Analysis of Agroforestry-Based Value Chains and Food System in Northern Ghana

The Cashew Value Chain

May 2023






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Analysis of Agroforestry-Based Value Chains and Food System in Northern Ghana:

THE CASHEW VALUE CHAIN

May 2023

Environment, Natural Resources, and the Blue Economy Global Practice

Abstract

This series of two reports contains market and viability analyses to help relevant stakeholders identify the best opportunities for supporting sustainable and profitable tree crop production systems (in Northern Ghana) that have ready markets and contribute to diversification of farming systems and household livelihood strategies. The assessment focuses on cashew and shea, as two tree crops with high economic viability in the Northern Savannah Zone.

Acknowledgements

This report was prepared by a team led by Neeta Hooda and Sheu Salau. The team was composed of Mujeeb Adams (field survey), Elias T. Ayuk (main author), Olamide O. Bisi-Amosun, Kwabena O. Asubonteng (survey support), and Lesya Verheijen.

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Glossary

Aggregators	Service providers in the supply chain who buy from producers, put together and sell to large-scale buyers.
Agroforestry	A set of 'systems and technologies where trees are deliberately used on the same land management units as agricultural crops and animals.
Agroforestry parklands	Land-use systems in which naturally occurring woody perennials are deliberately preserved in association with crops and/or animals in a spatially dispersed arrangement and where there is both ecological and economic interaction between the trees and other components of the system.
Carbon revenue /credit	Revenue or credit due to producers for undertaking deliberate activities to sequester or store carbon.
Carbon sequestration	The process of capturing and storing atmospheric carbon dioxide.
Cashew apple	Fleshy stem or peduncle (pseudo fruit) of the cashew fruit and responsible for 90% of the weight.
Cashew Nutshell Liquid	Dark brown viscous liquid present inside a soft honeycomb structure of the cashew nutshell - is the pericarp fluid of the cashew nut.
Climate resilience	The ability or capacity to bounce back from the impacts of climate change.
Cottage industry	A cottage industry is a small informal business characterized by several features including individual or family ownership, small capital investment, simple equipment, localized in the village/rural areas, use of locally available resources, raw materials, and local skills.
Gender equality	The concept that women and men, girls and boys have equal conditions, treatment, and opportunities for realizing their full potential, human rights, and dignity, and for contributing to (and benefitting from) economic, social, cultural, and political development as well as equal access to resources.
Kernel	The edible part of the raw cashew nut obtained after processing.
KOR	The kernel out-turn ratio indicates the amount of usable kernel after de-shelling the nut.

Land equivalent ratio	The ratio of the area under sole cropping to the area under intercropping to give equal amounts of yield, assuming the same management level.
Organic cashew	Cashew kernels produced following organic standards /organic or fair-trade certification.
Raw Cashew Nut	Unprocessed nut of cashew.
Testa	Protective outer covering of the cashew seed – can be used as feed for animals and fish.
Traceability	The ability to trace and follow a food, feed, food producing animal or substance intended to be incorporated into a feed or food through all stages of production, processing, and distribution'.
Upgrading	The possibility of (developing country) producers to move up the value chain, either by shifting to more rewarding functional positions or by making products that have more value-added invested in them and that can provide better returns to producers.

List of Acronyms

ACA	African Cashew Alliance
AF	Agroforestry
AFS	Agroforestry System
CaVC	Cashew Value Chain
CNFA	Cultivating New Frontiers in Agriculture
COCOBOD	Ghana Cocoa Board
COCOSHEA	Cocoa, Coffee and Shea Association
CNSL	Cashew Nutshell Liquid
CREMA	Community Resource Management Area
CRIG	Cocoa Research Institute of Ghana
DES	Decentralized Energy Systems
FDA	Food and Drugs Authority
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GEPA	Ghana Export Promotion Authority
GHG	Greenhouse Gases
GIZ	The Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH/German Development Coorporation
GoG	Government of Ghana
GTCP	Ghana Tree Crop Policy
GSA	Ghana Standards Authority
KOR	Kernel out-turn ratio
MASLOC	Microfinance and Small Loans Centre
MOFA	Ministry of Food and Agriculture
MOVE	Market-Oriented Value Chains for Jobs and Growth in the Ecowas Region
MT	Metric Ton
NDC	Nationally Determined Contribution
OFIS	Olam Farmer Information System
1D1F	One District One Factory
PBC	Public Buying Company
PLS	Progressive Learning Scheme
RCN	Raw Cashew Nut
ROWFAD	Rural Organization of Women Farmer and Agro Process /Development
SDG	Sustainable Development Goal
SFC	Savannah Fruits Company
SNV	Stichting Nederlandse Vrijwilligers

SOP	Standards of Operation
TC	Tree Crops
TCDA	Tree Crops Development Authority
UDS	University for Development Studies
USAID	United States Agency for International Development
VC	Value Chain
VSLA	Village Savings and Loans Association

Executive Summary

Ghana has achieved significant economic growth over the past three decades. In 2019, the economic growth rate stood at 6.5 % and was largely driven by exports of commodities such as gold, crude oil, and cocoa (World Bank, 2020). Cocoa is the dominant source of agricultural earnings in Ghana. The agricultural sector remains a high priority for the government. In 2020, agriculture accounted for about 19.25 % of Ghana's gross domestic product (GDP).

Economic growth has, however, been uneven as spatial inequalities exist in Ghana. The Northern Savannah Zone of Ghana (Upper West, Upper East, Northeast, Northern, Savannah, Bono, and Bono East regions) has not experienced the same growth patterns as the rest of the country. The production system in the zone is largely rainfed making it highly vulnerable to the impact of climate change. The situation is exacerbated by unsustainable practices leading to highest rates of deforestation, land degradation and low productivity.

To address the challenges faced in the Northern Savannah Zone (NSZ), there is an urgency to develop alternative livelihood strategies that build on the natural resource base of local communities and focus on sustainable land use. Agroforestry is a major land-use system in the NSZ with the potential to improve income, yield, and adapt to climate change. Ghana can do better in leveraging the potential of Agroforestry Systems (AF) to boost livelihood diversification, reduce land degradation, and improve resilience to climate change.

This study undertakes an analysis of an agroforestry-based value chain in the NSZ with specific reference to cashew. It draws from an extensive review of the literature, key informants' interview, and a field survey of stakeholders and actors in the cashew value chain. Eighty-nine respondents were randomly selected from seven regions in the Northern Savannah Zone. The study reviews the structure of the value chain, the governance structure, constraints and challenges, the economic viability of the value chain, and opportunities for upgrading.

Principal findings of the study are:

- **There are imperatives for alternative livelihood strategies in the Northern Savannah Zone:** The zone exhibits characteristics indicating a higher level of vulnerability (e.g., higher poverty and malnutrition). The economy relies on an agricultural production system that is dominated by low value grains such as maize, sorghum, and groundnut but which

are highly critical for the food security of the people. There is the urgency to diversify economic activities in the zone drawing from high value tree crops that are present in the land-use system and for which there is a growing global demand. Such an agroforestry system has both high mitigation and adaptation potentials.

- **Cashew-based agroforestry increases returns of food crops.** Land use efficiency analysis showed that it requires 1.53 ha of yam under sole cropping to obtain the same level of returns from one hectare of intercropped yam with cashew. The benefits of integrating cashew in agroforestry systems are quite promising. Farmers in the NSZ are already intercropping cashew with food crops such as maize, yam, soybeans, groundnuts, and cocoyam. In our sample for this study, 16% of the respondents intercrop cashew with food crops compared to 29% who grow cashew in monocrop.
- **Combining cashew production with beekeeping can boost farm incomes.** Yields of cashew farms associated with beekeeping were double of yields form cashew farms without bees. In addition, honey production augmented farmers' incomes by almost 400GHS/hectare based on previous studies undertaken in the study area.
- **Cashew production has increased in Ghana, but productivity remains low.** There are over 125,000 cashew growers in Ghana with a majority having land holdings between 1 and 5 hectares. Cashew production increased 13.5-fold in 2020 compared to 2005 with production increasing from 10,000 metric tonnes (MT) to 131,500 MT. However, the productivity remains low averaging about 500kgs/ha. Pest and Diseases and the uneven availability of good planting materials in the zone are the main drivers of low productivity**.** While availability of extension services was uneven in the study area, support services provided by farmers themselves and other service providers were largely available and affordable.
- **Very good cashew quality is produced in the NSZ**: Production of cashew in the NSZ adheres to very high-quality standards accepted by most actors that include producers, wholesalers, and processors. These actors demonstrate high knowledge of quality standards. There is low use of fertilizers in cashew farms. Tree Aid is assisting cashew farmers to ensure that organic cashew is the standard. Cashew farmers within the Community Resource Management Areas (CREMAs) are also conditioned to produce organic cashew. However, payment of premiums for this high-quality cashew has not yet been formalized owing to difficulties in ascertaining conformity.
- **Policies to incentivize the cashew industry exist**: The GoG established a policy providing 10 years of tax exemption for cashew processors in industrial free zones; customs duty exemption on imports of equipment and spare parts; and an indicative minimum farm-gate

price for the raw cashew nut (RCN) was set by the Tree Crop Development Authority (TCDA) in December 2021. These policies need to be implemented for the desired outcomes to be attained.

- **Buyers and merchants of RCN possess market power.** A high proportion of cashew producers reported that buyers and merchants who purchase RCN behave in an oligopolistic manner and farmers believe they collude to set prices.
- **High need for coordination of the value chain:** There is a diversity of actors in the VC, some organized and others informal. These actors include input suppliers and service providers, research institutions, producers' associations, processors' associations, aggregators and middlemen/ women, exporters, financial institutions (both formal and non-formal) and NGOs. This calls for the need of improved coordination among key stakeholders. TCDA, the recently created authority, can play an effective role in coordinating the VC.
- **Supply of RCN is one of the constraints for cashew processors:** Processors interviewed for this study have put in place mechanisms to ensure a regular supply of RCN. These include stockpiling, importing cashew from neighbouring countries and purchasing on credit at high prices. A major concern is the competition from foreign buyers who are better resourced financially. The bottom-line is if local processors have the necessary finances, they can buy RCN at any time. Establishment of a purchasing window at the beginning of each cashew harvest season for local processors might help them minimize the competition from foreign buyers.
- **Inadequate access to finance is another constraint faced by processors.** Processors do not receive sufficient support from financial institutions. High interest rates, poor record-keeping and lack of collateral are the major factors impeding access to finance from rural banks and village saving and loans associations (VSLA).
- **Manual operations hinder the extent of local processing of cashew:** Most processors interviewed for this study indicate that their operations are manual or semi-automatic, hence they operate with a deficit in equipment and machinery. An investment of about 50,000USD will be required to acquire equipment (machinery) that can process about 500 - 800kg/hour of RCN compared to the maximum of 600kgs/day reported by processors interviewed. This finding has significant implications for the type of policy needed to increase the level of local processing. Manual operations are neither efficient nor cost-effective.
- **The processing segment holds a high potential for job creation**: The potential for job creation is substantial in the cashew processing segment. Estimates suggest that 380 people are required to process 1,000 MT of cashew. Since women are the key actors in local processing, they stand to benefit more from this.

- **Price volatility is a major concern to all actors, especially to producers**: Prices fluctuate substantially and create uncertainties for the producers. Cashew producers report RCN prices getting to as low as 2GHS/kg compared to an average of 3.00 to 4.5GHS/kg. Farmers who were organized in groups (and hence were able to bulk market) reported being able to negotiate better prices with the buyers. The recent decision to set a minimum farm-gate price is expected to reduce the price volatility. However, efforts should be made to implement the policy.
- **Ample opportunities exist to add value and upgrade the cashew sector in the NSZ.** Cashew by-products have not been sufficiently explored in the NSZ. Making juice from the cashew apple and producing wine present good potential for a cottage industry in the area. For instance, cashew producers can potentially realize an additional 125USD/ton from these cashew by-products. The production of organic cashew, maintaining of high quality and improving traceability and market information through digital solutions can facilitate the upgrading of the sector.
- **Needs for improved data and quality for VC activities:** Data on land sizes, production, and export volumes, for instance, vary tremendously depending on the source of the data. It is critical to improve the quality and accessibility of relevant data, therefore, developing a comprehensive database will be a welcome effort. Good quality data is a necessary condition for the design of appropriate policies.

Several key recommendations that may be considered include:

1) Strengthen coordination and communications in the CaVC to address information asymmetries and curb excessive market power by some actors and enhance market interlinkages. This a role that TCDA is going to play as it rolls out its activities.
2) Scale-up the availability of quality planting material through appropriate policies to promote local nurseries and involve the private sector.
3) Take appropriate actions to increase productivity through amongst others, incentives, and acreage expansion.
4) Pursue current strategies and mechanisms to ensure quality compliance and formalize premium payments for quality cashew.
5) Facilitate the development and strengthening of farmer-based organizations in the cashew VC.
6) Build the capacity of small producers and strengthen value creation for cashew by-products.
7) Explore options for increasing local processing through creation of a fund, mobilizing resources under the ‘one district one factory’ scheme,

and developing policy tools including establishing a preferential purchasing window for local processors.

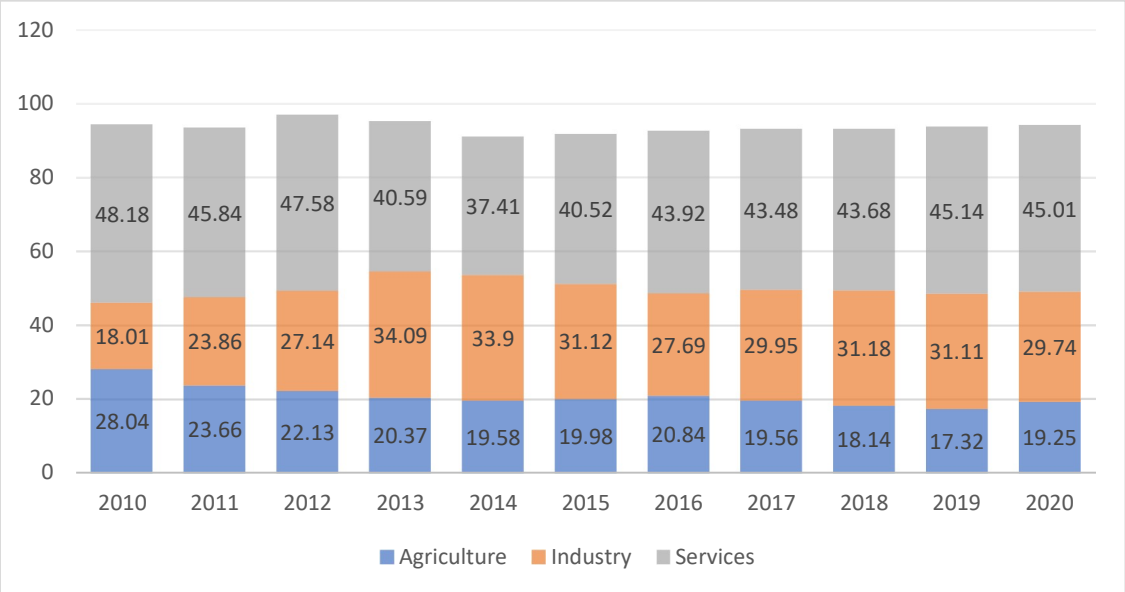
8) Strengthen market information systems by building on available digital solutions in use and ensuring greater uptake by farmers and processors to improve collection of data on yields and other relevant parameters.

Chapter 1: Background

1.1 Context

1. Ghana has achieved significant economic growth over the past three decades. The country's economy and growth have been largely driven by exports of commodities such as gold, crude oil, and cocoa. Cocoa is the dominant source of agricultural earnings. The agricultural sector remains a high priority for the government. In 2020, agriculture accounted for about 19.25 % of Ghana's gross domestic product (GDP) (Figure 1). The current government has developed several initiatives such as the 'One district, one factory (1D1F)'; and 'Investing for Food and Jobs (IFJ)' programme, which includes the 'Planting for Food and Jobs (PFJ) and 'Planting for Export and Rural Development (PERD)', to name a few, to enhance the contribution of the agricultural sector and to address challenges associated with its sustainable development.

Figure 1: Agriculture's contribution to GDP



Source : FAOSTAT : https : www.faostat.org.

2. The growth in Ghana's economy has, however, been uneven as spatial inequalities exist. The Northern Savannah Zone of Ghana (Upper West, Upper East, Northeast, Northern, Savannah, Bono, and Bono East regions) has not experienced the same growth patterns as the rest of the country. The zone exhibits several features. First, it is poorer than other parts of Ghana and lags economically with higher rates of poverty and malnutrition. Second,

the zone is highly vulnerable to climate change and its variability largely due to its agroecology. The soils are generally poor contributing to low productivity. Third, deforestation is higher in the region compared to the national average. The extent of degradation is quite pronounced in the Northern part of the country. The planetary crises of climate change, biodiversity loss and degradation of the natural resource base, and pollution are more acute in the Northern Savannah Zone (NSZ).

3. In its quest for economic diversification and building resilience of the agricultural sector, considerations that are highly relevant for the NSZ, the Government of Ghana (GoG) is paying more attention to a class of non-traditional tree crops such as shea nut, rubber, mango, oil palm, coconut, coffee, and cashew, which have emerged with interesting prospects. This is particularly important because there is growing evidence that climate change and its variability are affecting the major distribution areas of cocoa. Climate change projections suggest that by 2050, it will not be possible to grow cocoa in some cocoa-growing areas in Ghana because of recurrent flooding, the occurrence of cocoa pests associated with rising temperatures (Läderach et al., 2013; World Bank, 2021; Ameyaw et al., 2018; Bunn et al., 2019). Cashew is cultivated in the Northern Savannah Zone (NSZ) of Ghana. To highlight the importance of tree crops (TC), the Government of Ghana (GoG) developed a Ghana's Tree Crop Policy (GTCP), which aims 'to provide a comprehensive and holistic approach for the sustainable development of the tree crop sub-sector and proper targeting of support to the TC value-chains' (MOFA, 2012). The GoG also set up the Tree Crops Development Authority (TCDA). See Box 1 below for the objectives of TCDA.

4. Agroforestry (AF) described as 'systems and technologies where trees are deliberately used on the same land management units as agricultural crops and animals' (HLPE, 2017) is a perfect candidate to address both income diversification and food security aspirations of land users. It involves the practice of incorporating trees in farmlands and holds the promise of addressing some current planetary challenges. Agroforestry systems can increase climate change resilience, have adaptation and mitigation potential, mitigate greenhouse gas emissions, protect, and conserve biodiversity, soil, and water along with other natural resources (Agroforestry Network, 2018; Mbow et, al, 2019; Verchot et al., 2007). AF can also, by linking trees and agriculture, address food needs not only for humans but also for animals in the form of fodder.

5. One of the oldest forms of agroforestry is the parkland system, which has been practised for decades in the Sub-Saharan Africa (SSA) region. This system is common in most of the Sudan and Sahel regions of West Africa. The parkland system refers to the practice of maintaining multipurpose

trees in the farmlands and fallows. Bonkoungou et al. (1994) define agroforestry parklands as "land-use systems in which woody perennials are deliberately preserved in association with crops and/or animals in a spatially dispersed arrangement and where there is both ecological and economic interaction between the trees and other components of the system". In this system multi-purpose trees such as *Acacia senegal* (gum Arabic), *Adansonia digitata* (baobab), *Balanites aegyptiaca* (desert date), *Borassus aethiopum* (fan palm) *Faidherbia albida* (winter thorn), *Parkia biglobosa* (African locust bean), *Sclerocarya birrea* (marula), *Tamarindus indica* (tamarind), *Vitellaria paradoxa*, also known as *Butyrospermum paradoxum* (shea nut) and *Ziziphus mauritiana* (jujube), to name a few, are found dispersed in crop fields at varying densities.

6. The non-timber forest products of these parkland trees are of very high economic value. The trees also perform several productive functions (Seignobos, 1982). For instance, young shoots of *Borassus aethiopum* (fan palm) are eaten as vegetables during famine; seeds of *Parkia biglobosa* (African locust bean), *Adansonia digitata* (baobab) and *Tamarindus indica* (tamarind) are used as food condiments; fat and oil production from *Vitellaria paradoxa* (shea nut) and *Balanites aegyptiaca* (desert date) also for browsing; and *Faidherbia albida* (winter thorn) plays an important role in soil health and fertility and as well as also providing animal fodder.

7. AF is, without doubt, a central pillar in the livelihood strategies of the people in the Sudan and Sahel regions of West Africa, including the NSZ of Ghana. AF contributes to many of the SDGs, especially SDG 1.5, building the resilience of the poor through income diversification; SDG 2.4, ensuring sustainable food production systems; SDG 8.2, achieving higher levels of economic prosperity; and SDG 12.3, halving per capita global food waste. In the face of the urgency in building resilient systems to address climate change and biodiversity loss, there is an emerging consensus that AF can play a critical role (Agroforestry Network, 2018) in spurring economic growth.

8. Developing agroforestry-based value chains will be useful in connecting the poor rural population with the growing urban middle-class; in creating jobs and income generation opportunities and would benefit women who are very likely to be involved in the processing sectors of these value chains. Agroforestry-based value chains also present opportunities to benefit from the ecosystem services that they generate at the landscape or global levels (Agroforestry Network, 2018). In addition, greening AF value chains can bring other dividends in the form of higher prices as in the case of organic products.

1.2 Objectives of the study

9. The overall development objective is to generate evidence to support the development and implementation of a strategy for the promotion of tree crop value chains. The study focuses on cashew.

10. To be able to achieve the development objective above, this study undertakes an analysis of an AF-based value chain focusing on cashew (*Anacardium occidentale L.*). The study identifies opportunities for improving value creation, and governance of quality standards. The study also assesses the impact of bush fires on cashew production.

1.3 Approach

1.3.1 Study area

11. The broad area of this study is the NSZ, which comprises of the Upper West, Upper East, Northeast, Northern, Savannah, Bono, and Bono East regions. Figure 2 shows the geographical coverage of the study. As aforementioned, the NSZ of Ghana has not experienced the same growth patterns as the rest of the country. The zone exhibits several features that include higher poverty and malnutrition; high soil erosion and high variability to climate change; and higher land degradation and deforestation.

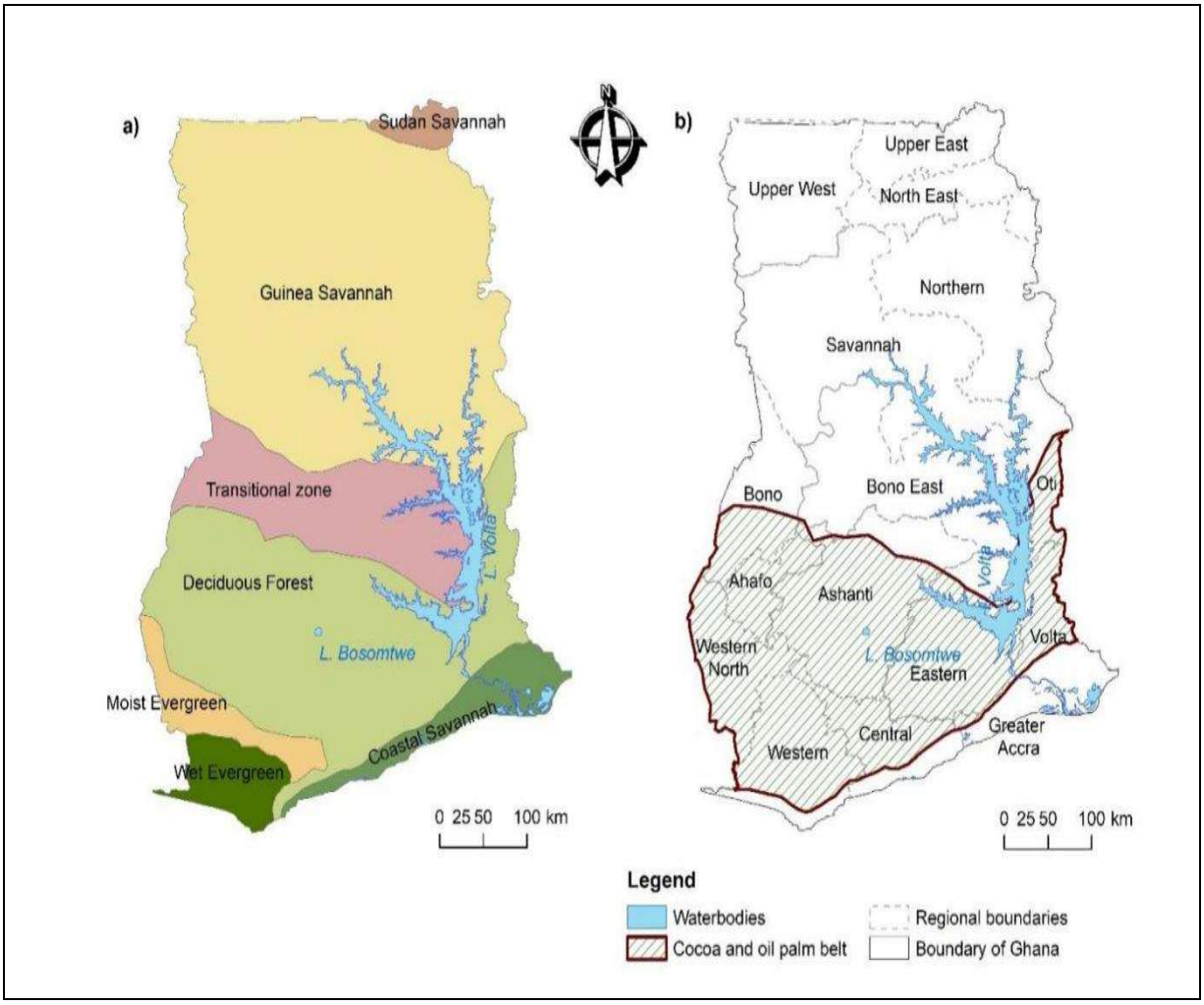
12. Given the prevailing circumstances in the NSZ, it is critical to ensure that natural resources and the environment are managed to sustain agricultural productivity. Research in the NSZ has shown that the adoption of AF can lead to high crop yields, availability of fuelwood and poles, and improved food security for households (Abukari, 2019).

13. Under AFR100, Ghana has identified the NSZ as a priority for land restoration. Northern Ghana also depends on the oldest form of agroforestry known as the Agroforestry Parklands (described above). In this land-use type, trees are integrated with cropped fields. On one hand, agroforestry has demonstrated a 'high[1]' mitigation potential and a 'very high' adaptation potential (Mbow et al., 2019). High-value products from agroforestry parkland trees provide opportunities for improved and diversified livelihoods, on the other hand. This is highlighted by the increasing global demand for raw cashew nuts. The practice of agroforestry

[1] Mbow et al (2019) make a distinction between high and very high potentials.

enables land users to address food security concerns and at the same time obtain income from tree crop products.

Figure 2: The Northern Savannah Zone (NSZ) of Ghana.



Source: Asubonteng, K.O. (2022).

14. The analysis in this study focuses on four components that include 1) mapping and analysis of the value chain; 2) identification of constraints and challenges; 3) evaluation of the value chain; and 4) identification of opportunities and potential for upgrading.

1.3.2. Study approach

15. Several methods were used in the implementation of this study. These include detailed desk reviews, key informant interviews, focus group discussions (FGD), and use of secondary data sources. The interviews and discussions targeted input dealers, producers, producers' associations,

retailers, wholesalers, aggregators, processors, and exporters. Discussions were also organized and held with the TCDA, the Directorate of Crop Services in the Ministry of Food and Agriculture (MoFA) and other relevant stakeholders. The field surveys in the NSZ of Ghana covered 89 randomly selected cashew producers, five cashew processors, and seven cashew merchants active in the zone. Tree Aid staff and one CREMA also provided useful insights. GIZ and MOFA were instrumental in identifying the study sites.

1.4 Structure of the Report

16. This report is organized into four chapters. Following this introductory chapter, Chapter 2 presents a mapping of the value chain; the governance, policies, and regulations of the value chain; economic viability and value creation; constraints and challenges; and opportunities and potential for upgrading. Chapter 3 takes on the cross-cutting themes including gender, the impact of fires and the incentives' structure. Chapter 4 concludes, provides recommendations, and identifies areas for future work.

Chapter 2. The Cashew-based agroforestry system

2.1 Cashew production in Ghana

17. In Ghana, Cashew is mainly produced in Bono East, Bono and Ahafo (previously Brong-Ahafo region), Northern, Upper West and Upper East Regions of Ghana. Cashew (Figure 3) is also produced in the Volta region. It is principally grown as a smallholder crop (0.8 – 3.0 ha) representing 88% and medium to large plantations (4-40 ha) accounting for about 12% (Wongnaa & Awunyo-Vitor, 2013). The production volume in 2020 was between 110,000 and 130,000 tons (ACI, 2021). Over the past decade, cashew has gained much interest from the Government.

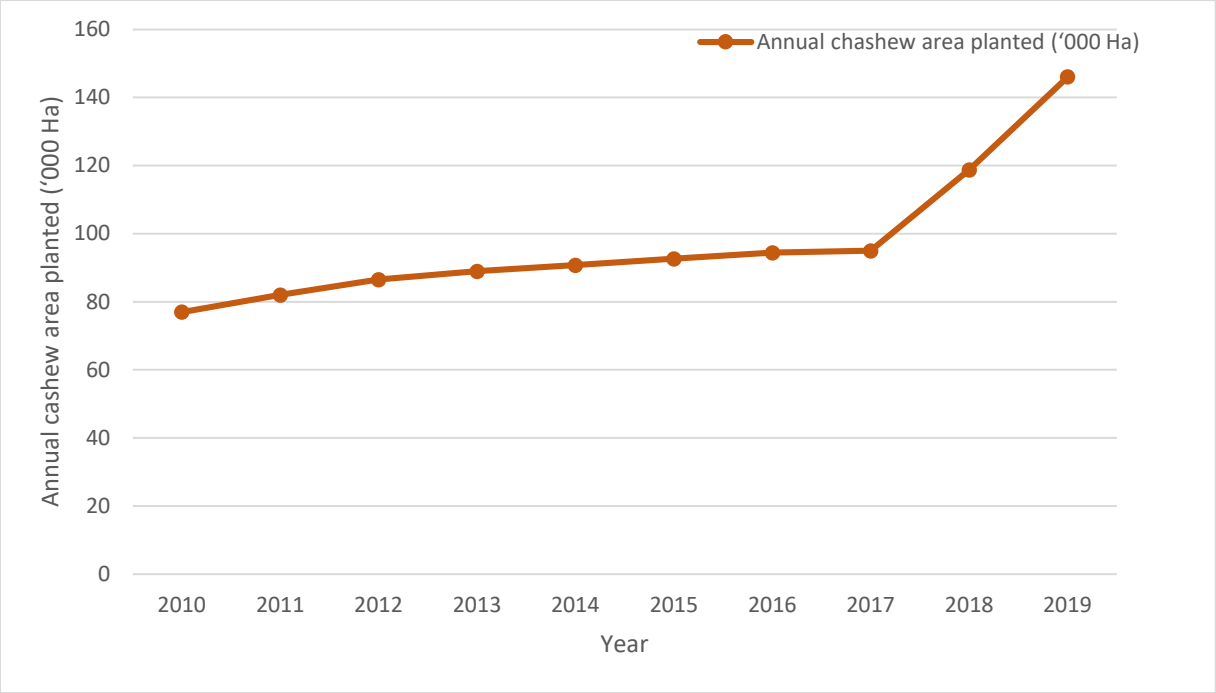
Figure 3: Mature cashew tree already bearing fruits.

Photograph: Courtesy Mujeeb Adams

18. The government had the target of increasing the production area by 100,000 hectares to reach 250,000 hectares by 2020. Acreage planted to cashew increased from a little less than 80,000 hectares in 2010 to more than 150 000 hectares in 2019 (Figure 4). Ninety-five percent of the raw

cashew nuts (RCNs) are exported, and cashew features prominently in Ghana's ten-year National Export Development Strategy.

Figure 4:Annual cashew area planted (in '000ha).



Source: Compiled by author from various editions of Agriculture in Ghana: Facts and Figures. MoFA, Ghana. https://mofa.gov.gh.

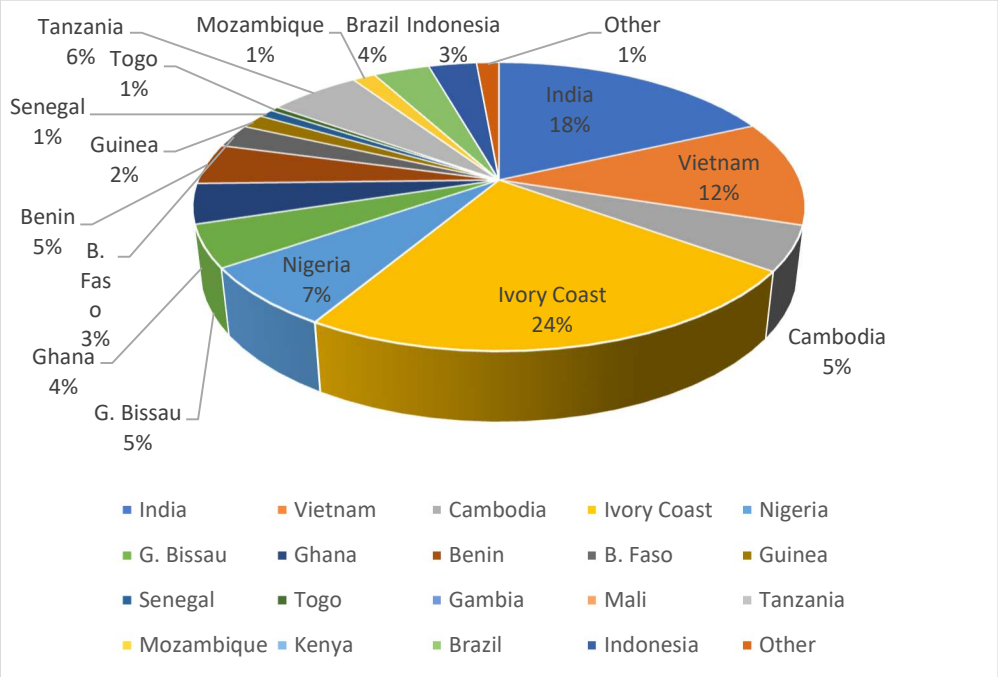
19. Cashew has become Ghana's highest non-traditional export earner (ACI, 2021). In 2020, Ghana was the fifth highest producer of RCN in West Africa (Table 1) behind Cote d'Ivoire, Nigeria, Guinea Bissau, and Benin. Between 2005 and 2020, Ghana RCN production increased 13.5-fold. This was the highest increase for all the countries in West Africa. Compared to 2019, there was a general reduction of RCN production for all the countries in 2020. Globally, Ghana's production amounts to 4% (Figure 5). In terms of global production, it is instructive to observe the comparative importance of African countries. Ivory Coast is by far the world's largest producer of RCN.

Table 1: Raw cashew nut (RCN) production in West Africa

Country	RCN Production (in MT)							
	2000	2005	2010	2015	2018	2019	2020	% Increase from 2005
Benin	31,000	61,000	77,000	101,000	140,000	160,000	155,000	2.54
Burkina Faso	5,000	17,000	36,000	73,000	85,000	115,000	100,500	5.91
Côte d'Ivoire	60,000	173,000	351,000	722,000	875,000	890,000	887,500	5.13
Gambia	700	3,000	4,700	7,500	6,000	18,000	11,500	3.83
Ghana	4,000	10,000	32,000	81,000	115,000	140,000	131,500	**13.5**
Guinea	3,000	10,000	23,000	43,000	58,000	65,000	56,000	5.6
Guinea Bissau	77,000	96,000	137,000	210,000	185,000	220,000	190,000	1.98
Mali	2,000	8,000	20,000	40,000	42,000	60,000	56,500	7.06
Nigeria	32,000	42,000	90,000	182,000	240,000	285,000	273,000	6.5
Senegal	7,000	16,000	28,000	27,000	30,000	45,000	38,500	2.4
Togo	1,000	1,500	2,200	10,000	20,000	21,000	19,500	13

Sources: For 2005 to 2018 (Nitidae, 2019); 2019, 2020 from USDA-ADVISEM, Technoserve (2021).

Figure 5: World production of RCN in 2021.



Source: Data for 2020/21 from International Nut and Dried Fruit Council (www.nutfruit.org).

20. Table 2 presents data on cashew productivity in five West African countries and the yield per tree. The production data are culled from different sources. A key observation is that despite the increased RCN production noted

above, productivity remains low compared to say, Vietnam with a productivity of 1,100 kg/ha. In West Africa, Ghana and Nigeria show higher yields per tree than the other three countries.

Table 2: Cashew productivity, yield per tree, and area under cashew in West Africa.

Data Source	Benin	Burkina Faso	Ivory Coast	Ghana	Nigeria
	Yield/ha (Kg)				
Nitidae (2018)	377	354	350	400	463
COMCASHEW (2019)	390	350	524	1000	-
ACA (2020)	343	-	310	404	416
CNFA (2021)	508	561	694	520	703
Consultation Survey (2021)				350[2]	
	Kilograms				
Yield /tree (CNFA, 2021)	3.9	3.3	3.9	5.8	6.9
	Hectares				
Average area under cashew (CNFA, 2021)	2.7	1.7	1.4	3.5	4.6

Source : CNFA (2021).

Notes: ComCashew (2019) provides data from Comcashew country profiles obtained from public bodies; African Cashew Alliance Cashew Barometer (ACA, 2021) is based on data collected from state institutions; Nitidae trade information (Nitidae, 2019) provides yields of 2018 based on market observation and monthly data requests from commodity (national and international) traders.

21. Available evidence indicates that technical inefficiencies are driving low cashew productivity in Ghana. Danson-Abbeam et al. (2021) observe that there was under-utilization of herbicides and insecticides in cashew production in the country. The authors concluded that herbicides and insecticides use need to be increased to boost cashew production. RCN that meet some qualities such as nut count, KOR, moisture content, percent of defective nuts and the extent of foreign matter can benefit from higher prices.

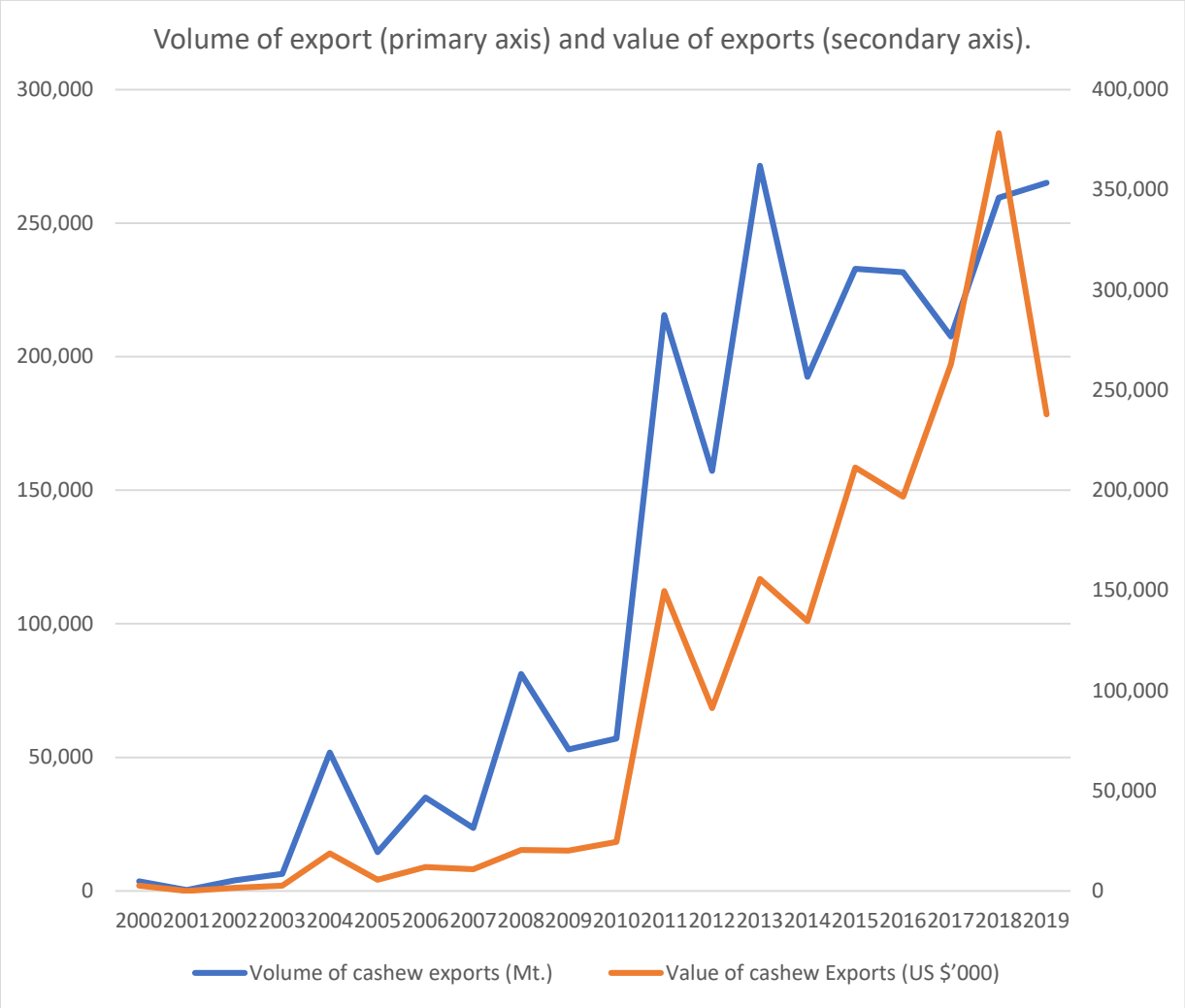
22. Figures 6 shows the volume and export values of cashew from 2000 to 2019. In 2018, the export value of cashew was about 378 million USD with a corresponding volume of about 260,000 metric tonnes. Over the period, export volume was highest in 2013 with about 270,000 metric tonnes being sold.

23. The development of an agroforestry-based value chain with cashew as the tree crop combined with different food crops can address the diversification

[2] The figure obtained based on the survey of 89 producers. Note that many producers reported having cashew farms that are not yet producing.

agenda of ensuring that households diversify their incomes and have food security. Though previous studies have highlighted intercropping of cashew with other crops, there is a need to intensify this strategy. This observation provides a solid justification for the current study. The integration of cashew in agroforestry systems is discussed below.

Figure 6: Volume (metric tonnes) and export values ('000USD) of cashew.



Source: Compiled by author from various editions of Agriculture in Ghana: Facts and Figures. MoFA, Ghana. https://mofa.gov.gh.

2.1.1 Cashew agroforestry systems.

24. The integration of cashew in cropped fields is well-known worldwide. In Côte d'Ivoire, Stephane et al. (2021), studying three zones where 40% of the country's cashew is produced, found that 42-62% of the cashew producers

participated in intercropping cashew. Studies in Nigeria (Famaye and Adeyemi, 2011; Lawal and Uwagboe, 2017; Olukotun, 1983; Aremu-Dele et al, 2021) show that intercropping cashew with arable crops, legumes and vegetables did not affect the growth of the young cashew, except millet, sorghum, and pigeon-pea. The studies also found that cashew/maize and cashew/yam/cassava had high returns. In Ghana, Opoku-Ameyaw et al. (2011) tested the intercropping of cashew with a select number of food crops. Table 3 presents a summary of the results from the study. The authors found significant improvement in the growth of cashew seedlings in the cashew-maize intercrop (girth of 41.9mm). Other studies (Visalakshi et al, 2015) in India and Ginigaddara et al., 2016) in Sri Lanka provide further evidence on the range of crops that can be intercropped with cashew.

Table 3: Intercropping cashew with food crops in Northern Ghana.

Cropping System	Parameters				Food Crop yields (Kg ha^{1})		
	Girth (mm)	Height (mm)	Crown Spread (mm)	Proportion of plants flowered (%)	2005	2006	2007
Sole cashew	37.5	125.0	195.6	78.8	-	-	-
Cashew + groundnut	38.4	132.9	190.5	81.6	132.4	212.2	194.7
Cashew + maize	41.9	159.1	236.4	77.3	462.4	2505.8	1280.7
Cashew + sorghum	38.4	146.9	199.1	62.1	-	643.5	202.5
Cashew + yam	40.1	122.5	194.2	87.9	6602	9663.	5615.3
Cashew + Sorghum in rotation with Groundnut	41.4	139.0	205.7	90.9	-	198.6	167.4
Cashew + Groundnut in rotation with Maize	37.4	130.6	205.9	83.4	126.6	2047	1104.0

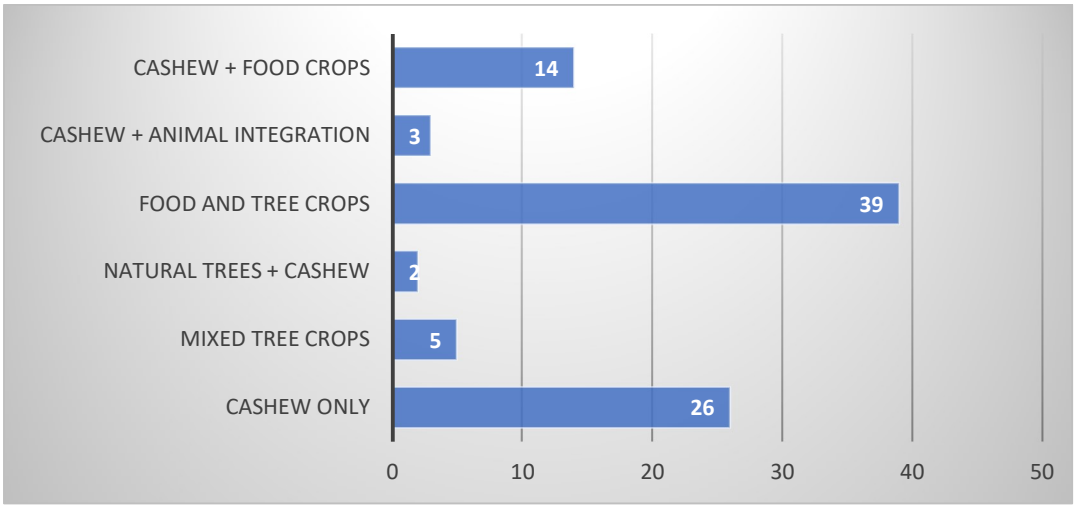
Source : Opoku-Ameyaw et al, (2011).

25. With respect to height, cashew-maize (159mm) and cashew-sorghum (146mm) intercrops were the top performers. The authors also found that during the establishment phase intercrops with maize and yam were more profitable (Opoku-Ameyaw et al., 2011). In another study (Opoku-Ameyaw and Appiah, 2000) examined the intercropping of cashew with the shea

tree. It was found that the girth and the canopy of cashew seedlings increased after the application of potash and superphosphate (Opoku-Ameyaw and Appiah, 2000). The result was the production of a shade effect and serving as weed control.

26. The survey undertaken for this study of 89 randomly selected cashew producers in the NSZ of Ghana indicated that farmers are already intercropping cashew with food crops. The average number of trees per hectare was about 98. Figure 7 shows that 14 out of the 89 cashew producers surveyed for this study intercropped cashew with food crops. This number is, however, lower than the 26 producers who reported growing cashew in monoculture. Some producers integrate cashew with animals, which is important because the integration of animals and food crops in the production system is a key characteristic of AF systems.

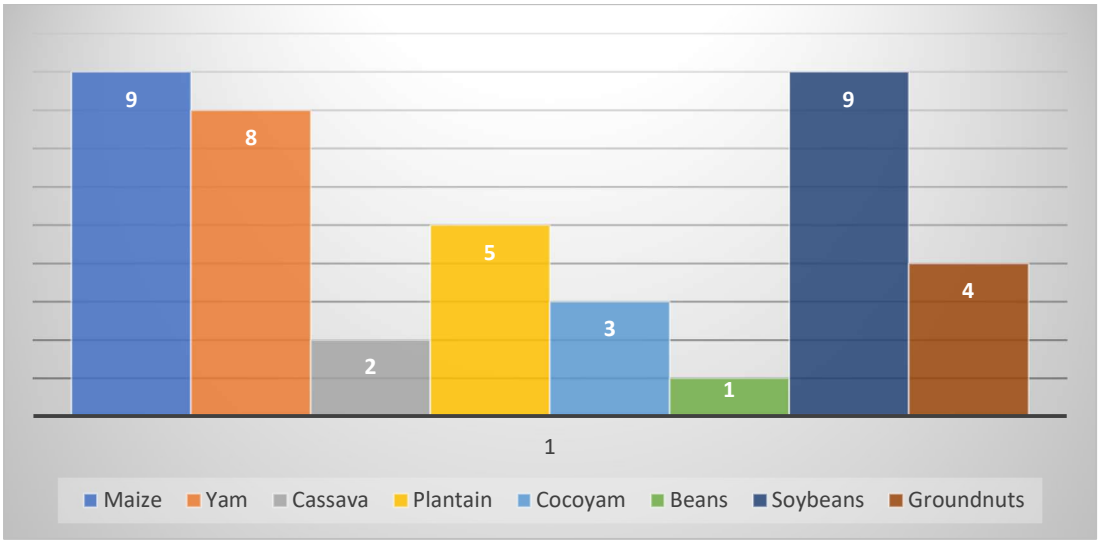
Figure 7: Production systems practised by cashew producers in the NSZ.



Source: Consultation Survey, 2021

27. Figure 8 presents further evidence on the specific food crops that were grown along with cashew. Maize, yam, and soybeans are the leading crops, followed by plantain, groundnuts, and cocoyam. These results suggest that the intercropping of food crops with cashew is a practice that farmers have already adopted. Consequently, it can be concluded that an agroforestry-based value chain with cashew has a place in the livelihood strategies of households in the NSZ of Ghana and can be scaled-up.

Figure 8: Crops intercropped with cashew in the study area.



Source: Consultation survey, 2021.

2.1.2 Prospects of an integrated Agroforestry System (AFS) with cashew

28. Intercropping cashew, especially during the establishment phase, carries several benefits including meeting food security needs, providing revenues for the livelihood of the growers and 'exploiting soil resources' (Rodrigo et al., 2001). The concern that expansion of cashew acreage is detrimental to attaining food security as producers emphasize cashew production while abandoning food crops (Evans et al., 2020) is a strong justification for the integration of cashew in farmed fields. As described above, AF aims exactly to integrate tree crops and food crops within the same land-use system. Intercropping with legumes such as beans and peanuts, which are nitrogen-fixing, can assist the cashew to grow.

29. However, the strategy of integrating cashew in AFS is not a 'one-size fits all'. Prospects for integrating AFS with cashew should be based on a rigorous characterization of the farmer's production environment. Farm size, household characteristics, especially concerning the available labour inputs, and other factors should guide the integration. For instance, a farmer who possesses only 0.5 hectares of land will have to adopt a different strategy with respect to tree density compared to another farmer who possesses four hectares of land.

30. A key message from the above is that there is a need for further understanding of the extent of intercropping for producers with different resources such as the size of their farms. The issue is whether intercropping is good for all farmers. A case may be made for encouraging intercropping

for farmers with middle- and larger-size farms. Evans et al. (2020) recommend a planting spacing between cashew trees of 30 metres to facilitate intercropping of cashew with food crops. For a producer with 0.5 hectares of land holding, this translates to about 8 cashew trees. An integrated analysis is thus required to understand the appropriateness and suitability of such an approach to develop innovative planting designs.

2.1.3 Benefits of Cashew intercropping

31. There is a dearth of knowledge on land-use efficiency of intercropped systems. A parameter that has been used in the literature to gain insight into land-use efficiency is the land equivalent ratio (LER). FAO (1985) defines LER as the 'ratio of the area under sole cropping to the area under intercropping to give equal amounts of yield, assuming the same management level'. For instance, a LER of 1.2 indicates that 1.2 hectares of sole cropping area will be required to obtain the same yields as one hectare of the intercropped system. Table 5 below culls data from Opuku-Ameyaw et al., (2011). The food crop yield data for 2008 is from FAO statistics. This data is used because the authors did not report monoculture data for the first year when cashew started yielding. Following Lehmann et al. (2020), LER is calculated as:

$$\text{LER} = \{[\frac{Crop\ yield\ in\ agroforestry}{Crop\ yield\ in\ monoculture}] + [\frac{Tree\ yield\ in\ agroforestry}{Tree\ yield\ in\ monoculture}]\}$$

32. The yields reported for cashew are for the fourth year after planting. That is, the cashew crop was planted in 2005 and its yield in 2008 was 70.8 kg/ha. Similarly, the crop yield in an agroforestry system for 2007 concerning groundnut, for example, is 194.7 kg/ha. This number represents the yield of groundnut intercropped with cashew. The yields for other food crops in intercrop with cashew are shown in this column. The LER is the sum of the partial LERs, representing tree LER and crop LER.

Table 4: Land Equivalent Ratios (LER) for cashew intercropped with food crops.

Intercrop	Cashew yield (kg/ha)	Food crop yield (kg/ha)		P(LER)		
	(2008)	In agroforestry (2007)	In monoculture (2008)	Tree (Cashew)	Crop	Total
Sole cashew	70.8	-				
Cashew + groundnut	71.0	194.7	1,340.6	0.145	1.003	1.15

Cashew + maize	51.8	1,280.7	1,737.10	0.737	0.732	1.45
Cashew + sorghum	55.5	202.5	1,199.7	0.169	0.784	0.95
Cashew + yam	80.3	5,615.3	14,038.1	0.400	1.134	1.53

Source : *Opuku-Ameyaw et al, (2011). Crop yield data for 2008 is from FAOSTAT.*

33. The LERs shown in the table suggest that the intercrop of cashew with the associated food crops is quite efficient. The highest land-use efficiency is for the cashew + yam intercrop. The results indicate that a total of 1.53 hectares of yam sole cropping will be required to obtain the same productivity as one hectare of cashew intercropped with yam. Caution should be exercised with the results, as the crop yield for 2008 could be an overestimate. Further research is required in the NSZ of Ghana to gain a better insight into land-use efficiency in intercropped systems.

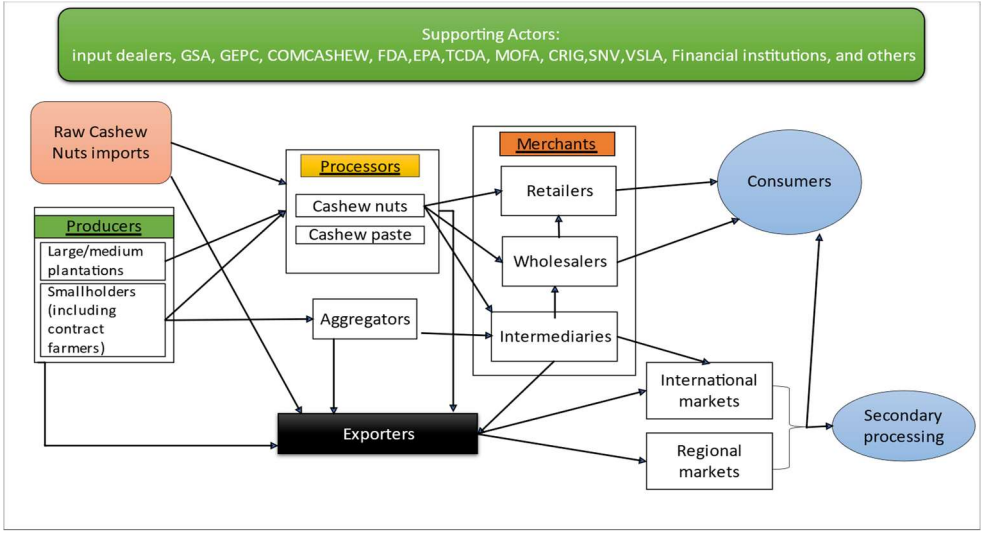
34. An important message is that the combination of cashew with some crops such as yams is more efficient than yam alone or cashew alone. This result supports the foundation of AF and the potential of AF-based VC with cashew as the tree crop.

2.2 Governance, policies, and regulations of the value chain

2.2.1 Mapping the value chain.

35. Figure 9 shows a schematic representation of the cashew value chain in Ghana. Note the limited scope of the processing segment with only nuts and paste as the main products reported in the NSZ of Ghana, as in most of Ghana. As observed later, there are enormous opportunities to process many other products from cashew nuts.

Figure 9: The Cashew value chain.



Source: Author's concept based on consultations, 2021.

2.2.2 Cashew value chain governance structure

36. The CaVC map shown above (Figure 9) highlights the plurality of stakeholders in different segments involved in the VC. Some of these like the processors and producers are organized into formal structures such as producers' and processors' associations. Others like the aggregators and agents operate under informal arrangements. The need for coordination is therefore critical to ensure orderliness in the VC.

37. A review of documents and discussions with key resource persons suggest an unclear governance structure of the cashew sector until the creation of TCDA (Box 1), which is quite timely. There is, therefore, urgency for the Authority to position itself to ensure the emergence of a clear picture of cashew governance in Ghana. It should be mentioned that the Ghana Tree Crops Policy, mentioned above, was the forerunner to the creation of TCDA. The Authority is expected to play a critical role in the diversification of the country's agriculture and consequently opening new income pathways. This should be achieved within the context of low carbon development and creating job opportunities, especially for the marginalized. There is an indication that the Authority has set the ball in motion to develop the required frameworks for policy and regulation.

Box 1. The Tree Crops Development Authority (TCDA)

The Tree Crops Development Authority was established by the GoG on December 28th, 2019, by an Act of Parliament (TCDA Act 1010, 2019). This corporate body was tasked to regulate and develop in a sustainable environment the production, processing, and trading of six TCs (cashew, coconut, mango, oil palm, rubber, and shea) in Ghana. TCDA:

- *focuses on research support (undertake, assist, and encourage scientific, technological, and economic research on TCs).*
- *provides production and value chain support (promote and optimize land utilization in the selected TCs in Ghana);*
- *builds capacity (coordinating and facilitating with relevant institutions to strengthen the capacity of farmers in best agricultural practices); and*
- *licenses and regulates activities of the VCs.*

The Authority is governed by a Board of Directors comprising 29 members, 24 of whom are selected from the private sector, four representing actors of each of the six TCs. The Ministry of Food and Agriculture (MOFA) has the overall responsibility of the Authority. In October 2020, the GoG appointed the Management of the Authority. The necessary resources and mechanisms to make the Authority fully operational have been put in place. It is expected that the full operationalization of the Authority will help the country to earn, beginning from 2028, about $US16 billion annually from the six TCs (TCDA, 2020).

38. Prior to the creation of TCDA, policy and regulation of the CaVC were guided by the 10-year cashew development policy and the National Tree Crops Board. The Cashew Development Plan aimed to modernize, expand, and transfer Ghana's cashew sector.

39. Generally, cashew governance structures aim at regulating value chain activities, which may be through price controls, tariffs and quotas or setting quality standards (Tessman, 2020) and facilitating local-global linkages. Governance should strive to upgrade primary production and increase the rate of local processing (See Box 2). Transparency and traceability considerations should also be components of the strategy (Tessman, 2020).

Box 2: Re-thinking industrial upgrading and promoting local processing.

Ghana is benefiting substantially from export earnings from cashew (Figure 6). In 2019, export earnings from RCN were about 278 million USD. A major challenge of the cashew sector in Ghana is the extremely low level of processing. For 2020, only 9.5 % of RCN is processed in Ghana (Nkalo, 2021).

Cashew in Ghana is processed mainly into edible nuts. But the fruit can be processed into juices or alcohol; cashew nutshell liquid (CNSL) can be extracted from the kernel or seed; the cashew nutshell can also be processed into a particle or chipboard or used as biomass fuel to generate electricity. Other by-products include testa that can be used as animal and fish feed. These are opportunities that should be seized, but it is not currently the case.

Two major challenges that processors in Northern Ghana face are the lack of adequate equipment/machinery and finances. The manual processes lead to inefficiencies in the processing of RCN. A complete machine processor costing about 50,000USD can handle 500-800kg/hour of RCN into finished product (Personal communication, processor interviewed), compared to a maximum of 600kgs/day reported by NSZ cashew processors. For processors, the supply of RCN is important but not the major constraint. A survey conducted for this study indicated that, on a scale of 1 to 5, where 5 represented high availability, the average score was 4 for RCN availability, indicating high availability of RCN.

Lack of access to finance hinders aspirations of mechanizing the processing for improved outcomes. Two out of the five processors interviewed for this study noted that they had been selected to benefit from the GoG 'One district, one factory' (1D1F) policy, but from their experiences, they claim the process has been cumbersome, and the implementation has been extremely slow.

There are experiences in many African countries on providing incentives to promote local processing. The following examples are culled from GIZ/CCI (2019).:

Cote d'Ivoire:

- *100% exemption from profit and sales taxes –in the first year of operation. Companies are granted 50% and 25% exemption in the second and third years of operations, respectively.*
- *The cost of environmental and social impact assessment for processing was reduced from 15.5 million FCFA to 5.5 million FCFA (until December 2020).*
- *Reduction of customs duties and exemptions from Value Added Taxes (VAT) on equipment spare parts (2014-2020).*

- *Processors benefit from government subsidy of 400FCFA/kg kernel processed (2016-2020).*

Ghana:

- *10 years of tax exemption for cashew processors in industrial free zones.*
- *Customs duty exemption on imports of equipment and spare parts.*

Mozambique:

- *Differential tariff for export: 18% for exports of RCN and none for cashew kernel exports.*
- *45 days priority RCN purchasing window for local processors at the beginning of each cashew harvest season.*

Nigeria

- *Reimbursement of 30% of the Free on Board (FOB) value of cashew kernels exported.*
- *Customs duty exemption on import of equipment and spare parts.*

Tanzania:

- *Differential tariff for exports: $160 per ton for export of RCN and none for cashew kernel exports.*
- *Customs duty exemption on imports of equipment and spare parts.*

Overall, Côte d'Ivoire is a benchmark for industrial upgrading and promoting local processing. The regulatory authority (CCA) has put in place an export tax of 30FCFA (about 5 cents US)/kg. The funds are reinvested in the VC. Measures to improve transparency and traceability have also been taken to improve the overall efficiency of the VC (Tessman (2019). The TCDA can learn from the experiences of CCA in Cote d'Ivoire, and drawing from Ghana's past experiences, as it works towards promoting local processing. The Authority should keep in mind, however, that 'one size does not fit all'. Caution should be exercised and the TCDA should undertake rigorous studies to understand how policy tools like an export ban or an export tax might affect RCN prices. Consultations with producers, processors and other key actors would be highly recommended.

40. As the TCDA positions itself to oversee the governance of the CaVC, it is imperative for the Authority to clearly articulate its regulatory and facilitative functions. Regulating the VC should create synergies between primary producers and buyers of RCN and improve the efficiency of the VC (Tessman, 2020). As indicated in Box 2 above, the policy tool to be used and/or preferred will depend on the policy objective that TCDA wishes to pursue: export orientation versus domestic processing; small- versus medium- to large- scale production. Facilitative functions include providing technical assistance and other facilitative services.

41. A governance structure should strive to maximize the benefits accruing to stakeholders along the VC. Increasing market access and consequently market participation, and improving quality are strategies that can

accomplish that objective. Bassett et al (2018) found in Côte d'Ivoire that 'power relations are more important than quality in setting producer prices for RCN'.

42. The governance of the CaVC should be more than just coordination of the activities of the VC. It should aim to increase the competencies of farmer organizations and the participation of all key actors in decision-making within the chain. Critical elements for this include, information sharing, addressing quality standards, fostering innovation and cooperation, and enhancing market information systems.

43. In summary, two years after its creation, TCDA is moving quickly to develop coordination mechanisms and the required frameworks within the cashew sector in Ghana.

2.2.3. CaVC actors and market power

44. As shown in Figure 9, the CaVC is characterized by a diversity of actors at different levels with a significant number of intermediaries. Generally, there are five main groups of actors in the CaVC comprising input suppliers and service providers, producers, buyers/merchants, processors, and exporters.

45. Starting with input suppliers in the value chain, the main inputs are tree seedlings, insecticides[3], herbicides, and the occasional use of organic manure. Tree seedlings are mainly provided by research institutions in collaboration with MOFA (see section 2.3.1 below), while a few producers and associations obtain their seedlings from their nurseries. Seedlings are also available at local and district markets.

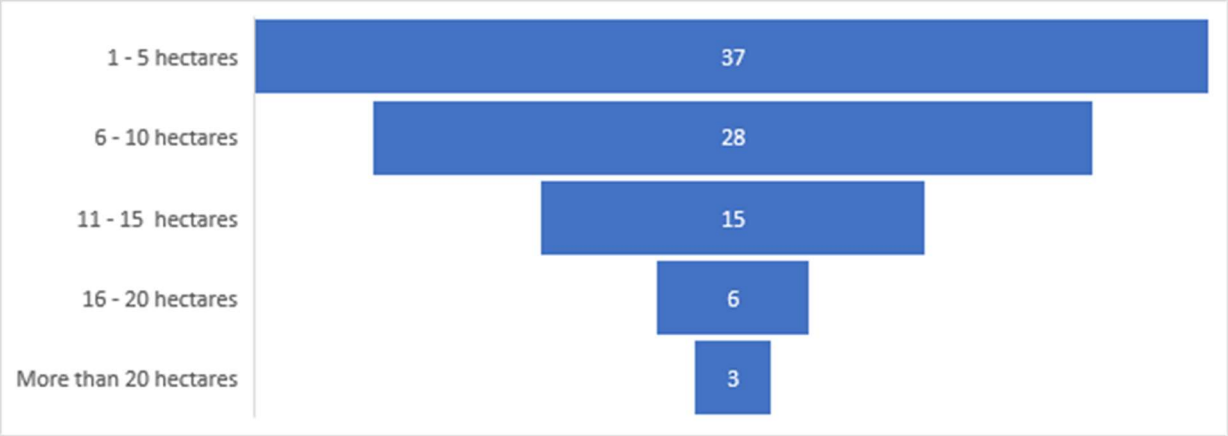
46. Results from the field survey indicate that cashew production is mainly undertaken by producers that vary in terms of their land holdings with a maximum farm size of about 60 hectares. However, generally, the results show that about 42% of the sample are in the one to five hectares group; 31%, on average, hold six to 10 hectares; 17 % hold 11-15 hectares; 7% had holdings within the 16 to 20 hectares range; and only about 3% held more than 20 hectares (Figure 10).

47. Moving to the producers in the CaVC, the GIZ project Competitive Cashew initiative (ComCashew), now known as MOVE, indicates that there are more than 125,000 cashew producers in Ghana organized into farmers'/producers' associations (GIZ/CCI, 2019). These producers mainly sell their end products (RCN) to large firms, wholesalers, aggregators, and exporters as shown in Figure 11. Note that at the rural level, some of these

[3] Insecticides and herbicides are used mainly by non-organic cashew producers.

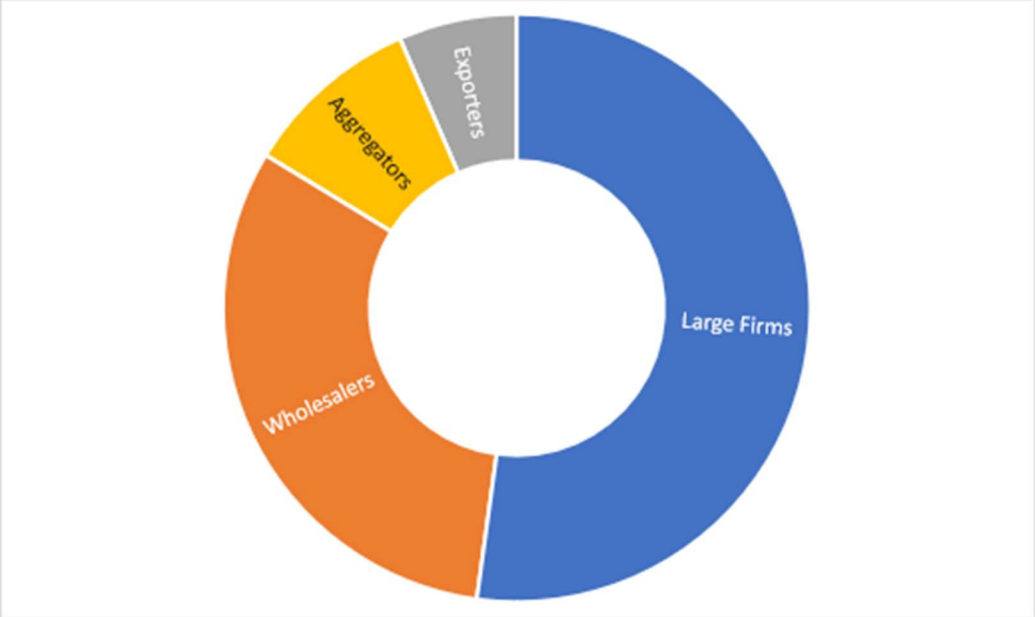
buyers are represented by their agents. Large firms and wholesalers buy from cashew producers.

Figure 10: Average cash farm size in the NSZ.



Source: Consultation Survey, 2021

Figure 11: Buyers of RCN from cashew producers.



Source: Consultation survey, 2021.

48. Complementing the above facts with results obtained from the field survey, cashew producers in overwhelming numbers indicate that buyers possess the market power. They decide on cashew prices to be paid and many times the cashew producers have no choice but to sell. Producers believe that there is some amount of collusion among the buyers who tend to behave

in an oligopolistic manner. Data from the survey conducted for this study showed that sometimes producers faced prices as low as 2GHS/kg compared to a seasonal average between 3.5GHS/kg and 4.5GHS/kg. Many producers indicated that they were sometimes obliged to hold on to their RCN and wait for better prices. Farmers who were organized in groups and consequently could sell in bulk reported being able to negotiate better prices with the buyers. This highlights the role farmer-based organisations can play in agroforestry-based value chains. Producers who stored their RCN waiting for favourable prices had to deal with maintaining the quality of the RCN. Respondents noted that storage could be a source of loss of quality.

49. There are also small-scale and middle-size traders who buy RCN directly from farmers and sell to wholesalers and large firms. During the peak months, their transactions range from 15 tons to 100 tons per month. Some of these buyers provide support for inputs to farmers. As aforementioned, these agents/buyers possess a lot of market power as they decide the prices for RCN. The recent decision to set a minimum price for RCN, will influence this perception and might change the power dynamics (Box 3) in the VC.

Box 3: Minimum farm-gate pricing of RCN

In December 2021, the TCDA, the regulatory authority responsible for cashew in Ghana, set a minimum farm-gate price of GH5.02 Cedis/kg of RCN. This decision addresses price volatility, which is a major challenge the cashew sector has been facing. A survey undertaken for this report shows that cashew prices go as low as 2 GHS/kg, compared to the average of 3.5 – 4.5GHS/kg, which makes it a challenge for the profitability of cashew farming. All the respondents in the survey indicated the need for a price stabilization policy and were looking forward to specific action from TCDA.

A minimum farm-gate price for cashew is good for the farmers as this enables them to plan accordingly and can be a catalyst for increased productivity. It is also good for local processors who will not have to deal with input price uncertainties. However, a minimum farm-gate is a necessary but not sufficient condition for a successful cashew industry. While there are successful cases as in Cote d'Ivoire, many countries such as Benin, Burkina Faso, Guinea Bissau, The Gambia, and Senegal have faced challenges with the system. Tanzania does not have a minimum farm gate price policy but has a successful cashew industry.

The keys to a successful minimum farm-gate price system are adequate consultations of all actors involved, a clear understanding of the mechanism and effective enforcement. As the TCDA has now announced a minimum farm-gate price, moving forward, it is important for enforcement mechanisms to be put in place and to pursue further discussions with all stakeholders to improve their understanding of the mechanism. Improving market information systems will be also useful in this endeavour. The system could include geo-referenced information on cashew farmers and their associations, processors, buyers, and exporters. It should be noted that when the survey for this report was undertaken, many cashew producers did not seem to be aware of the new minimum farm-gate price policy

that had just been announced. This should not be the case as this information should have reached cashew farmers in real-time.

50. Concerning the processors in the CaVC, results from the field survey suggest that processors buy directly from farmers, using their extensive contacts at farm gates, and from traders and/or their agents. Of the five processors consulted for this report, four undertook primary processing and one secondary. The quantity of RCN processed ranged from 18 to 120 tons/year. The processors are mainly limited liability companies and family-owned operations. Many processors use manual or semi-automatic machinery and are not able to operate efficiently. The available data suggest that 9.5 % RCN is processed in Ghana. Table 5 shows comparable rates for other West African countries with Burkina Faso leading (13.4%) followed by Ghana (9.5%), Nigeria (8.8%) and Côte d'Ivoire (7.9%). The average processing rate in West Africa is 7.2 Improving local processing can play a role in stabilizing farm-gate prices, which in turn can serve as an incentive for better quality and yields. Establishing strong farmer-processor links can be quite instrumental (GIZ/CCI, 2019) in enhancing this.

Table 5: Local cashew processing to kernel in West Africa.

Country	2020 RCN estimated production (in MT)	Local processing to kernel (in MT)	% Processed
Benin	155,000	10,000	6.5
B. Faso	100,500	13,500	13.4
Ivory Coast	887,500	70,000	7.9
Gambia	11,500	500	4.3
Ghana	131,500	12,500	9.5
Guinea	56,000	500	0.9
Guinea Bissau	190,000	3,000	1.6
Mali	56,500	500	0.9
Nigeria	273,000	24,000	8.8
Senegal	38,500	500	1.3
Togo	19,500	4,000	20.5
Total (W. Africa)	**1,919, 500**	**139,000**	**7.2**

Source: USDA, ADVISEM, Technoserve (2021).

51. Box 4 shows end-users' prices for cashew kernels in selected Accra retail outlets. The key finding here is that locally processed cashew kernels can earn substantial income for local processors.

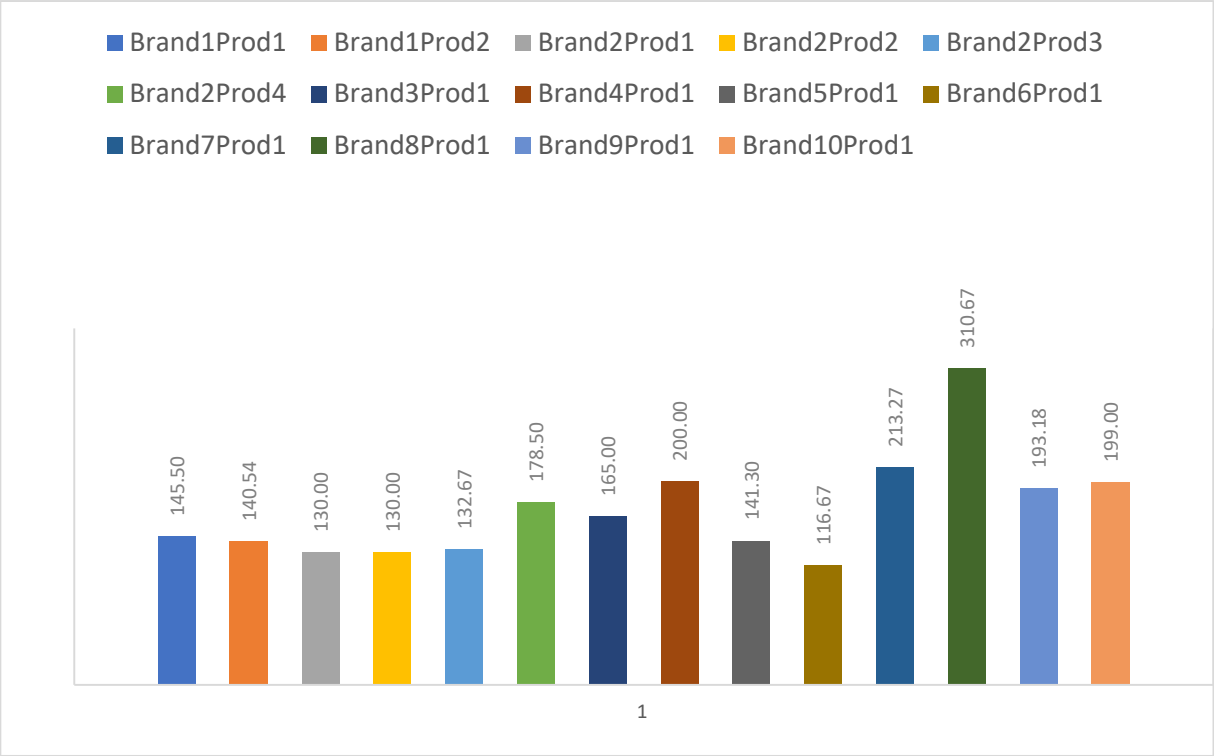
52. The employment potential associated with an increase in local processing is enormous. It is estimated that 380 people would be needed to process 1,000MT of cashew (USAID, 2014). The calculus is evident and indicates that increasing local processing has tremendous employment potential,

especially for women who constitute about 80% of those involved in processing. The leading buyer of the final products of these processors was the wholesalers, followed by retailers and then the large firms. The men to women ratio of those employed by the processors is 15 to 176, about a 12-fold advantage for women (based on the sample of processors who were interviewed for this study).

53. Final, in the VC are the exporters. Ninety percent of Ghana's RCN is exported to India and Vietnam. In 2018, for example, 60 % of RCN exports from Ghana went to Vietnam and the remaining to India. In the same year, cashew kernel was exported to European Union (816 MT), USA (507 MT), Brazil (241 MT), Canada (235 MT) and others (51 MT) (Nitidae, 2019). There is evidence that there are imports of RCN into the country. In 2018, an estimated 140,000MT was imported from Côte d'Ivoire, 36,000MT from Mali and 5,000MT from Burkina Faso (Nitidae, 2019). Overall, as shown in Table 5 above, local processing of cashew is low in West Africa. It has been estimated that the competitive gap is between 150USD/MT and 350USD/MT in favour of Vietnam (Ton et al., 2018).

Box 4: End-user prices of cashew kernels in retail outlets in Accra.

Five supermarkets and retail outlets were visited and displayed end-users' prices of cashew kernels were recorded. Ten processors/brands (Brand) with a total of 14 locally processed products (Prod) were registered and the per kilo consumer prices for the products were calculated! The analysis shows the cashew kernel price per kilo varies from 116.67GHS to 310.67GHS in the Accra market.



Source: Supermarket/Retail outlets survey by Author, 2022.

54. Box 5 presents some key indicators that highlight the competitive advantage/disadvantage compared to Vietnam.

Box 5 Competitiveness of West Africa cashew processing.

I. Competitiveness of West Africa cashew processing compared to Vietnam.

Competitiveness of cashew processing	
Competitive advantage	**Competitive disadvantage**
✓ **Availability of decent quality raw material (RCN).**	✓ Very high costs for energy and water.
✓ **Geographical access to markets.**	✓ Less usage of by-products (processing of cashew nut shells, which is common in Vietnam and India, could provide West African processors with an additional income of up to USD 100-125 per ton of RCN).
✓ **Traceability resulting from source proximity.**	✓ Lower confidence in quality by international buyers.
✓ **Low negative environmental impacts.**	✓ Less know-how on best techniques and technology.
	✓ Labor is significantly more expensive.
	✓ Labor productivity is lower (by a factor of approximately 2 or 3).
	✓ Lower efficiency of RCN use.

Source : Ton et al, 2018.

2.2.4 Institutional arrangements for quality control.

55. Buyers and processors who buy from producers adhere to rigorous standards to ensure good quality RCN. Standards for quality like Kernel out-turn ratio (KOR), the nut count and moisture level were consistently mentioned by the cashew merchants and processors that were interviewed for this study. Even cashew producers indicated that the colour and size of the nuts were important quality indicators that they adhered to.

56. The Ghana Standard Authority (GSA), the Food and Drugs Authority, Africa Cashew Alliance, and the Environment Protection Agency (EPA) have set standards of operations and requirements for cashew. These organizations along with COMCASHEW help these processors to conform to the standards.

57. The FDA and GSA undertake site inspections of processing facilities. On their part, processors and buyers use testing devices to determine the quality before buying. They also adhere to traceability principles by buying from known farmers. There was no conclusive evidence that processors

interviewed for this study receive premiums for supplying high-quality products although there are incentives to do so. A processor noted that they can get premiums if their product is up to 65% of whole nuts. One other processor mentions that they get higher prices for quality products. The others believe that good quality gives them visibility and potential access to international markets. It has been shown in Northern Ghana that good agricultural practices including post-harvest handing activities will enable quality to be maintained (Gyedu-Akoto et al., 2014).

2.3 Constraints and challenges

58. There are several constraints and challenges that are inherent in the CaVC. As mentioned earlier, pest and diseases are largely responsible for the low productivity observed in Ghana. An uneven availability of extension services was also observed in the study area. Cashew producers also lack the technical knowledge, especially with respect to by-products. In agroforestry-based value chains, the inputs supply sector is a critical component of the VC. The subsequent value additions depend considerably on the level of the inputs. For the cashew sector, whereby planting material is a critical input, the sources and quality of seedlings are key. Poor quality seedlings can be a source of risk and a potential constraint for the value chain development. There is consequently a desire to assess the sources and quality of seedlings in this VC. Processors also face the challenge of inadequate financial resources to acquire mechanized processing **equipment** (see Table 9 for further constraints faced by producers and processors). Chapter 3 addresses specific constraints that women producers face.

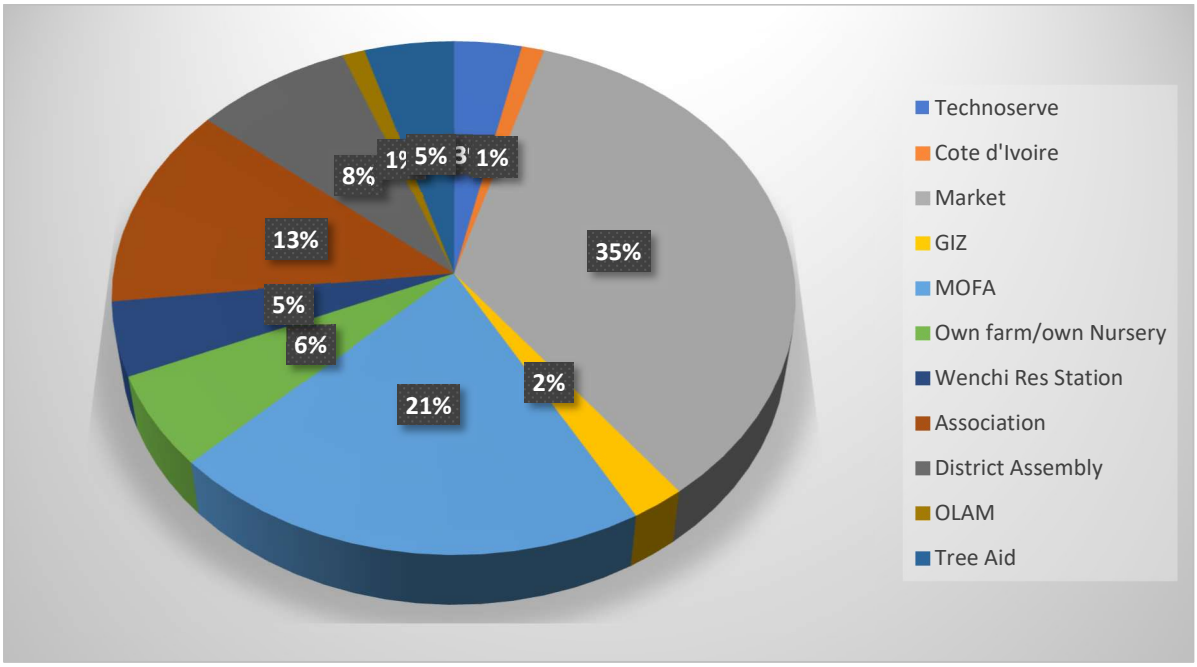
2.3.1 Sources and quality of seedlings

59. Timely availability and high quality of seedlings are two critical components on the inputs side for high productivity of cashew. The sources of seedlings determine to a large extent their availability while the quality has a direct link to the agronomic yield performance. The average yield per hectare in Ghana has been reported to be about 520kgs ha^{-1} (USDA/ADVISEM/TECHNOSERVE, 2021). The yield data reported varies substantially with the source of the data. In the survey for this study, the average yield was found to be about 350kgs/hectare (see Table 2 above). There is a need to develop robust databases and a catalogue of seedling producers.

60. Our survey of producers revealed that the top-three sources of cashew seedlings are the market, MOFA and cashew producers' associations. NGOs like Technoserve and Tree Biz were also reported as sources for seedlings.

District assemblies are also playing a role in supplying planting material, which may be related to actions by political elites from the communities (Figure 12). It should be noted that district assembles get their seedlings from MOFA, in most cases. Some producers also source their seedlings from their farms or own nurseries. Some communities (25 % of the respondents) mentioned that seedlings were not readily available in their locality/community. Some other producers indicated that they were not able to have access to improved varieties.

Figure 12: Sources of cashew seedlings.



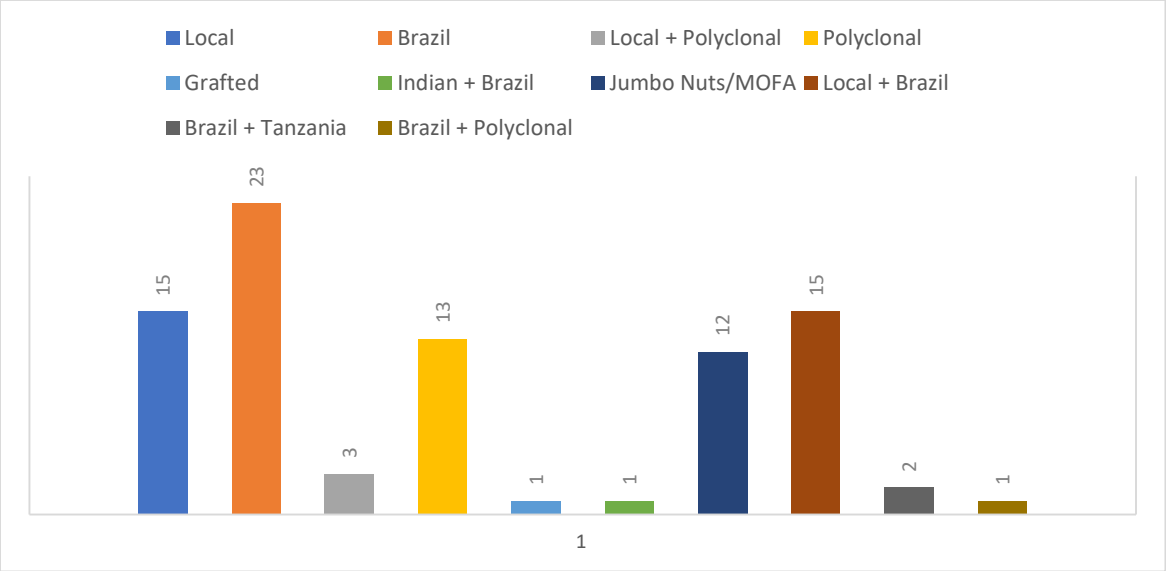
Source: Consultation survey of cashew producers in the NSZ, 2021

61. In the study area, most respondents indicated that seedlings were provided free of charge, which could be due to their affiliation with producers' associations and other project-related activities. Notwithstanding, the subsidization of planting materials like seedlings stifles private sector initiatives on developing nurseries for cashew planting material. It is obvious that an exit strategy of free planting material is necessary and should be given high attention. This strategy could include encouraging these programs and projects to buy seedlings from the private actors. The private sector, community, and association initiatives to develop nurseries as a source of planting materials should be pursued and incentivized. Böhringer et al. (2003) found that individual nurseries produced a much higher quantity of tree seedlings, compared to group nurseries.

62. Figure 13 presents the types of seedlings that respondents to the survey used. The Brazilian, local, local + Brazil, polyclonal, and Jumbo varieties were

frequently cited. The Jumbo nut is the variety supplied by MOFA. The Crop Research Institute has done considerable work to produce high-quality cashew planting materials.

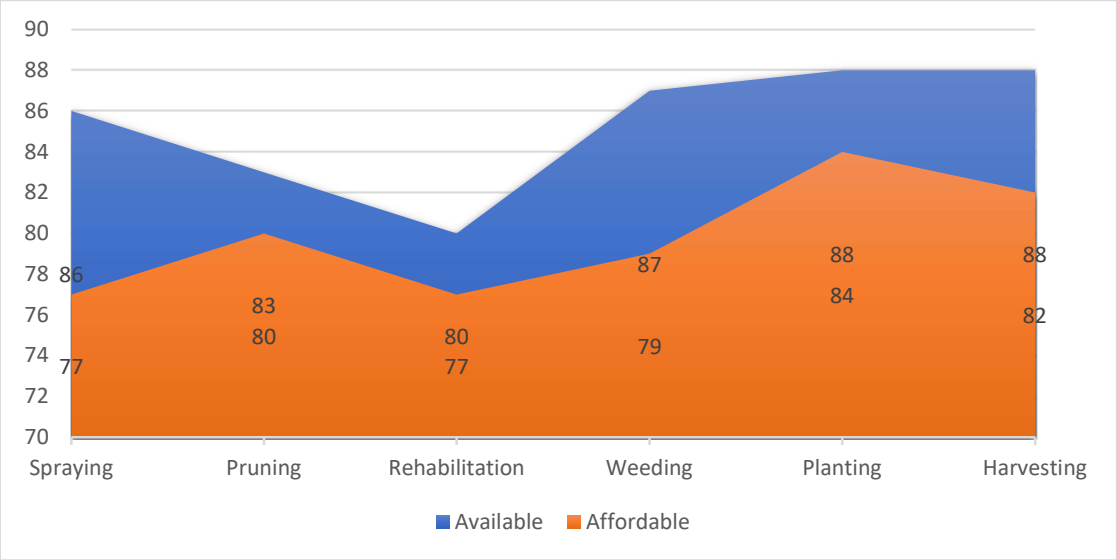
Figure 13: Types of seedlings used in the NSZ.



Source: Consultation survey, 2021.

63. The survey for this study looked at good agricultural practices (GAP) of the farmers with specific reference to spraying, pruning, rehabilitation, weeding, planting, and harvesting. As shown in Figure 14, cashew producers reported that several services are available and affordable. For instance, 86 cashew producers indicated that spraying services are accessible and 77 of these observed that these services are affordable. Availability of extension services was also found to be unevenly distributed in the study area.
64. In summary, access to good quality cashew seedlings is uneven in the NSZ. Some communities/districts report the unavailability of seedlings in their locality. Facilitating easy access to quality seedlings should be investigated. A database on the availability of seedlings in the zone could be quite useful to producers. In addition, certification of nurseries might be a useful strategy.

Figure 14: Accessibility and affordability of selected support services.



Source: Author's compilation from producers' survey, 2022.

2.4 Economic viability and value creation in the CaVC.

2.4.1 Value creation and distribution among various actors

65. There is a huge potential in the CaVC for value creation and addition. In Northern Ghana, as is the case with most African cashew-producing countries, emphasis has been on RCN with little attention to the potential of other products and by-products. As mentioned elsewhere in this report (Figure 11), RCN is the main product that producers in Northern Ghana rely on. However, there are well-known and documented uses of other cashew-related products. The cashew apple can be used to produce juices, wine/liquor, jellies, cakes, candies, and jam. Cashew Nutshell Liquid (CNSL) can be a source of adhesives, paint, acid, and other industrial products. The cashew testa can be used for brake pad linings, and as livestock, poultry, and fish feed. The shell is fuel for wood-burning stoves, ovens, and dryers (Box 6).

Box 6: By-products from Cashew Nutshell.

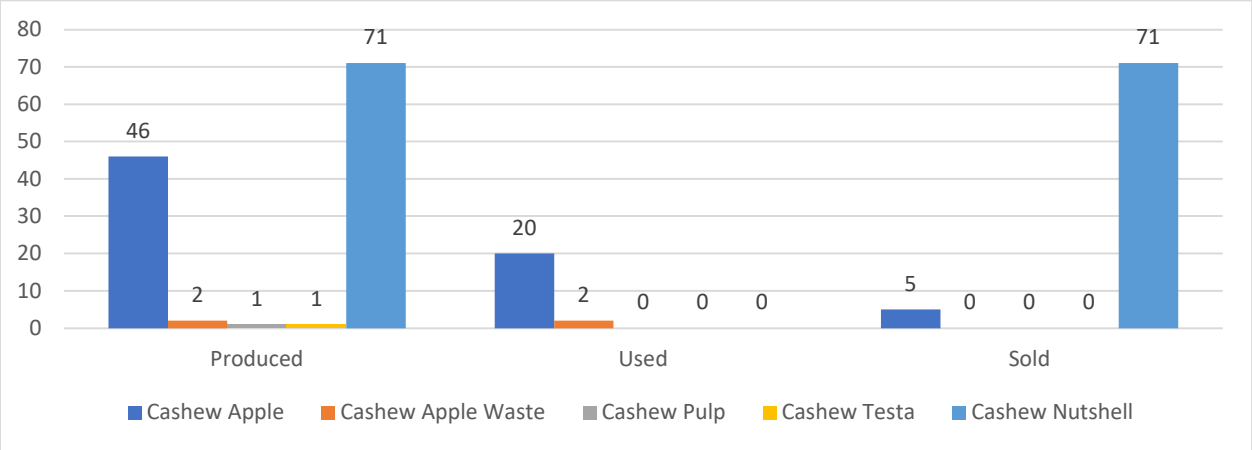
Biochar; Biochars are created in the processing of cashew nut shells along with other bioproducts. Biochars have a high carbon content (70–75 wt%) and high heating values in the range of 25–28 MJ kg^{-1} and can therefore be used as an energy source. Biochars also contain significant quantities of Potassium along with smaller amounts of Magnesium, Calcium, Copper, Zinc, and Iron. These minerals result in biochar being a potential fertilizer.

Bio-Oil: Bio-oils have a higher heating value than biochar with 32 MJ kg^{-1}. Bio-oil is not suitable for use in pure form but can be used in mixtures with Diesel. The gas phase of bio-oil is CO_2 and CO below 400 °C with a greater formation of H_2.

66. There are several uses and by-products of cashew with significant economic value. The RCN or the kernel and the cashew apple are the two main products of cashew. The kernel is consumed in the form of snacks, either raw or roasted. The cashew apple can be used to produce juice, cashew vinegar, cashew apple candy and jam, canned apple, cashew apple chutney, cashew pickles and a wide variety of mainly soft drinks (Dendena and Corsi, 2014). Cashew apple residues obtained after the extraction of juice are used to manufacture candies, jam, drinks, and cattle feed after drying (Dendena and Corsi, 2014). The juice can also be fermented to produce liquor. As shown below (Figure 15) the commercialization of the cashew apple and its associated by-products, is relatively low, if not inexistent, in Ghana.

67. Figure 15 shows the use of cashew products besides the RCN in the study area. As observed, about 50% of the respondents indicate that they collect cashew apples, less than 22% reported making use of the apples, while few respondents (6%) indicated that they sold the product. In terms of the cashew nutshell, it is highly in use with almost 80% of the respondents *reported* selling the product. The respondents indicated that they consume small quantities of the cashew apple and animals are also fed with the apple. Most of the apple is thrown away. Cashew apple waste, cashew pulp, and cashew peel/testa are completely ignored by this set of respondents.

Figure 15: Cashew producers use of by-products.



Source: Compiled by author from survey data, 2021.

68. Table 6 shows examples of processing cashew by-products in Africa. There are other by-products of cashew. These include cashew nutshell liquid (CNSL) derived from cashew processing and is used as a chemical

compound in brake linings, vanishes, paints and surface coatings (Kumar et al, 2002); cashew skin extract, usable as a natural antioxidant (Kamath et al, 2008) and cashew shell cake obtained after the removal of the CNSL has a high potential for use as fuel. The bark of the cashew tree also has medicinal properties and can be used in the treatment of diabetes mellitus (Alexander-Lindo et al, 2004), hypertension, gastric disorders, and inflammations (Mota et al, 1985).

Table 6: Examples of cashew by-products processing in Africa.

Country	Factory	Product
Benin	Kake 5 Industries	Shell to CNSL
Burkina Faso	Gebana Afrique Ltd	Shell to briquette & Dried cashew apple
Burkina Faso	Anatrans	Shell to CNSL
Ghana	Mim Cashews	Cashew apples for brandy
Ghana	Usibras Ghana Ltd	Shell to CNSL
Ivory Coast	Olam Ivoire Sarl	Shell to briquette
Kenya	Jungle nuts	Shell to CNSL
Kenya	Equatorial nut processing	Shell to CNSL

Source: GIZ/CCI (2019).

69. Nair (2010) reports other minor products that can be obtained from cashew such as cashew kernel flour, cashew kernel oil, cashew kernel butter, and cashew kernel milk. With exception of CNSL, there is little evidence in Africa in general, in the NSZ specifically about the use of the cashew by-products mentioned above.

70. This outcome confirms the generally well-known fact that African cashew producers are not adding value to their nuts, which also suffer from low levels of processing. Thus, to create value for cashew, attention must be paid to improving processing levels and to harnessing the potential of the different products and by-products mentioned above. Processing costs pf RCN to kernels in Ivory Coast are 3.17 USD/kg, compared to 3.90USD/kg in Nigeria and 6.79USD/kg *(*USDA-ADVISEM, Technoserve ,2021*).* The costs have also been found to vary by firm size. Smaller (less than 5000mT) incur cost of 3.55USD/kg, medium-size firms (between 5000 and 10000MT) incur costs of 4.75USD/kg, while large firms (greater than 10000MT) incur costs of 2.55USD/kg. There are, therefore, economies of scale in processing larger quantities *(*USDA-ADVISEM, Technoserve,2021).

71. Before examining where and how value can be created in the CaVC, we examine the distribution of value for RCN and the processed kernel sold at an Accra local market outlet. For RCN, the village agent and/or aggregator

buy from the producer and sells to a buying company that also exports the RCN (Table 7). Table 8 represents the situation in which processors buy directly from producers, undertake the processing of the RCN to edible kernels and sell to retailers.

72. As shown in Table 7, the producer's share in the FOB Tema price for a ton of cashew is 65 % (5,500/8,508.6). While the share of the buying company is 76 % (6,500/8,508.6) of the export price. Further examination of the marketing margins shows a more than 7-fold difference between the buying company and the exporter (compare 266.4GHS to 1,911.90GHS).

Table 7: Value addition across the CaVC.

Parameter	Actors		
	Cashew Producers	**Traders**	**Exporters**
Amount per 1,000kg (GHS)	5,500	6,500	8,508.6
Marketing costs	-	733.60	96.70
Marketing margin	-	266.4	1,911.90
Share of Value (%)	65	76	

Source : Bannor et al. (2019), and author's compilation.

73. Table 8 looks at a situation whereby processors buy directly from producers, process to edible kernels and sell to retailers who could be the supermarkets. Column 3 on this table is based on the domestic end-user prices for processed cashew nuts. This data was collected at five locations in Accra for locally processed cashew. Based on the True Brand locally processed cashew, the end-user price was estimated at 178.5GHS/kg. The survey found that the sale price of one kilogram of processed cashew nuts ranged from 116.67GHS to 310.67 GHS per kilogram See Box 4 above. Another important note is that processors indicated that producers obtain approximately 187.5 kgs of kernels from a ton of RCN. Processors also indicated that they sell to their suppliers at a price range of 40 – 52 GHS per kg of the processed kernel.

Table 8: Value addition for processed cashew kernel.

Parameter	Actors		
	Cashew producers	**Processors**	**Consumers /End users**

Amount received per 1,000kg	5,500	9,375	33,468.75
Share of value (%)	16	28	

Source: Author's calculation. Note: End-user/consumer prices were obtained for True Brand processed cashew nuts, which go on average for 100g =13GHS; 200g = 28.6GHS; 300g = 39GHS and 800g = 143GHS. Based on this, the per kg price is 178.5GHS.

74. From Table 8, producers receive 16 %of the price paid by end-users/consumers. This table assumes that the sale price to the shops/retail outlets or their agents is 50GHs/kg[4]. In this case, processors receive 9,375 GHS/ton of RCN, equivalent to 28 % of the price paid by consumers. The spread between the processors and the producers is 3,875 GHS and between the end-users and processors and producers is 24093.75 GHS and 27,968.75 GHS, respectively for a ton of processed cashew kernel (Figure 16). Between the processor and the retail outlets, there are some actors who are involved that include aggregators who may be providing some services. This might need further examination.

Figure 16: Processed cashew from the NSZ.

Photograph: Courtesy Mujeeb Adams

75. Value creation can be accomplished at the producer's level as well as at the processor's level. Table 9 summarizes some key potential areas along with barriers at both levels.

[4] This price is based on information received from some processors.

76. The potential and opportunities for value creation in the CaVC can bring along substantial benefits. For cashew producers, cashew apple processing provides opportunities for increased income and employment at the household level and might have nutritional benefits. For processors, increased processing of RCN and investing in the other cashew products and by-products constitute a source of further income generation and of unleashing employment opportunities. Strategies to increase awareness among producers and processors; to build the capacity of producers; and to develop enabling policies will enhance value creation in the cashew sector. Evidence from Tanzania indicates that by-products can yield a net value of up to 125 USD/ton of RCN (Away4Africa, 2018). Research and development activities should be initiated to better understand the challenges of value addition in the sector and to quantify the total value of RCN and the associated by-products.

Table 9:Potential and barriers to value creation in the CaVC.

Stage	Potential	Barriers / Constraints
Producers	• Processing cashew apple into other by-products such as juice, jam, wine, gin, and biscuit. • Obtaining acid and fuel from the husk. • Generating waste for organic manure from the pulp.	• Lack of awareness, technical knowledge, and capacity • Financial constraints. • Inadequate equipment and machinery. • Absence of enabling environment.

Processors	• Increasing level of processing of RCN
	• Cashew apple products
	  ○ Juice, vinegar, candy, jam, chutney, pickles, and soft drinks
	  ○ Wine and liquor
	• CNSL extraction
	  ○ Chemical compound for brake linings, paints, varnishes, and surface coatings
	• Cashew shells: for organic fertilizer
	• Cashew testa: animal, poultry, and fish feed.
	• Cashew shell cake: fuel
	• Other products: complement of wheat flour; cashew kernel oil; cashew kernel butter; and cashew kernel milk.
		• Main constraints here include a lack of appropriate equipment and machinery and inadequate financial resources.
		• Lack of incentives and deliberate policy to catalyse local industry. Import duties exemptions on machinery may address this.

77. Economic viability can also be enhanced by making beekeeping a top candidate for consideration as a complementary activity in cashew-based agroforestry systems. Apiculture is already an activity that is common in the

NSZ of Ghana and is practised by cashew farmers. It provides producers with an opportunity for income generation. The beekeeping value chain in Northern Ghana is quite profitable. Aidoo (2013) showed that RCN yield was much higher in cashew farms with bees (9.1kg/tree) compared to farms without bees (4.5kg/tree). The author further found that, in addition to the yield gain of 4.6kg/tree (9.1kg – 4.5kg), combining cashew with beekeeping generated honey sales valued at 396 GHS. In another study, Duah et al (2017) found that beekeeping contributed significantly to an increase in income levels of beekeeping value chain actors.

78. The production of complementary crops such as legumes, vegetables and sesame can be a good option to integrate in the cashew agroforestry farms. These crops have a short life cycle, have low requirements for water, are shade-tolerant, and can improve soil fertility (Monteiro et al., 2017).

79. The main conclusion here is that there are several pathways to adding value to cashew farming. Many by-products have been completely ignored and hold the potential of providing additional revenues to cashew producers. Combining cashew with beekeeping is also profitable.

2.5 Opportunities and potential for upgrading.

80. Several opportunities exist for upgrading of cashew. Through the introduction of a small cottage industry, certified organic production, maintaining good quality and standards, greening the VC, taking advantage of the carbon sequestration capacity of cashew, and the use of digital solutions that enhance traceability and market information, upgrading is highly likely.

2.5.1 Potential to introduce a small cottage industry for cashew in N. Ghana.

81. Considering the two main products of cashew, RCN and cashew apple, a small cottage industry[5] focusing on the cashew apple is quite possible. As mentioned earlier, the cashew apple is significantly underutilized. In a recent study, Akyereko et al. (2022) found that cashew apple utilization was low (less than 10% of respondents surveyed). The survey of 89 cashew producers undertaken for this report also shows that utilization of the product was equally low. Akyereko et al. (2022), however, found that almost

[5] The cottage industry is characterized by several features including individual or family ownership, informality, small capital investment, simple equipment, localized at the village/rural areas, use of locally available resources, raw materials, and local skills (Fening, 2015).

85% of farmers were knowledgeable of the potential value-added products of the cashew apple.

82. To explore the potential candidates for a cottage industry in Northern Ghana, this study gathered information from key informants. Table 10 provides the results of an assessment by 5 resource persons, consulted individually, composed of product development experts and food scientists/food technologists. They were asked to assess the five cashew apple by-products regarding the six major criteria that included raw material availability, market potential, needed financial requirements, nature of equipment/machinery necessary, technical knowledge and perishability of the by-product: all of these within the context a rural cottage industry setting.

83. It should be noted, concerning Table 10 that, the greener the shading the more favourable that criterion is in relation to the by-product. For example, in the case of raw material availability, cashew apples provide the required raw material necessary for juice making. In this example, also note that the column for juice has more 'greens' than the others. The results suggest that, overall, juice making satisfies many of the requirements. Note, however, the high perishability of the by-product.

Table 10: Potential cashew by-products for cottage industry development in Northern Ghana.

Criteria	Cashew apple by-products				
	Juice	Jam	Wine	Gin	Biscuit
Raw material availability					
Market potential					
Financial requirements					
Equipment/machinery					
Technical knowledge					
Perishability					

Source: Compiled by author from the survey of key informants, 2022.

84. GIZ and Technoserve are promoting the processing of cashew apples into juice, jams, marmalade, or alcoholic drinks (Ton et al., 2018). MIM cashew, a leading cashew producer in West Africa located in the Ahafo Region, Ghana, produces brandy out of the cashew apple (GIZ/CCI, 2019). Two major lessons learnt from cashew apple processing are the need to address product uniformity and markets (Ton et al, 2018).

85. Taken together, the key message of Table 10 is that a cottage industry of juice, wine and gin presents fewer challenges compared to the other by-products. The latter may require extensive technical knowledge, expensive

equipment, and high financial requirements in addition to the limited market potential for wine. Akyereko et al (2022) in a recent study report that the high cost of processing equipment, perishability of apples, lack of capital, underdeveloped market, technical know-how and lack of government support are among the challenges that cashew apple processors face.

86. Developing a cottage industry for the potential by-products will require an enabling environment. The Food and Drugs Authority (FDA) already has in place the Progressive Licensing Scheme (PLS) for small-scale and cottage-sized food processors. It is a government initiative that seeks to introduce a three-stage licensing regime aimed at supporting small businesses to address safety and quality issues related to their products. In addition to the enabling environment, several other strategies need to be explored. These include:

- Building the capacity of rural women in processing techniques and strengthening their entrepreneurial skills.
- Sourcing out processing equipment that can facilitate the processing of juice, wine, and gin.
- Exploring potential business models for rural women to enhance the marketing of their products, which may include a mobile cottage industry setup.
- Seek funding support for start-ups.

87. The TCDA and producers' associations can play a role here by intermediating with the private sector, NGOs, and donor communities. The Authority, for instance, can explore with GiZ on its training programmes and determine what synergies can be built upon and identify potential areas of collaboration.

88. In summary, the underutilization of cashew apple provides an opportunity to develop a cottage industry for juice, wine, and gin. These by-products present fewer challenges with respect to the level of financial resources required, the type of desired equipment, the extent of technical knowledge required, and the marketing potential.

2.5.2 Potential to meet certified organic production.

89. Most of the cashew marketed in Ghana now is the conventional cashew Organic cashew comes from cashew trees that have not been treated with chemical pesticides; trees that are not genetically modified; have been grown using natural fertilizers and follow hygienic processing conditions. While many cashew producers may be able to meet some of these standards, traceability issues make it difficult to offer premium prices for cashew which might meet the necessary conditions. Currently, Tree Aid is working with cashew growers in the NSZ to produce organic cashew. Cashew farmers in the CREMA can also produce organic cashew.

90. There is growing interest in importing countries, especially in Europe, for 'organic' products and consumers are willing to pay a premium price for these products. At the global level, trade in organic cashew has increased tremendously over the past decades and is currently more than 30 billion USD. However, organic cashew, like many products labelled as 'organic' is mainly a question of establishing a production process that avoids the use of modified genetic material and other inputs such as pesticides and fertilizers. Assessing the potential of meeting certified organic production in the NSZ of Ghana, therefore, calls for an examination of the processes involved at the different stages of the CaVC.

91. Several conditions need to be fulfilled. First, a reliable supply chain is required. Second, a mechanism for quality control, which includes putting in place a traceability system is important. This will require action at every level. Third, obtaining certification for organic agriculture from competent bodies is essential, which is critical for organic markets. Fourth, building capacity and providing training on fair-trade and organic agriculture practices should be in place. Fifth, the use of clean energy solutions in the entire value chain would also be critical.

92. There is a very high potential in Northern Ghana to meet certified organic production of cashew for export markets. Organizations such as Tree Aid have trained farmers on organic protocols; most cashew producers indicate that they don't use fertilizers in their cashew farming operations; a high number of producers recognize the quality standards for cashew; and a recurrent benefit mentioned by producers for belonging to producers' associations or cooperatives is to adhere to good quality standards.

93. Buyers and their agents have put in place strategies and mechanisms to ensure that they purchase good quality RCN. Processors in the study area mentioned that they place high importance on quality. All the producers interviewed for this study use testing devices to ensure the good quality of the RCN. The weather conditions in the NSZ make it easy to obtain RCN that

meet the required moisture level of between 7% and 10%. In 2020, the RCN kernel out-turn ratio (KOR) for Ghana was 46.0, which compares favourably with ratios from other major producers in West Africa (Cote d'Ivoire, 46.11; and Nigeria, 46.72) (USDA, ADVISEM, Technoserve, 2021).

94. Most processors can trace the source of the cashew, which is also central to certification processes. Health and food safety standards are key elements in the processing of RCN and the processors in the NSZ adhere to these principles.

95. In conclusion, there is a potential in Northern Ghana to meet certified organic production of cashew for export markets. The following considerations can be highlighted:
    - Cashew producers in Northern Ghana use low levels of chemicals and insecticides in their production system. Seventy six out of the 89 cashew producers (close to 85%) surveyed for this study used no chemical fertilizers. In an AF-based system where intercropping is practised, the choice of crops is important to ensure that the intercrops will do well without chemical fertilizers. Tree Aid is advising farmers to intercrop cashew with groundnut, bambara beans, and soya beans. While organic cashew is the desired standard in the zone, and producers aim to produce good quality cashew, it was, however, found in this study that, with a few exceptions, producers and processors do not receive a premium for quality RCN. The inability of producers to conform to organic cashew standards and the lack of certifications services for cashew are largely responsible for the absence of premium prices for high quality cashew. Some cooperatives and associations can, however, negotiate for higher prices.
    - Certification of cashew farms is potentially difficult for smallholders who have limited acreage planted with cashew, especially given the low yields experienced in the zone.
    - Stockpiling by producers to benefit from better prices can lead to contamination of RCN with negative consequences on quality. A warehouse receipt system may help these small producers to store their products better. The recent decision to fix minimum farm-gate prices may go a long way to address this issue.
    - Significant progress is being made to acquire certification to access African Cashew Alliance (ACA) sales. There are standard operating procedures (SOPs) at all levels and COMCASHEW, EPA, FDA, and GSA are helping producers and processors to acquire organic certification.
    - It is important to provide organic producers with the necessary inputs (good planting material) and skills through training and capacity building. While producers may face the challenge of inadequate use of organic manure, they, however, generate a substantial amount of waste.

Converting the waste, such as the fruit, to organic manure has a high potential and will increase resource efficiency.

- Experiences in other countries like Mozambique show that establishing an institution responsible for Internal Control System may help monitor and regulate the activities of organic producers and processors. This is a role the TCDA is expected to pay attention to as it rolls out its activities.

2.5.3 Maintaining high quality and standards.

96. Key actors in the CaVC including processors and exporters generally admit that cashew from Ghana is of good quality. As indicated above the KOR of Ghana cashew is about 46.0, which is comparable to that of other West African countries. Owing to the climate conditions in the region, the moisture levels are in the required ranges.

97. There is high level of knowledge of quality standards among the key actors in the CaVC in Northern Ghana. Most producers who participated in the surveys and discussions for this study demonstrated high knowledge of the quality standards and practices. Meeting high quality and familiarity with good agricultural practices for cashew farming were two, amongst others, underlying reasons for joining cooperatives and cashew farmers associations. Most cashew farmers demonstrated mastery of practices that would ensure that the cashew is of good quality. Cashew farmers undertook a physical inspection of their cashew before and after drying, picked out the bad nuts and cleaned the nuts. They were able to articulate actions related to drying, cleaning, storage and packing of the cashew to meet the quality standards of agents and merchants who buy from them.

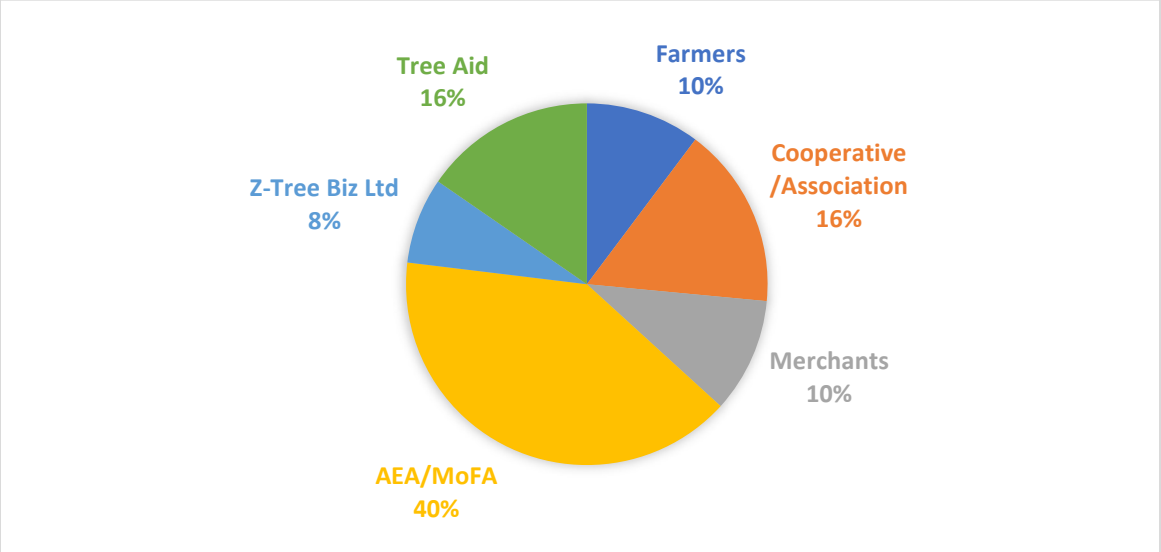
98. A source of loss in the quality of cashew is storage. Cashew producers are tempted to hoard their cashew when prices are low and wait for the prices to increase or according to them 'wait for when the price is right'. When the cashew is stored for a long time, there is weight loss, and the quality reduces. A sticky point that has emerged from cashew producers in Northern Ghana is the price of cashew. The recent intervention by TCDA to fix a minimum price for cashew may go a long way to resolve this issue and eliminate the need for storage and consequently improve the quality of cashew. It is important to point out here that improving quality is not a sufficient condition for upgrading, especially for higher prices. Recent research from Côte d'Ivoire suggests that power relations, that is, the nature and quality of interaction between the key actors in the value chain are also as important as quality in setting prices for raw cashew nuts (Basset et al., 2018).

99 There is no doubt that cashew farmers know the quality of raw cashew nuts and strive to produce cashew, which is of high quality. Although a high majority of cashew farmers regretted the fact that they don't receive a

premium for producing high quality cashew, they noted that they are able to sell their cashew very quickly if the quality is good. About 15% of the cashew producers interviewed for this study indicated that their associations and cooperatives were able to negotiate for higher prices if their cashew was of high quality.

100. Buyers of cashew also check on the quality of the product. They perform nut counts and use cutters to split a few randomly selected nuts to check for quality. Processors have also put in place mechanisms to ensure that they are receiving good quality cashew. Some have recruited quality control supervisors to ensure the quality of the inputs as well as the processed output. Figure 17 shows the source of technical support (training on improved practices and technologies) to cashew farmers. MoFA and agricultural extension assistants play a leading role in providing technical support. Merchants and NGOs are also key actors in providing technical support.

Figure 17: Top six sources of technical support.



Source: Consultation Survey, 2021.

2.5.4 Greening the CaVC

101. The global increase in cashew consumption has brought into focus environmental issues in the supply chain. There is growing interest to decouple cashew production with environmental degradation that may arise in the production, processing, and transportation sectors of the value chain. In general, greening a value chain aims to 'ensure the sustainable use of natural resources and to increase the share of renewable and recycled resources at the input side of the value chain; to maximize material and

energy efficiency at each stage of the process; and to reduce negative environmental impacts as outputs at all points of the chain' (DCED, 2012).

102. Greening of enterprises such as cashew is becoming of great interest as countries attempt to align themselves with the Paris Agreement, specifically to reducing Greenhouse Gas (GHG) emissions and with the growing demand by consumers for products that are produced in a sustainable manner consistent with the SDGs. A few opportunities for greening the cashew value chain are summarized as follows:

- Use of abundant cashew shells as a source of energy can provide reliable and affordable green energy, which addresses a major challenge faced by processors related to unreliable and expensive energy. This would increase the profitability of processing.
- Processors sometimes pay for the shells to be disposed of. The conversion of shells to clean energy means that revenue/profit can be generated from the shells. Solar power can also be used in processing. Cashew shells can also be used to make briquettes which can be used for cooking and heating. This will have a direct impact on tree cutting for cooking and reduction in GHG emissions. Biomass burning for charcoal and direct cooking is a significant source of GHG emissions in rural households in Ghana.
- Redesigning packaging material can reduce the environmental impact of materials used for packaging.
- An increase in local processing with an associated decrease in exports of RCN can shorten the supply chain leading to potential decrease of the carbon footprint of exporting RCN.

103. Technoserve (2020) has estimated that the potential regional impact of fuelling with cashew shells will lead to increased competitiveness through higher efficiency and a reduction of carbon emissions by -575,000MT CO2. Similarly, they find that generating income from sales of cashew shells can lead to 67 million USD from the sale of cashew shells and 122 million USD from power generation. There is also the potential to create 3,500 green jobs with 16 million USD as annual salaries.

104. Greening the cashew industry has enormous potential. A course of action that TCDA can pursue is to explore the potential of turning cashew shells from waste to wealth. The shells can also be used to compliment current energy sources for local processing.

2.5.5 Opportunities for carbon revenue generation/ carbon sequestration

105. Cashew trees have a high potential to sequester carbon. Below are some of the findings, which clearly show that cashew farms can be carbon sinks:

- In Côte d'Ivoire, Koffi Kouadio et al. (2021) found that the carbon stock of the clear forest is 177.854 t/ha. For cashew plantations, it was 8.657 t/ha, 66.304 t/ha and 193.32 t/ha, respectively for plantations of 4, 10 and more than 10 years old.
- Mlagalila (2016) estimated carbon stocks of cashew stands at 34.41 ±4.96tC/ha, and the stand volume was found to be 48.88±11.67m^3/ha in Tanzania.
- In a study comparing the transitional zone and the Sahelian zone in Benin, Daouda et al. (2017) carbon stock recorded in the transitional zone was 84.84± 4.06 t C /ha against 63.14±3.78 t C /ha in the Sudanian zone.
- Ndiaye et al. (2020) compared carbon stocks of secondary forests to those of a cashew tree plantation. They found that the secondary forest has a potential of 58.274 t C/ha compared to 109.398 t C/ha for cashew tree plantation. The CO_2 equivalent was found to vary from 213.69 t/ha for the secondary forest to 401.14 t/ha for the cashew tree plantation. However, it is worth noting that the study focused on the above-ground biomass excluding other carbon pools (deadwood, litter below-ground biomass) and a consideration of the age of the secondary forest, all of which could impact the difference significantly in favour of the secondary forest. The secondary forest showed higher biodiversity than the cashew. This indicates that if marginal lands are converted to cashew, carbon sequestration will be high.
- In Cameroon, Awe et al. (2021) estimated carbons stocks ranged from 69.29 to 96.67; 62.24 to 82.61; 59.00 to 90.64 and 66.14 to 84.03 tC/ha, respectively at four different sites in the Sudanian-Sahelian.

106. According to the IPCC guidelines, the account for carbon stocks in a land category requires activity data and emission factors. Because of varying data availability, we adopted different approaches to generate insights into the carbon sink potentials of cashew in Ghana.

107. For cashew, the activity data, and land area is estimated based on historical growth in the national area. The average annual rate of change in newly planted areas from 82,000 ha in 2011 to 146,060ha in 2019 is estimated to be 8,007.5. At this rate, total land under cashew production is expected to increase from 325,000.00ha (Ricau, 2019) to 639,217.50ha. The expectation is that about 314,217.50 ha of food cropland will be converted to cashew by 2040. This value is used in our computations of the carbon potential over the period. In the absence of cashew specific biomass expansion factor, we used the AFOLU Carbon Calculator Agroforestry Tool developed by the USAID. This tool has less data requirement in estimating the potential carbon of projects, allowing users to apply built-in default data developed based on project locations. Starting from 2018 and assuming the project will

last for 22 years with a 60% project implementation efficiency in the Savannah landscape.

108. The carbon sink potential of the 314,217.50 ha of cashew is about 1,589,941 tCO_2 per annum and cumulatively translating into 36,568,633 tCO^2 in 22 years. Note that this estimate does not account for emissions from disturbances such as fire, harvesting, and branch drop-offs as well as from the previous land cover that can have significant impacts on that landscape.

109. In summary, the evidence from around Africa is that cashew tree plantations have a high carbon sequestration potential and consequently for carbon revenue. As producers plant these tree crops, a mechanism needs to be explored to provide them incentives.

2.5.6 Use of Digital Solutions for Traceability[6] and Market Information.

110. As mentioned above, there are many actors in the CaVC. It is a complex system with farmers and numerous intermediaries at one end, all undertaking supply chain activities for the cashew nuts to reach the final consumers. Consumers constitute the other end of the supply chain, mostly located in developed countries, specifically in Europe and the United States. These consumers have different expectations for the cashew nuts they purchase. These include an increasing desire for products that are sustainably produced and are sourced responsibly. Consumers need information on who is producing the cashew, where it is being produced and how it is produced. A growing interest in healthy and sustainable diets is an additional impetus for transparent information about how cashew is produced.

111. Sustainability and traceability are two features that consumers are currently looking for in their cashew nuts and are willing to pay for cashew that meets certain standards. Producers also have needs for market information, especially pricing data, information on inputs prices, and advice on meeting quality standards, among others.

112. Several digital solutions are being used in the CaVC in Ghana. OLAM is one of the main actors spearheading these initiatives. The OLAM Direct platform

[6] Traceability refers to the 'ability to trace and follow a food, feed, food producing animal or substance intended to be incorporated into a feed or food through all stages of production, processing and distribution' (European Union Regulation 178/2002). Traceability makes it possible to achieve several objectives. It supports food safety and quality objectives to meet consumer specifications; communicates information to relevant stakeholders and consumers; facilitates the fulfilment of local, regional, and international regulations and standards; and supports authenticity claims about products (FSA, 2021).

is digitizing cashew chains in Ghana and consequently empowering cashew producers. The platform enables farmers to be in direct contact with OLAM, to have up-to-date market prices and negotiate directly bypassing the multitude of buyers in the sector. Digital Origination is one of the digital products in the CaVC. It integrates digital solutions to achieve several goals: enable traceability; ensure transparency of price; capture data on sustainability initiatives; provide advice on yield and quality; and facilitate payment (OLAM, undated). Another digital product is the OLAM Farmer Information System (OFIS). OFIS allows the capture of information on farm sizes, crops, location, infrastructure, and eco-support systems. The system uses a hand-held device, which is easily affordable to small farmers. OLAM also operates OLAM Direct, a direct purchasing App that provides customers greater traceability for their purchasing.

113. As of 2019, about 5,400 Ghanaian small-scale farmers are benefiting from these tools and receiving better prices for their cashew, estimated at 3,100 tons. The Apps "provide greater transparency on pricing, access to inputs, farming advice on fertilizer use, and insights on efficient land use, especially in the context of climate change" challenges (OLAM, undated).

114. ComCashew has developed several digital solutions. First, the SAP Rural Sourcing Management connects small-scale farmers in developing countries with global producers, thereby providing transparency, accountability, and access to financial services. Second, there is the Securing Sustainable Supply software system (3S), which allows buying companies to make informed decisions about their supply base and facilitates the exchange of data between links in the supply chain. Third, the organization has also developed the ACA Market Information System, introduced to provide information on market trends in cashew-producing countries. Finally, ComCashew employs a digitized database for the phytosanitary monitoring of cashew farmers in Cote d'Ivoire. In Ghana, a GIZ/Comcashew EU project aims to establish a digital library, which will make it possible to conserve existing technical and institutional knowledge (GIZ/CCI, 2019).

115. A recently launched initiative spearheaded by Development Gateway in partnership with Cultivating New Frontiers in Agriculture (CNFA) under the USDA West Africa PRO-Cashew project has developed the Cashew-IN data collection and analysis platform. The multi-country cashew data management system (Cashew-IN) will facilitate access to and use of data to improve decision-making for policymakers, farmers, and the private sector. It aims to generate better market outcomes for cashew nuts in the five implementing countries (Côte d'Ivoire, Benin, Burkina Faso, Ghana, and Nigeria). TCDA is a partner in this initiative (www. developmentgateway. org /blog).

116. The digital solutions in use in the Ghanaian CaVC can be effective in ensuring traceability and empowering small farmers by providing them relevant services. Meeting traceability characteristics is an important pillar for progress towards the international certification of cashew nuts from Ghana. The reward for this could be premium prices that Ghanaian producers can receive given the changing demand by consumers in the importing countries for sustainable products.

117. In sum, digital solutions aim to provide with precision the quantities of RCN that might be expected, varieties planted, and climatic conditions. These solutions make it possible to trace the product across the VC. They facilitate the management of the increasing quantity and quality of data.

118. OLAM, the MOVE project (previously COMCashew) and other actors involved in the CaVC should continue to build the capacity of farmers in the use of these digital solutions. TCDA, as the regulatory body, should provide oversight to ensure that the goals of traceability and transparency are effective vis-à-vis OLAM and the producers, on one hand, and OLAM and the regulatory authority, on the other hand. TCDA should also consider the importance of both financial and non-financial incentives to enable small-scale farmers to adopt digital solutions. The authority should also consider investing in research and development on innovations such as the use of blockchain technologies. TCDA should be encouraged to create the appropriate ecosystem that allows for the engagement of all stakeholders in the VC. Digital solutions will go a long way to resolving the current challenges of having access to reliable data.

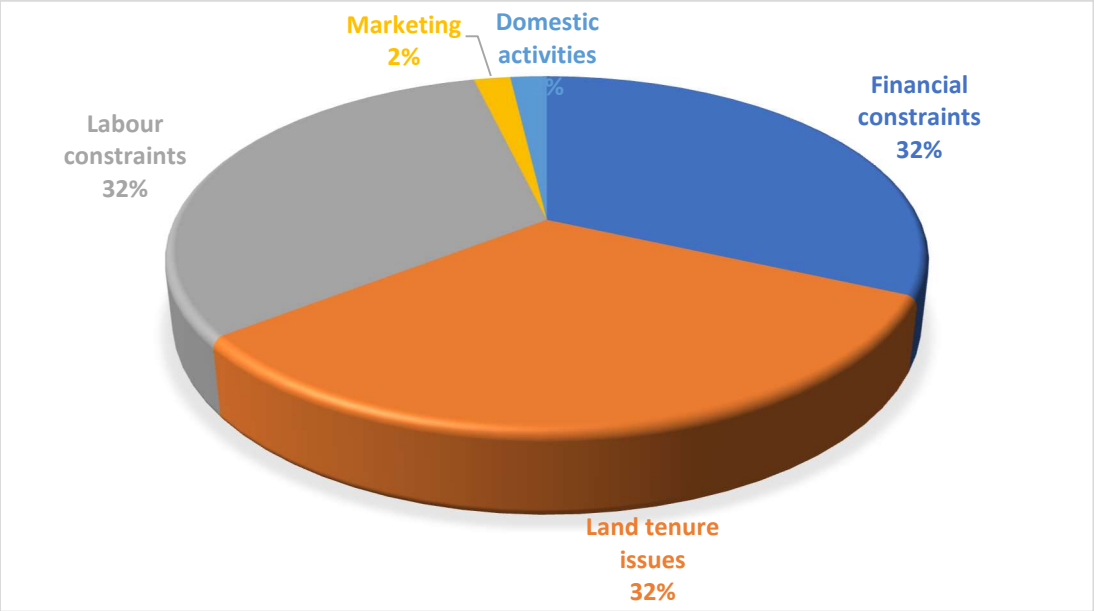
Chapter 3: Cross-Cutting Issues:

3.1 Gender Considerations in the Value Chains

120. There are gender dimensions in the CaVC that are critical for achieving sustainable outcomes and enhancing employment creation. As mentioned earlier, the local processing is dominated by women. Large numbers of women are also involved in cashew production.

121. Three challenges that hinder women's participation in the CaVC are customary land tenure rights, financial and labour constraints. Figure 18 is a representation of the responses that were recorded concerning constraints faced by women. The question was addressed to both male and female cashew producers. Fewer men identified land acquisition/ownership as a constraint. When they did, there was a high probability that they were not indigenes.

Figure 18: Constraints women producers face.



Source: Consultation survey, 2021.

122. Actions to remove barriers for women are very critical. Specific efforts should be made to review customary laws to enable women to have access to and use these resources. Village Saving and Loans Associations can be a conduit to provide financial resources to these women cashew producers. Significant progress has been made in organizing women's groups, which has given them some market power. Numerous training activities targeting women have also been undertaken. These actions should be pursued.

3.2 Impact of Wildfires

123. Wildfires or bush fires are a common feature in AF parklands. Two types of fires have been observed in the Sahelian region: early fires and late fires. The early fires occur early in the dry season whereas the late fires occur late in the dry season. Fires constitute one of three major human impacts on the parkland ecosystem, including agriculture and grazing (Lohbeck et al., 2020). These factors are directly related to FMNR practices. Fires may be needed to reduce the abundant woody biomass following a fallow period and to clear the land (Kandel et al., 2021).

124. Studying bush fires in the Wa Municipality, Dapilah et al. (2019) found that the use of fire is common, especially in the dry season. The respondents indicated that bush burning facilitates 'wildlife/game hunting and enhances the regrowth of grass for animals and cattle'. Pastoralists are known to use fire to regenerate the grasslands (Krätli, 2015).

125. Over the years, farmers are aware of and have adopted practical approaches to prevent fires. Farmers have learnt to weed around trees to protect them from fires (Kandel et al., 2021). Shu-aib Jakpa (2018) found that farmers in Northern Ghana create fire-belts around farms and trees and weed around the trees to protect them from bush fires. Husseini et al. (2020) have identified indigenous practices to control forest fires. These include pre-fire suppression methods (boundary cleaning and early burning) and post-fire and reactive mechanisms (fire rides and break creation, fire beating and firefighting with water knapsacks). Respondents of the survey for this study listed some of the above methods including tree planting, boundary cleaning, and fire breaks. These respondents also indicated that they are beneficiaries of training on a regular basis on bush fires with specific emphasis on prevention and management. Some of such training is being offered by organizations such as GIZ.

126. Summing up, several key messages have emerged concerning the impact of bush fires in the NSZ on the AF parklands:

- Bush fires are common in the AF parklands in Northern Ghana. Some occur naturally from lightning strikes and others are set deliberately to achieve certain objectives (wildlife/game hunting, enhancing the regrowth of grass for animals and cattle, weeding and removal of unwanted trees, and soil fertility enhancement).
- Although bush fires have ecological benefits, they can damage the health of the AF parkland system. In fact, there is research suggesting that fires are largely responsible for the degradation and deforestation occurring in the system (Agyeman et al, 2012; Boffa, 1999; Kyere-Boateng and Marek, 2021).

- There is a need to explore mechanisms to address the use of bush fire as a management tool. Given the presence of different actors (farmers, pastoralists) and stakeholders in the landscape, a community-based approach needs to be adopted and implemented. This could involve developing a fire management strategy and strengthening communication messages on bush fires.
- Proper fire management can have desirable environmental, economic, and social impacts. As shown by some authors, the effects of bush fires must be put in their proper context. It is, therefore, important to put in place fire management options that satisfy various stakeholders in the landscape and review the simplistic notion that fire prevents natural regeneration (Weston et al., 2015) and not to confuse the causes and effects of bush fires (Lovett and Phillips, 2018). It might be beneficial to promote early fires, especially when the necessary capacities have been strengthened.
- Arresting the negative impact of bush fires is a necessary step in improving the productivity of cashew in the parkland.
- Continuous building of the capacity of all actors needs to be pursued. The approaches of the CREMAs provide useful lessons that can be replicated.

3.3 Revisiting the incentives' structure.

127. This study found that there are no premium payments for good quality cashew. Even for organic cashew, premium payments are not formalised nor institutionalised. There is a need to revisit this situation.

128. As it has been shown that cashew can sequester a considerable amount of carbon, is there a way to integrate premium payments with carbon credits for cashew producers? The moment is here to explore mechanisms and strategies to make carbon credits effective. What possibilities are there to associate this concept with the Carbon Fund managed by the World Bank under the Forest Carbon Partnership Facility (FCPF)? In any case, there is a need for action to incentivize cashew producers.

Chapter 4: Conclusions, recommendations, and further research needs.

4.1 Conclusions

129. The main findings of this study can be summarized as follows:

- **There are imperatives for alternative livelihood strategies in the Northern Savannah Zone:** The zone exhibits characteristics indicating a higher level of vulnerability (e.g., higher poverty and malnutrition). The economy relies on an agricultural production system that is dominated by low value grains such as maize, sorghum, and groundnut but which are highly critical for the food security of the people. There is the urgency to diversify economic activities in the zone drawing from high value tree crops that are present in the land-use system and for which there is a growing global demand. Such an agroforestry system has both high mitigation and adaptation potentials.
- **Cashew-based agroforestry increases returns of food crops.** Land use efficiency analysis showed that it requires 1.53 ha of yam under sole cropping to obtain the same level of returns from one hectare of intercropped cashew with yam. The benefits of integrating cashew in agroforestry systems are quite promising. Farmers in the NSZ are already intercropping cashew with food crops such as maize, yam, soybeans, groundnuts, and cocoyam. In our sample for this study, 16% of the respondents intercrop cashew with food crops compared to 29% who grow cashew in monocrop.
- **Combining cashew production with beekeeping can boost farm incomes.** Yields of cashew farms associated with beekeeping were double of yields form cashew farms without bees. In addition, honey production augmented farmers' incomes by almost 400GHS/hectare based on previous studies undertaken in the study area.
- **Cashew production has increased in Ghana, but productivity remains low.** There are over 125,000 cashew growers in Ghana with a majority having land holdings between 1 and 5 hectares**.** Cashew production increased 13.5-fold in 2020 compared to 2005 with production increasing from 10,000 metric tonnes to 131,500 metric tonnes. However, the productivity remains low averaging about 500kgs/ha. Pest and Diseases and the uneven availability of good planting materials are the main drivers of low productivity in the NSZ**.** While availability of extension services was uneven in the study area, support services were largely available and affordable.
- **Very good cashew quality is produced in the NSZ**: Production of cashew in the NSZ adheres to very high-quality standards accepted by

most actors. These actors demonstrate high knowledge of quality standards. There is low use of fertilizers in cashew farms. Tree Aid is assisting cashew farmers to ensure that organic cashew is the standard. However, payment of premiums for this high-quality cashew has not yet been formalized owing to difficulties in ascertaining conformity.

- **Policies to incentivize the cashew industry exist**: The GoG established a policy providing 10 years of tax exemption for cashew processors in industrial free zones; customs duty exemption on imports of equipment and spare parts; and an indicative minimum farm-gate price for RCN was set by TCDA in December 2021. These policies need to be implemented for the desired outcomes to be attained.
- **Buyers and merchants of RCN possess market power.** A high proportion of cashew producers reported that buyers and merchants who purchase RCN behave in an oligopolistic manner and farmers believe that they collude to set prices.
- **High need for coordination of the value chain:** There is a diversity of actors in the VC, some organized and others informal. These actors include input suppliers and service providers, research institutions, producers' associations, processors' associations, aggregators and middlemen/ women, exporters, financial institutions (both formal and non-formal) and NGOs. This calls for the need of improved coordination among key stakeholders. TCDA, the recently created authority, can play an effective role in coordinating the VC.
- **Supply of RCN is one of the constraints for cashew processors:** Processors interviewed for this study have put in place mechanisms to ensure a regular supply of RCN. These include stockpiling, importing cashew from neighbouring countries and purchasing on credit at high prices. A major concern is the competition from foreign buyers who are better resourced financially. The bottom-line is if local processors have the necessary finances, they can buy RCN at any time. Establishment of a purchasing window at the beginning of each cashew harvest season for local processors might help minimize the competition from foreign buyers.
- **There are two other key challenges facing cashew processors**: About 9.5% of Ghana's RCN is processed. Cashew processors identified two major constraints they face: equipment and machinery deficit, and inadequate access to finance. High interest rates, poor record-keeping and lack of collateral are the major factors impeding access to finance from rural banks and village saving and loans associations (VSLA).
- **Manual operations hinder the extent of local processing of cashew:** Most processors interviewed for this study indicate that their operations are manual or semi-automatic. An investment of about 50,000USD will be required to acquire equipment (machinery) that can process about 500 -800kg/hour of RCN compared to the maximum of 600kgs/day

reported by processors interviewed. This finding has significant implications for the type of policy needed to increase the level of local processing. Manual operations are neither efficient nor cost-effective.

- **The processing segment holds a high potential for job creation**: The potential for job creation is substantial in the cashew processing segment. Estimates suggest that 380 people are required to process 1,000MT of cashew. Since women are the key actors in local processing, they stand to benefit more from this.
- **Price volatility is a major concern to all actors, especially to producers**: Prices fluctuate substantially and create uncertainties for the producers. Cashew producers report of RCN prices getting to as low as 2GHS/kg compared to an average of 3.00 to 4.5GHS/kg. Farmers who were organized in groups (and hence were able to bulk market) reported being able to negotiate better prices with the buyers. The recent decision to set a minimum farm-gate price is expected to reduce the price volatility.
- **Ample opportunities exist to add value and upgrade the cashew sector in the NSZ.** Cashew by-products have not been sufficiently explored in the NSZ. Making juice from the cashew apple and producing wine present good potential for a cottage industry in the area. For instance, cashew producers can potentially realize an additional 125USD/ton from these cashew by-products. The production of organic cashew, maintaining of high quality and improving traceability and market information through digital solutions can facilitate the upgrading of the sector.
- **Needs for improved data and quality for VC activities:** Data on land sizes, production, and export volumes, for instance, vary tremendously depending on the source of the data. It is critical to improve the quality and accessibility of relevant data. Developing a comprehensive database will be a welcome effort. Good quality data is a necessary condition for the design of appropriate policies.

4.2 Recommendations

130. Several recommendations that may be considered include:

1. Strengthen coordination and communications in the CaVC to address information asymmetries and curb excessive market power by some actors and enhance market interlinkages. This a role that TCDA is going to play as it rolls out its activities.
2 Scale-up the availability of quality planting material through appropriate policies to promote local nurseries and involve the private sector.

3. Take appropriate actions to increase productivity through amongst others, incentives, and acreage expansion.
4. Pursue current strategies and mechanisms to ensure quality compliance and formalize premium payments for quality cashew.
5. Facilitate the development and strengthening of farmer-based organizations in the cashew VC.
6. Build the capacity of small producers and strengthen value creation for cashew by-products.
7. Explore options for increasing local processing through creation of a fund, mobilizing resources under the 'one district one factory' scheme, and developing policy tools including establishing a preferential purchasing window for local processors.
8. Strengthen market information systems by building on available digital solutions in use and ensuring greater uptake by farmers and processors to improve collection of data on yields and other relevant parameters.

130. Table 11 highlights several actions for each sector that can b undertaken by key actors in the CaVC.

Table 11: Key recommendations by sector

General	
Theme	***Key recommendations***
Agroforestry ***(Supporting integrated agroforestry systems)***	• Promote and support agroforestry practices along with training on GAPs. • Upscale the availability of improved planting material for cashew and the establishment of local nurseries and consider their certification. • Disseminate knowledge about productivity gains from using improved planting material. • Collaborate with relevant partners and stakeholders to control bush fires and stop the cutting of trees for charcoal and explore the potential of promoting agroforestry woodlots for fuelwood. Develop policies to expand the establishment of scion gardens in the NSZ to propel production.
Governance ***(Improving the organization and***	• Assess and strengthen TCDA's capacity to provide guidance, advisory services, and support to VCs actors. • Improve coordination of the VCs including addressing information asymmetries and strengthening

governance of the CaVC)	horizontal and vertical coordination to improve the relationships among actors in the VCs. • Enhance the participation of all actors in decision-making, for instance on minimum farm-gate prices. • In collaboration with existing actors (e.g., OLAM, MOVE (formerly COMCASHEW), Cashew-IN) establish a geo-referenced information system for the VCs including remote sensing and develop databases on the number of producers, coverage of trees, volume of production, market evolution, for instance, can facilitate decision-making. This would require strengthening the data collection capacity of farmer cooperatives and addressing ownership issues. • Explore options for financing production and processing (engaging financial institutions, private sector actors, and funds under the 'One district one factory'(1D1F) scheme). • Facilitate the provision of VC support services (technical and business advice and R&D).
Policy ***(Strengthened enabling environment)***	• Consider an exclusive buying window policy (that is, establishing a preferential purchase window) during the first three months following the harvest of cashew. The policy allows only local processors to purchase RCN during this period. • Assess the opportunity to create a fund to support processors' purchase RCN for local processing as a buffer for competition from foreign buyers. • Strengthen and empower processors associations to ensure the regulation of local cashew purchase (ref. Mozambique cashew processor association example). • Advocate for the pursuance of customs duty exemption on imports of equipment and machinery and tax exemptions for cashew processors. • Conduct studies to determine appropriate policy tools to increase cashew production and promote local processing (includes exploring incentives to encourage the export of kernel, e.g., by providing subsidies; and analysing the ramifications of taxing RCN export). • Develop strategies and mechanisms to enforce the minimum farm-gate prices.
Specific /technical	

Improving value addition ***(Increased profitability)***	• Set targets and promote more processing of RCN. • Explore opportunities for value addition through the development of by-products. • Conduct studies to understand the distribution of gains and value through the value chains.
Governing quality standards ***(Improved marketability)***	• Explore opportunities to formalize premium payments for quality products. • Establish mechanisms to ensure quality compliance. • Pursue certification schemes.
(Production: **Increasing productivity)** **(Also see Agroforestry)**	• Scale up the use of improved varieties of cashew. • Support farmers'/associations' nurseries to produce good quality planting material. • Identify opportunities for acreage expansion and intensification. • Explore incentives to enhance productivity. •
Greening AF value chain ***(Building sustainability)***	• Develop strategies to reduce water use and energy consumption, e.g., the use of energy-saving devices such as solar-powered water pumps or biogas. • Promote the use of by-products, e.g., cashew shells, to provide reliable and affordable green energy. • Redesign packaging material to reduce waste. • Explore mechanisms and strategies to provide incentives (carbon credits) to producers.
Building Resilience ***(Climate-resistant AF parkland system)***	• Promote crop diversification in the AF parklands of the NSZ. • Explore opportunities for carbon credits.
Marketing ***(Improving market access)***	• Develop regulations and policies on the marketing of cashew products. • Strengthen market information systems by building on available digital solutions to facilitate the timely availability of information. • Continue to support producers' association and women working groups.

4.3 Further research needs

131. The recommendations above point to some areas that may be of interest for further research. These include:

- Developing databases and management information systems that build upon existing platforms. Currently, access to pertinent data on the VCs is quite difficult.
- Understanding the distribution of gains along with the VC. Between the local processors and outlets in Accra, the price difference is very huge.
- Assessing appropriate policy tools to improve local processing.

References

Abankwah, V. and Abebe, M. (2011). Economic empowerment of rural women in Northern Ghana through indigenous rural enterprises. *Journal of Sustainable Development in Africa* 13(2);106-115.

Abukari, A. (2019). Contribution of agroforestry to improving food security in the Sagnarigu district of northern Ghana. *Agriculture and Forestry Journal* 3(1):1-5.

ACI (2021). Alphonsa Cashew Industries. https://alphonsacashew.com/. Accessed November 20, 2021.

Agroforestry Network (2018). Scaling up Agroforestry: Potential challenges and barriers. A review of environmental, social, and economic aspects on the farmer, community, and landscape level. https://viagroforestry.org/app/uploads/2018/11/scaling-up-Agroforestry-Potential-Challenges-and-Barriers_FINAL_pdf.

Agyeman, K. O., Amponsah, O., Braimah, I., and Lurumuah, S. (2012). Commercial Charcoal Production and Sustainable Community Development of the Upper West Region, Ghana. *Journal of Sustainable Development,* 5 (4).

Agyemang, M., Zhu, Q., ad Adzanyo, M. (2018). Evaluating barriers to green supply chain design and implementation of related practices in the West Africa cashew industry. *Resources, Conservation and Recycling* 136:209-222. Doi: 10.1016/j.resconrec.2018.04.011.

Aidoo, K (2013). Study of the effects of integrating beekeeping into Cashew farms in Ghana and Benin. African Cashew initiative (ACI), GIZ, Germany. June 2013, 34p.

Akyereko, Y.G., Wireko-Manu, F.D., Alemawor, F., and Adzanyo, M. (2022). Cashew apples in Ghana: Stakeholders' knowledge, perception, and utilization. *International Journal of Food Science* 2022:1-10.

Alexander-Lindo, R.L., Morrison, E.S.A., & Nair, M.G. (2004). Hypoglycaemic effect of stigmast-4-en-3-one and its corresponding alcohol from the bark of *Anacardium occidentale* (cashew). *Phytother Res* 18(5):403-407. Doi.10.1002/ptr.1459.

Ameyaw, L.K., Ettl, G.J., Leissle, K., and Anim-Kwapong, G.J. (2018). Cocoa and Climate Change: Insights from Smallholder Cocoa Producers in Ghana Regarding Challenges in Implementing Climate Change Mitigation Strategies. *Forests* 9, 742

Aremu-Dele, O., Adesanya, K. A, Olorundare, B.O., Asunbo, O.I. and Odeyemi, E.F. (2021). Intercrop practices in cashew production. *World Journal of Advanced Research and Reviews*. 10(03), 281–288. DOI: https://doi.org/10.30574/wjarr.2021.10.3.0268

Asante, F.A., Amuakwa-Mensah, F., (2015). Climate change and variability in

Ghana: Stocktaking. *Climate* 3, 78–99. https://doi.org/10.3390/cli3010078.
Asubonteng, K.O., (2022). Expanding tree-crop farming: an integrated socio-spatial analysis in a transitioning mosaic landscape in Ghana. (PhD thesis). Department of Human Geography, Planning and International Development Studies, Amsterdam Institute for Social Science Research (AISSR), University of Amsterdam, the Netherlands
AWAY4AFRICA (2018). Key findings about Cashew by-products in 8 African countries. Presented at the SIETTA & ACA conference, November 2018, 1p.
Awé, D.V., Noiha, N.V., Nyeck, B., Vroh Bi Tra, A. and Zapfack, L. (2021). Carbon storage in cashew plantations in Central Africa: case of Cameroon, *Carbon Management* 12(1): 25-35, DOI: 10.1080/17583004.2020.1858682.
Baffour-Ata, F., Antwi-Agyei, P., Nkiaka, E., Dougill, A.J., Anning, A.K., Kwakye, S.O., (2021). Effect of climate variability on yields of selected staple food crops in northern Ghana. *J. Agric. Food Res*. 6, 100205. https://doi.org/10.1016/j.jafr.2021.100205.
Bannor, R.K., Abele, S., Kyire, S.K.C, Oppong-Kyeremeh, H. and Mensah, E. (2019). Value Chains and comparative advantage assessment of the Ghanaian cashew sector. *International Journal of Value Chain Management*. 10(3):196-218.
Bassett, T.J., Kone, M. and Pavlovi, N.R. (2018). Power relations and upgrading in the Cashew value chain of Cote d'Ivoire. *Development and Change* 49(5):1223-1247. doi:10.1111/deech.12400.
Boafo, J. and Lyons, K. (2019). Expanding cashew nut exporting from Ghana's breadbasket: A political ecology of changing land access and use and impacts for local food systems. *International Journal of Sociology of Agriculture and Food* 25(2): 152–172.
Boateng, S.K. (2015). Farmer perspectives on the use of indigenous fruit tree species in cocoa growing systems in Suhum-Kraboa-Coaltar District of Ghana. Ghana Journal of Agricultural Sciences 49:87-97.
Boffa, J.M. (1999). Agroforestry Parklands in sub-Saharan Africa. FAO Conservation Guide 34. FAO, Rome.
Böhringer. A., Ayuk, E.T., Katanga, R. & Ruvuga, S. (2003). Farmer nurseries as a catalyst for developing sustainable land use systems in Southern Africa. Part A: nursery organization and productivity. *Agricultural Systems,* 77: 187 – 201.
Bonkoungou, E.G., Ayuk, E.T., & Zoungrana, I., eds (1994). Actes du séminaire international, ICRAF/IRBET/CILSS/LTC, Ouagadougou, Burkina Faso, 25-27 octobre 1993. Nairobi, Centre International pour la Recherche en Agroforesterie (ICRAF).
Bunn, C., Läderach, P., Quaye, A., Muilerman, S., Noponen, M.R. A., and Lundy, M (2019). Recommendation domains to scale out climate change adaptation in cocoa production in Ghana, Climate Services, 16 https://doi.org/10.1016/j.cliser.2019.100123.

CBI (2019). Dutch Centre for the Promotion of Imports.
Chemura, A., Schauberger, B., Gornott, C., (2020). Impacts of climate change on agro-climatic suitability of major food crops in Ghana. PLoS One 15, 1–21. https://doi.org/10.1371/journal.pone.0229881.
Danso-Abbeam, G., Fosu, S., Ogundeji, S.A. (2021). Technical and resource-use efficiencies in cashew production in Ghana: implications on achieving sustainable development goals. *Scientific African* 14
Daouda, B.O., Aliou, S., Léonard, A.E. Yasmine, A.J.F., Ezin, A.V., Irénikatché,
A.P.B., and Nestor, A. (2017). Assessment of organic carbon stock in cashew plantations (*Anacardium occidentale* L.) in Benin, West Africa. *International Journal of Agriculture and Environmental Research* 3(4):3471-3495.
DCED Green Growth Working Group (2012). Green Value Chains to promote Green Growth, available at www.Enterprise-Development.org.
Decker, A., 2012. The Implications of Climate Change on Food Security and Rural Livelihoods. *J. Environ. Earth Sci*. 2, 21–29.
Dendena, B., & Corsi, S. (2014). Cashew, from seed to market: a review. *Agronomy for Sustainable Development*. Springer Verlag/EDP Sciences/INRA. 34(4):753-772. DOI:10.1007/s13593-014-0240-7.
Dayamba, S.D., Djoudi, H., Zida, M., Sawadogo, L., Verchot, L. (2016). Biodiversity and carbon stocks in different land use types in the Sudanian Zone of Burkina Faso, West Africa. *Agr Ecosyst Environ* 216:61–72.
Dimobe, K., Tondoh, J.E., Weber, J.C., Bayala, J., Ouédraogo, K., Greenough, K. (2018). Farmers' preferred tree species and their potential carbon stocks in southern Burkina Faso: Implications for biocarbon initiatives. *PLoS ONE* 13(12): e0199488. https://doi.org/10.1371/journal.pone.0199488.
Duah, H.K., Segbefia, A.Y., Adjaloo, M.K. and Fokuo, D. (2017). Income sustainability and poverty reduction among beekeeping value chain actors in the Berekum Municipality, Ghana. *International Journal of Development and Sustainability*, Vol. 6 No. 8, pp. 667-684.
Famaye, A.O., and Adeyemi, E.A., (2011) Effect of cashew/rice/plantain intercropped on Weed incidence in Edo State, Nigeria*. ARPN Journal of Agricultural and Biological Science*. 6(6).
FAO (1985). Guidelines: Land Evaluation for Irrigated Agriculture. FAO soils bulletin 55. FAO, Rome, Italy.
Faye, M.D. Weber, J.C., Mounkoro, B., and Dakouo, J-M. (2010). Contribution of Parkland Trees to Farmers' Livelihoods: A Case Study from Mali. *Development in Practice* 20, no. 3 (2010): 428–34. http://www.jstor.org/stable/27806719.
Fening, P.A. (2015). The state of cottage industries in Ghana: A case of cast aluminium pot fabrication industry. *Asian Journal of Humanities and Social Sciences* (AJHSS). 3(2):100-108.

Ghana National Chamber of Commerce and Industry (2021). The Ghana Chamber Trade Alert, Issue No. 2 (Q3).

Gibbon, P. and S. Ponte (2005). *Trading Down: Africa, Value Chains, and the Global Economy*. Philadelphia, PA: Temple University Press.

Ginigaddara, G., Fernando, A and Wijethunga, P. (2016). Technical feasibility of Coconut (*Cocos nucifera*) Cashew (Anacardium occidentale) Intercropping System in Puttalam District, Sri Lanka*. International Journal of Advanced Scientific Research and Management.* 1(10): 79-85.

GIZ/CCI (2019). Cashew processing guides No 2: Opportunities and challenges in cashew processing in Africa. Accra, Ghana.

Goncalves, N., Andrade, D., Batista, A., Cullen, L., Souza, A., Gomes, H., et al. (2021). Potential economic impact of carbon sequestration in coffee agroforestry systems. *Agroforestry Systems*. 95, 419–430. doi: 10.1007/s10457-020-00569-4.

Gyedu, E., Lowor, S.T., Assuah, M., Kumi, W., and Dwomoh, E.A. (2014). Assessment of Post-harvest handling effects on quality of cashew nuts and kernels in Ghana. *Journal of Scientific Research and Reports 3(7):* 953-965, Article no. JSRR.2014.006.

Haglund, E., Ndjeunga J., Snook, L., and Pasternak, D. (2011). Dry land tree management for improved household livelihoods: Farmer managed natural regeneration in Niger. *Journal of Environmental Management* 92(7):1696-1705.

Hale, I., Ma, X., Melo, A.T.O., Padi, F.K., Hendre, P.S., Kingan, S.B., Sullivan, S.T., Chen, S., Boffa, J-M., Muchugi, A., Danquah, A., Barnor, M.T., Jamnadass, R., Van de Peer, Y. and Van Deynze, A. (2021). Genomic Resources to Guide Improvement of the Shea Tree. *Front. Plant Sci*. 12:7 20670. doi: 10.3389/fpls.2021.720670.

https://doi.org/10.1007/978-3-319-92798-5_18.

Husseini, R., Aboah, D.T., and Issifu, H. (2020). Fire control systems in forest reserves: An assessment of three forest districts in the Northern region, Ghana. *Scientific African* 7: 1-14.

ILO (2021). *Taking a Systems Approach to Young Africa Works Ghana: A Rapid Market Assessment of Agricultural Value Chains and Decent Work for Young Women in Northern Ghana.* ILO, The LAB, Mastercard Foundation, CAMFED.

Kamath, V., Joshi, A.K.R., Rajini, P.S. (2008). Dimethoate induced biochemical perturbations in rat pancreas and its attenuation by cashew nut skin extract. *Pestic Biochem Physiol* 90(1):58-65. Doi: 10.1016/j.pestbp.2007.07.007.

Kandel, M., Agaba, G., Alare, R.S., Addoah, T., and Schreckenberg, K. (2021). Assessing Social Equity in Farmer Managed Natural Regeneration (FMNR) Interventions: Findings from Ghana. *Ecological Restoration* 39(1-2): 64-76.

KIT, Agri-ProFocus and IIRR (2012). *Challenging chains to change: Gender equity in agricultural value chain development*. KIT Publishers, Royal Tropical Institute, Amsterdam.

Klutse, N.A.B., Owusu, K., Boafo, Y.A., (2020). Projected temperature increases over northern Ghana. SN *Appl. Sci.* 2, 1–14. https://doi.org/10.1007/s42452-020-3095-3.

Koffi Kouadio, A. D., Silue, P.A., Kouassi, K.E., Coulibaly, T.N., and Koutouan-Kontchoi, M.N. (2021). Changes in Vegetation Structure and Carbon Stock in Cashew (*Anacardium occidentale* L., Anacardiaceae) based Agro-Ecosystem after Clear Forest in the North of Cote D'Ivoire. *International Journal of Research in Agricultural Sciences* 8(2): 2348 – 3997.

Krätli, S. (2015). *Valuing Variability: New Perspectives on Climate Resilience Drylands Development*. IIED.

Kumar, P. Paramashivappa, R., Vithayathil, P.J., Subba Rao, P.V., Srinivasa Rao, A. (2002). Process for isolation of cardanol from technical cashew (*Anacardium occidentale L.*) nutshell liquid. *J Agric Food Chem* 50 (16):4705-4708. Doi:10.1021/jf, 20224w.

Kyere-Boateng, R. and Marek, M.V. (2021). Analysis of the Social-Ecological Causes of Deforestation and Forest Degradation in Ghana: Application of the DPSIR Framework. *Forests* 12, 409. https://doi.org/10.3390/

Läderach, P., Martinez-Valle, A., Schroth, G., and Castro, N. (2013). Predicting the future climatic suitability for cocoa farming of the world's leading producer countries, Ghana, and Côte d'Ivoire. *Climatic Change* 119**,** 841–854. https://doi.org/10.1007/s10584-013-0774-8

Lawal, J.O., and Uwagboe, E.O. (2017). Cost Effectiveness of Intercropping Patterns by Cashew Farmers in Oyo State, Nigeria. *International Journal of Forest, Animal and Fisheries Research* (IJFAF). 1(1).

Lehman, L.M., Smith, J., Westaway, S., Pisanelli, A., Russo, G., Borek, R. Sandor, M., Gliga, A., Smith, L, and Ghaley, B.B. (2020). Productivity and Economic Evaluation of Agroforestry Systems for Sustainable Production of Food and Non-Food Products. *Sustainability* 12, 5429; doi:10.3390/su12135429.

Lohbeck, M., Albers, P., Boels, L.E., Bongers, F., Morel, S., Sinclair, F., Takoutsing, B., Vågen, T-G., Winowiecki, L.A., and Smith-Dumont, E. (2020). 'Drivers of farmer-managed natural regeneration in the Sahel. Lessons for restoration'. *Scientific Reports* 10:15038 https://doi.org/10.1038/s41598-020-70746-z.

Martini, E., Nguyen, H.T., Mercado Jr, A.R. Martini E, Nguyen HT, Mercado Jr A.R., Finlayson R.F., Nguyen T.Q., Catacutan D.C., Triraganon, R. (2020). *Practitioners field guide: agroforestry for climate resilience*. Bogor, Indonesia. World Agroforestry Center (ICRAF); Bangkok, Thailand: RECOFTC.

Mbow, C., Rosenzweig, C., Barioni, L.G., Benton, T.G., Herrero, M. Krishnapillai, M., Liwenga, E., Pradhan, P., Rivera-Ferre, M-G., Sapkota, T., Tubiello, F.N. and Xu, Y. (2019). Food Security. In*: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Portner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press.

Mlagalila, H.E. (2016). Assessment of volume, biomass, and carbon stock of cashew nuts trees in Liwale District, Tanzania, M.Sc. Dissertation, Sokoine University of Agriculture, Morogoro, Tanzania https://www.suaire.sua.ac.tz/handle/123456789/1521.

MOFA (2012). Ghana Tree Crop Policy, Ministry of Food and Agriculture

Mota, M.L.R., Thomas, G., Barbosa Filho, J.M. (1985). Anti-inflammatory actions of tannins isolated from the bark of *Anacardium occidentale. L. J. Etnopharmaco*l 1 3(3) :289-300. Doi :10.1016/0378-874(85)90074-1.

Nair, P. R., Nair, V. D., Kumar, B. M., and Haile, S. G. (2009). Soil carbon sequestration in tropical agroforestry systems: a feasibility appraisal. *Environ. Sci. Policy* 12, 1099–1111. doi: 10.1016/j.envsci.2009.01.010.

Nair, K.P. (2010). *The agronomy and economy of important tree crops of the developing world*. Elsevier.

Nath, A. J., Sileshi, G. W., Laskar, S. Y., Pathak, K., Reang, D., Nath, A., and Das, A.K. (2021). Quantifying carbon stocks and sequestration potential in agroforestry systems under divergent management scenarios relevant to India's Nationally Determined Contribution. *J. Cleaner Prod.* 281:124831. doi: 10.1016/j.jclepro.2020.124831.

Ndiaye, S., Djighaly, P.I., Diarra, A.M., Dramé, F.A. (2020). Comparative study of the carbon stock of a cashew tree plantation (*Anacardium occidentale* L.) and secondary forest in Casamance, Senegal. Nipp. J. Environ. Sci., 1(9), 1022. https://doi.org/10.46266/njes.1022.

Nitidae (2109). The West African Cashew Sector in 2018. General trends and country profiles. https://www.nitidae.org/files/41dc7432/wa_cashew_sector_review_2019_nitidae.pdf.

OLAM (undated). Cashew trail: Creating a trail to sustainable cashew through partnerships, Olam Food Ingredients. www.olamgroup.com.

Olukotun, O.A. (1983). Intercropping of cashew with food crops. CRIN Annual Report. 42.

Opoku-Ameyaw, K., Oppong, F.K., Amoah, F.M., Osei-Akoto, S, and Swatson, E. (2011). Growth and early yield of cashew intercropped with food crops in Northern Ghana. *Journal of Tropical Agriculture* 49(1-2):53-57.

Opoku-Ameyaw, K. and Appiah, M, R. (2000). Improving the growth of cashew (*Anacardium occidentale L.*) seedlings interplanted in mature shea nut stands in northern Ghana. *Ghana Journal of Agricultural Science* 33(2):159-164.

Owusu, K., (2018). Rainfall changes in the savannah zone of northern Ghana 1961–2010. *Weather* 73, 46–50. https://doi.org/10.1002/wea.2999.

Ricau, P., (2019). The West African Cashew Sector in 2018: General trends and country profiles, Analysis of cashew production, processing, and trade in West Africa.

Rodrigo, V.H.L, Stirling, C.M., Teklehaimanot, Z., Nugawela, A. (2001). Intercropping with banana to improve fractional interception and radiation use efficiency in immature rubber plantations*. Field Crops Research* 69(3):237-249. Doi:10.1016/S0378-4290(00)001 47-7.

Rwahwire, S., Tomkova, B., Periyasamy, A.B., and Kale, B.M. (2019). Green thermoset reinforced bio-composites, Editor(s): Georgios Koronis, Arlindo Silva, In Woodhead Publishing Series in Composites Science and Engineering, Green Composites for Automotive Applications, Woodhead Publishing,

Sawadogo, L., Nygård, R. & Pallo, F. (2002). Effects of livestock and prescribed fire on coppice growth after selective cutting of Sudanian savannah in Burkina Faso. *Ann. For. Sci.* 59, 185–195.

Sousa de Brito, E., de Oliveira Silva, E., and Rodrigues, S. (2018). Caju—*Anacardium occidentale,* In Editor(s): Sueli Rodrigues, Ebenezer de Oliveira Silva, Edy Sousa de Brito, Exotic Fruits, Academic Press, Pages 85-89, ISBN 9780128031384, https://doi.org/10.1016/B978-0-12-803138-4.00012-5.

Stephane, K., Halbin, K. and Joseph, S. (2021). Disparities in Agricultural Practices According to Cashew Nut Production Regions in Côte d'Ivoire and Probable Incidence on Nut Quality. *Agricultural Sciences*, 12, 1168-1183. Doi: 10.4236/as.2021.1210075.

Takimoto, A., Nair, P.K.R., Alavalapati, J. (2008). Socioeconomic potential of carbon sequestration through agroforestry in the West African Sahel. *Mitig Adapt Strat Glob Change* 13:745–761.

Technoserve (2020). Cashew shells: From waste to energy and profit. https://www. technoserve.org.

Tessmann, J. (2020). Global value chains and policy practice: The making of linkages in the Ivorian cashew industry. *Competition & Change* 24(1): 26-43. Doi: 10.1177/1024529419877491.

Ton, P., Hinnou, L.C., Yao, D. and Adingra, A. (2018). Cashew Processing in West Africa: Value chain analysis in Benin and Côte d'Ivoire. Final Report. Fair and Fair Consulting.

UNICEF (2017). Gender Equality: Glossary of Terms and Concepts. UNICEF Regional Office for South Asia. https://www.unicef.org>rosa

USDA/ADVISEM/TECHNOSERVE (2021). Technoserve Prosper Cashew Project-

Baseline Report, 2021.
USAID (2014). Case study – cashew: the African Cashew Alliance – Cracking Cashew's potential.
USAID/WINROCK (2018). Ghana Agriculture and Natural Resource Management Project: Natural Resource Product Analysis – Road Map.
Verchot, L.V., van Noordwijk, M., Kandji, S., Tomich, T., Ong, C., Albrecht, A., Mackensen, J., Bantilan, C., Anupama, K.V. & Palm, C. (2007). Climate Change: linking adaptation and mitigation through agroforestry. *Mitig. Adapt. Start. Glob. Change (*12):901-918.
Visalakshi, M., Jawaharlal, M., and Ganga, M. (2015). Intercropping in cashew orchards. ISHS *Acta Horticulturae* 1080: International Symposium on Cashew Nut. Doi: 10.17660/ActaHortic.2015.1080.38.
Waldén, P., Ollikainen, M. and Kahiluoto, H. (2020). Carbon revenue in the profitability of agroforestry relative to monocultures. *Agroforestry Systems.* 94:15-28.
Weston, P., Hong, R., Kabore, C., and Kull, C.A. (2015). Farmer-Managed Natural Regeneration Enhances Rural Livelihoods in Dryland West Africa. *Environmental Management* 55: 1402-1417.
Wongnaa, C.A. & Awunyo-Vitor, D. (2013). Profitability analysis of cashew production in Wenchi municipality in Ghana. *Botswana Journal of Agricultural and Applied Sciences,* 9(1):19-28.
World Bank (2021). Climate Change Knowledge Portal. World Bank, Washington DC. https://climateknowledgeportal.worldbank.org/contact-us.
Yaro, J. A. (2010). Customary tenure systems under siege: Contemporary access to land in Northern Ghana. *Geo Journal.* 75, 199–214.
Yeboah, S., Owusu Danquah, E., Oteng-Darko, P., Agyeman, K. and Tetteh, E.N. (2021) Carbon Smart Strategies for Enhanced Food System Resilience Under a Changing Climate*. Front. Sustain. Food Syst. 5:715814. doi: 10.3389/fsufs.2021.715814.*

Annex I: List of stakeholders and project beneficiaries consulted.

- Dr. K. A. Nuamah, Nana Damoah Kofaboye IV, Akyeamehene of Wenchi Traditional Area, CEO, K & A Genesis Limited
- Ms Addo Nunana, GIZ-COMCASHEW
- Dr. Julius Yeboah, Senior Researcher, CRIG.
- Dr. Forster Boateng, Deputy Chief Executive Officer, TCDA
- Mr Seth Osei-Akoto, Director, Directorate of Crop Services, MOFA
- Mr. Yaaana Yahaya, CEO ROWFAD
- Mr Sarpong, CEO, Gensap Ventures
- Field survey covered:
    - 89 cashew producers
    - 7 cashew merchants
    - 5 cashew processors
    - TREE AID
    - 1 CREMA