a multiscalar approach to network coordination, which capitalises on the wealth and resources of the more powerful actors within the sale to enable such actors as cocoa farmers to implement sustainable biodiversity practices. The leveraging of the most powerful level actors in this sector shows signs of positive integration of biodiversity sustainability in the studied networks, with room for further improvement and integration which may come over time with such levels of engagement. Incorporating social sustainability factors in Co. 1's approach to biodiversity sustainability dissemination is a spark in a sometimes-bleak outlook of environmental sustainability efforts which can either pit environmental standards against human participant survival or fail to consider this crucial element altogether. A question to be answered in the broader conversation with other MNC, government and third-sector actors engaged in these efforts is whether it is possible to achieve or maintain environmental/biodiversity sustainability if social sustainability aspects aren't addressed? If social sustainability issues are a foundational driver toward unsustainable actions, is it feasible to strive for biodiversity sustainability until resolving the critical barrier to its attainment? Furthermore, with ever-fluctuating market prices and geopolitical landscapes sometimes changing abruptly and without warning, the intense level of relicense upon the government to provide the resources and workforce needed to disseminate such

sustainability and maintain it into the future could become an area of concern. This research would argue that government involvement while necessary in creating a sustainable structure for current cocoa PNs, should the social sustainability aspects affecting cocoa farmers be addressed, these actors will become able to sustain and expand biodiversity sustainability independent of government assistance as their own financial sustainability becomes more secure and reflecting of the value added to the sector by these key actor farmers.

The shea case study in this research has found a lack of powerful actor engagement (government and private actor) with biodiversity sustainability dissemination throughout shea PNs. NGO engagement was high but limited by a lack of tools and financial resources. Biodiversity threats to shea trees are present, but not at the extreme level as in cocoa's case. With proper investment and the integration of a multiscalar effort toward biodiversity, sustainability dissemination could tip the scales in shea's favour, rehabilitating and preserving the natural environment shea trees grow in and ensuring supply into the future. While further study is needed in several areas of shea production, biodiversity, and social sustainability in this field, the lack of research, investment and engagement may cast a dark future for Ghana's shea sector. As stated, shea parklands' environmental threats and degradation are lower than in the cocoa study. However, the effects of unsustainable practices and global climate change are clear from this study (for example, the visible reduction of the shea tree population in the region studied in the fieldwork). Being a slow-burn issue compared to the extreme case in the cocoa study perhaps has not triggered the same urgency to address biodiversity sustainability in the studied shea PNs; it is essential.

As shown in this discussion, this research finds that while the studied cocoa PNs have significantly more investment into biodiversity sustainability dissemination, both sectors lack self-sustained frameworks toward this sustainability. Both commodities are impacted considerably by social sustainability issues and global environmental change that is not being addressed in current approaches on a broad scale, particularly in shea's case. In the example of cocoa, where both elements are integrated, we can see a potential path toward achieving biodiversity sustainability

throughout PNs that is mutually equitable to all parties involved, including the natural environment.

The key differences between the two cases are the lack of investment in the shea sector versus the high investment into the cocoa sector and the outcomes of these different levels of investment and multiscalar engagement. Due to the actions in cocoa production, this sector has a brighter outlook than shea currently. As discussed above and in chapters 4, 5, & 6, there are multiple levels of actors engaged in direct biodiversity sustainability dissemination in cocoa PNs in Ghana, with intense resource provision toward these ends, involving government, private and global actors (i.e. IMF, WB, FAO, etc.) contributing whether it be through finance, physical resources, workforce, or accountability structures. In shea, the only found direct level of engagement is the third sector, with minimal investment by government actors and an unknown level of investment by Co. 2. However, it should be noted that the women respondents who participated in interviews for data collection are members of the cooperative Co. 2 is known to source a large portion of shea. As discussed, the lack of these specific villages having contact with or receiving resources from Co. 2 could be singular and not a reflection of the entire PN for Co. 2.

7.7 Further research consideration and conclusion

Both shea and cocoa PNs studied here open avenues for further research. In cocoa, this research has highlighted further investigation into whether Co. 1's approach to biodiversity sustainability dissemination is unique to their organisation or if other MNCs with cocoa PNs in Ghana have similar systems. If there are other MNCs implementing similar sustainability frameworks to their Ghana PNs, what be improved upon between the various approaches, and how can the processes and their outcomes for both biodiversity and social sustainability impact supply forecast, future investment and even policymaking? If there are no other (or very few) MNCs operating in a similar approach to Co. 1, what barriers or challenges are preventing them from such integration and dissemination of sustainability throughout their PNs, and are there avenues through a cross-level partnership or policy/law that could be

utilised to drive these MNCs toward more sustainable PN coordination approaches? It is also necessary to understand the outcomes of Co. 1's system, with time given for the various aspects of their framework to be applied throughout their entire network and effects to be observed, to inform the efficacy of these approaches. A significant enquiry would be to track the level of investment by the lead firm into upgrading their PN and the ROI they may be receiving. As a business has a bottom line to meet consistently, operating at a profit is necessary. What impact does the investment into their dual sustainability framework for PN coordination have on those profits?

The question of self-sustained sustainability structures is also a considerable aspect of further research. Is it possible to create PNs sustained independently from government subsidies, and what steps would be required to achieve this? Finally, further consideration of the trade-offs of international funding (i.e. IMF and WB) on network coordination should be pursued. As evidenced in such work as Chalfin (2004), the power wielded by such bodies has significant (and sometimes detrimental) impacts on network coordination to secure or maintain international funding. What is required for Ghana's cocoa sector to break from the necessity of these funding bodies, and how could that impact biodiversity sustainability dissemination should the country achieve this independence from external agendas and demands? This is not to say that external factors are all negative or should be replaced, as has been shown in the effects of consumer outcry against name-brand actions and the financial implications of these that can act as a catalyst toward positive change. The line to be drawn, however, I would argue, is the level of influence to impact network coordination outside of this accountability keeping.

For shea, this research has found a need for further study in multiple areas, including the current shea tree population, hybrid/cross-fertilisation effects, regional shea butter differences (Gwali *et al.*'s (2011) and (2012) studies as well as other scholars offering strong start to this line of enquiry), and in what ways is the feminisation of the industry a barrier or facilitator toward achieving biodiversity sustainability in shea production. These topics are necessary to avoid a blanket prescription of "successful actions" to achieve biodiversity sustainability throughout all shea PNs in Africa when it

is likely that due to geographical, cultural, historical, and socioeconomic differences, a one-size-fits-all approach is not appropriate. A macro analysis of Ghana's current shea tree population is needed to understand the actual population of shea. It can guide the level of threat to extinction the current rates of shea tree loss may present. While Lovett & Haq's (2000) studies are brilliant insights into the shea tree population in certain regions in Ghana and the foundation from which to build, there is room for further study, especially in consideration of the academic interviews conducted for this research. In these conversations, great appreciation was expressed for the work done by such scholars and used widely to inform current shea research in the contacted university. In these conversations, it was also confirmed that such seminal work as Lovett & Haq's studies offer exemplary pictures of certain parts of the shea region and would benefit from expansion to study the entire shea-producing areas of Ghana (GHI 70; GHI 73). Finally, a better understanding of approaches to multiscalar organisation engagement that could exist in this sector or be implemented would be invaluable.

Further data collection from as many shea cooperatives as well as from independent shea producers in Ghana would provide significant insight into the sector's movement, the flows and tensions of power, survival, economic gain, and environmental preservations. Understanding the genuine relationship between such MNC actors as Co. 2 and the several big players (ie Fuji Oil and Unilever) and the women collective supplying their unrefined shea butter. As mentioned above, there may be possibilities to adapt and apply biodiversity, and social sustainability dissemination approaches from the cocoa sector (i.e. Co. 1's framework) to the shea sector. If successful in upgrading cocoa PNs biodiversity and social sustainability in some of Ghana's cocoa PNs, the various multiscalar approaches applied in cocoa may offer a framework that can be used in the shea sector, with further research on how to adapt to shea's unique biodiversity sustainability needs.

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Appendix A

Lead Firm Interview Schedule

General

1) Please provide an overview of your organisation?
    a. What goods/services do you provide to buyers/costumers?
2) What is your role in the organisation?
3) Who are the key people/departments in procuring Ghanaian cocoa/shea?
    a. How do you rank them?
    b. Can you provide me a list?
4) What does biodiversity mean to your firm in term of sourcing?
    a. How has this level of biodiversity commitment affected the way you source cocoa/shea?
    b. Have you had to change supply practices over the course of business history?
    c. If so, how?
    d. How do sustainable practices affect overhead costs and profits?
    e. What are the biggest risks in being oriented toward biodiversity sustainability?
    f. What are the drivers to achieve this sustainability for your firm?
    g. What is the greatest return from this sustainability effort?
5) Who sets internal sustainability standards for the firm?
    a. How much is written down?
    b. How do you track progress toward goals?

Internal Organisation

1) Tell me about how your company fits in the industry as a whole?
2) Who do you purchase cocoa/shea from in Ghana? (Direct from farmer or through an LBC?) Can you provide me a list?

3) How often do you have contact with suppliers?

4) Do you have direct contact with farmers? Can you provide me a list?
5) How do you ensure the sourcing of sustainably produced cocoa/shea?
6) Do you provide sustainability instruction/compensation for participating famers?
7) Are you considered an LBC?

    a. If so, are you required to process the beans you purchase through CMC, QCD, QA? Why/why not?

    b. If you aren't an LBC, why not?

    c. Would you become one if possible?

8) How do you deal with crop loss due to pests/disease?

Sustainability Initiatives

1) How many farmers/suppliers in Ghana are participants in your Foundation?
2) How does participation affect these suppliers/farmers?
3) How many Ghanaian farmers are in your data system?
    a. How do you provide support to these farmers (what form does it take)?
4) Do you take soil quality into consideration for the biodiversity sustainability goal?
    a. If so, how do you address the issue of fertilisers and pesticides utilising harmful chemicals being used on supplying farms? (Based on the offering of these types of harmful chemicals being provided through COCOBOD)

Competition

1) Can you draw me a map of the industry key actors/market influences in your experience?

    a. Do you know how your biggest competitors' approach industry biodiversity issues?

    b. What do you think of these approaches?

c. Why do you choose the same or different approach?

d. Apart from through your organisation, are there other ways that your suppliers/farmers/other organisations cooperate (e.g. joint sustainability/sourcing operations, financial ties, links through key personnel)?

2) How does participation in your supply chain provide your suppliers with competitive advantage?

Government

1) What is your relationship like with the government of Ghana?

    a. How does this level of involvement affect your cocoa/shea procurement?
    b. Is COCOBOD involvement helpful?
    c. Why or why not?

    d. Do you think there is a better way to implement sustainable practices at point of origin?

2) How long has COCOBOD been involved in the cocoa/shea industry?
3) What is the difference between COCOBOD's QCC, QCD, and QA at port?
4) How does cocoa/shea export work?
5) How much FOB does COCOBOD retain?
6) Do you export cocoa/shea beans?

    a. Do any other private firms or 3rd sector organisations directly export?

    b. Do you pay any fees to COCOBOD for this export privilege?

Chain coordination

1) How does your relationship with farmers work?
2) How do you coordinate purchases?
3) What do your supply contracts with farmers look like?

4) Who sets sustainability standards with farmers?

5) How much is written down?

6) How do you deal with suppliers who cannot/do not implement required sustainability practices?
7) What percentage of farms utilise shade growth? Why not more or less?
    a. Is the shade naturally occurring forest canopy or planted trees by farmers?
8) How do you get your suppliers to do what you want?
    a. Are certifications used? Why, why not?
    b. Do suppliers have direct contact with you? Do you use intermediaries?
    c. How often is contact made? What are the goals of these meetings?
    d. Who pays for certifications?
    e. What do supplier contracts look like? Who checks that suppliers are keeping standards?
    f. How?
    g. Are benchmarks set for suppliers?
    h. Who sets them?
    i. How are they measured?
    j. How often?
    k. By who?
9) What resources do you provide to farmers?
    a. How often?
    b. Who pays for service/tools?
10) Are any of your suppliers certified fairtrade and/or organic?
11) Who pays for farmer certifications (FT, organic)?
12) What do you think keeps more farmers from becoming Fairtrade or organic certified?

13) How many farmers have access to such resources as SPU, CSSVDCU, CODAPEC, CRIG?

    a. How many farmers annually receive hybrid seed pods?

Cocoa & Forests Initiative

1) Based on the "multi-stakeholder" approach of the Cocoa & Forest Initiative, how do Government, Private, and civil society relationships work on-the-ground?
2) How do you determine which stakeholder is responsible for what?
3) The initiative speaks of mapping on forest cover and land use. Has this happened? Can I see these?
4) How does "growing more cocoa on less land" work?
    a. How does this aim affect biodiversity of the land being cultivated for higher yield?
    b. Who provides improved planting materials, and training for good practices and development of farmers' organisations?
5) Regarding crop diversification, who provides initial resource investment for this?
6) How do the government "landscape-level approach" strategies (REDD+, Ghana Cocoa Sector Development Strategy II) affect the firm's production network coordination?
7) How do you deal with farms lacking legal status in Forest Reserves?
    a. How about farms lacking legal land rights outside Forest Reserves?
    b. Is the percentage of farms lacking these legal status significant?
8) (Framework Actions For Forest Protection and Restoration D&F speak of public-private collaboration to mobilise new sources of funding for forest protection and restoration, farmer incentives, MTS implementation, partnership with private, local, and global experts to identify good practices for forest conservation and restoration, shade grown cocoa, and MTS in Forest Reserves) – What role/responsibilities does the firm take in these actions?

9) (Framework Actions for Sustainable Production and Farmers' Livelihoods E says that "signatory companies are putting in place verifiable monitoring systems for traceability from farm to first purchase point, operational policies and control systems") –
    a. What systems is your firm putting in place?
    b. How do you implement them?
    c. Who verifies the traceability?
    d. Who assesses success of implementation of these processes?

Snowballing

1) Based on what we've discussed, is there anything else that you think is important for me to understand?
2) Who else would you suggest that I speak to, to better understand the biodiversity issues in sourcing Ghanaian cocoa/shea?

Cocoa Farmer Interview Schedule

1) Do you own your land?
2) How much land do you cultivate?
3) How much of the farm is in the forest?
4) Did you have to clear land to grow cocoa?
5) Do you have any other trees next to the cocoa trees?
6) Did you plant these other trees?
7) Why do you (or don't you) keep different trees next to cocoa trees?
8) Do you practice organic farming (not using chemicals on the farm)?
9) Why do you or don't you practice organic farming?
10) Do you receiving training from COCOBOD?
11) How often to you receive training from COCOBOD?
12) Do you receive inputs (like fertiliser, pesticide, disease treatment, tree samplings) from COCOBOD?
13) How do you decide who gets these inputs?
14) How are the inputs distributed?
15) Outside of COCOBOD do you have interaction with other organisations (ie Kuapa Cocoa, Olam, Barry Callebaut, Mondelez?)
16) Who do you sell your cocoa to?
17) About how many bags of cocoa do you sell each year?
18) Over the past 10 years, have you seen cocoa yields, increasing, decreasing, or staying the same?
19) Why do think it is increasing/decreasing/staying the same?
20) When you sell the cocoa at what stage is it in (dried, fermented, crushed, etc)?

Shea Producer Interview Schedule

1) How much land do you cover when you collect shea fruits?
2) Do you own this land?
3) How far do you travel to harvest from shea trees?
4) How long does it take to cover this area?
5) Who do you sell your shea to?
6) Are there many different traders you sell to?
7) Is the land you collect on your land? Who does the land belong to?
8) Do you have any troubles with other people harvesting on your land?
9) Do you have any troubles collecting shea fruit yourself?
10) What do you get from the shea that you collect?
11) Do you have any contact with private companies?
12) Does anyone visit you from COCOBOD?
13) Did you have to clear any land to start collecting shea?
14) Do you see any changes in the animals, insects or land where your shea trees grow?
15) Is that good?
16) Do you get paid for the trees cut down or burnt?
17) Do you get paid for access to the land your shea trees grow on?
18) Does anyone come and speak to you about the environment, and if so who?
19) Have you seen any changes in the way you harvest and process shea because of this training?
20) Is there anything else you think is important for me to understand about shea?

Academic Interview Schedule

1) What are the main environmental issues with cocoa/shea?
2) Who are the main actors in the cocoa/shea industry?
3) Why is that?
4) Who owns the land that is farmed/she ais collected on?
5) Some women say construction destroys their trees, is there anything the government, MNCs or NGOs do to protect trees for the women of the villages? (shea only)
6) How involved is COCOBOD in cocoa sector?
7) How involved is COCOBOD in the shea sector?
8) Does COCOBOD provide any inputs for cocoa farmers?
9) Does COCOBOD provide any inputs for shea producers?
10) Does COCOBOD provide any training for the cocoa sector?
11) Does COCOBOD provide any training for the shea sector?
12) Are private companies involved in the cocoa sector?
13) How involved are they?
14) Are private companies involved in the shea sector?
15) How involved are they?
16) I've been reading about shea being used as a cocoa butter substitute, how do you think this will affect the shea sector and shea parklands?
17) In the past 10 years has there been any changes in annual yield for cocoa/shea?
18) Does the type of shea tree affect the 5 year cycle (shea only)
19) Why aren't shea tree cultivated?
20) Why are shade trees removed in cocoa farming?
21) Can you tell me about the laws prohibiting cutting down shea trees?
22) Has there been any efforts to replant other trees around shea/cocoa?
23) What research does CRIG focus on?
24) Aside from funding is there anything else that you think is crucial to help reverse the negative environmental impacts that have gone on around shea?
25) What do you think is crucial to help reverse the negative environmental impacts that have gone on around cocoa?

Third sector interview schedule

1. Could you describe what the shea/cocoa production network look like here in Ghana?
2. What is the split of amount of annual sales between shea kernels and unrefined shea butter, and why? (shea only)
3. Do private companies have cocoa/shea processing facilities here in Ghana? Why/why not?
4. DO you know if The Jojoba Collective process the shea they sell or is it only kernels sold or how much of each? (shea only)
5. How does shea/cocoa processing for market work?
6. During harvesting and processing what are the environmental factors that are at play?
7. Breaking shea fruit down into kernels, you said the unwanted part gets scattered on the ground, what the impact of this practice? (shea only)
8. Are there any positive effects of this practice? (shea only)
9. What is the impact of waste water in shea production? (shea only)
10. Are there any sustainable reuse/recycle processes in cocoa processing and if so what are they?
11. How involved is COCOBOD in the cocoa/shea sector?
12. Does the government provide any inputs for cocoa/shea producers?
13. Do you know what the COCOBOD shea unit does? (shea only)
14. It sounds like the government isn't very involved in shea, are private companies involved in the shea sector, and what is their focus on their involvement if so? (shea only)
15. Have there been any studies on how much land is clear for cocoa production in the past ten years?
16. Have there been any studies on how much land ahs been cleared of shea trees in the past ten years?
17. How do women get permission to access shea trees? Do they own this land or pay to harvest? (shea only)
18. How do women gain access to land to produce cocoa? Do they own this land or pay to use it? (cocoa only)

19. For shea/cocoa trees, is there an average harvest yield per tree/farm?
20. How many acres is the average farm/shea collecting area?
21. I was told by somone at COCOBOD that shea is not easy to propagate, is that true and if so why is that?
22. How long do cocoa/shea trees produce fruits?
23. Are farmers starting to plant shea trees? (shea only)
24. How do producers manage shea/cocoa tree lifespan in their cultivation/harvesting processes?
25. What percentage of total shea kernels per tree are being harvested now? (shea only)
26. Is there anything that can be done to increase this amount? And is that a desire? (shea only)
27. Are there any public or private programmes that are trying to provide positive incentives in the cocoa/shea sectors toward biodiversity sustainability?
28. How many women are in one cooperative? (shea only)
29. How does the cooperative work? (shea only)
30. Are there any water recycling systems?
31. For women in the collectives, what form of processing do they typically use? (shea only)
32. How do women access the machinery that they use for processing? (shea)
33. For the cooperatives that you work with, how does machine allocation/use work? (shea only)
34. So is it the same women processing in the shea plants the same as those that collect the fruits? (shea only)
35. I notice in the market that shea is much cheaper than cocoa, why is that?
36. How many times per year is shea/cocoa harvested?
37. What impact does it have on the butter if collectors shake the tree to make the fruit fall off the trees? (shea only)
38. What is the shea/cocoa processing steps/timeline?
39. Is your organisation involved in the processing part, and if so how?
40. What is the steps to sell shea/cocoa to private firms?

41. How do you deal with tensions in production/selling cocoa/shea to private buyers?
42. What projects does your organisation have and how long have these been in operation?
43. In the last 10 year, what changes have you seen in the environment around shea/cocoa lands?
44. What do you think is crucial in preserving cocoa/shea?

Appendix B

Fairtrade and organic certification

It would be worth noting whether shade cover + organic production practices (particularly non-use of chemical pesticides and harmful fertilisers, which are argued to negatively affect soil and water quality and endemic species longevity (Daniels, 2006)), has a greater positive biodiversity and yield impact than shade cover + conventional production practices as this may lend to understanding another aspect of motivation for using chemical pesticides and fertilisers over organic tree husbandry. Should the latter be found to have a higher yield for cocoa farmers, a follow-up research inquiry may be how to incentivise farmers to choose the slightly lower yield and, theoretically, higher positive biodiversity implications of organic farming, such as those government incentive programmes for organic farming proposed by Bisseleau, Missoup and Vidal (2009).

Fairtrade and organic certifications prohibit GMO production, hence the line of inquiry into the use of hybrid trees may come into play. According to the International Society for Horticultural Science, there is a difference between GMO and hybrid plants, so these lines will have to been drawn for the Ghanaian cocoa industry in order to meet the Fairtrade standards (Ishs, 2016). If certain hybrid trees are considered GMO, the use of traditional trees only would have an impact on the pest and disease resilience of the trees.

Additionally, according to Fairtrade (2015), the use of environmentally friendly pest and disease control through the fostering of agroforest habitats to coexist on cocoa farms, allows for the environmental standards to be met for certification as well as encouraging environmentally friendly farming practices on these farms. Coupled with the restrictions to types of agrochemicals allowed on Fairtrade and organic certified farms, this may prove a distinct issue for these farmers who produce Ghana's Fairtrade and/or organic cocoa (Ameyaw, Dzahini-Obiatey and Domfeh, 2014; Akrofi *et al.*, 2015).

It is important to understand the government's view of their role in production network coordination, their reasoning for heightened control of the network, why they may allow certain private firms to export while maintaining control over the majority of cocoa exports from Ghana, and the procedures set in place by COCOBOD to determine who is allowed to export versus who must use the government's export services. It is in these interactions that the relationship between lead firm □ □ government and 3rd sector □ □ government can be pursued, as KKL is certified Fairtrade and may be able to offer insight into the relationship between the 3rd sector agents from Fairtrade with itself as well as COCOBOD. Understanding how these relationships, in terms of export allowance, are set up can show whether COCOBOD is involved directly in KKL's export of cocoa, and if so, they level of involvement and what they receive in return for said involvement can be traced. On the other hand, it may be that COCOBOD is not involved in this export, in which case a better understanding of the production network and rules and regulations may be pursued to build a more accurate picture of the Ghanaian cocoa production network operates.

Questions in this arena are geared to understanding how biodiversity sustainability standards are met withought negatively affecting the economic sustainability of the farmer. There is often not any margin for these hand-to-mouth smallholder farmers to accommodate loss of product due to pest and/or disease, so this balance between income and environmental sustainability must be achieved (Anim-Kwapong & Frimpong, 2004; Asuming-brempong et al., 2015). The economic impact of organic versus conventional cultivation is important. The lack of financial resources for high overhead investment without increased return for farmers is detrimental the their livelihoods, and could offer a great barrier to attempting organic and more positive biodiversity sustainable farming practices.

According to Asuming-brempong et al.'s (2015) report, due in part to increased investment into the cocoa industry through COCOBOD, Ghana is able to sell Fairtrade cocoa on the international market through KKL. This cooperative is registered as a Licensed Buying Company (LBC), fitting into one of the few privatised intermediary functions within Ghana's cocoa industry. As both producer cooperative and LBC, KKL

works with 45,000 farmers and purchases 7-10% of Ghana's faitrade and organic cocoa. KKL is also part-owner of UK-based chocolate company Divine Chocolate, as well as being the sole source of cocoa for The Co-operative grocery outlet's own-brand fairtrade chocolate line (Asuming-Brempong et. al, 2015; Fairtradelabel.org, 2012). Being a Fairtrade certified business, KKL's sustainability aims are geared toward both environmental and social aspects of sustainability. Of KKL's cocoa production (representing about 5.5% of Ghana's annual production), about 50% is Fairtrade, receiving the fairtrade market price premium. Typical farms in KKL cooperative are small family-run farms, about 7 hectares in size, with 75% of the farm being utilised to cultivate cocoa (Fairtradelabel.org, 2012). This provides lines of inquiry relating both to the biodiversity sustainability practices mentioned above, providing a significant intermediary player to examine for this research. Discussion with KKL may provide useful insight as to how the cooperative a) motivates members to achieve Fairtrade certification, b) the amount of farmers who also hold organic certification and the motivation behind acquiring this second certification, c) the ways in which KKL (and potentially Fairtrade, Co. 1 and Co. 2 may be able to offer insight in this line of inquiry as well) answer the financial security concerns of achieving and maintaining Fairtrade and/or organic certification requirements (i.e. do they offer financial assistance or incentive programmes to encourage sustainable practices?), and d) the impact KKL farmers feel in the area of biodiversity impacts from the use of sustainable cultivation practices as well as yield and economic impacts due to these practises.

This to understand the multi-scalar interactions and dynamics that affect the production network as a whole, wherein these relationships, drivers, and influencers are important aspects to understand as they can push suppliers toward or away from environmentally sustainable practices.

An understanding regarding the allowance for export of cocoa as a private-owned firm is sought. According to the World Bank (2011), COCOBOD alone is granted permission to coordinate export of cocoa for international sales. Understanding regulatory changes to a) allow private firms to export cocoa products, or b) what types of special allowances may be given to KKL and other private firms such as, Co. 1, to export are

important processes (*Fairtrade Sourcing Programs*, no date). This inquiry can lead to understanding the interplay between actors throughout the production network, especially regarding the influence between lead firm and government agencies, the extent to which lead firms can move government to action (or inaction if this suits their purposes).