

ASSESSING EFFECT OF FARMING PRACTICES ON QUANTITY AND QUALITY OF CASHEW NUT PRODUCED BY SMALLHOLDER FARMERS IN WENCHI MUNICIPALITY OF BRONG AHAFO REGION , GHANA



By
EDWARD EGHAN
September, 2018



copyright © Edward Eghan
All Rights Reserved

ASSESSING THE EFFECT OF FARMING PRACTICES ON QUANTITY AND QUALITY OF CASHEW NUT PRODUCED BY SMALLHOLDERS IN WENCHI MUNICIPALITY OF BRONG AHAFO REGION, GHANA.

**A Research Project Submitted to Van Hall Larenstein
University of Applied Sciences
In Partial Fulfilment of the Requirements of Degree of Master in Agricultural Production Chain Management,
Specialization: Horticulture Production Chains**

BY

EDWARD EGHAN
September 2018

Supervised by: Mr. Stilma Anko

Examiner: Kijne Abertein

Copyright©Edward Eghan
All Rights Reserved

ACKNOWLEDGEMENT

For this research project to be successful contributions were obtained from various organizations and people who I would like to extend my gratitude. I acknowledge the following:

Royal Government of Netherlands through Netherlands Scholarship Program (NUFFIC) which made this Professional Masters possible. My supervisor, Mr. Stilma Anko for his guidance throughout the research. I am grateful for your contribution. Mr. Marco Verschuur, our Course Coordinator, who had been very accommodative and always encouraging in times of difficulties.

I thank all other lecturers and staff of Van Hall Larenstein for their contributions to this success. I appreciate the contribution from MOFA during the data collection especially Mr. John Osei Gyimah desk officer for CDP, Wenchi municipality.

All the people who gave me the information for my research. Special thanks go to my wife Cynthia Turkson her for the encouragement and, support physically and spiritually.

May the Almighty, God bless you all.

DEDICATION

This research work is dedicated to my beloved child Emeli Sika Eghan and my wife Cynthia Turkson for the encouragement and support during my studies. I am proud of you for the achievements you have accomplished without me. Be blessed.

TABLE OF CONTENTS

ACKNOWLEDGEMENT	iii
DEDICATION	iv
LIST OF FIGURES	viii
LIST OF TABLES	ix
ABBREVIATIONS.....	ix
ABSTRACT	xi
CHAPTER ONE: INTRODUCTION	13
1.0. Background	13
1.1. Cashew Nut Sub-Sector in Ghana	14
1.2. Research Problem Statement	15
1.3. Problem Owner	15
1.4. Research Objectives	15
1.5. Main Research Questions and Sub Questions	15
1.5.1. Research Question One	15
1.5.2. Research Sub-questions One	15
1.5.3. Research Question Two	16
1.5.4. Research Sub-questions Two	16
1.6. Justification	16
1.7. Definition of Concepts	17
CHAPTER TWO: LITERATURE REVIEW	18
2.0. Introduction	18
2.1. Recommended Farming Practices for Cashew Nuts Production	18
2.2. Post-Harvest Handling of Cashew Nut	19
2.3. Challenges for Adopting Good Agricultural Practices by Smallholder Farmers	19
2.4. Cashew Nuts Production Strategies	20
2.5. Roles Play Public Institution in Transfer of Farming Technologies to Farmers	20
2.6. Private Sector Roles Play in Transfer of Technologies to Farmers	21
2.7. Adoption of Technologies by Smallholder Farmers	21
2.8. Conceptual Framework	22
CHAPTER THREE: METHODOLOGY	23
3.0. Introduction	23
3.1. Study Area Description	23
3.1.1. Climatic Conditions	24
3.2. Research strategy	24
3.3. Method of Data collection	25

3.3.1. Desk Research.....	25
3.3.2. Field Research.....	26
3.3.3. Survey.....	26
3.3.4. Focus Group Discussion.....	27
3.3.5. Key Informant.....	27
3.4. Method of Analysis.....	28
3.5. Research Limitations.....	28
3.6. Quality of Research Output.....	28
CHAPTER FOUR: RESEARCH FINDINGS.....	29
4.0. Introduction.....	29
4.1. Key findings on Current Farming Practices Adopted by Small holder farmer.....	29
4.1.1. Planting Material Type.....	29
4.1.2. Quantity of Harvest per hectare(Ha).....	29
4.1.3. Planting material source.....	30
4.1.4. Weed Control.....	30
4.1.6. Soil fertility maintenance.....	31
4.1.7. Reasons for soil fertility maintenance.....	32
4.1.6. Access to Improved Planting Material.....	32
4.1.7. Insect-Pest Infestation.....	33
4.1.8. Major Pest Attack.....	33
4.1.9. Agricultural Extension Advice.....	33
4.2.0. Plant Population per Hectare.....	34
4.2.1. Pruning of Cashew Nut Tree.....	34
4.2.2. Thinning of Cashew Nut Tree.....	35
4.2.3. Drying of cashew nut.....	35
4.2.4. Ways of Cashew Nut Drying by Farmers.....	36
4.3. Relevant Farming Practices for Cashew Nut Production.....	37
4.4. Consequences of Post-Harvest Handling on Quality of Nuts.....	38
4.5. Challenges for Adopting Good Practices by Cashew Nut Farmers.....	39
4.5.1. Cashew nut Market Channel.....	39
4.5.2. Stakeholder Matrix.....	40
4.5.3. Cost of Farm Maintenance and Profit Margin.....	41
4.5.4. Rank of Challenges.....	42
4.5.5. Calendar for Farming Activity.....	42
4.6. Current Production Strategies for Cashew Nut in Wenchi Municipality.....	43
4.7. Farming Technologies Transferred Adoption by Public Institution.....	44
4.8. Current Roles Played By Private Institutions in Transfer of Gaps to Smallholder Farmers.....	45

4.8.1. Roles played by Major Actors	45
4.8.2. Roles played by Supporters	46
CHAPTER FIVE: DISCUSSIONS OF FINDINGS	48
5.0. Introduction	48
5.1. Current Farming Practices	48
5.2. Relevant farming practices against current farming practices by smallholder farmer	50
5.3. Consequences of Post-Harvest Handling on nuts Quality	52
5.4. Challenge for adopting good agricultural practices	52
5.5. Current production strategies for cashew nut production in Wenchi Municipality.	53
5.6. Current roles played by private institutions in the transfer of GAPs to smallholder farmers	55
5.7 Factors hindering smallholder farmers from adopting farming technologies transfer by public institutions.. ..	56
CHAPTER SIX: CONCLUSION AND RECOMMENDATION	57
6.0 . Conclusion	57
6.1. Recommendation	58
REFERENCE	60

LIST OF FIGURES

Figure 1:Cashew nut growing Regions in Ghana	14
Figure 2: Conceptual Framework	22
Figure 3: Map of Wenchi Municipality	23
Figure 4: Climatic data for Wenchi Municipality	24
Figure 5: Research Framework.....	25
Figure 6: Extension agents facilitating FGD at Buasu community.....	27
Figure 7: Source of planting material	30
Figure 8: Soil fertility maintenance	31
Figure 9: Reasons for soil fertility maintenance.....	32
Figure 10: Improved planting material accessibility	32
Figure 11: Access to extension service.....	33
Figure 12: Recommended cashew tree per ha	34
Figure 13: Pruning of cashew tree.....	34
Figure 14: Thinning out tree.....	35
Figure 15: Drying of cashew nut.....	35
Figure 16: Place where cashew nut is dried by farmers.....	36
Figure 17: Value Chain Map	39
Figure 18: Use of weaver ants to control insect by farmers in Buasu.....	44

LIST OF TABLES

Table 1:Planting material used.....	29
Table 2:Quantity harvest per ha @80kg/year.....	29
Table 3:Number of times weed is controlled.....	30
Table 4:Means of Weed Control.....	31
Table 5:Insect-pest infestation.....	33
Table 6:Common pest attackn pest attack.....	33
Table 7:Stakeholders in cashew nut value chain, Wenchi municipality.....	40
Table 8:Cost of maintenance & profit margin for smallholder farmers per Ha Wechi Municipality, 2017/2018 Cropping Season.....	41
Table 9:Ranking of challenges faced by smallholder farmers.....	42
Table 10:Cropping calendar for cashew nut farmers in Wenchi municipality.....	42
Table 11:Financial institution package for cashew nut farmer, Wenchi municipality.....	46
Table 12:Un-adopted technologies and reasons behind.....	47
Table 13:Current farming verses recommended practices.....	50

ABBREVIATIONS

ACI	African Cashew Initiative
ADF	Africa Development Fund
AEA	Agricultural Extension Agents
ADRA	Adventist Development Relief Agency
AFFLIN	Africa future feeder leadership integrity network
CBT	Cashew Board of Tanzania
CDP	Cashew Development Project
CRIG	Cocoa research institute of Ghana
CSIR	Council for Scientific and industrial research
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GAPs	Good agricultural practices
GEPA	Ghana Export Promotion Authority
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GP	Gross Profit
GoG	Government of Ghana
GSS	Ghana Statistical Service
HA	Hectare
ITC	International Trade Center
IRD	International Relief and Development
KOR	Kernel outturn Ratio
MOFA	Ministry of Food and Agriculture
MUCG	Methodist University Collage of Ghana
NGO	Non-Governmental Organization
USAID	United States Agency for Development
WATH	West Africa Trade Hub
RCN	Raw Cashew Nuts
TIPCEE	Trade and Investment Program for Competitive Export Economy

ABSTRACT

In Ghana, cashew nut sub-sector has gained attention ever since cashew development project was instituted in 2006 and since then several interventions have been geared towards improvement of yield. Despite those efforts production have not reached desirable level hence the need to assess effect of farming practices on quantity and quality of cashew nut produced by smallholder farmers in Wenchi municipality of Ghana. Specifically, the study identified gaps in farming practices of smallholder farmers whose farm size was between 0.8-3ha as they form larger part of producers along the cashew nut value chain in Ghana.

Both quantitative and qualitative data were used for the research where multi-stage process was used to select 40 respondents for survey using structured questionnaire to obtain views on current farming practices adopted by cashew nut farmers. Purposive sampling was effected focus group discussion. Based on their current activeness in the cashew nut value chain, 3 farmers groups comprised of 10 members each were selected from 29 groups to ascertain challenges hindering adoption of some of the technologies transferred to them. Value chain analysis, cropping calendar and pairwise ranking were employed to analysis the qualitative data. Key informants, major actors, financial institutions and nonprofit agency were also used to get divergent opinions on the research sub-questions. 89 respondents were engaged for the research. Both semi-structure and unstructured questionnaires were used to extract data from the respondents. Excel was to analyze qualitative data and grounded theory was used to organize the qualitative data.

On the survey part, findings indicated that majority (85%) of respondents used cashew seed nut planting while only few (7.5%) used grafted seedlings. Most of the farmers(82.5%) harvested between 1.5-13bags at 80kg. Almost (90%) all the respondents sourced their planting material from friends or relatives other than the certified source. All the respondents (40) did not maintain soil fertility and most of the respondents (55%) pointed out that cashew tree did need fertile soil for its growth. Most of the respondents (67.5%) indicated that insect-pests attack on their field and 47.5% of respondent's field were infested with all the common pest in the study area. Large percentage of the respondents (85%) did not seek advice from extension agents on good agricultural practices. Majority (92.5%) did not plant the required number of cashew nut trees while only a few of the respondents (7.5%) planted the recommended plant density.

Findings for focus group discussion also shown that, major challenges hindering smallholder farmers from adopting good agricultural practices were ranked and grouped into on-farm and off-farm. Most pressing challenges were found under the off-farm group and these included high cost of grafted seedlings, expensive chain saw machine and its operation for pruning/thinning, difficulty in accessing and high cost of insecticides, and expensive cost for mist blower spraying machine. It costed a farmer 1271GHc (235.4€) to maintain a hectare of cashew nut farm. During 2017/2018 production season, majority of smallholder farmer (33) had a gross profit of **2233GHc** (413.5€).

Currently, only few major actors extend supportive services to smallholder farmers to adopt GAPs. There is a gap on the part of financial institutions on due to high interest rate (60%)which is deterring farmers from accessing credit.

The gap(14-24kg) between the current yield (6kg) and standard (20-30kg is which is so huge. But based on both literature and research findings, if farmers applied the GAPs and institutions perform their task accordingly yield could increase by 30% for the exiting plantations.

On the recommendation, two phases of action ought to take by Ministry of food and Agriculture(MOFA) to enhance quantity and quality of cashew nut production. Phase one must focus on measures that would improve yield of already established plantations. Phase two should be on actions that will smoothen adoption and activities of smallholder farmers who want to go into new plantation.

CHAPTER ONE: INTRODUCTION

1.0. Background

Cashew nut crop (*Anacardium occidentale* L.) was introduced to Ghana and other West Africa countries by Portuguese in the precolonial period. However, its production was not vigorously promoted till 1960's after the independence where there was a sporadic planting in Greater Accra and Central region and gradually advanced to the Brong Ahafo, Northern, Upper east and west regions of Ghana. Now, cashew nut production is concentrated in Brong-Ahafo and Northern of Ghana which are close to Ivory Coast border (Ajayi & place, 2012). There been a new prospect for cashew nuts production because of the current trade for nuts among Africa and Asia. Rise in world's demand have strengthen the sub-sector for smallholder farmers who have planted cashew nut tree as a cash crop (Adjei-Frimpong, 2016).

Cashew nut crop is drought tolerant, thrive well in high temperatures and light to medium- textured soils, and these conditions are common in Ghana's savannah and transitional ecological zones (Dedzoe et al., 2001).

In the past years, cashew nuts cultivation was not considered as lucrative venture by a lot of Ghanaian farmers. Likewise, all attention of government has been skewed towards cocoa production until recently where there has been raised in price and demand making its more economically profitable for smallholder farmers to go into its production. Due to insufficient technical know-how on GAPs, cashew nut production has not scale up to its potential quantity and quality needed in world market. Enhance practices has ability to boost productivity to 20-30% and at the same time require less capital to invest in them. cashew nut farmers could raise their output level to 65-100% if they practice GAPs fully (Heinrich, 2012). For instance, greater yield could be attained via adoption of elite planting materials where the mean output stand between 3-6.5kg per tree in Ghana could shot up to 12kg-15kg/tree/year (ACI, 2010).

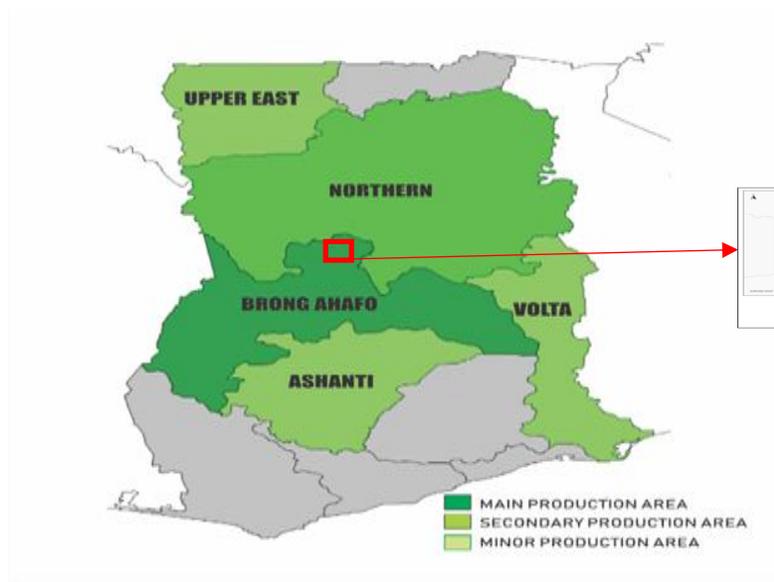
One of the fundamental problems of smallholder cashew nut farmers is inadequate arrangement and organization of cashew nut value chain. Since a lot of farmers are not into groups, 68% of these farmers sold their nuts to middlemen at village level making them losing good prices that could have been obtained when sold in aggregated form via farmer association (ACI, 2011).

This has necessitated, the country to develop 10 years cashew development plan which was launched in Wenchi by the president of Ghana on January 2018. Ministry of local government and rural development in conjunction with Ministry of agriculture have been tasked to play a lead role in the implementation of this policy and this move is anticipated to boost production by 30% which will help to diversify Ghanaian agriculture export base (myjoyonline, 2018).

1.1.

Cashew Nut Sub-Sector in Ghana

Figure 1: Cashew nut growing Regions in Ghana



Source: (Rongead, 2015)

Figure 1 indicates regions in Ghana where cashew trees thrive well, and as shown in the map the study area fall within main production area (Rongead, 2015). It is projected that 88% of producers are small holder farmers with farm size between 0.8ha to 3.0 while large scale producers are 12% with average farm size of 4 to 40ha (Osei-Akoto et al.,2005). Marketing channels depend largely on middlemen and the value chain mainly is on export of raw cashew nuts (ACI, 2010) with booming export market with estimated 40,000 farmers who are into cashew nut crop production (ACI, 2013). Currently, it is the leading non-traditional export commodity (GEPA, 2017) and it has been projected that, it can reduce poverty by creating more than 200,000 stable and causal jobs especially for farm labourers and middlemen (CDP, 2008).

Cashew nut sub-sector has seen some form of interventions since 2001 to improve and increase cashew nut production. These interventions were instituted via CDP which was funded with a loan amount of \$12.83 million from ADF. The project offered extension services and training to enhanced farming practices and disbursement of credit to farmers. Other agencies such GEPC, USAID, ADRA, Technoserve, WATH and TIPCEE, reinforced efforts of GoG on training on best cashew nut production practices, business management to farmers and agricultural extension officers, mapping of cashew nuts farm using Geographic information system to enabled smooth extension service transfer and yield predictions (ITC, 2011).

Since cashew nut production gained attention not long ago, research work on cashew is not extensive but CRIG and CSIR had been directed by GoG to carry out research to develop improved cashew nuts production. Companies that are into export are registered with GEPC, Ghana Cocoa Board Quality Assurance Certificate and Department of Registrar General. Cashew nut export fall under non-traditional export crop and cashew nut trading is being operated in free market as there is no price control (Ashiley, 2012).

Two main research sub-stations under MoFA situated at Wenchi and Bole place emphasis on cashew nut research activities such as the improvement of the planting materials and agronomic practices of cashew nut production presently (ITC,2011).

1.2. Research Problem Statement

Ever since cashew nut production gained attention (2006) in the agricultural sector in Ghana, several interventions from public and private sector have been geared toward increase the output of cashew nuts in Wenchi municipality. Various government regimes have tried to enhanced cashew nut sub-sector by improving the production level.

Farmers in Wenchi municipality have received numerous technologies in order to improve production of nuts to appreciable level . However, production has not hit the standard. This is attributed to improper farming practices such as poor farm sanitation, inadequate soil fertility maintenance, inadequate insect-pest and disease control, use of poor planting material and inadequate post- harvest handling by the smallholder cashew nut farmers. Cashew nut sub-sector in Ghana is being faced with key encounters like low output, bush fires, low soil nutrient conservation practices(ACI, 2010).

These inconsistencies in farming practices had led to low quantity and quality of cashew nut along the value chain which is affecting productivity at local and national level, and farmers' income.

1.3. Problem Owner

10 years development plan had been developed by GOG (Jan.2018) to improve the cashew nut sub-sector because, cashew nut production has a lot of potentials to diversify the export earnings, create jobs for the teeming youth. Because of this development, Ministry of Food & Agriculture has been tasked to play a facilitating role by helping farmers to enhance production as well as strengthen the cashew nut value chain.

1.4. Research Objectives

To identify the gaps in farming practices of smallholder farmers in cashew nut value chain and recommend strategies for resilient production of cashew nuts.

1.5. Main Research Questions and Sub Questions

1.5.1. Research Question One

What are the influence of technology adoption level of smallholder farmers on quantity and quality of cashew nuts production.

1.5.2. Research Sub-questions One

- I. What are the influences of current farming practices adopted by smallholder farmers on quantity and quality of production of cashew nut in the value chain?
- II. What are the relevant farming practices crucial for higher quantity and quality of cashew nuts production?
- III. What are the consequences of post-harvest handling of nuts by smallholder farmers on quality of nuts?
- IV. What are the challenges for adopting good agricultural practices (GAPs) by smallholder farmers to obtain higher quantity and quality of cashew nut?

1.5.3. Research Question Two

What are farming technologies that have been transferred to smallholder farmers by public and private institutions to improve cashew nuts production?

1.5.4. Research Sub-questions Two

- II. What are the current production strategies to increase cashew nuts quantity and quality in Wenchi municipality?
- III. What are the cashew nuts farming technologies that have been transferred by public institutions for adoption by smallholder farmers to improve quantity and quality of cashew nuts?
- IV. What are the current roles played by private institutions in the adoption of good farming practices by smallholder farmer to improve quantity and quality of cashew nuts?
- V. What are the factors hindering smallholder farmers from adopting farming technologies transfer by public institutions ?

1.6. Justification

There has been a growing attention for cashew cultivation in the ecological zones in Ghana where cashew tree thrives. Reason for increase interest is because of the economic importance to farm households alongside with great demand and blooming export market (ACI, 2010).

Cashew is a leading non-traditional agricultural export commodity in recent times in Ghana, generating about US\$ 981,158,000 and 11 million USD of raw cashews and kernel respectively in 2016. It contributed 53% of non-traditional export crop in Ghana, and 43.8% of total world's exports of raw cashew nut during 2016 season (GEPA, 2017). Campaign for cashew cultivation has the likelihood to support attainment of Millennium Development goals (MDGs) and effective operationalization of national plan for decreasing poverty (ACI, 2010).

Effect of cashew nut production on socio-economic growth of Ghana in general and middle belt is huge. Countries such as Brazil, India and Vietnam are benefiting enormously from cashew nuts production and Ghana has the potential to also reap huge foreign exchange from it (Frimpong-Adjei, 2016). Apart from foreign exchange earnings from cocoa, Government of Ghana(GoG) want to develop another export commodity which cashew nut is to boost export base as well as for employment creation especially for youth.

This is evident in the 10 years development plan that was lunched by president of Ghana on January 2018 to improve the cashew sub-sector (myjoyonline, 2018). This research has become imperative because, GOG wants to improve cashew nut production as well the value chain. However, if one of the basic issues which is farming practices is not well assessed and identify the bottlenecks in it, government efforts will not be realized in the long run. There will be no cashew nut value chain to be developed if farming practice is not sustainable.

Cashew nut production has only one main season so if farming practices are not right within the season production will be low . This can affect income level of household families who depend mainly on proceeds from cashew nut. Again, production at national level will decrease which in turn could affect foreign exchange earnings generated by cashew nuts.

As cashew nut production is being dominated by small scale farmers (88%) with farm size ranging between 0.8 to 3hectares (Osei-Akoto et al., 2005) and farming practices of these large producer of the chain need be assessed to identify the lapses and find solutions to gaps. Farming practice such as usage of poor planting material, poor plant spacing, absence of soil maintenance, inadequate insect-pest and disease control are the cause of low output for cashew nuts production (Aliyu, 2010).

Hence, the need to research into farming practice of these smallholder producers to identify the gaps in their practices to recommend resilient solutions to fill those gaps to sustain production.

1.7. Definition of Concepts

Small-holder cashew farmers: Cashew nut farmers with farm size between 0.8-3ha (Osei-Akoto et al.,2005)

Farming technology transfer: technology transfer is a step-by-step activity from the development of new technology by the technology generator, until it is developed into new technological products that can be sold by technology recipients in the market place (Abu et al., 2013)

Public institution: All institutions and agencies owned by the state and run at the national or decentralized level (FAO,2016)

Private institution: these the institutions not owed by the state Agricultural technologies

Loevinsohn et al., 2013 defines adoption as the integration of a new technology into existing practice and is usually proceeded by a period of 'trying' and some degree of adaptation.

Good agricultural practices: applying the standard and existing information to address environmental, economic and social sustainability for on-farm production and post-harvest processes leading to safe and healthy food and non-food agricultural products(FAO,2003)

2.0. Introduction

This part presents a review of literature to comprehend the level to which past research have documented major topics in the effect of farming practices by smallholder cashew nut farmers. Review covered key issues such as farming practices for cashew nuts production, relevant farming practices, consequences of post-harvest handling on nut quality, challenges faced by farmers in adopting good farming practices, strategies for cashew nut production, roles played by both private and public sector in transfer of technologies to smallholder farmers and adoption of technology.

2.1. Recommended Farming Practices for Cashew Nuts Production

Type of planting material used for cashew nut plantation is very important for higher yield and quality nuts. For instance, use of cashew seed nuts will result in longer gestation period, heterogeneity, high disease and insect infestation whereas use of clone material such as grafted cashew nuts seedlings produce true to type seeds, uniformity in tree structure and high yielding. Planting of improve material produce qualities such as yield which is greater than 10kg/tree/yea, nuts lightly attached to apple, good shell, high kernel to nut ratio of more than 25% , early to mid-fruiting period between Jan-April with harvest period which last for less than 45 days (Aliyu,2010).

Planting distance for cashew trees depending on variety type and ecological zones. For instance, open pollinated varieties are bulky in nature which require various spacing with number of trees per ha such as ;7.5 x 7.5m = 178 trees/ha, 9.0 x 9.0m = 123, 10x 10m = 100, 12 x 12m = 69 , 15.0 x 15.0m = 44 (Aliyu,2010)

Removal of unwanted branches serves as insect-pest control measure, by discarding infested branches minimize spread on the tree (Costa & Bocchi, 2017). Cutting off apex branches aid sunlight into the tree canopy thereby reducing pest and disease attack (Mohammed, 2014).

Insect-pest attack like mirid reduces cashew nut production and farmer's income, therefore its control is important (ICIPE, 2011). Recommended insecticides at various rate are effective against insect -pest attack and applications are done in two phases; at flushing period any of these insecticide could be used monocroptophos 1.5ml/L, Imidadoprid 0.6ml/L, Acetamiprid 0.5g/L, L-cyhalothrine 6ml/10L, and Profenophos 50EC 1.5ml/L., while Triazophos 40EC 1 ml/L, Profenophos 1.5ml/L and L-cyhalothrine 6ml/10L could be applied at the flowering time(Naya et al., 2017)

Control of weeds in cashew farm should be done to curtail accidental fire and to permit movement during picking of fruit (IRD, 2011). Root of weeds compete with cashew plants for water and nutrients resulting in reduction in yield (Opoku-Ameyaw et al., 2012).

2.2. Post-Harvest Handling of Cashew Nut

Kernel out-turn is vital measure for quality of RCN and controls processing of nuts output (Fitzpatrick, 2010). However, farmers have not taken keen interest on quality because of inadequate information on quality criteria of cashew and traders of nuts do not edge farmers to observe quality practices and drying before selling (Ogunwolu, 2016).

For higher farm gate prices to be realized, improved innovation needs to be used to produce cashew nut since quality nut determines price and farmers ought to follow standard measures and use make them (Demang et al. 2018).

Regulation measures for quality standard for cashew nuts such as desirable moisture of 8.5% or less, total of defective nuts and foreign materials under 5% of nut weight, free from insect-pest infestation and under developed nuts (FMCI, 2007). Nuts should be detached from apple as soon as possible and in a way that there will be no left over on the nut as this serve as an entry point for pathogen infection. To enhance quality of nuts, it is necessary for farmer to pick and detach nut from fruit daily (IRD, 2011).

Gathered fruit collected in sacks or baskets should not be kept for extensive time by farmers as these may deteriorate the quality of nut. Drying of nuts should last for 2-3days on concrete floors and rattling sound of nuts shows the readiness of nuts and at this stage moisture content will be 8-9%. Sorting out of foreign materials, grading into standard grades, bagging of nuts into jute sack at 80kg and mount them on pallet in an airy water proof storage room (Aliyu, 2010).

2.3. Challenges for Adopting Good Agricultural Practices by Smallholder Farmers

Outcome of some technologies disseminated could not be predicted but some of them give a positive return whereas others led to disappointment. For transfer of technology to be successful, ability of the end user to make use of it is paramount (Abu & Adham, 2013). Factors such as absence of enhanced panting materials, scanty extension services, poor farm gate prices serve as disincentives for a farmer to fund on cashew business and accept an innovation (Kidunda et al., 2013). Inadequate financial and weak input delivery system hinder small scale farmers to apply those inputs causing low output of cashew nuts (CBT, 2013).

According to Webber and Labaste (2015), inadequate and excessive interest on credit facility serve as obstacle to smallholder farmers to buy better inputs to improve production, increase farm size and regenerate plantation. This exorbitant interest on loans make it difficult for smallholder farmers to pay back the loans (Nathalie & Vermuelen, 2006).

2.4. Cashew Nuts Production Strategies

Causes of low output of cashew nut is because of unapproved planting material used by farmers. Grafted planting material is now preferable for cashew nut production due to its ability to maintain characteristics as the parent tree therefore farmers are advised to use this material (Sarjo,2015).

Strategies to improve production of cashew nuts to appreciable level could be the use of high-quality planting material, loans and grants to farmers, punitive measures against bush burning and adequate funds for research (Adegbija, 2018).

For higher quantity and quality to be achieved in cashew nut cultivation, good farm practices such as use of insecticides, planting of elite materials in addition to application of technical know-how (CBT, 2013). Technological strategies such as use of elite planting materials, soil nutrient enrichment, weed control, insect-pest control and soil water management turns to rise crop yield (Loevinsohn et al., 2012)

2.5. Roles Play Public Institution in Transfer of Farming Technologies to Farmers

Numerous agricultural, socio-economic and ecological encounters confronting small holder farmers in their countryside could be answered by technical know-how (Langat et al., 2014). But the embracement of new knowledge such as use of improved seeds and inorganic fertilizers is not well applied especially Africa farmers (Sheahan & Barrett, 2014). Farmers proceed turns to improve when technology transferred to them decrease cost of production and at the same time increase yield (Challa, et al., 2013).

Government agencies like extension services transfer sustainable agricultural practices that can tolerate occurrence of climate change and these practices include soil fertility management like mulching, proper way of applying fertilizer, growing of cover crops and trees (Frank & Buckley, 2012).

Technological advancement and government strategies in agriculture will help to increase food production by 70% while increase of land size will enhance food growth by 10% and intensive agriculture production will contribute 20% therefore transfer of innovation to farmers is important (FAO, 2009).

Public agencies like ministry of agriculture and other development institutions are responsible for new crop breeding, practices and training of farmers. New strategies like packaging, processing and marketing of food have the tendency to improve export value of a product (Tuttle, 2012).

2.6. Private Sector Roles Play in Transfer of Technologies to Farmers

Better coordination between government, private sectors and non-profit organizations should not only be seen in transfer of improved technology to farmers but more integrated approach from before planting to market creation. Private sectors help in transferring technology, carry out extension services to faithful farmers related to their business and get faithful customer, better products and creating better business. This relation will be sustained in the long run and giving benefit to both parties (Syngenta, 2016).

Buyers can offer supplier a contract, which includes transfer of technology and conditions for purchasing the supplier's product (Kuijpers & Swinnen, 2016). For instance, processing companies in Madagascar are active in the supply of improved seeds, fertilizer and pesticides to farmers to increase their yield (Bellemare, & Marc. 2012).

2.7. Adoption of Technologies by Smallholder Farmers

For food reliance, country side growth, and physical transformation to be enhanced, acceptance of improved agricultural innovation would lead to higher output of agricultural commodity there by improving the lives of rural poor farmer in especially emerging countries (Kuijpers & Swinnen, 2016).

Implementation of agricultural innovation is anticipated to enhance the farmers' output and returns. Farmers will opt for practices that increase their effectiveness, and so when smallholder farmers are faced with two options, they will compare the usefulness of technology and choose the best opportunity. Access to institutional support like extension services to farmers is a determinant of acceptance of improved practices so limited access to extension information decrease likelihood of adoption (JEA, 2017).

According to Loevinsohn et al. (2012) the most common areas of technology development and promotion for crops included new varieties and management regimes; such as soil fertility management; weed and pest management; irrigation and water management. By improved input/output relationships, new technology tends to raise output and reduces average cost of production which in turn results in substantial gains in farm income (Challa, et al., 2013).

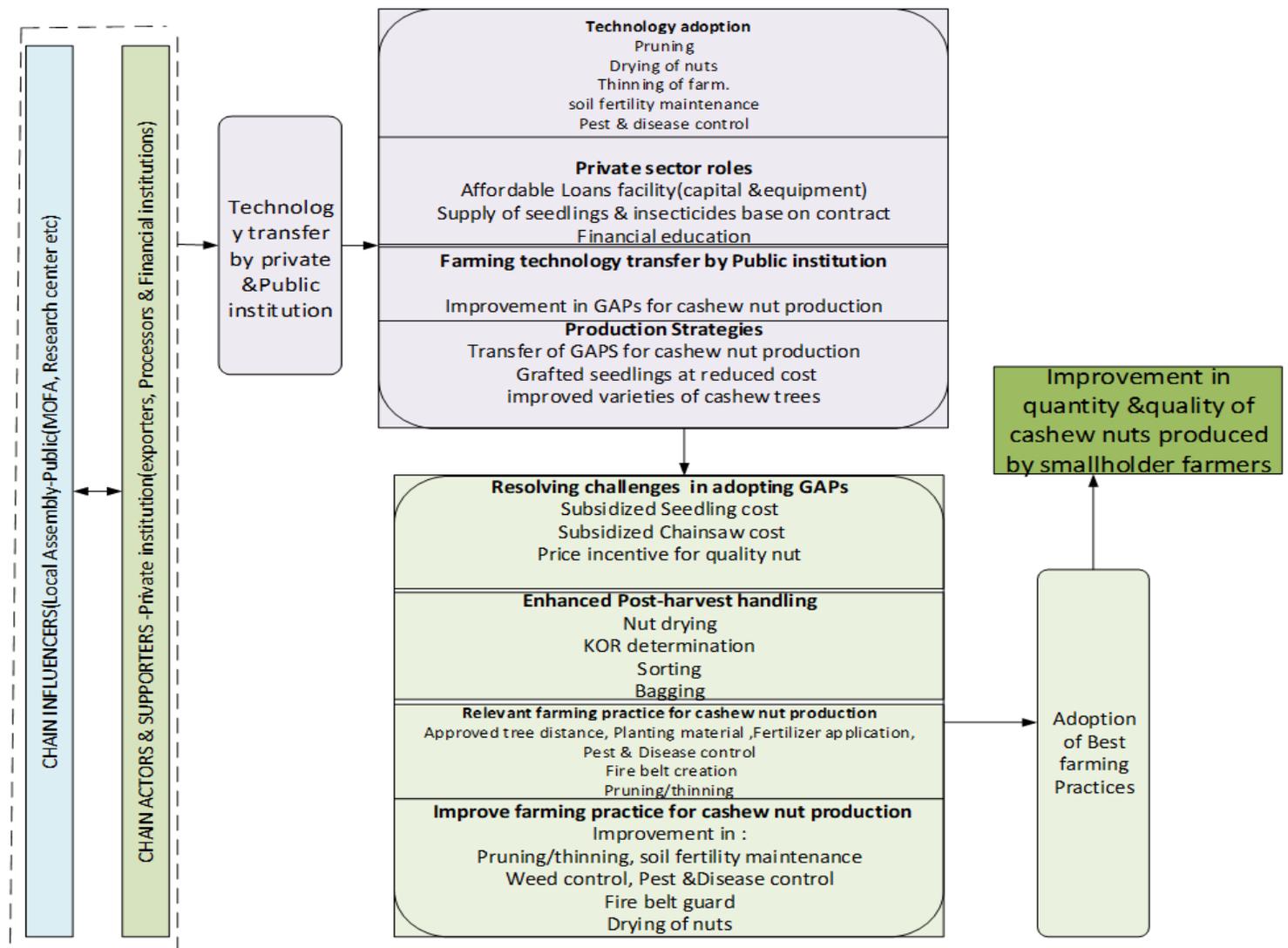
Farm-gate prices of cashew nuts determined the acceptance of an innovation hence low prices of the nut is disincentive for adoption of new technology and vice versa. Farmers will only invest in the innovation if they are conceiving that income form the output is tenable therefore, technologies which are supposed to increase their profitability have a greater chance to be adopted (Beshir, 2014).

2.8. Conceptual Framework

According to Graham et al.,(2012) bringing on board public, private and NGOs to collaborate could speed up dissemination and adoption of technology.

Framework below was used to study how both private and public sector collaborate to transfer technology to smallholder farmers for adoption and how transfer of technology translate into reducing challenges confronting farmers in adopting good farming practices, enhancing post-harvest handling, relevant farming practices and improvement in current farming practices, and these could result in increase in quantity and quality of cashew nut produced by smallholder cashew nut farmers along the value chain in Wenchi municipality of Ghana.

Figure 2: Conceptual Framework



Source: own framework,2018

3.0. Introduction

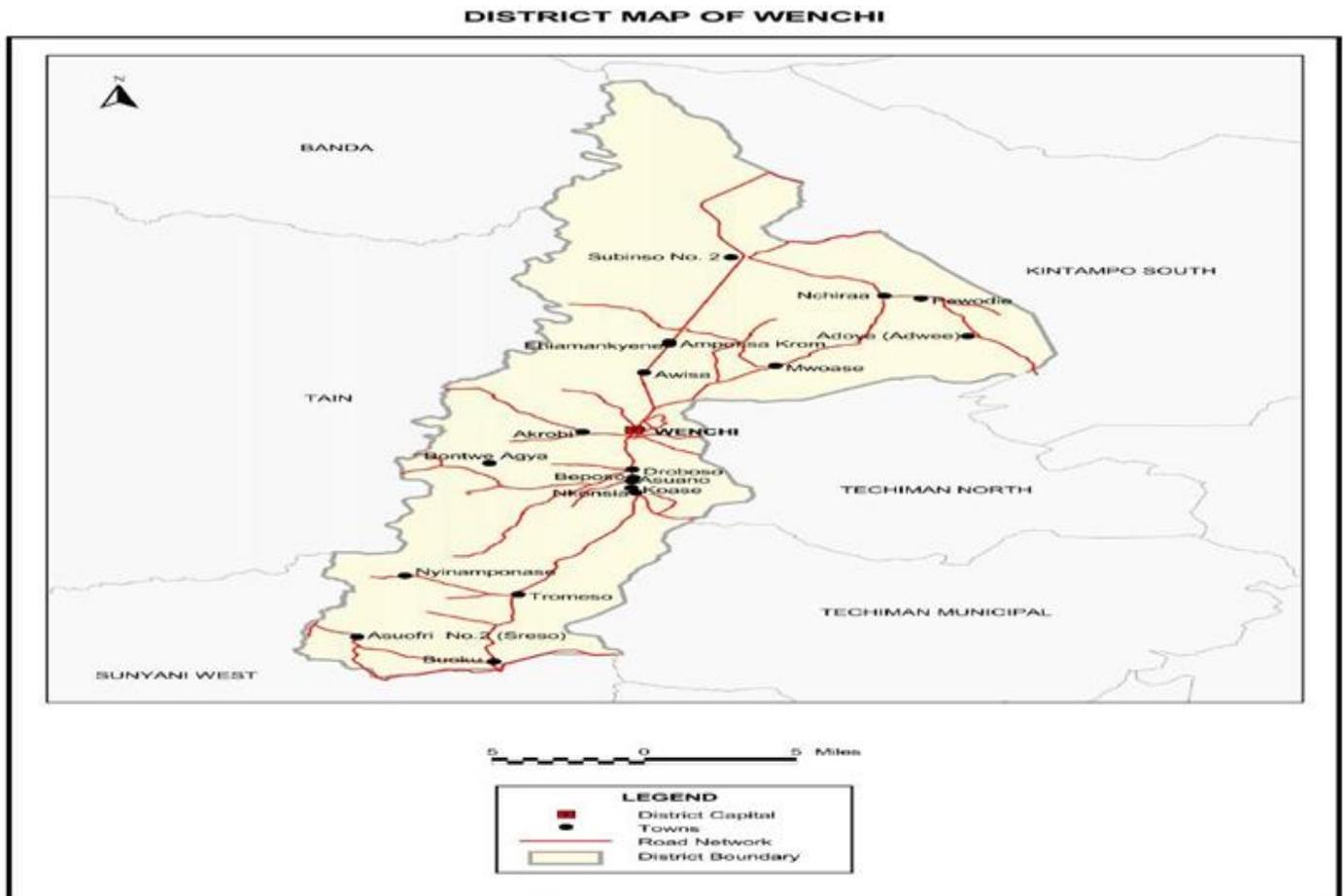
This chapter describes the study area, strategy, research frame and how data was collected and processed, analyzed and limitation of research.

3.1. Study Area Description

The research was conducted in Wenchi municipality of Ghana as it is one of the key areas where cashew nut production is booming. It is located in western part of Brong-Ahafo Region. It falls within latitudes 7°30' and 8°05' N, and longitudes 2o 15' W and 1o 55' E. Land size is 1,145 Sq. km. The land in the area is undulating with gently slope of less than 1% inclination. It rises from 30m above sea level to over 61m in North -West. High lands are in the North–Western part while other part is low land around the tributaries of Volta Lake. Black Volta Lake serves as northern boundary between the municipality and northern region of Ghana (MOFA, 2016).

According to GSS (2010) total inhabitants was 89,739 comprised of 49.1% males and 50.9% females. 65.2% of the population depend agricultural occupation for their livelihood.

Figure 3: Map of Wenchi Municipality

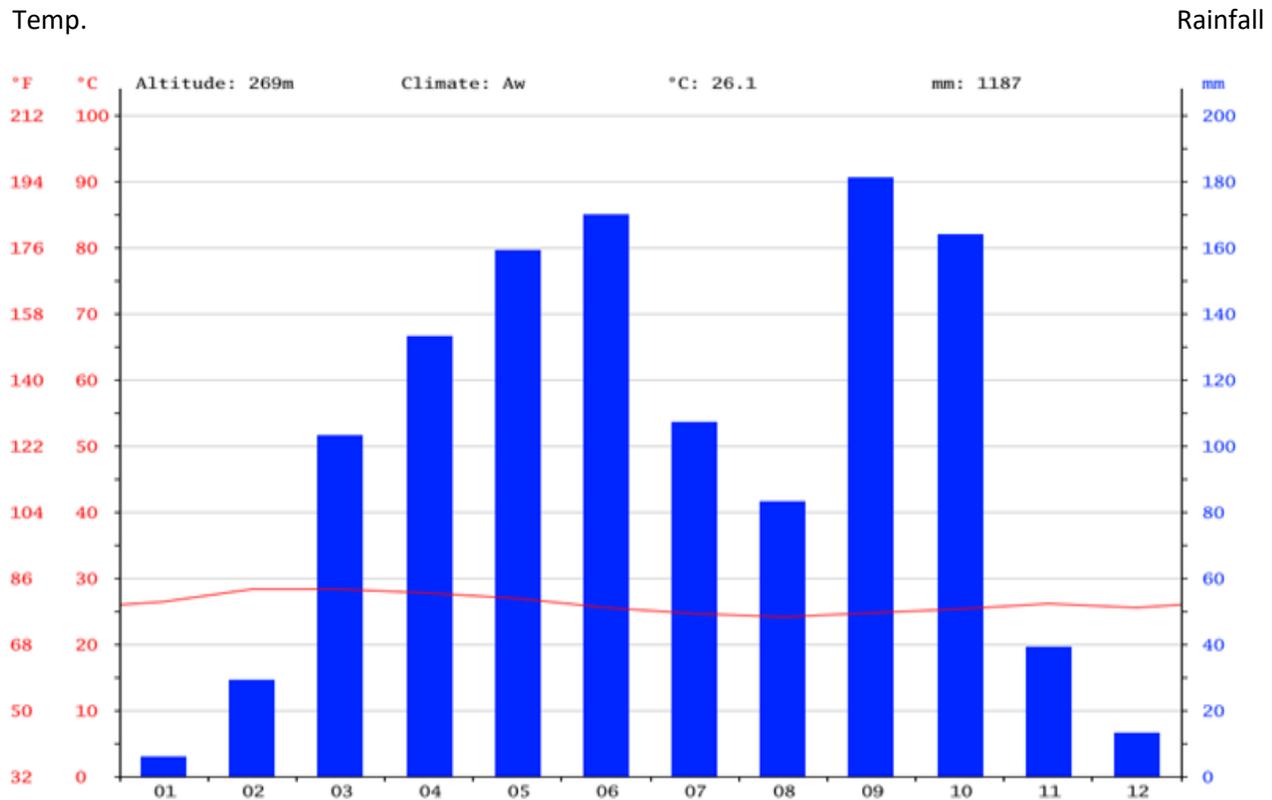


Source: GSS, (2010)

3.1.1. Climatic Conditions

The figure indicates Average temperature and rainfall figure for a month. Average maximum and minimum temperature is 28.3°C and 24.1°C respectively (www. en.climate-data.org). According to climatic-data .org. the minimum rainfall is 1187mm. However, annual rainfall volume is between 1,140-1,270mm and begin from April to October. Warm weather conditions start from February-April. Prevailing climate favours cashew nut production making it a hub in the Brong Ahafo region of Ghana. Long period of dryness in November and February makes the area susceptible to bush fires (MOFA, 2016).

Figure 4: Climatic data for Wenchi Municipality

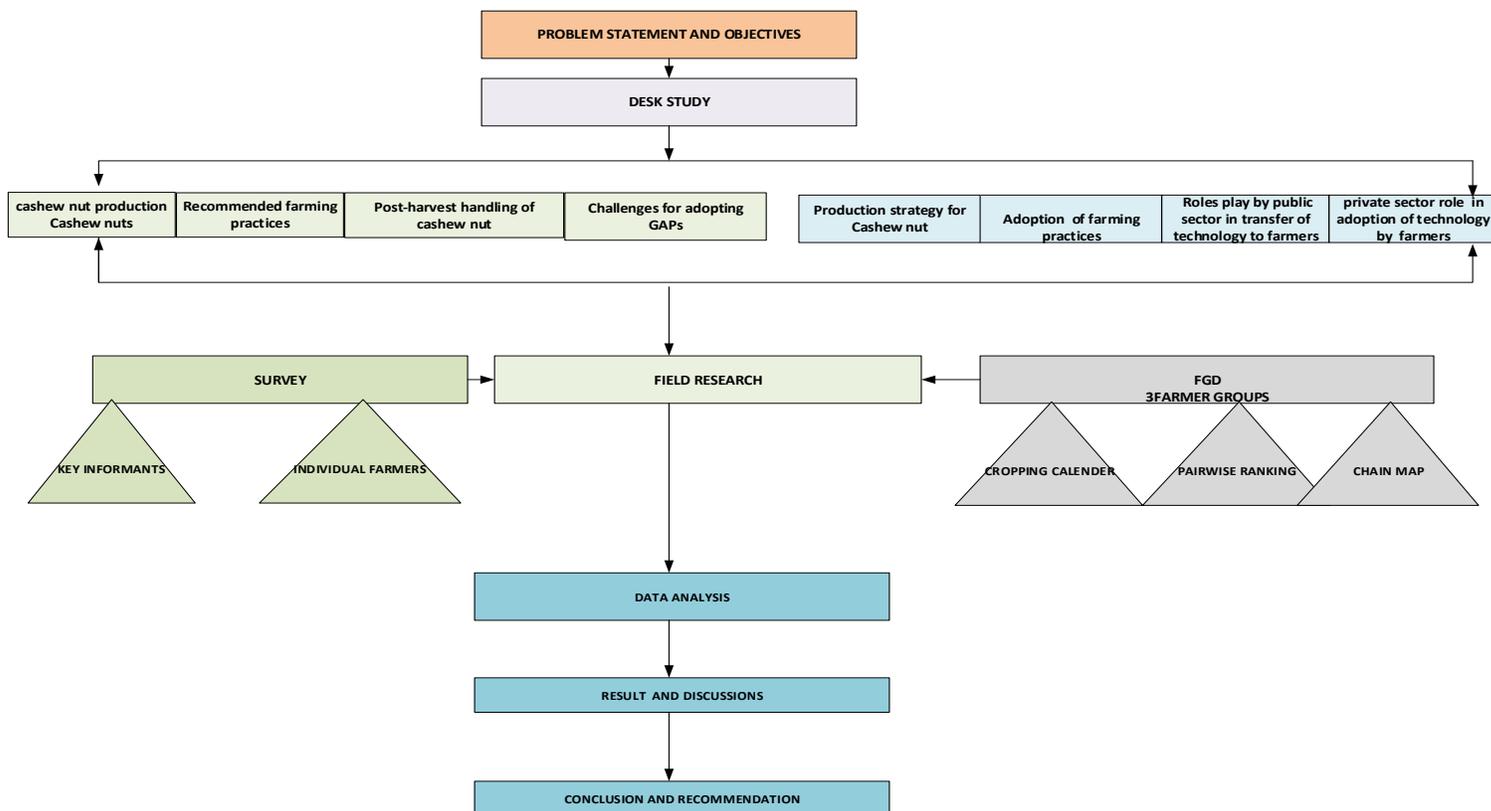


Source: climate-data.org (online)

3.2. Research strategy

Desk study was done on key concepts to obtain data from reports, journals, new paper articles via electronic search basically google. For field research, two methods and value chain approach were used. These methods included Focus group discussion (FGD) and survey. Interviews, audio and video recordings, observations, cropping calendar, pair wise ranking, chain map and key informants were employed to obtain qualitative while quantitative data was obtained using questionnaire. The figure below gives a mental picture about how the research was carried out.

Figure 5: Research Framework



Source: own framework, 2018

3.3. Method of Data collection

The data for the research was collected via desk and field studies as describe below(See Annex1)

3.3.1. Desk Research

Desk research was used to collect data from existing literature that's important to establish strong information for the research. Literatures were reviewed on key concepts of the research such as recommended farming practices for cashew nut production, production strategies, challenges for adoption, post-harvest handling, roles played by public and private institutions in transfer of technology and adoption of technologies by farmers. This was done to obtain information to support or deny the findings from the field study. Mostly, the source were online books, scientific journals, department reports, articles via search engines such as google.

3.3.2. Field Research

A total of 89 respondents were used for the study. Primary qualitative and quantitative data were used for the study. These data were collected through semi-structured, and closed ended questionnaire, interviews for the survey part. Semi-structured questionnaire was administered to processors, exporters, rural bank and NGO to obtain their views on roles they play in helping farmers to adopt technologies. Closed ended questionnaire were used for individual smallholder farmers to know the current farming practices. Face-face interviews were used for key informants such as desk officer for CDP, director of local research station, private quality control agent, forester, and MOFA director to extract data on the various sub-questions. Participatory tools such as cropping calendar, ranking and chain map were used to gather data on challenges for adopting GAPs by farmer groups via FGD. Details of respondents and various questions they answered is in annex 1.

3.3.3. Survey

Pre-test of questionnaires was done using three informants from research center, farm instituted, MOFA and two smallholder farmers from Nkosiah community to test the relevance of both checklist and closed ended questions. It was emerged that assessing effect of climate change on cashew nut production was not the impressing problem but rather effect of farming practices on cashew nut quantity and quality was the urgent issue that need to be investigated. This led to adjustment of the topic and questions making the study very clear.

Survey was conducted on individual smallholder farmers in 4 communities using a multi sampling process. Based on the standard for VHL (Braada, 2014), 40 individual farmers were sampled. MOFA has demarcated 4 zones for its operations and under these zones are 7 operational areas with several communities. Each Agricultural extension agents manage each operational area. The zones included Wenchi north and south, Subinso, and Buoku. With assistance from desk officer for CDP, random sampling was done to select one community from each operational area. Major communities were listed and written on a piece of papers and selection was done base on probability. Amponsakrom, Subinso 2, Tremeso and Nkonsia were town selected. Purposive sampling was used to select smallholder farmers with farm size of 0.8-3ha because according to Osei-Akoto et al.(2005) they form majority of producers and tree age from five years upward because proper inference on yield assessment could only be made base on this age and above. For questionnaire used for the survey see annex 2

10 farmers each were selected communities were targeted to give a fair representation of the study area, 12 farmers in each communities were organized by AEAs in each of the selected community. "Yes or No" was written on a piece of paper and folded, farmer picked "yes" were made to answer the questions relating to current practices. Based on the presence of the exporting companies at the time the study was conducted, two (OLAM and Ecom) were purposively picked from 5 major companies and those companies only operate when cashew nuts harvesting season start.

Two processing companies were purposively selected from three processors because they operate in the study area.

Three financial institution were also purposively selected from five banks base on the roles they play in the cashew nut value chain. These were Wenchi, Akuwamang and Opportunity savings and loan Ltd rural bank.

3.3.4. Focus Group Discussion

In the records 29 farmer groups exist in the study area but currently only 3 group are organized and have been participating actively in the cashew nut activities. Base on that those groups were purposively selected to ascertain challenges they face in practicing or adopting a technology. The groups were Buosu cooperative and marketing Ltd., Gye Nyame and Nchiraah farmer Association.

Participatory tools used to capture data from the groups were Value chain map, Cropping Calendar and Pair wise ranking.

Chain map- was used to identify various actors and marketing channels they trade their nuts in.

Cropping calendar was used to identify whether the farming practices for cashew nut production coincide with the major season for food crop production.

Russell, (1997), Pairwise ranking was used to rank pressing challenges and this was done base on three criteria.

- a. Effect of a challenge on cashew nut quantity
- b. Effect of a challenge on cashew nuts quality
- c. How wide spread of a challenge among farmers

Ranking of challenges were done one against another to compare which one has more influence on cashew nut quality and quantity, based on simple major a challenge was chose over the other. The checklist used for FDG is in Annex 3

Figure 6: Extension agents facilitating FGD at Buasu community



Source: field survey, (2018)

3.3.5. Key Informant

To obtain cross sectional view on relevant practices for cashew nut production, an in-depth interview was done face to face were interviewed via open ended questionnaire to gather pertinent information from these technical experts. These technical experts were drawn from Research station MOFA, farm institute, forestry and private quality control agent. The details of the respondents are in annex 2.

3.4. Method of Analysis

Qualitative data from collected via FGD was analyzed using some aspect of value chain analysis such as chain map, stakeholder matrix and simple gross margin were used to ascertain various market channels, stakeholders of the chain, and annual gross profit of famers. Pairwise ranking and cropping calendar were also used to analyzed challenges and period farming activities is performed respectively.

Audio and video recorded data from key informants, were transcribed done . Their opinions were coded and base on common responses relevant information were picked.

Data through the semi-structured interviews from exporters, processor, NGO and financial institutions were also transcribe, coded and answers were used for the questions base on the characterization of the respondents.

Quantitative data obtained from survey was analyzed using tables and excel to put data into bar graphs, line graph and vane diagrams. Pictures from field observations were used to depict the current practices of farmers in the study area.

3.5. Research Limitations

Research was carried out at the time(July) when transaction for cashew nuts was over and as a result most of the major exporting company targeted for the research were not available. Most of the companies do not have permanent offices and it was difficult to get staff in charge of operations to get their views for the research.

Several request via corresponding were effected to internal revenue section to obtained secondary data on revenue that have been generated internally for the past 5 years by cashew nuts sub-sector via taxes to buttress the need to develop sector could not materialized.

Since Municipal chief executive is the political head of the local Assembly, he was included in the number respondents designed for the research but several attempts were made but could grant the interview because of his busy schedules. He promised to send his views on the strategies use to improve cashew nut production through email but could not honour it.

3.6. Quality of Research Output

Mixed approach was used and data were secured from variety of stakeholders of cashew nut value chain of the study area. For credibility of data to be obtained, divergent sources of information from desk and field studies were employed to double check the outcome of results. This serves as a check and balances for the research to avoid biased much as possible. For instance data collected form farmers groups on challenges for adopting a technology was confirmed via interviews with extension agents.

CHAPTER FOUR: RESEARCH FINDINGS

4.0. Introduction

This chapter presents findings from the field study. Results are broadly presented in the thematic areas of the research such as: current farming practices adopted by smallholder farmers, relevant farming practices, consequences of post-harvest handling on cashew nut quality, challenges for adopting GAPs, current production strategies for cashew nut, cashew nuts farming technologies transferred by public institution, current roles played by private institutions in transfer of GAPs to smallholder farmers, best farming technologies transferred public institution that is widely adopted and un-adopted by smallholder farmers

4.1. Key findings on Current Farming Practices Adopted by Small holder farmer

The section presents findings on the survey part of the research to determine current farming practices adopted by smallholder farmers along the cashew nut value chain in Wenchi municipality.

4.1.1. Planting Material Type

Table 1 indicates that, majority (85%) of smallholder farmers planted their fields with seed nut while 7.5% each used either improved grafted seedlings or combination of seed and improved grafted material to establish their farm.

Table 1:Planting material used

Planting Material Type	frequency	Percentage (%)
Cashew Seed Nut	34	85
Grafted seedlings	3	7.5
Others(seed &grafted)	3	7.5
Total	40	100

Source: field survey, 2018

4.1.2. Quantity of Harvest per hectare(Ha)

Table 2 shows that majority (33) of harvested between 1.5-13bags of cashew nuts representing 82.5% while 7 harvested 14-25.5bags per hectare during the 2017/2018 season.

Table 2:Quantity harvest per ha @80kg/year

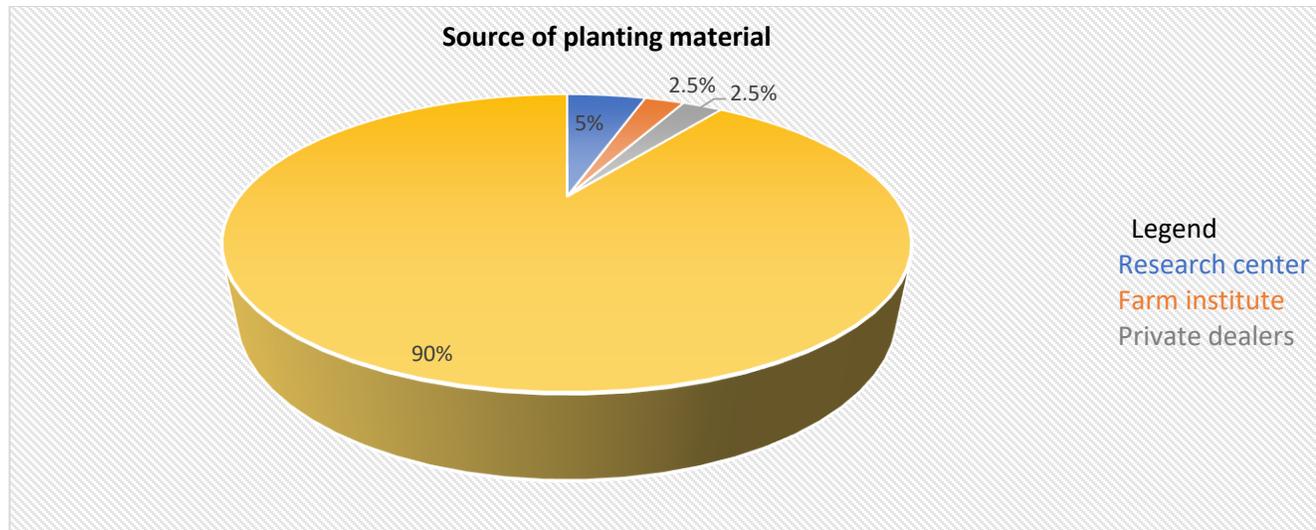
Quantity nut harvested/ha @80kg	frequency	Percentage (%)
1.5-13	33	82.5
14 -25.5	7	17.5
Total	40	100

Source: field survey,2018

4.1.3. Planting material source

Figure 5 shows that, 90% of smallholder farmer’s sourced planting material form other source such as friend and relatives. 5% purchased from the research station for planting. 2.5% each sourced from either farm institute or private dealer.

Figure 7: Source of planting material



Source: field survey, 2018

4.1.4. Weed Control

Table 3 indicates number of times is weed is controlled and herbicides use by the respondents. 60% control weed two times during a cropping season whereas 35% do this activity 3times.

Table 3: Number of times weed is controlled

Number of weed control	frequency	Percentage (%)
Once a year	2	5.0
Twice a year	24	60
Thrice a year	14	35
Others	-	-
Total	40	100

Source: Field survey, 2018

4.1.5. Ways of Weed Control

Table 4 depicts that majority of (95%)of respondents applied herbicides to control weeds while only 5% controlled it manually.

Table 4: Means of Weed Control

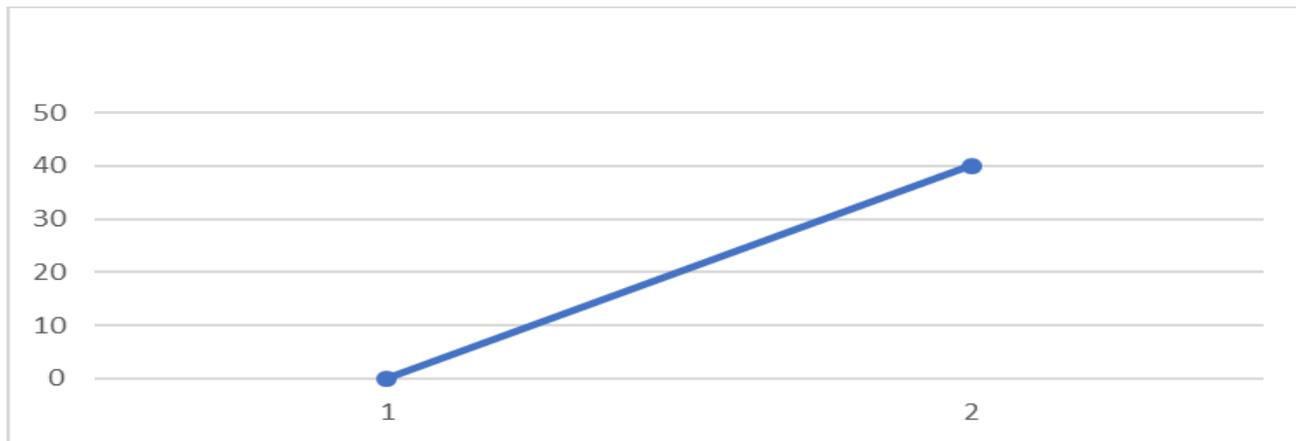
Herbicides use	Frequency	Percentage (%)
Yes	38	95
No	2	5
Total	40	100

Source: Field survey, 2018

4.1.6. Soil fertility maintenance

Figure 8 indicates that all the respondents (40) representing 100% do not maintain soil fertility

Figure 8: Soil fertility maintenance

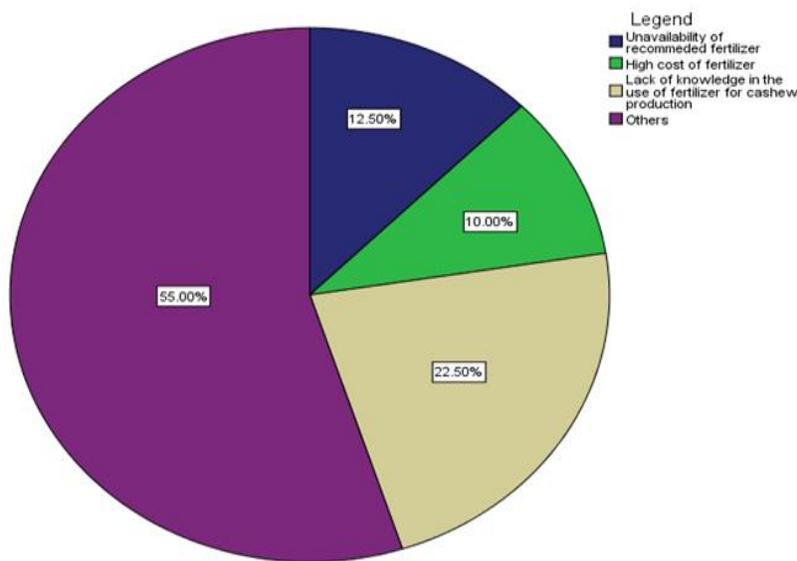


Source: field survey, 2018

4.1.7. Reasons for soil fertility maintenance

Figure 3 shows that, 55% of cashew nut farmers gave various reasons such as cashew tree do not require good soil fertility for its growth. 22.5% also indicated that, they lack technical know-how in application of fertilizer being it organic or inorganic. 12.5% of farmers also said that there was no recommended fertilizer available to be purchased while 10% pointed out that cost of fertilizer was high

Figure 9: Reasons for soil fertility maintenance

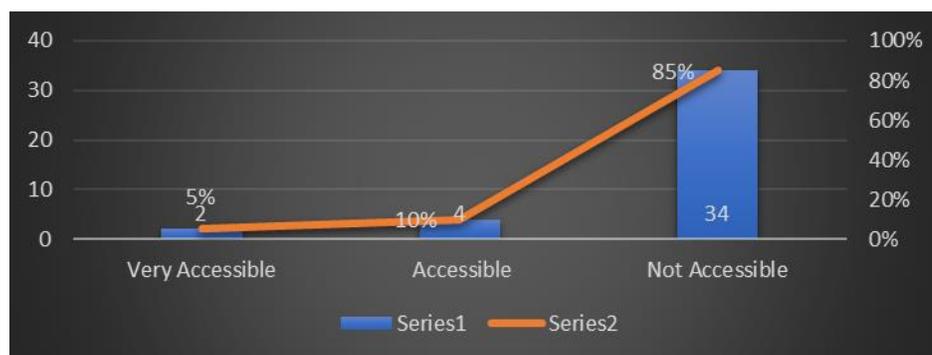


Source: field survey, 2018

4.1.6. Access to Improved Planting Material

Figure 10 shows that in terms of physical and financial access, 34 respondents representing 85% do not get access to improved planting material. 4 farmers representing 15% confirmed that they had access while 2 of them translating into 5% during planting of new plantation.

Figure 10: Improved planting material accessibility



Source: field survey, 2018

4.1.7. Insect-Pest Infestation

Table 5 shows that a lot of respondents (67.5%) experienced insect- pest attack while others (32.5%) do not experience infestation in their farm.

Table 5:Insect-pest infestation

Insect-pest infestation	Frequency	Percentage (%)
Yes	27	67.5
No	13	32.5
Total	40	100

Source: field survey, 2018

4.1.8. Major Pest Attack

47.5% of farmers indicated that common pest attack that their field were stem borer, aero plane bugs and aphids. 32.5% do not experience any of the pests. 12.5% and 7.5% of the respondents specified that stem borer and aero plane bugs respectively attack their farm.

Table 6:Common pest attack

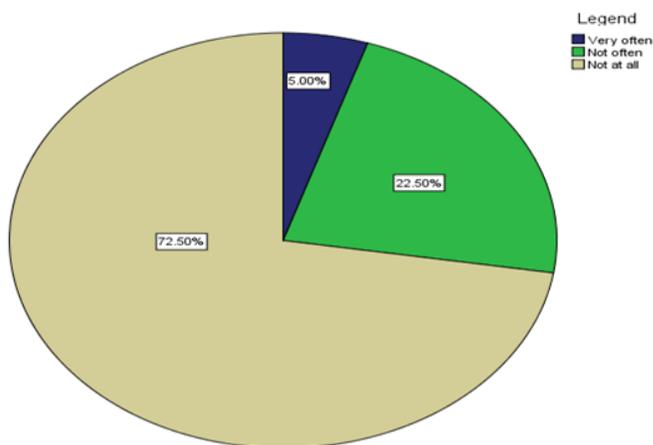
Name of pest	Frequency	Percentage (%)
Stem borer	5	12.5
Aero plane Bugs	3	7.5
Others	19	47.5
Absence of pest attack	13	32.5
Total	40	100

Source: field survey, 2018

4.1.9. Agricultural Extension Advice

Figure 11 expressions that majority of the respondents (72.5%) do not access extension advice on good agricultural practices. 22.5% indicated that, they sought extension agent’s advice but not on regular basis while only handful (5%) seek out extension advice very often.

Figure 11: Access to extension service

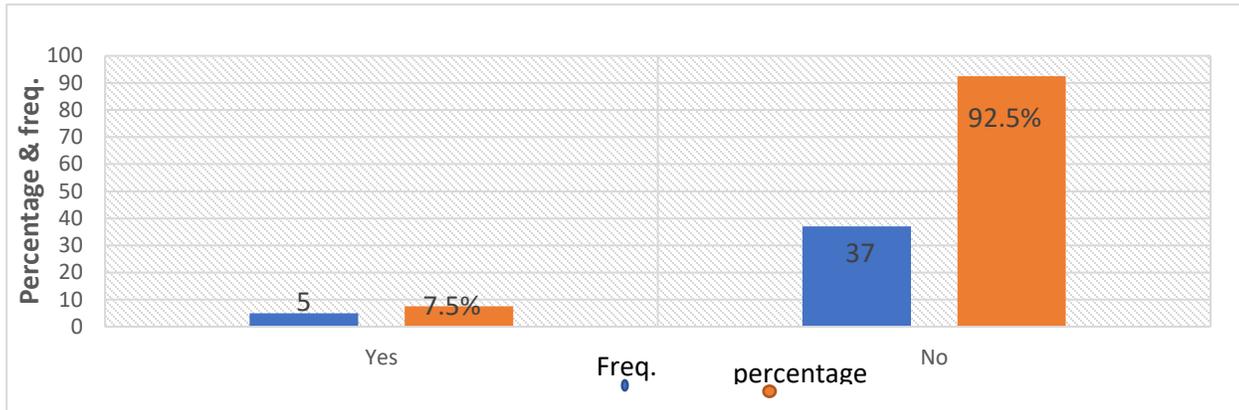


Source: field survey, 2018

4.2.0. Plant Population per Hectare

Figure 12 illustrates that, majority (92.5%) of smallholder farmers do not have required number of trees per ha. whereas few (7.5%) planted the right number of cashew nut trees per ha.

Figure 12: Recommended tree per ha

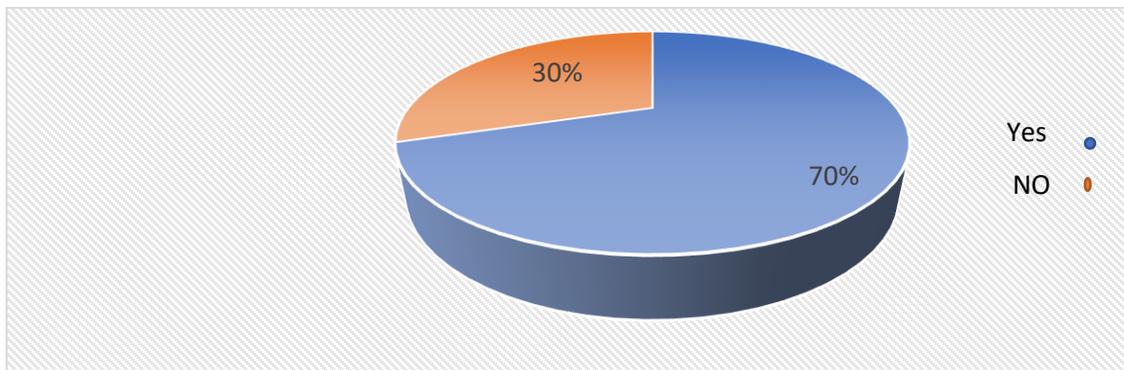


Source: field survey, 2018

4.2.1. Pruning of Cashew Nut Tree

Figure 13 demonstrates that most (70%) farmers performed pruning as an agronomic practice whereas 30% do not carry out this technology.

Figure 13: Pruning of cashew tree

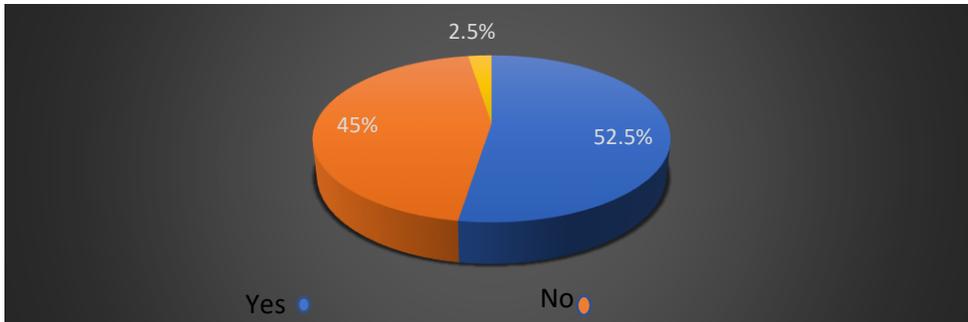


Source: field survey, 2018

4.2.2. Thinning of Cashew Nut Tree

Figure 14 displays that 52.5% of respondents do perform thinning while 45% had not done this operation to maintain the right plant density. 2.5% already have recommended trees per ha and so do not fall within “yes or no” answer

Figure 14: Thinning out of tree

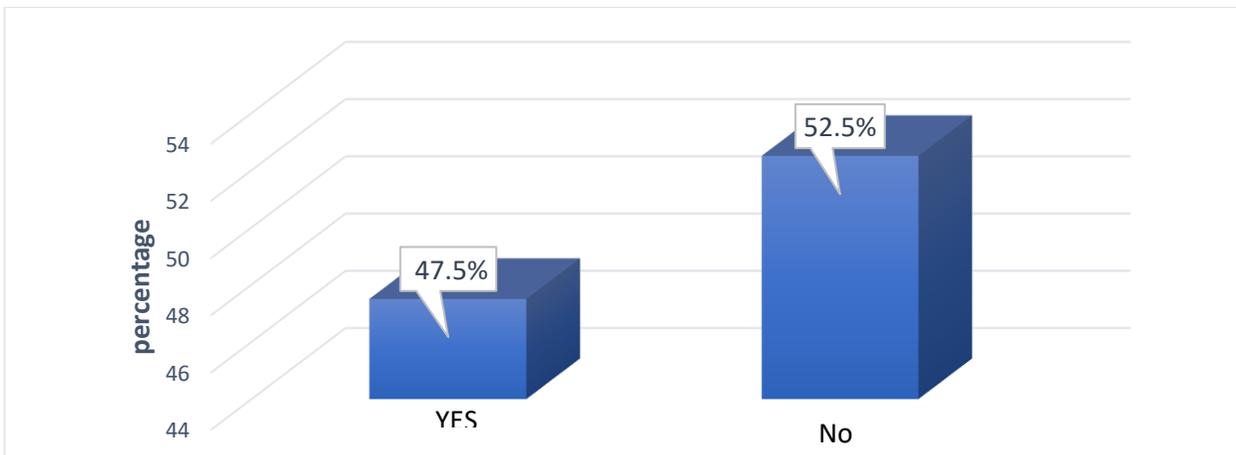


Source: field survey, 2018

4.2.3. Drying of cashew nut

Figure 15 shows that quite a lot of farmers (52.5%) do not dry cashew nut after picking from farm while 47.5% perform drying after harvesting.

Figure 15: Cashew nut Drying

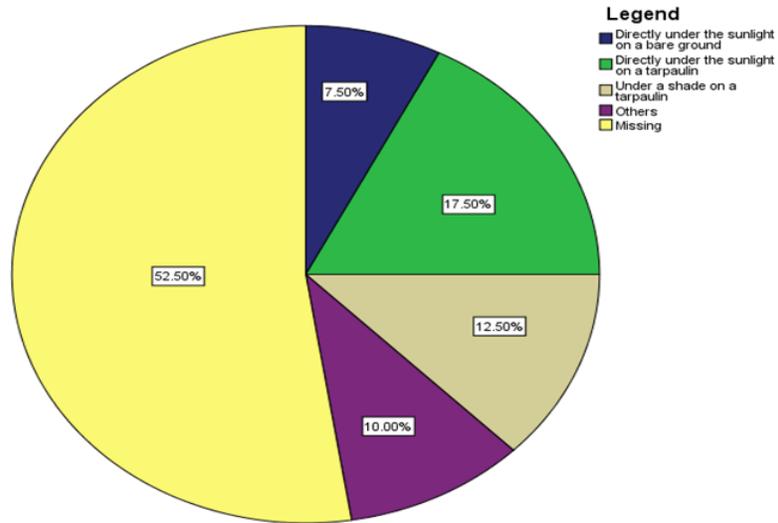


Source: field survey, 2018

4.2.4. Ways of Cashew Nut Drying by Farmers

Figure 16 depicts that over half farmers (52.5%) do not dry at all. 17.5% dry the nut directly under sunlight on a tarpaulin while 12.5% dry under a shade on tarpaulin. 7.5% also dry directly under sunlight on a bare ground. 10.0% dry under other methods.

Figure 16: Place where nut is dried



Source: field survey, 2018

4.3. Relevant Farming Practices for Cashew Nut Production

Findings from two experts on the above subject are presented below:

Use of grafted seedling from elite planting material which gives 20-30kg/tree/year for planting. “Farmers should be discouraged from using seed for planting because segregation could set in said by the researcher”.

Recommended spacing should be either 10m*10m or 12m*12m depending on soil fertility level. which give plant density of 100 or 69 trees per hectare. Trees canopies should be well maintain via either light or heavy pruning. One of the expert said ***“as a result of improper or lack of pruning a lot of cashew nuts farms in Wenchi municipality have canopies which crisscross with each other contributing to reduction in yield because fruiting occur at periphery of the tree”.***

Weed control should be done at least three times within a season (February-march, May-June, and September-October).

Insect-pest and disease control is another should be staked to if higher is to be obtained, insect like stemborers, aeroplane bugs and aphids which are prevalent in the municipality should be well managed by the farmers.

Thinning out of tree should be done be done by farmers to maintain right density of cashew trees per ha.

According to one of the key informant, farmers have notion that cashew tree does not require fertilizer application because it can even survive on marginal lands. However, trials have been done by the farm institute with some farmers to prove that application of 2.5 ton of organic or 5 bags of inorganic fertilizer(NPK 15:15:15 or 23:15:15)per ha boost yield of 5 years old trees from 4 or 5bags to 10bags during the season. The two respondents stressed that even though, research is still on going in Cocoa research institution of Ghana (CRIG) to develop the right type of fertilizer, required dosage but until that farmers who have financial capacity can buy those prescribed fertilizer for trees which are 5 years and above.

Wenchi municipality falls within forest -savannah ecological zone, creation of fire belt 2m*2m wide around boundaries of cashew nut farm should be done by farmers during dry period.

On the quality side, the respondents said picking of nuts from farm should be done every other day, and drying should be done at between 2-3 days under airy and shady environment this reduce moisture content to about 10-12%.

4.4. Consequences of Post-Harvest Handling on Quality of Nuts

Findings on consequences of post-harvest handling on quality of cashew nut by smallholder farmers in the municipality were spelt out by two key informants.

Presently, majority of farmers do not dry cashew nuts after picking from farm and reasons being that, during peak seasons buying agents rush for the buying of nuts as a result of competition making them unable to dry the nuts. Again, some farmers have fear of losing the weight of nuts which is one of the determinant of price. One informant pointed out that percentage of kernel outturn dropped from 48.7-51% generally to 45% during the middle of 2017/2018 season which lead to reduction of price of nuts.

Wenchi municipality has no one particular percentage for kernel quality, it can be category into two zones. That is communities around Tremeso, Akrobe and Amponsakrom fall between 48.7-49% while Kokroko and chinichiniso fall within 49-51%. Cashew nut from communities around Japeakrom turn to have high moisture content(35%) due to high humidity in the area so nuts from around this area have high mould or brown when quality checks were done during the season.

Senior technical officer also said that “I have observed that those farmers who opted to dry the nuts before selling do it directly under the sunlight which deteriorate the kernel quality because heat will cause the acid imbedded in the shell of the nut to dissipate onto the kernel making it useless”. Another consequence, is that during storage there is a presence of high “brown nut” which is one of the parameters for determining quality of nut which is caused by high moisture content

Bagging of nuts is not done right by a lot of farmers after pickings from the farm. During storage because some of them use nylon sacks instead of recommended jute sack which aid in accumulation of heat within the sack causing slow dripping of cashew shell liquid (CSL) onto the kernel making it useless. This cause most of the big buying companies to reject most of the nuts to avoid financial losses.

The informants suggested the following measures to curtail the fluctuation in the KOR of the nuts in the municipality

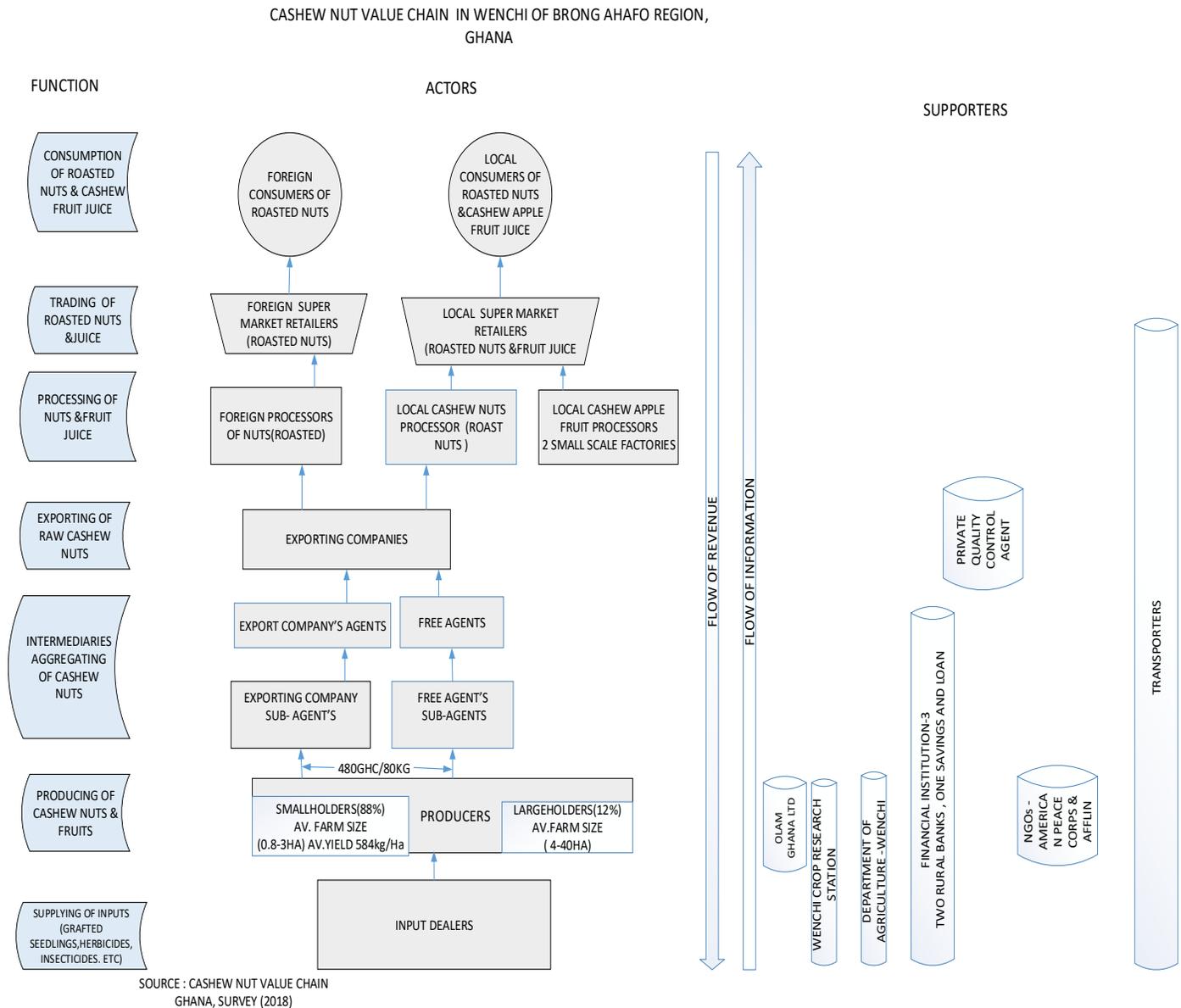
- a) Farmers should be trained on proper handling of cashew nuts.
- b) Followed by buying agents so that it will help them to handle the nuts properly.
- c) Transporter who move the cashew nut to warehouse, harbor or factory should also be trained on better nut handling. in a situation where the driver stops for a while during transporting process or when there is a breakdown of vehicle, driver is supposed to remove the tarpaulin for air to pass through the nuts.
- d) Lastly, warehouse keepers are also supposed to be trained to know how to keep the nuts in the warehouse to maintain the quality.

4.5. Challenges for Adopting Good Practices by Cashew Nut Farmers

4.5.1. Cashew nut Market Channel

Figure 17 demonstrates the various market channels through which farmers sell their nuts after harvesting and the various stakeholders in the chain.

Figure 17: Value Chain Map



4.5.2. Stakeholder Matrix

Table 7 presents various stakeholders and their roles played in cashew nut value chain in Wenchi municipality of Brong Ahafo region of Ghana.

Table 7:Stakeholders in cashew nut value chain, Wenchi municipality

S/N	ACTORS	ROLES PLAYED IN CASHEW NUT VALUE CHAIN
1.	Input Dealers	➤ Supply of grafted seedlings, cashew seed nuts weedicide, insecticides,
2.	Producer	➤ Producing cashew nuts, picking of nuts from farm, drying and bagging of nuts
3.	Sub-Agents	➤ Aggregating of nuts at village level ➤ Further drying of nuts, sorting out of bad nuts
4.	Main Agents	➤ Gathering and transporting of all aggregated of nuts from sub-agents to exporting companies' warehouse
5.	Exporting Companies	➤ Exporting of raw nuts to abroad
6.	Local Processor	➤ Processing of raw cashew nuts into roasted nuts, ➤ Processing of the fruit apple into juice
7.	Retail Super market	➤ Selling of roasted nuts and cashew apple juice
8.	Foreign Processor	➤ Processing of cashew nuts into kernel and roasted nuts
9.	Consumers	➤ Consumption of roasted nuts and juice
SUPPORTERS		
1.	OLAM Ghana Ltd (Exporting company)	✓ Supply of grafted seedlings, insecticides ,herbicides ✓ Training on good agricultural practices(GAPs), ✓ Provision of financial assistance to some farmers during the lean season
2.	Wenchi Crop Research Station	✓ Training on grafting techniques to farmers and extension officers ✓ Supply of grafted seedling to farmers ✓ Supply of scions(cutting) to farmers and general public who the cuttings for grafting ✓ Training of Extension officers and farmers on nuts quality management
3.	Wenchi Farm Institute	✓ Train farmers on GAPs and supply of grafted seedlings to farmers ✓ Disseminate best farming practices on cashew to farmers via radio programmes
4.	NGOs America Peace Corps AFFLIN	✓ Help farmers to develop farm site plan ✓ Educate farmers on GAPs ✓ Facilitate access to grafted seedlings form the research to farmers groups ✓ Train farmers on grafting techniques, good agricultural practices
5.	MOFA Wenchi	✓ Train farmers and buying agents on quality management of cashew nuts ✓ Training farmers on grafting techniques
6.	Private quality Control Agent	✓ Conduct quality checks on nuts by determining the quality of kernel before transported to companies' warehouse or exported
7.	Transporters	✓ Transporting of aggregated nuts from villages to municipal capital ✓ Transporting of certify nuts to warehouses and harbor for export ✓ Transporting of nuts and cashew apple fruit to factories for processing
8.	Wenchi Rural Bank Opportunity &Savings Ltd Akuwamang Rural Bank	✓ Give loans to individual cashew nuts farmers ✓ Train cashew nut farmers groups who have contracted loans with the bank on GAPs ✓ Offer education on financial literacy to farmers groups ✓ Provide loans to cashew nuts farmers group

Source: field survey, 2018

4.5.3. Cost of Farm Maintenance and Profit Margin

Table 8 presents the cost for maintaining a hectare of cashew nut farm during 2017/2018 season by smallholder farmers. Findings shows that, a farmer spent 1271Ghc to produce 7.3 bags of cashew nuts and Profit margin of 2233Ghc was realized by farmer during the production season.

(*1 euro=5.4Ghc)

Table 8:Cost of maintenance & profit margin for smallholder farmers per Ha Wechi Municipality, 2017/2018 Cropping Season

Maintenance cost per hectare						
Description Of Activity	Item Needed	Unit of Measure	Frequency	Quantity	Unit Cost(Ghc)	Total Cost(Ghc)
Weed Management	Herbicide	Liter	3	2	15	90
	Labour	Man/day	3	1	50	150
Insect -Pest Control	Insecticide	Liter	2	3	25	150
	Labour	Man/day	2	1	50	100
Disease Control	Fungicide	Gram(g)	2	3	20	120
	Labour	Man/day	2	1	50	100
Construction of Fire belt/guard	Labour	Man/day	1	1	120	120
Picking of nuts &detaching of nuts from fruit	Labour	Bag@80kg	1	7.3	40	292
Buying of Jute bag	Jute bag	Bag	1	8	15	120
Transporting of nuts from farm to home	Tricycle motor bike/Truck	Bag@80kg	1	7.3	3	22
Transporting of bagged nut to buying agent shop	Tricycle motor bike/Truck	Bag@80kg	1	7.3	1	7
Total Cost						1271
Gross Revenue(GR)						
Selling of Bagged nuts	Buying agent	Bag@80Kg	80	7.3	6	3504
Total Revenue						3504
Gross Profit(GP)						
GP- Maintenance Cost						2233
GP						2233

Source: field survey, 2018

4.5.4. Rank of Challenges

The table below shows wide spread challenges confronting farmers for adopting best farming practices disseminated by various developmental institutions such as MOFA, Farm institute, research station, NGOs like Africa cashew initiative, Self-help Africa, and private institution like Olam Ghana Ltd among others. Ranking of challenges were done with three farmer groups based on criteria mentioned in the chapter 4(methodology):

Table 9:Ranking of challenges faced by smallholder farmers

S/N	Challenges	1	2	3	4	5	6	Total	Rank
1.	High cost of chainsaw machine or operating cost for pruning and thinning		2	1	1	1	1	4	2nd
2.	High cost of grafted seedlings			2	2	2	2	5	1st
3.	High cost and difficulty in accessing recommended insecticides in market				3	3	3	3	3rd
4.	High time consuming in gathering of leaves and other debris under cashew trees during harvesting period					5	6	0	6th
5.	High cost of mist blower machine to apply insecticide						5	2	4th
6.	Time consuming in using rope/thread to detach nuts from fruit							1	5th

Source: field work 2018

4.5.5. Calendar for Farming Activity

Table The cropping calendar below indicates various months of the year in which cashew nut farmers perform their farming activities and this was used to determine whether the period they perform those activities coincide with major season for food crop production.

Table 10:Cropping calendar for cashew nut farmers in Wenchi municipality

N/S	ACTIVITY	MONTH											
		JAN.	FEB	MAR	APRIL	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1	Land Preparation												
2.	Planting of seed/seedlings												
3.	Weed control												
4.	Pruning/thinning												
5.	Application of Insecticide against insect-pest												
6.	Construction of fire belt												
7.	Picking of nuts from the farm												

Source: field survey, 2018

4.6. Current Production Strategies for Cashew Nut in Wenchi Municipality

The following are the responses from the three key informants for current strategies adopted by Wenchi municipal assembly to improve quantity and quality of cashew nuts.

- a) Transfer of technology on good agricultural practices GAPs cashew nuts such as pruning, thinning out, sorting out, bagging and storage, right cashew tree density to farmers via extension delivery.
- b) Supply of kernel outturn kits to two groups have received training on KOR so far to aid in determination of KOR percentage by farmers
- c) Trained some farmers and twenty buying agents of the major exporting companies such as red river fruit commodity, Olam, Ecom Ghana Ltd, Greenland commodities and Gold cost commodity on how to calculate KOR so that they can determine the quality of the nuts on the spot during transactions.
- d) Three chain saw machines which have been leasing out to farmers groups for pruning and thinning during a season.
- e) Development of hybridization plots to develop locally improved variety by the research station in Wenchi
- f) In the process of expanding scion bank from 20ha to 24ha research station in Wenchi. Elite planting material are being accessed as free of charge by farmers or organization all over Ghana. However, some amount is being taken from those bigger organization like tree Global who access large scale of scion so as to maintain the scion bank.
- g) Establishment of grafted nursery site which can contain up to 200,000 grafted seedling. This site serves farmers and organization all over Ghana
- h) The station is intended to train more extension agents and some farmers on the quality management of the nuts all over Ghana. This has been captured in 2018 work plan
- i) Established a strong linkage between extension, farmer and research center in Wenchi.

Responses from the forester showed that, the commission has not been playing major roles in the development of strategies for cashew nut production. However, indicated that forest commission of Ghana is ever ready to collaborate with MOFA, to train cashew nut farmers on how to incorporate trees like acacia or leucine tree as fire belt in the boundaries of cashew nut farms to reduce accidental fire which destroy farms during the dry period.

Acacia or leucine can be planted 3m*3m around the boundaries of cashew nut farm. Acacia and leucine do not shed leaves during dry period, the presence these trees create moisture environment, help to replenish soil nutrient especially leucine and litters from those trees are scanty to aid in spread of accidental fire. The canopy of the tree could suppress weed growth around boundaries there by reducing cost for creating fire belt during dry period where incidence of bushfires were very high.

4.7. Farming Technologies Transferred Adoption by Public Institution

The findings the respondent show that several technologies have been disseminated through MOFA, research station and farm institute to cashew nuts farmers across in the municipality since 2006 when the cashew development project was initiated.

Extension delivery techniques such as on-farm trials, farmer's field school, field days, radio programmes and workshop have been used to spread best farming practices on cashew nut production to farmers.

Technologies that have been transferred included pruning, thinning, grafting techniques, weed control (minimum 3times), construction of fire belt around the boundaries (2m*2m), use of rope or thread to separate nuts from fruit, sorting of bad nuts, drying of nuts, gathering of debris under trees during harvest period to aid in the spotting of dropped fruit under the cashew trees and regular collection of nut (1-2days). Training on calculation of kernel outturn ratio (KOR) has been introduced to two farmer groups and KOR kits have been giving to these groups as well.

Training on Pest management using two methods chemical and biological have been given to section of farmers. That is either the use of recommended insecticides (Cyperdium) or weaver ants (*Oecophylla longinoda*) depending on infestation level of insects-pests like " areoplane bugs" (*Anoplecnemis curvipes*)

Figure 18: Use of weaver ants to control insect by farmers in Buosu



Source: field survey, 2018

4.8 Current Roles Played By Private Institutions in Transfer of Gaps to Smallholder Farmers

4.8.1. Roles played by Major Actors

Exporters

Responses from the two exporting companies (Olam & Ecom Ghana Ltd) that were interviewed depicted the following findings; Olam has been providing supportive services to farmers in various communities for almost seven years.

These supports included supply of improved grafted seedlings to farmers who want to start new plantation, insecticides and protective gear to farmers who supply nuts to the company. Loan packages ranging between 500-5,000Ghc have been given to trust worthy customers during off-season every year to support farming activities.

The company had established strong collaborate with department of agriculture to train farmers on lining and pegging occasionally. Section of farmers in Akete, Awisia and Tremeso communities have been trained by the “organic unit” of Olam Ltd to produced organic cashew nut.

Ecom Ghana started buying cashew nut from Wenchi municipality since 2017 season. The company’s agent have been tasked to register 1000 farmers during last cropping season. Farmers will be offered education on good farm maintenance, safe handling and application of agro-chemical, gender issues, child labour, good environmental issues, additional livelihood like plantain sucker multiplication, training cassava cultivation & soap making via its subsidiary department called “Crop Doctor.

Processors

Two small scale processors of the chain were interviewed to find out specific roles play by their outfit to support small holder cashew nut farmers to adopt best farming practices. These respondents were from food processing unit of Methodist University, Wenchi campus and NATU Company Ltd. Findings show that, the university has been using its facility from time to time to train farmer groups from different parts of municipality. Training on agronomic practices such as pest and disease management, safe handling of agro-chemical, good farm sanitation and marketing their produce have been transferred to farmers from Wenchi, Subinso, Ayoyah and Boadu communities.

Response from NATU Company also revealed that, the only major role being played to help some section of farmers within Wenchi town is to buy cashew fruits of which hitherto were of no economic value. The company apart from making use of the fruit also link farmers who are customers to extension Agents to recommend agrochemicals and appropriate ways to apply them.

4.8.2. Roles played by Supporters

Financial institution

Findings from three banks revealed that, interest rate for cashew nut famers ranges between 26-60% and banks have been assisting cashew nut farmers with loan package between 1-3years ago. According to the banks one year loan package is given to farmers since proceeds from cashew is only realized by farmers within 3-5months a season. 9 months grace period is giving to the farmers to use the loan for their farming activities and 3 months for repayment after harvesting and finished selling the nuts.

Loans are meant for farm maintenance activities such as pruning, creation of fire belt, weed control and control of insect. Opportunity & saving Ltd offers other support services like training of good agricultural practice (GAPs) and financial literacy to farmers who have secured loans from the bank.

Conditions farmers should fulfill before they can access loan included formation of groups, cashew trees should be already in the bearing stage and group should save with the bank. Banks managers indicated their readiness to extend credit facility to other farmers if those conditions were met by farmers. Currently, some of the farmer groups in communities such as Awisia, Akete, Amponsakrom, Wurompo, Tremeso, Drobuso, Boaden, Adubie and Wuwasi have been enjoying loan package from these 3 banks in the municipality.

Table 11: Financial institution package for cashew nut farmer, Wenchi municipality

S/N	Name of bank	Interest rate (%)	Duration for repayment	Loan Duration (Year)	No. year(s) supporting cashew nut farmer with loans	No. of farmer groups enjoying loan facility
1.	Opportunity saving & Loan Ltd	36	3 months bullet payment	1	6	16 groups (270 farmers)
2.	Wenchi Rural Bank	26	3 months bullet payment	1	3	unquantified
3.	Akuwamang Rural Bank	60	3 months bullet payment	1	1	2 groups (14 farmers)

Source: field survey, 2018

NGO

The study revealed that, AFFLIN started operating in the municipality since 2017 and the target is to promote food security by training farmers on GAPs.

It has been providing support services to 10 farmer groups in Nchiraa and Botenso communities since its inception. Services offer to farmers in those two communities included training on grafting techniques, pruning, pest management using recommended insecticides and weaver ants.

AFFLIN play facilitating roles in helping farmers to secure grafted seedlings from research station in Wenchi to farmers in it operational area.

According to the CEO, their operation will last for five years and aiming to cover over 500 cashew farmers.

4.9 Factors hindering smallholder farmers from adopting farming technologies transfer by public institutions

Table 14 indicates presents findings from four agricultural extension agents (AEAs) to confirmed the underlining factors hindering smallholder farmers from adoption of farming technologies transferred by public institution.

Table 12:Un-adopted technologies and reasons behind

N/S	TECHNOLOGY	REASONS FOR NOT ADOPTING TECHNOLOGY
1.	Recommended planting distance	<ul style="list-style-type: none"> ❖ Time consuming in lining and pegging ❖ Encourage high weed growth which add extra cost to the farm expense
2.	Thinning out	<ul style="list-style-type: none"> ❖ High rate of weed growth ❖ High operation cost
3.	Use of grafted seedling	<ul style="list-style-type: none"> ❖ Accessibility to seedlings that is farmers had to travel to a long distance in getting the seedlings ❖ Farmers find it expensive ❖ High maintenance cost compare to use of seed
4.	Use of rope to detach the nuts from fruit.	<ul style="list-style-type: none"> ❖ High time consuming
5.	Drying of the nuts to the recommended time interval of 2-3days	<ul style="list-style-type: none"> ❖ Fear to lose a lot weight of the nuts ❖ Buying agents especially sub-agents are the cause for giving farmer space to dry the nuts after picking from farm. some of them because of competition to buy more nuts even follow the farmers' to their farm to buy the nuts
6.	Sorting out of bad nuts from the good ones	<ul style="list-style-type: none"> ❖ Farmers do not see the need for adopting this technology because the buyers are willing to buy everything during the season ❖ Time consuming for separating the nuts into various sizes

Source: field survey, 2018

CHAPTER FIVE: DISCUSSIONS OF FINDINGS

5.0. Introduction

This chapter gives an in-depth discussion on current farming practice, relevant farming practices, consequences of post-harvest handling on quality of cashew nuts, current production strategies for cashew nut production, and widely adopted and un-adopted best farming technologies by smallholder cashew nuts farmers. Outcome of findings from survey on small holder cashew nut farmers, key informants, focus groups, major actors, financial institutions and NGO was linked with the evidence reviewed from the literature. This would then be interpreted based on likelihood and contradictions from literature.

5.1. Current Farming Practices

From the findings, substantial number of farmers established the existing farm with seed nuts which could be the cause of low average yield and quality of nuts. Due to inadequate knowledge, physical and financial access to improved grafted seedlings farmers resorted to picking seeds from friends or relative farms for planting. This could be the cause for low yield (584kg/ha) because those seeds may be already infested with disease and pest. Desai et al., (2010) confirms that seed propagation results in vast changes in seedling progeny. Few farmers that used grafted seedlings might have appreciated the benefit or can afford to buy it.

Majority of farmers sourced their planting material mostly seeds from either a friend or relative. This implies that farmers did not access planting material from the right source such as research station and other certified source in the municipality. This may be caused by major factors such as inaccessibility in terms of financial, physical and low educational level of the farmers. Section of farmers that sourced planting materials from input dealers might have recognized the benefits of obtaining planting material from a good source. ref

Most farmers control weeds growth 2 times within a cropping season which may be a contributing factor for low yield because of competition for nutrient from weeds. Weed control can be done 3-5 times depending on the environment and cropping methods (Aliyu, 2010). Farmers did not adhere to recommended way of weed control because some of them have notion that cashew crop can survive in adverse environmental conditions and therefore no need to spend resource keep weeds under control. Depend on extent of weed attack, 60-70% yield reduction can occur (Kalaivanan & Sarjo, 2017). Generally, farmers used herbicide (glyphosate) to check weed growth because it is cheap, easy and effective against harmful weeds compared to manual control. However, spillage from glyphosate onto dropped cashew fruit may occur because high weed growth coincides with harvesting period and this could affect quality of fruits and nuts. Rosenberger et al., (2010) droplets from glyphosate onto Apple fruit during weed control could result in internal browning during storage.

None of the smallholder farmers managed soil nutrient and this was caused by unawareness on the need to replenish lost soil nutrient, lack of technical know-how, high cost of fertilizer and unavailability of recommended fertilizer. Some farmers have view that cashew tree does well on unproductive land hence no need to apply fertilizer. This could be one of the sources of low quantity for cashew nut produced in the Wenchi municipality. According to one of the key informants, field trial conducted by Wenchi farm institute proved that application of organic fertilizer at a rate of 2.5 tons/ha or NPK(15:15:15 or 23:15:5) 5 bags/ha proved to increase yield from 5 bags to 10 bags for trees of 5 years and above. Although, cashew tree could thrive in low quality soil, but for yield to be improved, consistent use of fertilizer is required for trees of 4 years onwards and this can be done in split dose from May-June, N 250g: P 65g : K 65g per tree and this is repeated in Sept-Oct (Agricultural farming, 2018)

Largely, insect-pest infestation was common in the farmer's fields. Prevalent of common insects such as stem borer, aeroplane bugs and caterpillars coupled with improper pest management could cause cashew trees to die off or become unproductive. Hence, low quantity of cashew nut produced by farmers in Wenchi municipality. The rest of the farmers that did not experience any of the insect attack might have done good agronomic practices. ref

Enormous number of farmers do not access extension services at all which may be caused by notion that cashew plant does not require any special attention and so no need for advice on its production. Again, due to limited number of extension agents, some farmers struggle to get access to agricultural extension agents. Anik & Salam, (2015) had established that extension services have a positive impact on technology adoption by farmers and introduction of new practices requires extra care from an extension agent than the old practices.

Farmers' low educational level may also be the cause of not realizing the importance of advice on good agronomic practices. Educational background of farmers influence their attitude and thinking making them able to scrutinize benefits link to recommended practices (Akinbobe & Bamire, 2015). This could lead to choice of improper farming practices which in turn affect farmer's productivity.

Majority of the respondents confirmed that they did not plant the required number cashew nut trees. This could be one of the setbacks for achieving desirable quantity and quality. Based on field observation of one farmer's field, the number of trees were roughly as high as 200 trees/ha causing overcrowding. This contradicts the standard of 100 or 69 trees per ha. Crisscrossing of canopy could be one of the causes of low yield. This might have been caused by reasons such as inadequate knowledge at the time of planting, as a weed control strategy and intention to get high quantity per ha.

Pruning technology has been well adopted by a lot of farmers which is a good indicator that could scale up production. This is confirmed by Wongnaa, (2013) that most farmers have accepted pruning technology in Wenchi municipality. However, some section of farmers indicated challenges they go through in performing this operation. These included high operational cost and difficulty in getting financial access to chain saw for this practice.

Most of the farmers have adopted thinning technology after planting trees so close to each other during the initial planting. However, farmers who have not accepted this innovation stated that they use this as a strategy to suppress weed growth, intentions to use dense trees to obtain higher yield, and due to lack of financial means to render services of chainsaw operator. This practice causes overcrowding which creates an avenue for infestation, disease and low quantity of nuts.

Insufficient standardization along the cashew nut value chain could lead to unsustainability of cashew business in Wenchi municipality as majority of farmers do not dry nuts after collection from farm. Reasons given by farmers were that, fear to lose weight of the nuts because it is one of the determinants for raw cashew nut price. Farmers also indicated that, because of high competition among buying agents during a season, especially sub-agents at the village level follow them to farm to buy the nuts. This coercion from agents do not allow farmers to dry the nuts, after picking from field. This normally led to general reduction of kernel quality causing price to drop during the season particularly between April- May where rainfall intensity is high. During that period, farmers do not do regularly pick nuts from their farms coupled with absence of drying causing deterioration of nut quality. Cashew nuts ought to be collected under the trees regularly prevent insect-pests from destroying it (Sinan & Zoumana, 2017). Few farmers that do the drying of nuts put them directly under sunlight causing it to decrease in kernel quality. Extreme temperature on nuts could cause the acid under the shell to leak into the kernel thereby blemishing the quality (Akoto-Gyedu et al.,2014)

5.2. Relevant farming practices against current farming practices by smallholder farmer

As depicted in the table 14 this section dealt with current practices of farmers as compare to standard practices and the detail is describe below the table

Table 13:Current farming verses recommended practices

S/N.	Current farming practices	Recommended practices	Difference in practices Yes/No	Impact (+/-)	Observation	Risk	Cost	benefit
1	Use of cashew seed nuts (Farmers 85%)	Improved grafted planting material	Yes	-.	Yield(5.8kg/tree/year)-av.(584kg/ha)against (20-30kg/tree/year)-av.(2500kg/tree/year)	Low yield Low income for farmers	High	High
2.	unapproved distance (Farmers,92%)	planting distance 10m10m or 12m*12m	Yes	-	200 or more trees per/ha against 100 or 69trees/ha	Low yield Pest & disease infestation	High	High
3.	Pruning (farmers70%)	Pruning	No	+/-	Some field well pruned Others were not	Low yield Pest &disease infestation	Medium	High
3	Weed control 2×(Farmers,60%)	3-5times weed control	Yes	-/+	High weed growth	Low yield Pest & disease infestation	Medium	High
4.	Thinning (Farmers,52%)	Thinning (100 or 69tree/ha)	No	+	Section field have required tree/ha	Low yield Pest & disease infestation	High	High
5	No Fertilizer Application (farmers100%)	4tons organic fertilizer/ha or 5bags/ha NPK(15:15:15 or 23:15:5)	Yes	-/-	Low yield(5.8kg/tree/year)	Low Yield Flower abortion	High	High

6.	Construction of fire belt(2m*2m) (Farmers 92.5%)	Construction of fire belt(2m*2m)	No	+v/+v	Farmers experience fire outbreak (37.5%) Reduction in fire outbreak	Accidental fire can destroy farm	Medium	High
7	Picking of nuts (1-3day) (farmers 90%)	Picking of nuts (1-3days)	No	+/+	Reduction in nuts thievery Maintain nut quality (firm shell)	Deterioration of nut quality reduction in nut price	Medium	High
8.	Nut drying (1-3days) (Farmers 47.5%)	Nut drying (2-3days)	No	-/+	Quality of kernel drop (48-45%)	Reduction of nut quality Mould growth	Low	High

Source: field survey,2018

The table above was used to compare the ideal practices for cashew nut production as against current farming practices of farmers using indicators such as difference in practices, impact, risk, cost and benefit associated with farming practices. For instance, cost for buying elite planting grafted seedlings and its maintenance on the field may seem to be costly presently but benefit connected to it is enormous compare to the current situation where a farmer can just harvest 7.3 bags @80kg/ha/year when the age of the tree is 5years upwards. Comparatively, a farmers can harvest twice with quality nut when using the improved seedlings. According Gyedu-Akoto et al. (2014) nut from unimproved planting materials have a weight of 4.1-6g which is small in size making it not to receive a premium price from exporters. However, Aliyu,(2010) indicated that quality nut should have a weight of 6-13g.

Based on the findings, the order of importance of ideal practices are as follows:

1. Use of elite grafted seedlings
2. Recommended spacing
3. Soil maintenance
4. Pruning and thinning
5. Regular picking and drying of nuts
6. Proper weed control
7. Construction of fire belt.

5.3. Consequences of Post-Harvest Handling on nuts Quality

Consequences associated with post-harvest handling of nuts in cashew value chain cannot be over emphasis. Quality of nuts count, kernel out turn and desirable moisture content could only be achieved if proper drying of nuts is done by farmers.

As majority of farmers do not dry nuts after picking from the farm, nut could grow mould during storage there by reducing the kernel quality. A lot of nuts from Brong Ahafo region fall outside the standard moisture content(10-12%) and, this is caused by high humidity in the area and inadequate drying by farmers(Gyedu-Akoto et al., 2014). Section of farmers who dry the nut, do it wrongly by placing the nuts on bare ground under hot sunlight. This could cause acid in the shell to melt onto the kernel making it unwholesome. Out-turn is a common platform use to analyze the quality of cashew nuts by all market players worldwide (ACi, 2010). Danger associated with this could be the general reduction in quality kernel in Wenchi municipality as time goes on. Preferably, drying of nuts could be done on a tarpaulin, polythene sheet and clean concrete floor under a shady airy environment for 2-3 days

Prices of nuts during the seasons fluctuate (3-9Ghc/kg) and lower prices usually occur in mid-season (April-June) where rainfall becomes intensive. This could be attributed to high moisture content of nut because during this time farmers do not pick nuts regularly from field. Absence of drying by farmers could causes nuts to deteriorate leading to drop in prices. Of course price drop might have caused by simple demand and supply but quality nut play a major role in price determination by the traders.

Some farmers store nuts in polythene or nylon sacks which contribute to the spoilage of nuts. These bags buildup heat in the sack which could cause the acid to gradually drip onto the kernel leading to drop in quality during a season. It could also cause “browning” of nut or mouldy especially if moisture content is very high (18-35%). Best sack for storage of nuts is jute sack since it is well perforated which allow air circulation to reduce heat and moisture accumulation (Cost & Bocchi, 20017)

5.4. Challenge for adopting good agricultural practices

Smallholder cashew nut farmers in their quest to adopt or practice a technology confronted with challenges. For instance, production cost is associated with inputs such as hired labour, and insecticides which hinder some farmers to practice improved technology. Various challenges in agricultural, socio-economic and ecological encountered by small holder farmers in their rural areas could be answered by innovations (Langat et al., 2014). Achievement of quantity and quality of cashew nuts rely on the use of improved inputs in addition application of technology by farmers.

Based on challenges enumerated by three farmer groups (Table 7) could be broadly grouped into on-farm and off-farm. On-farm challenges hinder farmers from applying a technology smoothly and these included, time consuming for gathering of debris under cashew tree to aid easy spotting of dropped nuts and use of rope/thread for detaching nuts from fruit. On the other hand, off-farm challenges are the organization of necessary inputs that could enhance adoption of technology by farmers and these also included; expensive grafted seedlings, high cost of chainsaw machine/operating cost for pruning and thinning, high cost of mist blower machine and insecticides. All these might have contributed to low quantity of nuts produced by farmers leading to insufficient nuts in the chain.

Again farmers' annual income might be a precursor for adoption of an innovation. Based on the calculation (table14), its cost a farmer 1271Ghc to maintain a hectare of cashew nut farm during the 2017/2018 season. Farmer's gross profit was 2233Ghc this income included family labour and should family labour cost be deducted from the gross profit it would be left with meager income. Diiro (2013) confirms that off-farming earnings of farmers stimulate acceptance of improved methods of farming. Since revenue from cashew nut production is on annual basis, and production is last for at most six months, farmers who depend solely on proceeds from cashew nut could have nothing left to organize the needed inputs for next season. Farmers with high dependency ratio could be a barrier farmers from reserving money to buy the needed inputs for next season. This could prevent farmers from practicing a technology which could lead low quantity and quality nut production.

Timing of operating a technology could also pose a challenge to farmers. For instance, if pressing need such as food need of a farmer is not met, all the attention will be on activities for food production to the detriment of other crop production. Based on general cropping calendar (Table16) in Wenchi municipality, most of the farming activities for cashew nuts coincide with activities for food crop. For example, picking of nuts coincide with land preparation for the major season. This may prevent farmers from performing certain activities for cashew nut production causing delay in the operation.

5.5. Current production strategies for cashew nut production in Wenchi Municipality.

As a means to improve quantity and quality of cashew nuts various technologies and measures have been put in place by development agencies in Wenchi municipality. Presently, institutions such as department of agriculture and crop research station play key roles in the development of crucial production strategies for cashew nut sub-sector.

Transfer of technical-know how on good agricultural practices (GAPs) on cashew nuts to farmers through extension delivery services. Extension agents play a middle role in the transfer of technology from the researchers to farmers. However, from field observation, number of AEAs (4) used to covered extension delivery technique was are limited to do effective dissemination. As a result of this challenge faced by department of agriculture in the municipality, many farmers might not receive training or information on benefits of an innovation to make them appreciate its importance. These could impede adoption of best practices by farmers which could lead to negative effect on nut quantity and quality.

As a means to enhanced quality management of nuts, two farmer groups and twenty buying agents from bigger exporting companies have been given training on how to calculate kernel outturn (KOR). In addition to training, KOR kits have been distributed to those trained group of farmers to boost their understanding on how to measure quality of their nuts during a season. This could help them to know the grade for their kernel so as to help them to negotiate for price during transaction. But, this training covered just a few section of farmer groups leaving large number of groups at the mercy of some of the buying agents that turn to hide the actual price of a nut due to knowledge gap of farmer.

In order to improve pruning/thinning techniques, 3 chain saw machines have been procured by department of agriculture which have been given out to farmers groups for pruning and thinning during the season. This could facilitate adoption of a technique by farmers but is also limited to few farmers considering the large number of cashew nut farmers in the municipality.

It worth researching into appropriate technologies that could ensure sustainable production of cashew nuts. Researchers in Ghana, are yet to develop hybrid cashew variety. Currently, researchers have device means to select good performing germplasm (accessions) which have been used for grafting. Grafted seedlings are raised from nursery site in the Wenchi research center with capacity of 200,000 seedlings which serve farmers from all over Ghana. This is inadequate because farmers in Wenchi town alone who want to establish a new plantation could not been sufficed looking at large number of farmers in the municipality. This could prevent farmers from getting smooth access to improved material making farmers to rely on poor planting material for planting.

Research station has established twenty hectares of scion bank with elite material to augment the supply of improved planting material to farmers across Ghana. Elite planting materials were careful selected accessions form different part of the country and have been studied via trials to determine good performing material. According to research station manager, these materials give nuts with uniform size, same fruit colour, high amount of juice for those who want to process cashew apple, yield of 20-30kg/tree/year, and no segregation of progeny. Most farmers may not have knowledge in grafting techniques hence cannot take advantage of this facility. Again, many farmers may not be aware due to few AEA to create awareness on this facility. There is a link between researcher center, extension service and farmers. But effectiveness of this linkage could not be ascertained because majority of farmers via the survey were not aware of this opportunity. Again, data to back this claim could not be substantiated with from the respondent.

5.6. Technologies transferred by public institutions

Among these innovations were introduction of grafted seedlings which are high yielding than seed type. This has the tendency to increase quantity and quality of nuts at the producer level. However, because this technology comes with extra care, majority of farmers feel hesitant to adopt this resulting in farmers still resorting to use of seeds for planting associated which is low yield.

Recommended spacing of 10m*10m or 12m*12m has been spread out to farmers to improve nut quantity and quality. This technique depending on the quality of soil nutrient, a farmers can either plant 10m*10m or 12m*12m to obtain 100 or 69 trees/ha. This could aid in reduction of heavy pruning and avoidance of thinning thereby eliminating cost associated with pruning/thinning. Farmers who opt to use his activity usually use 10m*10m for reason being that large spacing leads to excessive weed growth with it attendant high cost of weed control. Majority of farmers do not adhere to this technology because of a lot of weed coverage.

At least 3 times weed control aid in reduction in spread of pest and disease, avoid competition with nutrient and space. However, most farmers perform this 2 times a year, probably due to widespread use of glyphosate which tend to be effective and cheaper than manual weed control which kill weeds outright hence weed emergence takes quite a long time to start. Effective weed control could help farmers to identify clearly dropped fruit under trees during harvesting period to avoid losses of fruit.

Since bush fire is rampant in Wenchi municipality because of its location in transitional ecological zone, how to construct fire belt around boundaries (2m*2m) has been transferred to farmer via field trials. This is widely adopted by farmers to prevent accidental fire from destroying their farms. Some farmers also do not create fire belt due to the high cost involved.

To ensure quality nut production usage of rope has been transferred to farmers to detach nuts from the fruit smoothly without leaving remnant on the nuts. Separation of nuts from fruit if it is not done well can destroyed nut quality because leftover on nuts serve as entry point for pathogen to enter the kernel. Majority have resorted to hand twisting of the nut because according to the farmers their method is faster than using rope/thread. Sorting out of bad nuts help to maintain quality nuts along the chain as well as increase price of nuts for farmers. Mostly, famers do not carry out this because of pressure from buying agents to buy the nuts during the season. Drying of nuts is necessary if kernel quality is to maintain along the value chain. But most farmers do not perform this operation due to fear to losing weight of their nuts as well as sub-agents in their bid to buy more nuts rush for buying of nuts which do not encourage farmers performing this activity. Pricing of nut is influenced by atmospheric conditions,

farming practices, and period of nut collection. Due to insufficient kernel quality, nut from West Africa countries usually attract low prices basically caused by poor post-harvest handling (ITC, 2011)

Education on gathering of debris under trees during harvest period is way of helping farmer to get access to dropped fruit easily so as to avoid losses but farmers find it laborious and time wasting to do this activity.

Calculation technique on kernel outturn (KOR) has been also introduced to two farmer groups together with KOR kits. The purpose is to make farmers aware of quality of nut they produce so as to bargain well for better price from buying agents. This knowledge could help to sustain nut quality but this technology is limited to few farmers.

Insect-pest management play a major role in determining the quantity and quality of nut produce by farmers. Two ways of controlling insect-pest have been disseminated to farmers via field schools, trial and field demonstrations. Use of recommended chemical (Cyberdium) and weaver ants (*Oecophylla longinoda*). As of now, cyperdium is most common in the market. It use could be the fastest way to control insect like aeroplane bugs, stem borers, aphids and caterpillars which are common in the municipality. Nevertheless, excessive use or wrong application could reduce quality of nuts and fruit especially during the harvesting period.

Farmers prefer to use biological means of control (weaver ants) because it is ease to acquire their colony either from a friend or relative to introduce them to their farm. According, Anto et al. (2015) introduction of weaver ants help cashew nuts yield go up (78-151%) compared to trees with no ants.

5.6. Current roles played by private institutions in the transfer of GAPs to smallholder farmers

Roles played by private institutions was segmented into major actors and private supporters of the chain. Harmonization between value chain actors is important to produce different agri-food that is acceptable to consumer in a manner that ensure food quality and ecological safety (FAO, 2016).

As a result of scanty resources available to public institution like MOFA, role play by private institutions in cashew nuts value is very necessary to augment the effort of MOFA to transfer technologies to farmers. Major exporting companies that operate in Wenchi municipality are OLAM, Ecom, Red river fruit and Greenland commodities.

Current, it is only OLAM Company, has been supplied grafted seedlings to over 6,000 farmers who wants to expand their farm since seven year now and these farmers are customers of the company. Loans have been given to farmers to buy inputs during the beginning of the season. Training on farm maintenance practices have been transferred to farmers via collaboration with MOFA.

Ecom Ghana Ltd has begun registering farmers who are customers to offer support services. Via the unit in the company called "Crop Doctor" training will be giving to farmers on good farm maintenance, appropriate application of agro-chemical, gender issues, child labour, and good environmental maintenance. These efforts could contribute to enhancement of yield and quality of nuts produce by small holder farmers.

MUCG and NATU processing companies have been helping farmers to adopt GAPs. For instance, food processing unit of MUCG has been using its facility to organize training workshops for group farmers from different parts of the municipality periodically. Training on best practices such as pest and disease management, safe use of agro-chemical, good farm sanitation and how to market their produce have been transferred some farmers in Wenchi, Subinso, Ayoyah and Boadu communities. NATU Company also link farmers who are customers to extension Agents to

recommend agrochemicals and appropriate ways to apply insecticides. These could help to ensure sufficient nut and quality nut in the chain.

Three Banks and NGO which were classified as private supporters also support farmers to adopt best farming practices. These banks were Opportunity international savings and loan Ltd, Wenchi and Akuwamang Rural bank. These banks have been offering loan at different rate (26-60%) to support farmers. Apart from loan services, opportunity savings and loan Ltd. via its agricultural unit has been extending training on GAPs and financial education to farmers (customers) occasionally. The high interest rate from some of the banks could make a farmers not to get enough income to save for inputs during the next season. It could also deter some farmers to access loans from some of the banks.

AFFLINK an NGO operates in two communities (Nichraa and Botenso). 10 farmer groups so far have been receiving training on seedling management and pest and disease control, and also facilitate access to grafted seedlings form research station to farmers.

5.7 Factors hindering smallholder farmers from adopting farming technologies transfer by public institutions

According to the Agricultural extension agents, factors preventing farmers from not adopting technologies transferred by public institutions . Those reasons were time consuming, high cost, and high weed coverage. The most important technologies among them are use of improve grafted seedlings, planting distance of 10m*10m or 12m*12m ,drying of the nut and sorting which have direct bearing on quantity and quality of nuts produced in the municipality.

These reinforced challenges given by farmer groups during the FDG as well as result from the survey. These could have negatively impact on quantity and quality of nuts produced by smallholder farmers. According to Heanue et al. (2012), regardless of any advantage associated with a technology time factor of an innovation, cost, benefit and easiness of application of technology have influence on acceptance of technology by farmers as well as could prevent farmer from adopting a technology

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.0 Conclusion

Based on the discussion, it can be confirmed that there are inconsistencies in majority of current farming practices adopted by small holder farmers compare to recommended practices. Most farmers used unimproved planting materials to establish their plantation and, also secured planting materials from uncertified sources caused by physical and financial access. Weed control is not sufficiently done and heavily use of herbicides can cause spillage unto dropped fruit. None of the farmers do soil fertility maintenance as a result low knowledge in it benefit. Insect-pest attack was pervasive and there was inadequate control measures. Farmers do not seek extension advice on GAPs, recommended plant spacing is not widely adopted and drying of nuts is virtually absence. Among the gaps mentioned the most ones which need urgent attention are unimproved planting material, lack of soil maintenance and inadequate insect-pest control

For the post-harvest handling, the bottlenecks identified have consequences on kernel quality where there was reduction from 48.5 -51% to 45%

From FDG, the main challenge for adopting GAPs is cost of practicing these practices. These were High cost of grafted seedlings, chainsaw machine/operating cost, high cost of insecticide and difficulty in assessing it in market, high cost of mist blower, high time consuming on the use of rope to detach nuts from fruit and gathering of debris under trees during harvesting. Gross margin of 2233Ghc per annum and timing of operating some of the activities coincide with other activities that ensure farmer' household food security. These were challenges confronting small holder farmers for adopting technologies smoothly.

In term of current production strategies, the capacity of two public institutions is insufficient . These are seen from the following; limited AEAs (4) to transfer technologies on GAPs to small holder farmers, training on KOR to only two farmer groups, low nursey site capacity (20,000 grafted seedlings/yr.), hybridization process to develop cashew nut variety long overdue, pruning material inadequate only three chainsaw machines to facilitate pruning/thinning and no proper records on the small holder cashew nut farmers in the municipality.

Certain technologies such as soil maintenance programme, incorporation of useful trees in cashew plantation and training on KOR determination were not seriously spread to farmers by the two public agencies (MOFA and research service) spearheading activities in cashew nut value chain.

Currently, only few major actors extend supportive services to smallholder farmers to adopt GAPs.

There is a gap on the part of financial institutions on due to high interest rate (60%)which is deterring farmers from accessing credit.

Difference in current yield of 6 kg per tree and standard of 20-30kg per tree per year is 14-24kg which is so huge. But based on both literature and research findings, if farmers applied GAPs and institutions perform their task accordingly yield could increase by 30% for the exiting plantations.

6.1.

Recommendation

Based on the inference, for desirable quantity and quality of cashew nut to be achieved in Wenchi municipality and Ghana in general the, two phases of action ought to be considered by MOFA.

Phase one

First priority must focus on existing cashew nut plantations and based on this, the following measures must be effected by MOFA.

Gaps in the current farming practices

- ❖ Fertilizer programme should be introduced to the cashew nuts production and this can be captured under ongoing “planting for food and jobs “fertilizer subsidy programme to enable farmers to get access to both organic and inorganic fertilizer to enhance soil fertility.

Consequences of post-handling on cashew nut quality by smallholder farmers;

- ❖ There should be stakeholder engagement that will focus on enforcement of standardization of the cashew nut quality along value chain
- ❖ Training on how to determine kernel out turn should be intensified and more KOR kits should be extended to more farmer groups. Again, more agents for exporting companies should be trained so that they will become abreast of the calculation of kernel quality.

Recommendation for challenges hindering farmers for adopting Technologies are as follows

- Introduction of mass spraying programme to control insect-pest every season where farmers should be supplied with mist blower spraying machine and recommended insecticides.
- Existing farmer groups (29) should be strengthen and additional ones should be formed.
- Between 10-15 members for each group should manage one mist blower machine as well as number of liters for recommended insecticides depending on farm size of the group. Simple hand pruning equipment which is cheap and easy to use could be introduced to farmers whose plantation is not older than 10 years.

Phase two

This phase concentrated on actions that will aid in smooth adoption of technologies and establishment of plantation by farmers who want to expand or go into new plantation. This is centered on current production strategies and roles played by private institutions

Based on the limitation of Current production strategies and technologies transferred by the public the following are recommendation made;

- ❖ Strong database of smallholder cashew nut farmers in the municipality should be developed and should be captured via the on-going agricultural census by the municipal Assembly.
- ❖ Training on grafting techniques should be intensified by research center, farm institute and MOFA to enable farmers who want to expand their farm to develop their own grafting planting material using elite material in the scion bank.
- ❖ MOFA should collaborate with forest commission of Ghana to train smallholder farmers on how to incorporate trees like acacia or leucine tree as fire belt on the boundaries (3m*3m) of cashew nut farms to reduce accidental fire as well as wind breaks.
- ❖ Radio programme should be organized more by MOFA to spread information on GAPs much faster and wider coverage to farmer.
- ❖ Grafted seedlings should be subsidized by MOFA to reduce the financial inaccessibility
- ❖ Research station partner with private seedling dealers to extend nursery site to major communities around Wenchi to reduce the cost of travelling long distance to buy improved grafted seedlings by farmers.

On part the roles played by private institutions the recommendation is as follows:

- ❖ MOFA should coordinate fully the activities in of the chain for now by facilitating stakeholder engagements to bring on board other major exporting companies to also help farmers to adopt GAPs.

REFERENCE

Abu R., Dardaka, Adham K.A. (2013). Transferring Agricultural Technology from Government Research Institution to Private Firms in Malaysia (e-Journal). Available at: www.sciencedirect.com. Accessed on: 5/9/18

ACI(2013). Promoting Competitiveness of African Cashew Farmers: Ghana Country Report(PDF). Available at:www.africancashewinitiative.org. Accessed on:10/5/18

ACI (2012). Estimating quality of raw cashew nuts(Pdf). Available at: www.africancashewinitiative.org/imglib/.../ACI_GH_CASHEW%20QUALITY_2012. Accessed on:29/9/18.

ACI (2011). Steering Committee Meeting Documentation (PDF). Available at: www.africancashewinitiative.org. Accessed on: 5/8/2018

ACI (2010). Value Chain Analysis of the Cashew Sector in Ghana (PDF): Available at: <http://star-www.giz.de/dokumente>. Accessed on 6/8/18

Adegbija D. (2018). Strategies to boost the production of cashew nuts in Nigeria (online) Available at: <https://infoguidenigeria.com/production-cashew-nuts-nigeria/> Accessed on: 5/9/18

Adjei-Frimpong E. (2016): The Story behind Cashew Production in Ghana (online). Available at: www.gardja.org/story-behind-cashew-production-ghana. Accessed on 5/4/18

Agricultural farming (2018). Cashew farming detailed information guide (online). Available at: www.agrifarming.in. Accessed on: 22/9/18

Ajayi, O. C., & Place, F. (2012). Policy Support for Large-Scale Adoption of Agroforestry Practices: Experiences from Africa and Asia. In P. K. R. Nair & D. Garrity (Eds.), *Agroforestry: The Future of Global Land Use* (Vol. 9)

Anato, M. F., Wargui R, Sinzogan A.A.C. , Joachim O., Adandonon A, Vayssie`res J.F, & Dansou K.K. (2015). Reducing losses inflicted by insect pests on cashew, using weaver ants as efficient biological control agent. *Agric. (e-Journal)* Available at: www.researchgate.net/publication/314519909. doi: 210.1111/afe.12105

Akinbobe W.O. & Bamire A.S. (2015). Determinants of adoption of improved maize varieties in Osun State, Nigeria (e-Journal). Available at: www.academicjournals.org/JAERD. DOI: 105897/JAERD2014.0605. Vol 7

Anik A.R, & Salam M.A. (2015). Determinants of adoption of improved onion variety in Bangladesh (e-Journal). Available at: www.jaeid.it/index.php/JAEID/article/view/259/145. DOI: 10.12895/jaeid.20151.259

Ashitey E.(2012). Ghana Cashew nut industry is growing(PDF)
Bellemare & Marc F. (2012). "As You Sow, So Shall You Reap: The Welfare Impacts of Contract Farming?"(Journal). Available at: www.ideas.repec.org/a/eee/wdevel/v40y2012i7p1418-143. doi: 10.1016/j

- Beshir H. (2014). Factors affecting adoption and intensity of use of improved forages in north east highlands of Ethiopia (Journal). Available at: www.sciencedomain.org. Accessed on: 5/8/18
- Braada, R. (2014). research Methods power point presentation (VHL lecture notes)
- CBT (2013).Ministry of Agriculture, Food Security & Cooperatives. Draft Cashew nut Industry Strategy (PDF). Available at: www.tzdp.org.tz/.../Cashewnut_Industry_Strategy_11_August_2013_Draft. Accessed on: 2/09/18
- CDP (2000). Status of Ghana Cashew Industry (PDF). Available at:www.afdb.org/.../Ghana_-_Cashew_Development_Project_-_Appraisal_Report. Accessed on: 24 /3/18
- Challa M. & Tilahun U. (2013). Determinants and Impacts of Modern Agricultural Technology Adoption in West (Journal). Available at: www.grin.com/en/e-book/280336/determiningfactors-and-impacts-of-modern-agricultural-technology-adoption. Accessed on: 5/8/18
- Climatic data for Wenchi municipality (online). Available at: www.Climate-data.org. Accessed on: 28/9/18
- Cost S. & Bocchi S. (2017). manual for small scale cashew cultivation in Sierra Leone(PDF). Available at www.researchgate.net/publication/313792965. Accessed on: 3/9/18.
- Dedzoe C.D, Senayah J.K, & Assiamah RD (2001) Suitable agro-ecologies for cashew (*Anacardium Occidentale L.*) production in Ghana. Available at: www.ajol.info/index.php/wajae/article/view/45566 accessed on: 15/4/18
- Demang F., Salengke & Brasit N. (2018). The Strategy to improve the Quality of Cashew Commodities (e-Journal) Available at: www.doi.org/10.22161/ijeab/3.1.3. Vol.3. Accessed on: 5/9/18
- Desai A. R., Singh S.P., Faleiro J.R., Thangam M., Pryia Devi S., Safeena S.A & Singh N. P. (2010). Techniques and Practices for Cashew Production (PDF) available at: www.ccari.res.in/TB%20No.21.pdf. Accessed on 28/8/18.
- Diirro, G. M.(2013). impact of off-farm income on Agricultural technology Adoption intensity and productivity(PDF) Available at : <https://pdfs.semanticscholar.org/9974/3ecd1ce61b8c8c5bd3a9c960c6a8e277ba9f.pdf>. Accessed on :6/9/18
- FAO (2016).Public–private partnerships for agribusiness development a review of international experiences (PDF). Available at: www.fao.org/3/a-i5699e.pdf. Accessed on: 7/09/18
- FAO (2009). FAO Quarterly Statistical Report(PDF). Available at: www.searchworks.stanford.edu/view/479210. Accessed on: 3/09/18
- FAO (2003).Development of a Framework for good agricultural practices(PDF) Available at: www.fao.org/docrep/pdf/010/ag856e/ag856e00.pdf. Accessed on:10/9/18
- Fitzpatrick, J. (2010). "Quality characteristics of Cashew nut" A survey compiled for CBI (PDF). Available at: www.CBI.eu/disclaimer. Accessed on 10/9/18.
- FMCI (2007). Meeting the quality requirements of cashew nuts. A paper delivered at a seminar on “Repositioning Cashew for Economic Growth and Development” Available at: <https://docplayer.net/85955231-Promoting-the-production-of-cashew-shea-and-indige>. Accessed on: 4/8/18

Frank, J. & Buckley, C.P. (2012). Small-scale farmers and climate change how can farmer organizations and Fairtrade build the adaptive capacity of smallholders? (PDF). Available at: pubs.iied.org. Accessed on: 5/4/18

GEPA (2018)cashew export rake (online) .Available at: www.gepaghana.org

Graham M., Kaboli D., Sridharan M. & Taleghani S. (2012).Creating Value and Sustainability in Agricultural Supply Chains: Models for Delivery of Crop Improvement Services to Smallholder Farmers in Africa (PDF). Available at: www.mitsloan.mit.edu/actionlearning/media/documents/s-lab-projects/Mars-report.pdf. Accessed on: 7/9/2018

GSS (2015). Ghana Statistical Year book (2010-2013). Accra, Ghana. Available at: www.statsghana.gov.gh

Gyedu-Akoto E., Lowor S.T., Assuah M., Kumi W. & Dwomoh E.A. (2014) Assessment of Post-Harvest Handling Effects on Cashew Nuts and Kernels in Ghana (e-Journal).

Heanue K., Donoghue C.O., & Howley P. (2012) Factors affecting farmer’s adoption of agricultural innovations (Journal). Available at: www.researchgate.net/publication/267781711. DOI: 10.5539/jas.v4n6p171

Heinrich M. (2012).Case study of the African Cashew Initiative – Focus: Ghana, Lessons from Working with New and Multiple Partners – Emerging Results (PDF). Available at: www.value-chains.org/dyn/bds/docs/824/DCED_ACiGhana_July2012.pdf. Accessed on 7/7/18

ICIPE (2011). Factsheets GIZ. Integrated Management of Major Insect Pests and Diseases of Cashew in East and Western Africa (PDF). Available at: www.giz.de/.../giz2011-en-factsheet-icipe-integrated-management-insect-pests. Accessed on: 7/9/18

IRD (2011). Cashew Business Basics; The Gambia River Basin Cashew Value Chain Enhancement Project (PDF). Available at: www.africancashewalliance.com. Accessed on: 7/08/2018

ITC(2011). Market News Service Cashew Quarterly Bulletin(PDF). Available at : [www.intracen.org/uploadedFiles/intracenorg/Content/About ITC/Where are we working/Multi-country programmes/Pact II/Cashew%20Report.pdf](http://www.intracen.org/uploadedFiles/intracenorg/Content/About%20ITC/Where%20are%20we%20working/Multi-country%20programmes/Pact%20II/Cashew%20Report.pdf). Accessed on: 7/9/18

JEAI (2017). Determinants of Adoption of Technologies for Cashew Production in Nampula, Mozambique Available at: www.journalrepository.org/media/journals/.../Nhantumbo1752017JEAI36035.pdf. Accessed on: 3/9/2017

Joyonline business news(2018).Cashew exports rake in \$981m(online). Available at: www.myjoyonline.com/business/2018/march-13th/cashew-exports-rake-in-981m.php. Accessed on:13/7/18

Kidunda B. R, Kasuga L. J., Magani S. F. & Mwakanyamale D. F. (2013). Adoption of Cashew Production Technologies by Farmers in the Southeastern Tanzania (e-Journal) V55. 18, Available at: www.ipcbee.com/vol55/018-ICFAS2013-G3002.pdf. DOI: 10.7763/IPCBE. 2013.

Kuijpers R. & Swinnen J. (2016). Value Chains and Technology Transfer to Agriculture in Developing and Emerging Economies (PDF) Available at: www.ageconsearch.umn.edu/bitstream/212834/2/Kuijpers.pdf. Accessed on: 4/9/18

Langat, B. K., Ngéno, V. K., Nyangweso, P. M., Mutwol, M. J., Kipsat, M. J., Gohole, L., & Yaninek. S. (2013). Drivers of Technology Adoption in a Subsistence Economy: The case of Tissue Culture Bananas in Western Kenya (PDF). Available at: www.ageconsearch.umn.edu/. Accessed on: 3/09/18

Loevinsohn M., Sumberg J., Diagne A. (2012) under what circumstances and conditions does adoption of technology result in increased agricultural productivity (PDF). Available at: www.epi.ioe.ac.uk/cms/LinkClick.aspx?fileticket=8WSxsZcAkaA%3D&tabid. Accessed on: 10/8/18

MOFA, Wenchi Municipality (2016). Agricultural Profile Report (Online). Available at: www.ghanalinks.org/...Profile...Wenchi+Municipal%2C.../e54824a0-d092-488. Accessed on 19/11/17

Mohamed P. (2014). Women set to Revive Cashew Nut Production (online). Available at: <https://allafrica.com> Accessed on: 7/09/18

Nathalie G., & Vermuelen S. (2006). "Towards Better Practice in Smallholder Palm Oil Production (PDF). Available at: www.fao.org/uploads/media/06_IIEDTowards_better_practice_in_smallholder_palmoil_production_01.pdf. Accessed on: 7/9/18

Naya M.G., Raviprasad T.N. & Philip P.S. (2017). Cashew cultivation Practices Available at: www.cashew.icar.gov.in. Accessed on: 5/9/18

Ogunwolu S. O., Yahaya L. E, Mokwunye F. C., Ogunjobi M. A. K., & Olalekan-Adeniran M. A. (2016) Evaluation of Quality of Raw Cashew Nut from Major Cashew Producing Areas of Nigeria (e-Journal) Available at: www.Pubs.sciepub.com. DOI: 10.12691. Vol. 4,

Opoku-Ameyaw K., Oppong F.K., Akoto S.O., Amoah F.M., Swatson E. (2012) Development of weed management strategies for cashew cultivation in Ghana(e-Journal).

Osei- Akoto, S., Topper, C.P., Swatson, E. (2005). Status of cashew production in Ghana and agronomic options for increasing production by smallholder farmers. Paper presented at Ghana Institute of Horticulture Annual Conference.

Kalaivanan D. and Saroj P.L. (2017).weed management (e-journal) available at: www.researchgate.net/publication/306323284. Accessed on: 4/09/2018

Prokopy L. S., Floress K., Klotthor-Weinkauff, & Baumgart-Getz. (2008). Determinants of agricultural best management practice adoption (Journal). Available at: www.dx.doi.org. Accessed on: 3/9/18

Webber C.M & Labaste P.(2015). Building Competitiveness in Africa's Agriculture (PDF). Available at http://siteresources.worldbank.org/INTARD/Resources/Building_Competitiveness_in_Africa_Ag.pdf. Accessed on 3/8/18

Wongnaa C.A. (2013). Analysis of Factors Affecting the Production of Cashew in Wenchi Municipality, Ghana (Journal) Available at : www.academia.edu/29602776/analysis_of_factors_affecting_the_production_of_cashew_in_wenchi_municipality_g_hana. Accessed on 7 /06/18

- Rabany C., Rullier N., Ricau P. (2015). The African Cashew Sector In 2015 General trends and country profiles(PDF) Available at: www.rongead.org. Accessed on: 4/9/18
- Russell, T., (1997). Pairwise ranking made easy Lakeland View(PDF). Available at <http://pubs.iied.org>. Accessed on 10/7/2018.
- Rosenberger, D. Watkins, C., Miranda Sazo, M., Kahlke, C., & Nock J. (2010). Glyphosate exposure contributes to internal browning of apples during long-term storage (PDF). Available at: www.nyshs.org. Accessed on 5/9/18
- Saroj P.L. (2015). Advances in Cashew Production Technology (PDF). Available at: www.cashew.res.in. Accessed on: 6/9/18
- Sheahan, Megan, and Christopher B. Barrett. (2014). "Understanding Agricultural Input Landscape in Sub-Saharan Africa (PDF). Available at: documents.worldbank.org. Accessed on: 4/7/18
- Sinan A. & Zoumana C. (2017). Diagnostic study of obstacles related to production of cashew nuts in the Odienne region in the north of the Cote d'Ivoire (Journal). Available online at: www.journalissues.org. doi.org/10.15739. Vol.5 (8)
- Syngenta (2016).The role of private sector in agricultural extension in Indonesia (PDF) Available at: www.syngentafoundation.org. Accessed on: 3/9/18
- Tuttle J.N.(2012). Private-sector engagement in food security & agricultural development (PDF). Available at: www.csis.org. Accessed on 7/9/18
- TWIN 2012, Small-scale farmers and climate change: How can farmer organisations and Fairtrade build the adaptive capacity of small holders (online). Available at pubs.iied.org/16518IIED. Access on 14/05/18

ANNEXES

Annex 1: Research methods, data collection and data analysis matrix

Research Sub-questions	Data Collection Method	Data Collection Tools	Data analysis Tool	Stakeholder	No. of Respondent	Community
Q1.	Survey	Structured Questionnaire	Excel	Smallholder farmers	40	Subiso no.II, Amponsakrom, Tremeso & Nkosiah
Q2	Face-face interview	Audio & Video recording Interviews using checklist	Grounded theory	Research station Manager Tree crop Tutor (Wenchi farm institute)	2	Wenchi
Q3	In-depth Interviews	Checklist	Grounded theory	Private quality control Agents Senior Technical	2	Wenchi
Q4	FGD	Checklist Interviews Observation Video recording	Value chain analysis Pair wise Ranking	Farmer groups(3)	30	Nchiraa, Buosu Wurompo
Q1	Face -face interview	Questionnaire Interviews	Grounded theory	MOFA director Forester	2	Wenchi
Q2	Face- to- face interview	video recording using checklist questionnaire	Grounded theory	Desk officer cashew development	1	Wenchi
Q3	Interview	Semi-structured Questionnaire	Grounded theory Description Tables	Local Producers Exporters Banks NGO	8	Wenchi
Q4	Face to face interview, Phone interview	Checklist	Grounded Theory	Agricultural extension Agents	4	Subiso no.II, Amponsakrom, Tremeso & Nkosiah
TOTAL RESPONDENTS					89	

Annex 2

QUESTIONNAIRES

RESPONDENTS (Smallholder individual farmers,)

A. Q1. What is the current farming adopted by smallholder farmers for cashew nuts production?

Identification no. _____1_____ Date __17_____

Name _____ Name of Community: _____

1. Education Level

(i) Basic (ii) MSCL (c) Secondary (iv) other reasons (specify) _____

2. What is household size of your family?

(i) 1-4 (ii) 5-8 (iii) 9-12 (iv) 13+

3. What is your Age?

(i) 18-28yrs (ii) 29-39 yrs. (iii) 40-59 yrs. (iv) 60+ yrs.

4. What is your Sex?

Male Female

5. What is the main source of income for your family?

(i) Income from cashew nuts from farm (ii) Trading (iii) others (specify) _____

6. What is the size of your farm?

(i) 0.8- 1.4ha (ii) 1.6ha – 2.2ha (iii) 2.4ha-3ha

7. How old is your cashew farm?

(a) 5- 7yrs. (b) 8-10yrs. (c) 11-13yrs (d) 14+yrs

8. How many bags of cashew nuts do you harvest per hectare during the last season?

(i) 1.5-13bags (ii) 14- 25.5bags (iii) 26-37.5bags

9. How many time do you control weeds on your cashew farm?

(i) Once a year (ii) twice a year (iii) thrice a year (iv) other (specify) _____

10. Do you pruned your farm? Yes/ No

11. If “No” what is the main reason for not pruning your farm when the canopy is so close?

(i) High labour cost (ii) Inadequate knowledge in pruning (ii) High cost of chainsaw machine for pruning (iv) others specify _____

12. Do you maintain the soil fertility of your cashew farm? Yes/ No
- (d) If “no” what are the reasons?
- (i) Unavailability of fertilizer (ii) lack funds to buy fertilizer (iii) High cost of fertilizer (iv) others specify_
13. Have you experienced fire outbreak in your farm before? Yes/No
14. Do you create fire belt during the dry period to protect your farm against any accidental bushfire? Yes/No
15. Do you experience insect-pest infestation in your farm? Yes/No
16. If “yes” how you control the insect-pest in your farm?
- (i) use of recommended insecticides (ii) use of biological control using red ants (ii) others specify_
17. Do you experience fungal disease in your farm? Yes/No
18. (a) if “yes” how do you control the disease in your farm ?
- (ii) Use of recommended fungicide (iii) destruction of affected trees (iv) other reason (specify) __
19. What type of planting material have you planted in your farm?
- (i) Grafted type (ii) Seeds (iii) others (specify)_____
20. What are the most reasons for choosing a particular variety?
- (i) Higher yield and quality nuts (ii) tolerate to harsh climatic conditions (iii) Early maturity (iv) others specify_____
22. What is the source of the planting material?
- (i) Purchase from research center (ii) Wenchi farm institute (iii) Purchase from private input dealer
- (iv) Others (specify)_____
23. What is the major reason for your choice?
- (i) Easily Access (ii) very affordable (iii) Assurance of quality (iv) others (specify) _____
24. Do your farm have the recommended cashew trees per acre? Yes/No
25. If “no” what is the reason for not planting the recommended trees?
- (i) High cost of grafted seedlings (ii) unavailability of grafted seedlings during the of planting (iii) lack of funds to buy grafted seedlings (iv) others (specify)_____
26. How many cashew trees per hectare in your farm?
- (i) 100 trees (ii) 90 trees (iii) 80 trees (iv) other (specify) _____
27. How many times do your control weeds in your farm?
- (i) Once a year (ii) Twice a year (iii) Thrice a year (iv) Others (specify) _____
28. Do you use weedicides to control weeds on your farm? Yes/No
29. What are the reasons for the choice?

(i) High cost of labour (ii) high yield and quality nuts (iii) unavailability of labour (iv) other specify ____

30. How often do you access advice on Good agricultural practices during the farming season?

(i) Very often (ii) not often (iii) not at all

31. Do you dry the nuts after picking from your farm use? Yes/No

32. If “yes” how many times do dry the nuts?

(i) 1-4 days (ii) 5-8 days (iii) 9-12 days (iv) 13-16 days

33. How do you package the nuts after harvesting/drying?

(i) Jute sack (ii) Nylon sack (iii) Polythene sacks (iv) others (specify) ____

Annex 3

Q. 4 Challenges faced by smallholder farmer for adopting good agricultural practices (FGD)

Q	Checklist for the barriers of not adopting recommended practices	➤
1	What the various channels market through which smallholder farmers sell their nuts ➤ Challenges face in selling the nuts after harvesting	➤
2	What is the profit margin of smallholder farmers during a production season	➤
3	What are the major challenges face in adopting the good agricultural practices that have been transferred to them (list of the major challenges)	➤
4	Ranking of the challenges base on its impact on the cashew nuts quantity and quality produce by the group. (base on quantity of nuts, quality of nuts)	➤

ANNEX 4

GALLERIES FOR THE FIELD DATA COLLECTION



One of the scion bank site



One of the farmer group for FDC(Wurompo farmer Group)



Nursery site, research station, Wenchi



Administering of Questionnaire during the survey



one of the rural Banks that offer loans to farmers



One the cashew fruit juice processing companies

