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STAKEHOLDERS' PREFERENCE AND ADOPTION OF IMPROVED COWPEA VARIETIES IN THE NORTHERN REGION, GHANA

JAMES AFFUL

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STAKEHOLDERS' PREFERENCE AND ADOPTION OF IMPROVED COWPEA VARIETIES IN THE NORTHERN REGION, GHANA

BY

JAMES AFFUL

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

SEPTEMBER 2020

DECLARATION

Candidate's Declaration

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

Candidates Signature: …… Date ……

Name: ……..

Supervisors' Declaration

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

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

Name: ……..

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

Name: ……..

ABSTRACT

The main objective of this research was to examine Stakeholders' preference and adoption of improved cowpea varieties in the Northern region of Ghana. A cross-sectional quantitative research design was used to collect data using a multistage, snowball, and convenience sampling techniques from farmers (n=415), marketers (n=60), and consumers (n=120) respectively. Content-validated questionnaires and structured interview schedules were used to collect the data. Descriptive statistics, chi-square test, Kruskal-Wallis H test, Kendall's coefficient of concordance, correlation coefficients, and logistic regression were used to analysed the data. The study revealed that, farmers have mixed feelings on the overall perceived attributes of improved cowpea varieties. There was low level of participation of all stakeholders (farmers, consumers, and marketers) in the development and release of improved cowpea varieties with no significant difference in the development of improved cowpea varieties. Also, improved cowpea varieties were highly adopted by farmers. The logistic regression revealed four independents (years of experience in cowpea production, farm size, access to extension, and observability) as the best predictors of the adoption of improved cowpea varieties and contributed 28.0% to 39.0% of the variance in the adoption of improved cowpea varieties. Lack of credit facilities, high cost of seeds, lack of information, among others were some of challenges that militated against farmers in the adoption of improved cowpea varieties. The study recommended, among others, seed breeders and scientist should involve major stakeholders' in future cowpea breeding process, and establishment of demonstrations plots by extension agents on these improved cowpea varieties.

KEY WORDS

Adoption

Improved Variety

Participation

Participatory Plant Breeding

Preference

Stakeholders

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DEDICATION

To my late father Mr. Kenneth Afful

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LIST OF ACRONYMS

CIMMYT	:	International Maize and Wheat Improvement Centre
DFID	:	Department for International Development
DOI	:	Diffusion of Innovation
FAO	:	The Food and Agriculture Organization
GSS	:	Ghana Statistical Service
IBM SPSS	:	International Business Machine Statistical Package for Social Sciences
IITA	:	International Institute of Tropical Agriculture
IRB	:	Institutional Review Board
MoFA	:	Ministry of Food and Agriculture
NGOs	:	Non-Governmental Organisations
ODA	:	British Overseas Development Administration
PPB	:	Participatory Plant Breeding
SARI	:	Savanna Agricultural Research Institute
SDGs	:	Sustainable Development Goals
SRID	:	Statistics, Research and Information Directorate
VIF	:	Variance Inflation Factor
WACCI	:	West Africa Center for Crop Improvement

CHAPTER ONE

INTRODUCTION

Background to the Study

Cowpea [*Vigna unguiculata (L.) Walp*.] is one of the world's commonly grown and eaten grain pulses, especially in the tropics of dry and semi-dry areas (Noubissie Tchiagam, Bell, Guissai Birwe, Gonne, & Youmbi, 2010). The crop can develop under dry-land conditions in serious settings, making it one of Sub-Saharan Africa's most commonly cultivated legume plants (Baidoo & Mochiah, 2014). ~~Worldwide cowpea production in 2007 was estimated at 5,249,571 tons, more than 64 percent of which were manufactured in Africa (Gbaguidi, Dansi, Loko, Dansi & Sanni, 2013).~~ It is a vital source of plant protein, including minerals and amino acids that improve human nutrition and health (Chinma, Alemede, & Emelife, 2008; Sefa-Dedeh, Kluvitse, & Afoakwa, 2001). ~~Due to its capacity to fix nitrogen and socio-cultural values, cowpea farming is a significant element of a viable crop scheme in Ghana (Quaye, Frempong, Jongerden, & Ruivenkamp, 2011).~~

~~Cowpea is grown for leaves, green pods, and human food grain as well as animal feedstuff. It is valued that animal feedstuff, waste, and seed make up near 15 percent of cowpea's national production (MOFA, 2009). Cowpea is Ghana's second-largest food legume. Regarding the land being cultivated, the quantity generated and consumed each year, it is second to groundnut (MOFA, SRID, 20~~

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Ghana's cowpea-growing area peaked at 190,400 ha in 2003 (MOFA, SRID, 2011). The area under cowpea cultivation, however, was decreased moderately from then to 163,700 ha in 2010. Cowpea production in Ghana is mainly focused in Savannah Guinea and transitional forest areas (mostly Upper West, Upper East, Northern Region and some Brong-Ahafo districts) (MOFA-SRID, 2016).

It cannot be overemphasized the significance of seed to any crop-based production system. It is the basic unit of any scheme of production as it is the source of life. Improving seed quality of any desired variety is the foundation for improving agricultural productivity (Louwaars and De Boef, 2012). In Ghana and perhaps Sub-Saharan Africa, a seed is probably the most significant factor in agriculture and possibly the cheapest input for crop manufacturing. In Ghana, there are two similar seed structures.

A formal structure introduced by the State and its official associates and a local or informal system based on a tradition of exchange and mutual support among farmers within a single area (Niangado, 2010).

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In present times, varietal growth in Ghana has seen greater investment culminating in the release of multiple crop varieties such as maize, sorghum, millet, groundnut and cowpea. Despite the accessibility of these new varieties in combination with the government's advertising attempts and its development partners, the awareness and acceptance of these new varieties appears to be declining due to poor seed distribution schemes in place and seed varieties not preferred by farmers and consumers (Etwire, Atokple, Buah, Abdulai, Karikari, & Asungre, 2013).

In spite of cowpea's monetary and dietary significance to consumers and farmers, the discrepancy between improved cowpea varieties and consumer preference is a serious issue with cowpea production (Faye, Jooste, Lowenberg-DeBoer, & Fulton, 2004). The attributes of improved cowpea varieties are not necessarily those priced by customers, according to Faye et al. (2004), but individual preferences around crop attributes, including taste and cultivation methods, influence how customers perceive profitability.

Farmer perceptions of technological attributes, such as ease of preparation and cooking, are directly linked to the results of adoption (Smale, Bellon, Alfonso, Gómez, & Smale, 2018). Improved varieties of cowpea may have distinct flavours and textures than local alternatives and may not be accepted even if they maximize returns and earnings. Atkin (2016) claims that low-income consumers are prepared to trade off significant caloric consumption for preferred foods in the developing world.

Therefore, understanding the needs and preferences of farmers and their farming systems is crucial for the comprehensive acceptance of newly established crop varieties (Hoffman, Allsopp, & Rohde, 2007).

Statement of the Problem

In Africa, legumes, especially cowpea, play a primary role in the livelihood of millions of relatively poor people, accounting for up to 80 percent of complete adult nutritional protein consumption, and are really the only protein source for many children (Anazonwu-Bello, 1976). Low returns, however, are an important element of the cowpea production in Ghana. The primary variables for low production of cowpea is high biotic stress, especially from insects and other pests, which often influence the plant during its life cycle and storage, low planting dates, low plant population, poor weed control, combined crops, and low soil fertility status. These factors have notified research organizations and breeders to release improved varieties of cowpea that can resist biotic pressures. Most cowpea breeders have concentrated on increasing returns and addressing drought and tolerance of diseases.

Several studies have reported mainly on breeding many improved cowpea varieties in sub-Saharan Africa, but adoption rates are poor, some may not be accepted in some instances due to non-compatibility or relevance with the requirements and views of stakeholders (Saidou, Ajeigbe, and Singh, 2011). There are several visual features of cowpeas shown to be preferred, at least in Ghana, by stakeholders. Stakeholders, however, perceive little benefit from such enhancement as such varieties are not intended to meet their needs (Bhattacharya, Korschun, and Sen, 2009). Therefore, it is essential to ascertain

improved varieties of cowpea that also suit characteristics that stakeholders prefer. Successful cowpea breeding cannot be achieved without an understanding of the characteristics preferred by stakeholders and their participation in all processes of selection and evaluation of cowpea varieties.

Objectives of the Study

General objective

The overall goal of this study is to examine stakeholder's preference and adoption of improved cowpea varieties in the Northern Region, Ghana.

Specific objectives

The specific objectives of the study are to:

1. Examine farmers' perceived attributes of current improved cowpea varieties produced and marketed in Ghana.
2. Compare the degree of participation of major stakeholders (farmers, marketers, and consumers) in the development and release of new cowpea varieties.
3. Compare stakeholders (farmers, marketers, and consumers) preferred traits and attributes of new cowpea varieties to be developed.
4. Examine farmers' adoption of improved cowpea varieties.
5. Explore the factors predicting adoption of improved cowpea varieties among farmers.
6. Identify and rank the challenges confronting the adoption of improved cowpea varieties among farmers.

Research Questions

The research questions for the study are as follows:

1. What is the perception of farmers on the attributes of the current cowpea varieties produced and marketed in Ghana?
2. What is the difference in the extent of participation between major cowpea stakeholders (farmers, marketers, and consumers) in the development and release of new cowpea varieties?
3. What are the preferences of stakeholders (farmers, marketers, and consumers) in new cowpea varieties to be developed?
4. What is the level of farmer's adoption of improved cowpea varieties among farmers?
5. What are the factors predicting farmer's adoption of improved cowpea varieties?
6. What are the challenges confronting the adoption of improved cowpea varieties among farmers?

Hypothesis of the Study

The following three (3) key hypotheses, which were tested at 0.05 alpha levels, were set to guide the research.

Hypothesis 1

H_o. There is no statistically significant difference in the degree of participation in the development and release of new cowpea varieties between cowpea farmers, marketers, and consumers.

H_a. There is a statistically significant difference in the degree of participation in the development and release of new cowpea varieties between cowpea farmers, marketers, and consumers.

Hypothesis 2

H_o. There is no statistically significant difference in all the preferred grain attributes of new cowpea varieties to be developed among cowpea farmers, marketers, and consumers.

H_a. There is a statistically significant difference in all the preferred grain attributes of new cowpea varieties to be developed among cowpea farmers, marketers, and consumers.

Hypothesis 3

H_o. There is no statistically significant difference in the challenges confronting the adoption of improved cowpea varieties among farmers.

H_a. There is a statistically significant difference in the challenges confronting the adoption of improved cowpea varieties among farmers.

Significance of the Study

In recent years, some attention has been focused on agricultural and rural development, especially in Africa, through the global discussion. There is broad consensus that the Sustainable Development Goals (SDGs), for example, can only be achieved if the rural population's economic conditions are improved. The conversion of agricultural-based economies into more urban industrial and service-based economies includes rural economic development. Cowpea is indeed a significant crop for the poor and the more disadvantaged, promoting

the consumption of such a crop can lead to enhanced demand that can lead to excessive production (Kirsten & Vink, 2005), thereby increasing rural poor earnings and the protein requirement of poor families. The preferences of stakeholders for better information on cowpea varieties will be of great value to scientists to aid focus their efforts on traits and methods that contribute to cowpea varieties having features that customers require.

The outcome of this study will assist stakeholders (agricultural officers, development partners, research organizations) identify consumer preferences for modified cowpea varieties and add to the existing inventory of information on cowpea varieties' consumer preference which will result in wide acceptance of such varieties. Furthermore, manufacturers and breeders will feel the outcomes of this research immediately as they will be able to have a better market for their products.

The results of this research will help to understand the factors affecting the country's acceptance of improved cowpea and consumption. Therefore, helpful data will be provided to guide policy formulation and execution approaches to improve acceptance among stakeholders of improved cowpea varieties.

Furthermore, identifying the degree of stakeholder involvement (farmers, marketers, and consumers) in the development and release of improved cowpea varieties will determine technology adoption success or failure. This study will also serve as a springboard in cowpea production for further detailed research.

Delimitations

This study was focused on stakeholders' preference and adoption of improved cowpea varieties in the Northern Region of Ghana. However, only four (4) cowpea growing areas (Yendi Municipal, Savelugu, Nanumba North and Nanumba South districts) were randomly selected the sixteen districts in the Northern region for the study. Measurement of adoption of improved cowpea varieties was based on farmers' perception but not the actual adoption of improved cowpea varieties. Also, the indicators used to measure Stakeholders' preference of improved cowpea varieties were crop and grain attributes as perceived by stakeholders to be the most preferred attributes of improved cowpea varieties to be developed.

Definition of Terms

The following terms are defined within the context of the study to mean:

Stakeholders

Farmers, marketers, and consumers along the cowpea value chain.

Participation

The action of taking part in an activity or involvement of stakeholders to give off their best, committed to the goals and values in the development and release of improved cowpea varieties.

Improved Variety

Defined as any variety that has been bred using formal plant breeding methods.

Adoption

It is farmers' acceptance and use of new farming techniques. According to Feder, Richard, and Zilberman (1985), at the individual level, when the farmer becomes fully aware of the technology, it is the degree to which new technology is used in the long-term equilibrium.

Preference

A greater liking for some characteristics of particular cowpea over another or others.

Perception

The process by which people receive information or stimuli from our environment and transform it into psychological awareness.

Organisation of the Study

There are five chapters in this research. Chapter one deals with the background, study, problem statement, research question, and hypothesis, study significance, delimitation, and terms definition. Chapter two is literature review relevant to this research. It includes the study-based theoretical review, empirical review, concept review, and summary chapter. Chapter three shows the research methodology that defines the process of research design, study region and population sampling, the tool, and processes used to gather data and the methods used to analyse data. Results, discussions, and interpretation are

devoted to Chapter four. The overview, findings, suggestions, and directions for future studies are presented in Chapter five.

CHAPTER TWO

LITERATURE REVIEW

General Overview

The review of literature combines the theoretical and conceptual framework for the study. It also illustrates empirical studies that provide the study with a context and the desired basis. It tries to review relevant research on the topic of the research.

Theoretical Review

The diffusion of innovation (DOI) theory

Diffusion of innovation theory defines the process of spreading new thoughts, procedures, or techniques into a social structure (Rogers, 2003). Diffusion of innovation theory maintains that innovation dissemination is ‘’a general mechanism, not certain by the type of innovation studied, by whom the adopters, or by location or culture’’ (Rogers, 2003, p. 16), so that the method by which an innovation is disseminated has broad applications in all areas that enhance innovation. Diffusion is described as ‘’the process in which, over time, the members of a social system communicate an innovation through certain channels’’ (Rogers, 2003, p. 5). Innovation is described as ‘’an idea, practice or object that a person or other adoption unit perceives as current’’ (Rogers, 2003, p. 12).

Rogers (2003) defined the innovation-decision process as an ‘’innovation-processing interaction where an individual is motivated to decrease uncertainty about an innovation’s benefits and disadvantages’’ (p. 172). According to Rogers, the process of spreading innovation consists of these five (5) facets, perceived characteristics of innovation, the type of innovation-

decision, the nature of communication channels spreading the social system in which innovation is spreading, and the magnitude of the attempts made by change officials to promote innovation spreads. A synthesis of this five-facet shows that there are factors for any farmer to embrace an innovation that is not solely linked to the grower but also linked to invention and means of broadcasting of information that affect the reaction of farmers. He further clarified that agricultural innovations differ greatly in their essential features, which influences the farmers' choice to engage to a bigger extent. As a consequence, the grower is more willing to take a suggested training if it is (1) lucrative, (2) consistent with the current farming scheme, (3) divisible, (4) user-friendly, (5) relevant to his use of labour, Farm supplies, sales, credit, values of the society and other variables in the crop environment.

In addition, the rate of innovation acceptance in most adoption research was explained by 'Innovation's perceived characteristics. The other four (4) variables (see Figure 1) gained little attention from the majority of authors of inventions. This theory has concentrated on perceived innovation characteristics that are relative advantage, compatibility, complexity, trialability, and observability to explain the variance in adoption, thus influencing the choice or inclination to accept an innovation by the five characteristics of innovation.

Relating this theory to the adoption of improved Cowpea varieties, the researcher adopted these five (5) attributes of innovation as well as adopter features to design a conceptual framework of stakeholder preference and adoption of improved Cowpea varieties in the Northern region of Ghana.

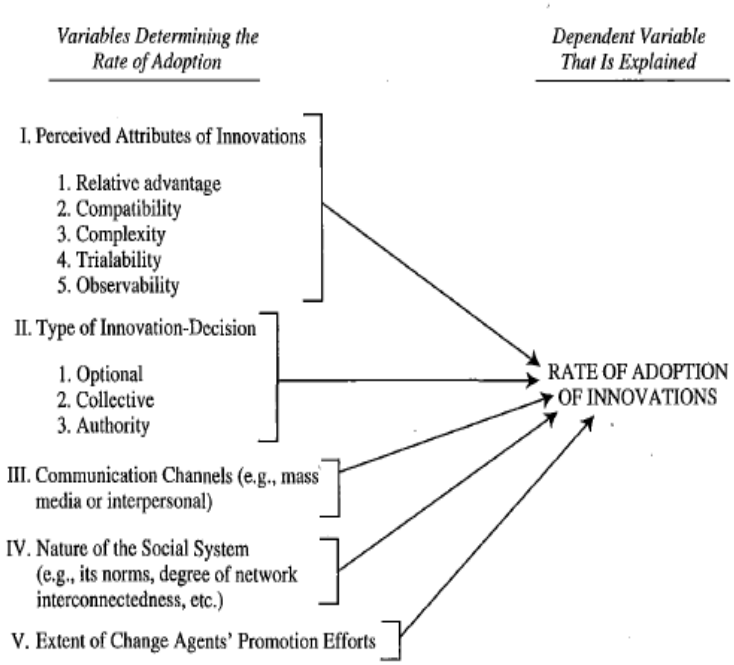

Figure *1:* Roger's Diffusion of Innovation Model

Source: Rogers (2003)

The expanded Rogers' attributes of innovation model by Moore and Benbasat

In relation to the perceived characteristics of innovations outlined by Rogers, the five characteristics of innovations were extended by Moore and Benbasat (1991). In addition to Rogers classification, Moore and Benbasat recognized two (2) primary constructs, namely (1) image, and (2) voluntariness. The first construct was described as 'the degree to which the use of an innovation is viewed in order to improve one's image or status in one's social structure' (Moore & Benbasat, 1991). Some researchers included image as an

element of relative advantage, including Rogers. Rogers also stated that ''the desire to obtain social status is certainly one of the most significant motivations for nearly every person to accept an innovation'' (1983, p.215). Again, the impact of image (social approval) was discovered to differ from relative advantage (Tornatzky & Klien, 1982). The second construct '*voluntariness*' was also described as ''the extent to which the use of an innovation is viewed as voluntary or free-will'' (Moore & Benbasat, 1991). According to Moore and Benbasat, consideration must also be provided to whether people are free to enforce individual acceptance or refusal decisions when examining the dissemination of innovations.

Among the eight (8) characteristics recognized by Moore and Benbasat, namely relative advantage, compatibility, ease of use, demonstrability of results, visibility, trialability, image, and voluntariness, it was found that the two extra constructs deemed to be the extension of Rogers' five innovation characteristics were image and voluntariness. Some of the constructs identified by Moore and Benbasat such as visibility and result demonstrability were considered similar to Rogers' attribute of ''observability''.

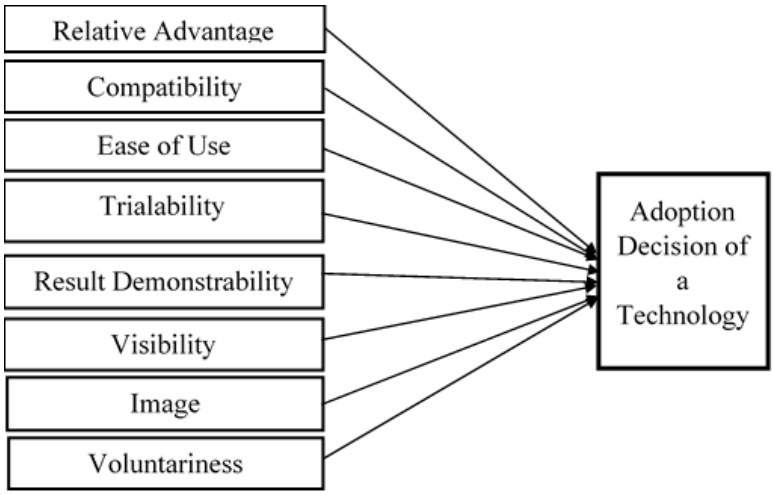

Figure 2: The Expanded Rogers' Attributes of Innovations Model by Moore & Benbasat (1991)

Source: Bosompem (2015)

Stakeholder engagement theory

The theory of stakeholder engagement thus argues that when those involved in projects participate in shaping choices through involvement, their views are likely to be resolved (Vermoolen & Hermans, 2015). In examining the magnitude of stakeholder involvement in the development and release of improved cowpea varieties, Stakeholder engagement theory was discovered to be suitable for this research to be thoroughly explored. The normative, descriptive and instrumental type of stakeholder engagement theory as advocated by Donaldson and Preston (1995) therefore underpins this research.

It therefore seeks to identify the project's specific stakeholders and then looks at the circumstances from which supervisors (researchers) regard these groups as stakeholders. This theory has a complexity of connection between various interest group inclusion can be readily viewed through executives,

clients, employees, and vendors. This interest group is somehow comparable to the interest group of this research in the development and release of improved cowpea varieties that are farmers, marketers (wholesalers and retailers), customers and scientists (facilitators). The theory is divided into three aspects, descriptive, normative and instrumental.

The Descriptive view obviously outlines the features of the stakeholder engagement in the program and how an organisation interacts with its stakeholders (Brenner and Cochran, 1991). This view helps to understand an organization's connection with its stakeholders. The descriptive aspect of stakeholder theory reflects and explains organizations and past, present and future of their stakeholder's assertions of matters. In the research of new fields, a straightforward description is prevalent and desirable and generates explanatory and predictive plans.

With the normative view, stakeholders are regarded as an end in itself based on the principle of fairness, that eventually all human beings are impacted by any choice because we all have an equal and legitimate interest in a secure and stable existence (Chamber, 1994). The correspondence between the theory and the observed corporate life facts is not an important problem in the normative view, nor is the association between stakeholder management and standard performance evaluation a critical test. Instead, on the grounds of some fundamental philosophical values, a normative theory tries to interpret the role of the developer-owned corporation and provide advice on it. The normative and instrumental analyses may indicate more or less suitable decisions on the part of decision-makers because they are based on completely distinct bases.

Instrument perspective regards stakeholders as an end itself and the organization is argued to consider stakeholders as this eventually leads to achievement. The theory also delineates stakeholder management in a suitable level of involvement within the project life cycle at various methods in the lifecycle phase. Instrumental stakeholder theory utilizes create a link between stakeholder methods and frequently preferred goals, according to Donaldson and Preston. The stakeholder theory's instrumental perspective generally stops short of exploring particular causal-effect linkages in detail, but such linkages are definitely understood.

Review of Empirical Literature

Global cowpea production

Cowpea has its roots in Africa, most notably in South, West, and East Africa, but the name Cowpea likely originated when it arrived in the United States of America and was used as a significant Cow feed (Timko, Ehlers, & Roberts, 2007). The annual world cowpea is projected to grow at 12.5 million ha, with a complete output of 3 million tonnes of grain, although a small percentage enters international trade (Akibode & Maredia, 2012). Brazil is the world's second-leading cowpea seed producer, generating 600,000 tonnes per year, with Nigeria being the biggest cowpea producer and consumer, generating about 2.2 million tonnes of dried grain per year (Khyade & Gosavi, 2016). An estimated 14.5 million hectares of land are allocated to cowpea globally each year, with 5.5 million metric tons of dried cowpea grain being grown globally (Owusu, 2015). Approximately, 40,000 ha of cowpea are cultivated in the southern United States with an estimated 45,000 tonnes of annual dry cowpea production and a big quantity of frozen green cowpea (Singh, Hartmann,

Fatokun, Tamo, Tarawali, and Ortiz, 2003). Western Africa's average cowpea yield was estimated at 483 kilograms per hectare (0.195 t/acre) (Singh et al., 2003). Asia (India, Myanmar) and the Americas (US, Brazil, West Indies) are the main production regions elsewhere in the globe. Among other developed countries, the US is the world's only major producer and exporter of cowpea (Akibode & Maredia, 2012).

Cowpea production in Africa

The world's major cowpea-producing areas are West and Central Africa. These areas generate 64% of the projected annual harvest of 3 million tonnes of cowpea seed (Murdock & Baoua, 2014). Nigeria is the world's leading cowpea producing nation, responsible for 61% of Africa's production and 58% of the world's output, with around 5 million hectares and over 2 million tonnes of annual output (Ddungu, Ekere, Bisikwa, Kawooya, Kalule, and Biruma, 2015). Other major producing nations are Ghana, Niger, Cameroon, Senegal, and Mali (Langyintuo, Lowenberg-DeBoer, Faye, Lambert, Ibro, Moussa, and Ntoukam, 2003).

According to the United Nations Food and Agriculture Organization (FAO), as of 2012, West Africa's average cowpea yield was estimated at 483 kg/ha, which is still 50% below the projected prospective output. The yield may be as small as 100 kg/ha in under traditional cropping techniques (Callo-Concha, Gaiser, & Ewert, 2012). Africa's low crop yield is due to several variables recognized somewhere: including insect pests, diseases, drought, unwanted plant, and harvesting difficulties (Egbazor, Yeboah, Offei, Ofori, & Danquah, 2013).

Production of cowpea in Ghana

Cowpea is a key element of Ghana's sustainable crop scheme (Singh & Tarawali, 1997). It is grown for animal feed, leaves, green pods, grain and haulm. For over 70 percent of Ghana's population, cowpea is a significant source of vegetable protein and minerals and is the second most significant grain legume (MOFA, 2010). It's one of the food security crop in the nation at the moment. Cowpea seed sources for planting include market/traders, stored seed from their own farm and from other farmers who retain seed for sale (MOFA, 2010). More than any other legume crop in the nation, farmers grow cowpeas on over 180,000 hectares in Ghana. Annual cultivation was estimated to exceed 235,000 tons in 2011. The average output in 2011 was approximately 1.3 metric tons per hectare. Most of Ghana's cowpeas are grown in northern savannah regions, but farmers can grow cowpeas anywhere in the nation (Langyintuo *et al.*, 2003).

Concept of stakeholders

The Stakeholder concept has been viewed differently by users and in the last two decades has taken a prominent position in the theory and practice of government and non-profit leadership (Bryson, 2004). According to Boakye-Agyei (2009), stakeholders may include local communities or people with special interests and their official and informal officials, domestic or local government authorities, politicians, religious leaders, civil society organizations and organizations. Bryson & Crosby (1992) defines stakeholder as ''any individual, group or organisation that is impacted by a problem's causes or effects''. Likewise, the British Overseas Development Administration (ODA,

1995) describes stakeholders as individuals, organizations or organizations with a project or programme interest.

However, Golder (2005) considers stakeholders as any person, group or organization that has a vested interest in the project area's natural assets and may be influenced by project operations and may have something to gain or lose if circumstances alter or remain the same. These definitions point to the influence or impact on people, organizations, and organizations of operations or procedures without stressing the impact of stakeholders on such operations or procedures. According to the World Bank (2002), stakeholders are those negatively or positively impacted by the outcome or those that may influence the result of a suggested action.

Freeman (1984) describes stakeholders as ''any group or person that may influence or be influenced by achieving goals of an organization''. This definition demonstrates that the notion of stakeholders can be bi-directional as both can be influenced by and can impact the objective of an organization (Campbell, 2008).

Concept of Participatory Research

The primary concept of participatory research is that farmers, consumers, and professional scientists have distinct understanding and abilities that can complement each other and that they can achieve better outcomes than working alone (Hoffmann *et al*., 2007). Preferably, one group's strengths would compensate for any other group's constraints and limitations. This may sound nice, but it needs a comprehensive understanding of the expertise, abilities, and limitations of both one's own community and the others. With limited

interaction and functional cooperation between farmers and scientists, participatory research projects are frequently carried out. This is basically because farmers' characteristics and scientists' confines are overlooked; therefore, the correspondence and cooperation between the two meetings remain shallow (Hoffmann *et al.*, 2007).

According to Gyawali, Sunwar, Subedi, Tripathi, Joshi, and Witcombe (2007), farmers' participation as collaborators through participatory research contributes to the development of a demand-driven study that enhances the implementation of new techniques. Studies have shown that the method of adopting current improved varieties tended to be small in regions where the participation of farmers in the study process was restricted (Tripp, 1982; Maurya, Bottrall & Farrington, 1988).

Participatory study approaches are close cooperation between study researchers and farmers in assessing varieties and setting breeding objectives (Nkongolo, Chinthu, Malusi & Vokhiwa, 2008). In order to guarantee recognition and eventual adoption, farmer involvement in the breeding of crop varieties is essential (Gyawali et al., 2007). This is critical when it comes to determining which features farmers value or prefer. Owing to the characteristics deemed undesirable, the breeders sometimes remove many lines during the selection phase. However, farmers may be interested in these characteristics (Abebe, Assefa, Harrun, Mesfine & Al-Tawaha, 2005).

Thapa, Sharma, Mudwari, Ortiz-Ferrara, Sharma, Basnet, Witcombe & Joshi (2009) claim that the participatory method improves the adoption of

enhanced technology and enhances the understanding of farmers and enables for the unification of native knowledge and innovation in studies. A variety of fresh cultivars are provided to farmers for evaluation and selection in their defined areas. Participatory plant choice is seen as a friendly strategy to the dissemination to stakeholders of new enhanced products (Witcombe, Joshi & Goyal, 2003; Ortiz-Ferrara, Joshi, Chand, Bhatta, Mudwari, Thapa, … & Virk, 2007).

Typologies of stakeholders and participation

Grimble and Wellard (1997) classify stakeholders as main stakeholders, primary, secondary, active and passive. Key stakeholders are those actors that are deemed to have an important impact on a project's achievement, according to Grimble and Wallard. Primary stakeholders are the project's expected beneficiaries, while secondary stakeholders are those acting as project intermediaries. Active stakeholders are those involved in the scheme or project that influence or determine a decision or action. Passive stakeholders are those impacted by other people's choices or behaviour.

Bawden (2002), also establishes an additional classification and separates four stakeholder kinds;

1. Owners: This reflects those influential in the sense that they impact the condition considerably.
2. The community or beneficiaries: Are the group of beneficiaries that are the planned transformation's assumed 'focus'.
3. Actors: Are the actors who need to participate in the change activities.

4. Guardians: Those who act as guardians of those who are unable to talk for themselves.

DFID (2003) indicates three primary kinds of stakeholders comparable to the Grimble and Wellard classification of stakeholders that can be recognized as key, primary and secondary stakeholders for rural projects.

According to DFID key stakeholders as those who can or are crucial to an activity's achievement. They describe the main stakeholders as those people and organizations that are either favourably affected or adversely influenced by activity. On the other side, the secondary stakeholders refer to all other people or organizations involved in the operation with a stake, concern or intermediary role. However, during project planning and execution, these categories may overlap (Peelle, 1995).

Pretty (1995) classifies stakeholder involvement into seven primary types of involvement, from passive involvement to self-mobilization. According to Pretty, the seven primary types or stakeholder classification range from low-level to high-level, namely passive involvement, information-giving involvement, consultation involvement, material incentive involvement, functional involvement, interactive involvement, and self-mobilization.

Passive participation: By telling people what is going to happen or has already occurred, they engage. It is a one-sided announcement by the leadership of an administration or project without listening to the answers of people. The sharing of data only applies to external experts.

Participation in information giving: People engage by taking survey assessments or comparable methods to answer questions posed by extractive

scientists. People have no chance to impact trials, as results are neither communicated nor accurate verified.

Participation by consultation: People are involved through consultation and opinions are heard by external officials. These external officials identify both issues and alternatives and may alter them in the light of the reactions of individuals. Such an advisory method does not grant any share in decision-making and there is no duty on experts to take on board the opinions of individuals.

Participation for material incentives: In exchange for food, money or other material incentives, people engage by offering resources, for instance, labour. There is a lot of on-farm studies in this category as farmers provide the areas but are not engaged in experimentation or teaching process. It is very prevalent to see this called involvement, but when the incentives come to an end, individuals have no interest in prolonging operations.

Functional participation: People engage by forming organizations to fulfil predetermined project-related goals that may involve developing or promoting the social organization that is initiated externally. Such participation tends not to occur at the early phases of project cycles or planning, but after significant choices have been made. These organizations tend to rely on internal initiators and facilitators, but they may become self-reliant.

Interactive participation: People participate in joint evaluation leading to the formation of action plans and new local institutions or the strengthening of existing ones. It tends to involve interdisciplinary methodologies that seek different opinions and use systematic and structured teaching processes. These

organizations take control of local choices and therefore individuals have a stake in the maintenance of buildings or procedures.

Self-mobilization: People are involved by taking measures to alter systems independently of external organizations. For resources and technical guidance, they need, they establish connections with internal organizations but maintain control over how resources are used. Such self-initiated mobilization and collective action may or may not contest current unfair wealth and power distributions.

Lilja and Ashby (1999) also developed a typology for empirical involvement assessment based on the concept that sharing choices at various phases of a plant breeding system will structure possibilities for co-production of fresh information. The typology describes two groups of decision makers: researchers who include study programmers and expansion organizations and farmers who include all expected users of participatory crop breeding varieties such as consumers, traders, and processors. These are ideal kinds of involvement along with a spectrum in which farmers are gradually more empowered, from standard, where farmers are not empowered, to farmer experimentation, where there is no scientific empowerment. The five kinds of involvement are as follows, according to Lilja and Ashby;

Conventional (no farmer participation): Without structured communication with farmers, scientists make the choices alone.

Consultative: Scientists create choices by themselves, but with structured interaction with farmers. Through systematic one-way communication with them, scientists understand about the views of farmers, variety preferences and

priorities. Scientists may or may not factor in their choices with this data. Decisions are not produced or delegated to farmers.

Collaborative: On the basis of structured communication between the two groups, decision-making power is shared between farmers and researchers. Through structured two-way communication, scientists and farmers understand each other's thoughts, hypotheses, and priorities for studies. Plant breeding choices are produced collectively, which is not made on their own by either researchers or farmers. No party has the right to revoke the joint decision or override it.

Collegial: Farmers create cooperative plant breeding choices either in a group process or through individual farmers who communicate with researchers in structured communication. Farmers acquire data on the priorities of researchers and hypotheses of experiments through structured communication between the two organizations. Farmers may or may not be allowed to affect their choices with this data.

Farmer experimentation (no scientist participation): Farmers make choices about experimenting with and introducing fresh genetic material without structured interaction with researchers, either in a group or as people.

Joshi, Staphit, and Witcombe (2001) and Lilja and Aw-Hasaan (2003) opined that the impact of any of these kinds of involvement on the likelihood of co-production of new information and the final impact of participatory crop breeding depends on how early farmers' involvement in the breeding system is sought.

Stakeholders participation in the development and release of crop varieties

Basically, cowpea production and innovation stakeholders worked without strong ties (Jama & Pizarro, 2008). Where connections exist, they are porous and weak. Research agendas are generally set without the goals, limitations and resource endowments of farmers leading to a substantial failure to accept some excellent innovations (Louwaars & De Boef, 2012).

Participatory plant breeding (PPB) is a type of participatory crop enhancement based on the concept that farmers share their knowledge, expertise and seeds as equal partners alongside agricultural researchers. Such partnerships findings include not only more efficient crop management methods, but also enhancing the ability of farmers to experiment, learn and adapt (Steinke, Vernooy, & Van Etten, 2016). The vital element of highly efficient participatory plant breeding is cooperation among farmers, other stakeholders, and formal breeders through different phases of the breeding cycle. Through this type of engagement, breeding plots are created in farmers' areas and sometimes on agricultural research stations with comparable plots, with farmers actively engaged in the choice and testing of agronomic and quality characteristics adapted to their particular demands (Shelton & Tracy, 2016).

According to the FAO (2009), participatory crop breeding has a potential benefit in enhancing user orientation and more effective distribution of study resources, greater adoption rates, a close relationship to local cultures, empowering farmers' understanding and abilities, and overcoming typical science constraints in the development framework. Participatory plant breeding involves all plant improvement methods that involve close cooperation between

farmers and researchers. In particular, the word 'participation' relates to the active involvement of farmers in at least one or all phases of a plant breeding program, including setting goals, generating variability, choosing and testing, and seed manufacturing and distribution. Farmers can take distinct forms of this active participation. If farmers are interviewed on agro-ecological problems or on the results of test varieties, farmer involvement may be advisory. Other active types of farmer involvement include trial management, choice, prioritization, and creation of action plans, or general project management and execution (Farnworth and Jiggins, 2003; Lilja and Ashby, 1999).

Researchers therefore need to determine which degree of farmer involvement is suitable and in which stage of a breeding program mainly depends on the program's objectives, as well as the type of changes required, and is therefore also a priority setting problem.

According to Sperling, Ashby, Smith, Weltzien & McGuire (2001), the most worldwide review of participatory crop breeding programs, the degree of involvement was commonly noted as consultative followed by collaborative and this occurs at the very first point of identifying breeding objectives. They discovered that separating the subsequent phases of participatory plant breeding, that is on-farm variety testing, seed multiplication and allocation, farmers are rarely engaged in participatory plant breeding program decision-making positions at all. Nine instances in which farmers were engaged in isolating plant genetic materials were again identified by Sperling et al. (2001). A few of the instances analysed by Sperling et al. have experienced collegial involvement involving a substantial delegation of accountability to farmers.

Farmers should be engaged in all elements of variety development, including priority setting, early-generation breeding, variety testing, and selection, according to DeVries and Toenniessen (2001), so that breeders receive frequent feedback from farmers to enable them to correctly structure their selection indices. Farmers should therefore not be merely technology recipients and beneficiaries, but actors influencing and contributing to the process of technology growth (Gonsalves et al., 2005).

Danial, Parlevliet, Almekinders, and Thiele (2007) discovered that as breeders engaged farmers as respondents, they learned more about male and female farmers' most significant criteria for preferred cultivars in Andean cropping systems' marginal settings. They claimed this strategy promoted the use of locally adapted cultivars, made the breeders less dependent on foreign products, and resulted in fresh wheat, barley, common bean, quinoa, potato and corn cultivars being selected and developed.

Unlike many authors' significance of participatory plant breeding, some writers have already pointed out that it may not be vital to involve farmers in the breeding process. Morris and Bellon (2004) describe the model of farmers who are only engaged in defining breeding objectives and participatory selection of varieties as ''effective participatory breeding'' rather than full ''participatory breeding'' whereby farmers are fully engaged in all participatory plant breeding processes. Courtois et al. (2001) state that a degree of unnecessary complexity may be involved in farmers' involvement in the breeding process. Also, for some of the case research they checked, Weltzein et al. (2003) draw comparable deductions that Farmers cooperation in breeding

procedures, however, is a decision that has been used successfully because it can be a cheap and easy way to match the selection set with the target place.

Concept of perception

Perception is conceived as a process that interferes with impulses and reactions. As such, it can be viewed as a concept that can delimit the features of converging operations. Converging activities are any collection of test activities that remove alternative theories and may result in a notion that is not clearly identified with any of the major activities but is defined by the outcomes of all the activities conducted. Depictions of current experimental perception problems indicate how certain response characteristics can be isolated from perceptual characteristics and vice versa (Garner, Hake & Eriksen, 1956; Broadbent, 2013).

Perception is the method through which people obtain information or stimuli from our setting and convert it into mental consciousness, according to Bargh and Pietromonaco (1982). Gamble and Gamble (2002) gave a comparable definition that perception is the method of choosing, arranging and interpreting sensory information in a manner that makes it possible for individuals to make sense of the globe. From these definitions, perception can be understood as; how we see and understand issues surrounding us, our own assessment of a situation, an event or issue, one's impression or opinion on an issue, and how we interpret what we see.

Farmer's perception of the characteristics of improved crop varieties

Improving the adoption of Improved Cowpea varieties can make a major contribution to food security in low-income countries like Ghana (Coulibaly &

Lowenberg-DeBoer, 2002). In Ghana, the agricultural industry accounts for a higher proportion (70%) of individuals. Agricultural improvement will have a direct beneficial effect on people's livelihood. Farmer perception of agricultural technology affects their choice of whether or not to accept the technology (Knowler & Bradshaw, 2007). Increased crop yields are mainly dependent on acceptance at the rural farm level of cultural and technological change. Farmers may be able to enhance their productivity by adopting enhanced farming methods; however, sometimes new methods are complex, making implementation hard for non-literate farmers (Apantaku, et al., 2008).

Perceptions of new agricultural technology's features are also significant variables connected with the demand of farmers for new agricultural technologies (Adesina & Baidu-forson, 1995). The technical and cultural attributes of innovations can be subjectively evaluated differently by farmers. In developing and supporting agricultural technologies, understanding the views of farmers is therefore significant (Uaiene *et al*., 2009). Farmers' perceptions of new agricultural technology features are generally split into three primary classifications; yield performance, cost requirements, and hazards.

Feder, Richard, & Zilberman (1985) argue that yielding performance or expected yield of new varieties is one of the features of improved varieties that influence the behaviours of technological adoption by farmers. Several empirical trials indicate a high level of acceptance of improved varieties if the varieties fulfil the expectations of farmers. If the new variety is technically and economically superior to local varieties, an improved variety will be accepted at extremely high prices. By producing a greater output than traditional varieties, improved varieties are technically superior. For example, Adesina &

Baidu-forson (1995) reported that farmers in Burkina Faso adopted a modern variety of sorghum because it yielded high yield compared to the traditional variety of sorghum planted by farmers in previous agricultural years.

Neill and Lee (2001) contend that the adoption of new agricultural technologies by farmers is also influenced by the perception by farmers of the quantity of original capital investment and labour requirements to be allocated if they accept the underlying technology. Martel et al. (2000), who performed a case study on the marketing of dry beans in Honduras, claim that farmers embrace new agricultural systems because they recognize that new technology could decrease labour demands and other related expenses and decrease losses owing to risk during production and/or after harvesting. They also claim that bean breeders always compare the new bean range with the present bean variety. A new bean variety is more likely to be adopted by farmers if it performs well under different environmental conditions, shows economic profitability, and is resistant to disease and insects.

Adegbola and Gardebroek (2007), who analysed the impact of information sources on technology acceptance and modification in Benin, report that, in relation to considering returns, direct expenses and revenues connected with enhanced corn plants, farmers also consider risk-reducing seed features, because damage from insects and/or illness may lead to significant yield losses and bad grain quality during maize production and storage. In some situations, these losses not only improve the danger of food insecurity for farmers' families, but can also reduce farmers' revenue if the volume losses are not adequately offset by a cost rise due to a domestic supply deficit. In terms of risks, several other studies indicate that farmers also consider environmental

elements, such as whether or not the improved varieties were developed for circumstances of the local environment and soil fertility (Gonzales-Ramirez, 2003), or for changes in local trends of agro-ecology (Doss, 2003). Farmers have diverse views about new innovations in agriculture and the economic profitability of new technologies in agriculture is unclear. Early adopters are first adopting farmers, while late adopters are waiting and observing early adopters' experiences. They decide whether or not to adopt the technology based on economic profitability after obtaining information about the technology from early adopters (Shampine, 1998; Basley and Case, 1993).

According to Feder et al. (1985) and Adegbola and Gardebroek (2007), farmers who are conscious of a certain element of agricultural technology will decide whether to embrace it, taking into account original investment and variable costs, by assessing the expected economic profitability or profit they anticipated. If the benefit or profit exceeds the aggregate investment and variable costs, agricultural technology is more likely to be adopted. In addition, they claim that the pace of technological adoption differs over time as socio-economic groups have distinct adoption behaviours and farmers' adoption choices for the next increasing era depend on the original effect of prior experience with technology, profitability, and other farmers.

According to Asiedu-Darko (2014), farmers who still grow traditional cowpea varieties believe that some traditional cowpea varieties still have desirable characteristics such as excellent flavour, colour, size and ease of conservation that are lacking in improved cowpea varieties. Some farmers also believe that the present production of cowpea is very costly. Asiedu-Darko discovered that only improved crop varieties cultivated by more than one-third

of the farmers surveyed while only 28 percent of farmers grow traditional plants with 31 percent of farmers growing both enhanced and traditional varieties. He claims that the reasons given by farmers for failing to adopt improved crop varieties are taste, ease of conservation, ready market, and production costs. Most farmers believe that using the improved cowpea crop varieties they would not afford would require inputs such as fertilizers and other chemicals (Giller, Witter, Corbeels, & Tittonell, 2009). Some farmers complain that farmers who cultivated the improved varieties sometimes had bumper harvest but discovered it hard to market the products that sometimes make some of the products go bad (Dinye & Ayitio, 2013).

Machida, Derera, Tongoona, Langyintuo, & MacRobert (2014) conducted a survey to investigate the preferences and perceptions of farmers in Zimbabwe for corn varieties. They discovered that most participants from three distinct areas perceived improved corn varieties as having elevated yield potential in comparison with open pollinated varieties. They also found that most of the respondent from one of the regions perceived that the open-pollinated varieties have better taste and diseases resistance than the improved varieties. The respondent considered that the improved was better than the open-pollinated varieties with early maturity. These findings are in line with that of Asiedu-Darko, who also claims that local cowpea varieties are perceived by farmers to have a better flavour than those enhanced.

Dinye & Ayitio claims that it is highly hard for farmers to get rid of traditional varieties because they found that they find them more tasteful and easier to maintain compared to the enhanced varieties. These characteristics of traditional varieties have encouraged farmers to grow them continually,

regardless of low returns (Giller *et al*., 2009). The ease of conservation raises the question of how enhanced variety distribution has been packaged. The package does not include post-harvest technology to assist farmers in preserving their bumper harvest. In a case where it would be hard for farmers to maintain their products, adopting them would be a disincentive. Other variables are restricted or unavailable, such as subsidies. Farmers have restricted resources and are not strongly supported in addressing major limitations such as access to quality plants and other inputs including access to equipment credit. Effective access to marketing tools and reliable consumer markets is also essential to promoting cowpea as a precious food safety and poverty reduction commodity chain (Jama & Pizarro, 2008). There have been very few market options in Ghana for cowpea. Constraints are not well established and should be regarded in study attempts as perceived by end customers (Bozeman, 2000).

Stakeholders (Consumers and Marketers) preferred traits and attributes of improved cowpea varieties

Consumer preferences are curtailed by decisions taken on a blend of financial and non-economic differences. Solomon (2010) claimed that the ultimate determinants of market circumstances are customer qualities, behaviour, and attitudes. Several surveys have disclosed that consumers are the basis of any commodity's value chain by which data flows back to consumers, manufacturers, and producers (farmers) and scientists about food choice (Kinsey, 2011).

Consumers and marketers will be informing producers (farmers) about growing varieties that fulfil their requirements. Producers and merchants are more likely to embrace storage and post-harvest handling techniques that

enhance consumer value features (Ibrahim, Nmadu, Baba, Danbaba, & Ibrahim, 2014). Ibrahim et al. (2014) conducted a survey evaluating customer preference in Nigeria for cowpea quality features and price trends. Consumers were discovered to have a preference for quality features such as rough texture, white eye colour, white seed testa colours and minimal insect damaged grains. This is a likely sign that customers in the study region prefer these cowpea features.

According to Mishili, Fulton, Shehu, Kushwaha, Marfo, Jamal, Chergna, Lowenberg-DeBoer (2007) cowpea customers in Nigeria, Ghana, and Mali are prepared to pay a premium for big cowpea grains. They also claimed that in these three nations, cowpea customers are discounting grains from the very first bruchid hole with storage harm. Their research findings also indicate that other cowpea characteristics such as colour of the skin, colour of the eyes and texture differ locally. Consumers in Nigeria usually prefer brown-skinned cowpea while Ghana and Mali prefer white-skinned cowpea. This provides the indication that cowpea has a distinct preference for customers from distinct nations and geographical areas. Related research by Langyintuo, Ntoukam, Murdock, Lowenberg-DeBoer, and Miller (2004) found that customers usually prefer big undamaged cowpea grains in Cameroon and southern Ghana markets. Grain eye colour has been differentiated in both nations as a significant trait of grain quality for which customers are prepared to pay a premium. Consumers prefer black-eyed cowpeas in Ghanaian (North Ghana) markets. In addition, Langyintuo et al. (2003) and Langyintuo et al. (2004) indicated that cowpea consumers in Cameroon, northern Ghana, southern Nigeria, and Senegal value big cowpea grains and dislike damaged cowpea grains. Furthermore, customers in northern Ghana prefer black-eyed

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cowpea grain. In northern Cameroon, cowpea customers are also discounting black-eyed cowpea grains. Once again, Langyintuo et al. (2003) noted that customers pay a premium for white cowpeas in northern Ghana. Hella, Chilongo, Mbwag, Bokosi, Kabambe, Riches and Massawe (2013) also discovered the preference of cowpea to be extremely subjective in Malawi and Tanzania. Cowpea seed coat colour is a dominant feature, according to Malawi participants, influencing consumer preference and hence traders. They were brown, red, white and mottled (Spotted) dominant cowpea plant coat colours in Malawi. Their preferences are based on what customers mostly preferred seed coat, according to traders. They observed that around 80% of manufacturers and traders preferred brown-coloured cowpea skin, respectively. Less than 10 percent of the participants preferred each other's colours (red, white and mottled). Tanzania's responses differed slightly from Malawi's. Seed size was the consumer's most significant preferred criteria as reported by more than 40% of the participants. Seed colour in Tanzania was of little significance compared to Malawi as much of the cowpea grain entering the market is first dehulled to remove the outer coat before other post-harvest processing operations can take place.

Quaye *et al.*, (2011) were two-level customers; trader and consumer. Consumer preferences were sought at the trader level as perceived by traders, while customers themselves ranked their preference through one-to-one interviews at the consumer level. They discovered that the cowpea reference by traders was cleanliness (stone-free and no dirt), colour (white seed colour), simple to cook, tasty, size (large to medium), less weevil harm, dryness (well-dried cowpea) and place of origin ranked in declining order. Cleanliness was

observed by traders as the most preferred attribute of cowpea followed by colour (white seed colour), size (large to medium), cooking time, delicious vegetables, dryness and location of origin. The ranking of consumer preferences was comparable to traders' perceived preferences. When customers were specifically asked to mention their preferred range of cowpea in relation to the source, their preferred selection was rather biased seed colour (white seed colour).

Farmers preferred traits and attributes of improved cowpea varieties

Farmers' requirements and preferences regarding crop varieties are very Farmers' requirements and preferences regarding crop varieties are very crucial Farmers' requirements and preferences regarding crop varieties are very crucial Farmers' requirements and preferences regarding crop varieties are very crucial for the broad implementation of freshly advanced crop varieties and manufacturing techniques as well as the farming systems needed (Hoffman et al., 2007). This strategy takes into account the importance of the expertise, preferences, skills, and innovation of stakeholders (Chandra, 2010). A descriptive evaluation of the crop's quality characteristics can also be used to determine the requirement of the farmer and preferential traits of crop varieties.

Horn, Shimelis, and Laing (2015), again discovered that when choosing cowpea varieties, lengthy pods are a significant feature for farmers. Farmers stated that several seeds were often set by longer pods, a significant determinant of grain yield. Horn et al. stated that in the study fields, farmers preferred cowpea Horn et al. stated that in the study fields, farmers preferred cowpea

characteristics to be a straight pod shape, together with pod size, white seed colour, and high above ground biomass. Accordingly, 61.4 percent of farmers preferred straight-shaped cowpea pods, 33 percent stated the insignificance of pod-shape as their choice criterion, while 5.3 percent said they could grow straight-shaped and coiled cowpea pods. Accordingly, 61.4 percent of farmers preferred straight cowpea pods, 33 percent stated the insignificance of pod-shape as their choice criterion, while 5.3 percent said they could grow straight and coiled cowpea pods. Bruchids prefer smoothed surface grains for oviposition to other texture of the coat of grain, according to Baidoo and Mochiah (2014).

Egbadzor *et al*. (2013) indicated that farmers in Ghana's Volta region prefer big cowpeas to smaller and medium-sized cowpeas. They claim that cowpea seed retailers view insect pest resistance, drought tolerant and yield as the most significant features to be enhanced on present cowpea varieties. They also claim that the region's farmers and consumers prefer easy-to-cook cowpeas. This characteristic was, in reality, the most preferred characteristics for farmers and customers in the region to grow and consume. Nearly all of the respondent agreed that it may not be adopted in the study region once a range takes a long time to boil. They also discovered that colour does not matter when selecting the area's cowpea varieties, but most participants prefer cream-coated grains for commercial reasons in the region. Few of the participants prefer any other colour in the study region to the mottle form of cowpea. The sweetness was also found by farmers and consumers as one of the most significant cowpeas feature desired.

Quaye *et al*. (2011) again noted that the top three preferred varietal characteristics listed by farmers for breeding factors included yield, disease and pest tolerance and seed colour, while processors in the research region preferred white seed coat varieties because of their excellent whipping capacity and brief cooking time. Farmers emphasized the role of local varieties in food sovereignty, with the early maturing varieties being the most important in providing family food. From their study, when farmers were asked what precisely their criteria were for adopting a range, they included yield (68%), disease and pest tolerance (68%), seed colour (50%), market cost (18%), crop morphology (18%), taste (9%) and cooking time (5%). Farmers stated that their entire financial life or livelihood, in particular, will be enhanced if the desired characteristics are improved.

Hella *et al*. (2013) again noted that farmers in Malawi and Tanzania prefer early-maturing cowpeas, elevated yield, resistant to *electra* and disease, seed colour, taste and drought tolerance, seed size, lots of leave, and tenderness. With these cowpea features preferred by farmers, most farmers claim brown-coloured seeds, excellent taste, many tender leaves and large-sized seeds are the top five most cowpea features preferred over other features such as pest tolerance, drought tolerance, early maturation, elevated yield and disease resistance. This finding is not in line with Egbadzor *et al*. (2013) and Quaye *et al*. (2009) findings. This heavily indicates that at a distinct stage in time farmers from distinct geographic locations prefer distinct cowpea characteristics and characteristics. Orawu, Obou, & Omadi (2013) also indicated that Ugandan farmers prefer elevated yield cowpea, large pods and dimensions, tolerant illnesses and delicious cowpea lines.

Definitions and conceptualization of adoption

Agricultural study focuses on the development of new techniques to enhance farm efficiency and the well-being of farmers. In developed and some developing countries, fast adoption of new agricultural technologies has boosted agricultural output, led to general fiscal growth, and decreased food insecurity and poverty (Bandiera and Rasul, 2005; Cornejo and McBridgje, 2002).

Experts vary in defining and conceptualizing the adoption of agricultural technology. Adoption and diffusion are ideas which are different but interrelated. Adoption generally discusses the choice by financial units to use a new technology or practice on a periodic basis. Diffusion often relates to the spatial and temporal diffusion between distinct financial units of new technology. The two ideas have been described by many scientists from distinct disciplines in relation to their own areas. Among others, Rogers' (1983) definition is commonly used in several research of acceptance and diffusion.

Rogers (1983) distinguished adoption from diffusion. He described diffusion (overall adoption) as the mechanism through which technology is transmitted over time among the members of a social system through certain channels. This definition acknowledges the following four aspects: (1) the technology representing the new concept, practice or object being disseminated; (2) communication channels representing how data about the new technology flows from agents of change (extension, technology providers) to end consumers or adopters (e.g. farmers); (3) the period during which the technology is adopted by the social system and (4) the social system. Rogers (1983) then described a farmer's acceptance at a specified moment as the use or

non-use of fresh technology. This definition can be expanded in the social system to all financial units.

Feder et al. (1985), differentiated from aggregate adoption by individual adoption (farm level). Individual (farm) adoption has been described as the degree of use of new technology (innovation) in a long-term equilibrium when the farmer has complete information about the new technology and its potential. Aggregate adoption (diffusion) has been described as the method of technology dissemination within a region. This definition means that aggregate adoption within a specified geographical region is measured by the aggregate rate of use of a given technology.

Similarly, Thirtle and Ruttan (1987) described overall acceptance as the spread within a population of a fresh method. The adoption decision also includes choosing how many resources the new and old technologies will be assigned if the technology is not divisible. Loevinsohn, Sumberg, Diagne, and Whitefield (2013) also define acceptance as the inclusion of new technology into current practice and generally follow a 'trying' period and some degree of adaptation.

Doss (2003), who performed a survey of implementation of farm-level technology in Eastern Africa, distinguishes between discrete and ongoing implementation of technology among typical farmers using either enhanced or enhanced inputs. He defines a farmer as an adopter if any improved materials are discovered to be used. Discrete adoption relates to a farmer who stops using a traditional variety and adopts an enhanced range with regard to the implementation of improved varieties. On the other side, constant adoption

relates to circumstances where, while some local varieties continue to develop, farmers are increasingly planting more land for improved varieties. In addition, he points out that it is complicated to define agricultural technological acceptance. CIMMYT studies used several different definitions of acceptance to distinguish between, for example, varieties officially introduced as improved hybrids, but recycled constantly against the planting of new approved plants. The author also argues that it is crucial to distinguish between farmers who continue to use newly adopted technology from those who stop using it. If the technology is divisible, however, the decision process includes area allocations as well as the amount of use or implementation frequency (Feder et al., 1985). The adoption decision process therefore involves the concurrent choice of whether or not to adopt a technology and its use intensity. In addition, a farmer makes a collection of several interdependent decisions prior to adoption (Hassan, 1996).

Famers adoption of improved cowpea varieties

Low adoption of improved varieties is asserted as one of the factors for low returns, according to Coulibaly, Alene, Abdoulaye, Chianu, Manyong, Aitchedji, Fatokun, Kamara, Ousmane, Tefera, and Boahen (2010). Even when a farmer is said to have adopted an improved crop, the seeds have generally been recycled for many generations to the extent that the recycled seed yield benefit has been lost and therefore they produce no more than the local varieties. Moreover, the characteristics that farmers enjoy are missing from most improved varieties. This, in turn, was due to the failure of crop enhancement programs to involve farmers in the development of improved varieties to achieve their goals and preferences (Coulibaly et al., 2010).

Purcell and Anderson (1997) noted that when farmers think that the suggested change is applicable to their conditions and can assist them to attain their goals, they would embrace new techniques and alter their use of resources. They also indicated that the level at which a farming population adopts a technology would rely on the features of the production conditions of the person, the attributes of the technology itself, the socio-cultural qualities of individual farmers and the speed at which they become aware of the innovation and its adaptation to the systems of local production.

Agwu (2004), performed a survey of variables affecting cowpea technology adoption in Nigeria. He discovered that the cultivation of enhanced cowpea varieties was the second most practiced improved cowpea production technologies by farmers . This could have been ascribed to the reality that Nigerian farmers have access to other inputs that facilitate the implementation of improved varieties of cowpea. Farmers' knowledge of these enhanced varieties of cowpea can also affect their rate of adoption.

Similar findings have also been reported by Ibrahim, Waba, Mohammed and Mustapha (2016). They discovered that the majority of participants embraced the enhanced cowpea varieties among other production techniques such as seed treatment, seed spacing, soil preparation, etc.

Although Agwu (2004) and Ibrahim et al. (2016) indicated that most of their participants adopted improved varieties of cowpea, Bashir, Ndaghu, Nakwe, Abdulazeez and Samuel (2018), discovered that few of their participants embraced enhanced cowpea seeds among other cowpea

manufacturing techniques, with approximately 57% of participants being conscious of improved cowpea varieties but not yet beginning to use them, 26.7% and 5.3% at the interest and assessment point. In the implementation of this technology, approximately 3.3 percent of the participants were at the trial point. This implies that most participants still had to embrace the use of improved varieties of cowpea.

Similar findings were achieved by Horn *et al.* (2015), who performed a survey on Participatory assessment of cowpea's production limitations, preferred characteristics and farming scheme and its breeding implications in Northern Namibia. They discovered that approximately 70 percent of farmers grow unimproved local varieties of cowpea while approximately 30 percent use improved varieties. The use of improved or improved varieties or their combinations showed very important distinctions in the study region between the areas. Farmers recorded poor performance of the unimproved cowpea varieties with yields ranging from 100-500 kg/ha. Nearly 68 percent of farmers said local varieties of cowpea generate pods comprising less than 10 seeds per pod. This shows that farmers in Northern Namibia lack access to improved varieties of cowpea and other factors that impede patronage of improved varieties of cowpea. This adds to the low acceptance of improved varieties of cowpea.

Quaye, Adofo, Madode, and Abizari (2009) also revealed that approximately half of the farmers surveyed in their study reported growing both improved and local varieties. It was observed that only local and enhanced varieties were grown by 33 percent and 22 percent respectively. Farmers usually stated preferential market value for improved varieties but preferred local

varieties for household consumption and food security reasons. Farmers who grow local varieties clarified from their research that they have low-cost repercussions and that some local varieties are tolerant of disease and pest and that there is no critical need for agro-chemical implementation and, most importantly, their leaves can be consumed as vegetables in local meals. These landraces were preferred in the preparing of local meals due to their distinctive cooking features. High yielding features and high market value encouraged the cultivation of improved cowpea varieties. This indicates that farmers in Ghana's Tolon-Kumbungu district are growing enhanced cowpea for commercial purposes and producing local (landrace) varieties for home consumption. The high price of the improved cowpea varieties may also result in farmers in the district adopting them. This has consequences in Ghana's Tolon-Kumbungu district for the growth, promotion and adoption of improved cowpea varieties.

Tijjani, Nabinta & Muntaka (2015) also found that the adoption rate of improved cowpea production methods, including improved cowpea planting, proposed by the Nigerian Institutes of Agricultural Research, was very small among the local farmers surveyed in their research region. They argue that the Nigerian Agricultural Research Institutes are finding methods to ensure greater acceptance of enhanced practices among rural farmers as well as how to maintain adoption, given that low implementation of these methods could considerably reduce farmers' earnings and living standards.

Research undertaken in some villages in Southwest Nigeria by Lawal, Saka, Oyegbami, and Akintayo (2005) disclosed the high adoption of improved seed varieties. A comparable study was undertaken by Omobolanle and Samuel (2006) in the same region, however, also recounted the

level of enhanced implementation of crop technology was small owing to low research and expansion outreach received by farmers. Mohammed (2018) also discovered that there were usually low levels of implementation of enhanced maize farming techniques such as planting enhanced maize seeds in the region. Holloway, Lapar, and Lucila (2007) and Langyintuo and Mekuria (2008) recognized neighbourhood impacts as a key factor that could have a major impact on the adoption choice of a farmer. They said farmers' technology decisions are affected by neighbouring farmers' behaviour or agro-ecological features.

Factors influencing the adoption of technology or innovation

Different technology adoption studies across different locations revealed that a combination of socioeconomic, demographic, and institutional variables determines technology adoption and use intensity. This subsection will, therefore, concentrate on analysing related African and non-African literature that would provide a short account of the outcomes and explanations of some of the variables that affect technology or innovation adoption.

Sex

In studying adoption determinants, sex discrepancy between family heads is a very important explanatory variable. Rural households ' predominant social set-up put a varied obligation between male and female members. Women are disfavoured groups of society in most parts of rural Africa that could not easily access information on technology. As a result, countless adoption surveys had produced outcomes that showed that a woman farmer had a negative impact on choices to adopt a technology. For example, in his research on fertilizer adoption determinants in Ethiopia, Techane (2002) discovered that

male-headed households are more probable than female-headed households to embrace fertilizer. A similar study carried out by Fitsum (2003) confirmed a negative and significant relationship between intensity of fertilizer use and households headed by women. The presence of the difference in wealth between woman headed and male-headed homes was the possible reason given by the two organizations for the difference in fertilizer acceptance. In addition, Bashir et al. (2018) reported that gender was negative and not statistically significant. This implies that gender is not a factor that influences the adoption in their area of study of cowpea production technologies.

Educational level

Farmers' education status is the most prevalent and significant variable observed to explain the behaviour of farmers' adoption of agricultural technology. Different studies have verified that it has an important beneficial impact on technology adoption. For example, in the Somali region of Ethiopia, Mahadi *et al* (2012) researched factors influencing the acceptance of improved sorghum varieties. They discovered that more trained farmers in the study region are more likely to adopt improved sorghum varieties. This finding is consistent with other findings such as Alene *et al* (2000) in the research of adoption determinants and use intensity of improved maize varieties in Ethiopia's Central highlands. Teferi (2003) also analyses fertilizer use determinants in the Gozamin district, Amhara Region, Ethiopia and discovered that education strongly influenced fertilizer use acceptance. Similar research by Bayissa (2010) proposed that the adoption and intensity of use of sesame techniques was favourably explained by education. Agwu (2004) revealed that the level of formal education had affected the implementation of improved

cowpea techniques in Nigeria favourably and substantially. Ibrahim et al. findings (2016) are in line with Agwu's findings (2004). They also discovered that the level of education had an important impact on the implementation of techniques for cowpea production.

Bashir et al. (2018) recorded a favourable and statistically significant amount of education in their research. The favourable coefficient of instructional status implies that there is a direct connection between acceptance of cowpea manufacturing technology and instructional status, thus increasing the rate of acceptance among farmers as an instructional status. On the other side, some writers reported that education had an insignificant or negative impact on the level of acceptance of technology (Khanna, 2001; Banerjee, et al., 2008; Samiee et al., 2009; Ishak and Afrizon, 2011).

Studying the impact of education on adoption of technology, Asnake et al. (2005) showed that education had no important impact on the adoption of improved varieties of chickpea. Uematsu and Mishra (2010) also observed an adverse impact on the adoption of genetically modified crops from formal education. Since the above-mentioned empirical evidence has shown mixed outcomes on educational impact and the adoption of new technology, more research requires to be done to achieve a more coherent outcome.

Age

Farmers' age is additional variable in explaining farmers' behaviour in adopting technology that plays a significant part in affecting farmers' access to information and shaping their capacity to alter the data available into practice (Mwangi & Kariuki, 2015). Older farmers may have expertise and resources to

provide them with more opportunities to try fresh technology. Younger farmers, on the other side, are more likely to embrace fresh technology because they have had more education than the elderly generation (Morris, Henley, & Dowell, 2017). Different surveys of adoption of agricultural technology disclosed conflicting outcomes in terms of age impact in adoption. Some results have verified that age has a negative impact on farmers' adoption behaviour.

Research by Yitayal (2004) verified that the likelihood of using improved technology declines when a farmer's age rises. Assefa and Gezahegn (2004), and Feleke and Zegeye (2006) have also achieved similar results. Other studies of adoption of agricultural technology by other scientists stated that adoption was favourably influenced by age. For example, research by Lapar and Pandey (1999) disclosed that age had a positive impact on hedge-growing techniques being adopted. The outcome was described as a better understanding of elderly farmers gave them the opportunity to better understand new technology's potential risks and limitations. Farmers who embraced the technology ranged from 25 to 54 years of active aging. The age of the farmer has been divisive in explaining the adoption of technology. Sometimes it is believed that older people are less willing to change and therefore unwilling to change their old ways of doing things.

Bashir et al. (2018) recorded similar outcomes. They discovered age to be positive and statistically relevant. The positive age coefficient implies that the adoption of cowpea production techniques and the age of the farmers were directly related.

Age is anticipated to have an adverse effect on adoption in the case of Mbavai et al. (2015). Agwu (2004) also noted that age has no important impact on the adoption of improved techniques for cowpea. On the other side, Muyanga (2009) noted that elderly individuals may have greater accumulated wealth, more expansion contacts, and more predisposing credit institutions to the adoption of technology than younger ones. This statement shows that age in the adoption decision is a main latent feature (Bonabana-Wabbi, 2002).

Marital status

Marital status has an impact on the adoption of agricultural technologies. Idrisa et al. (2010) defined married people as having more duties and thus taking with greater rates of seriousness whatever they do. This implies they will be prepared to search for information on improved techniques to enhance their families' welfare. In their research, Ibrahim et al. (2016) noted that marriage status did not demonstrate any important connection among the variables influencing the adoption of cowpea production techniques. Mohammed (2018), who found that marital status was not an important factor in affecting the implementation of enhanced maize techniques, reported similar outcomes. Akumbole (2017) also noted that marital status was not found to be a major determinant of the rate of adoption by farmers.

Farming Experience

The number of years spent in farming can increase farming understanding and it is anticipated that farmers with more years of experience will perform better in their farming operations (Doss, 2001). Farming experience is a significant variable in determining both the amount of productivity and the amount of production in farming and may have a beneficial

or negative impact (Hassan & Nhemachena, 2008). Up to a certain number of years, it could have a beneficial impact, after which it could become negative. The adverse impact can be obtained from aging or reluctance to shift to improved methods from old and familiar farming methods and techniques. The elderly farmers tend to have an issue using the improved varieties together with the suggested methods that vary from those they have used over the years. In affecting the probability of implementation of cowpea manufacturing techniques, the farming experience was discovered to be crucial. Farmers' leadership know-how is influenced by their farming experience and they are better prepared to evaluate the significance of new techniques. The farming practices associated with improved varieties could be applied and better results could be achieved.

Agwu (2004), Kolawole (2006) and Amaza *et al*. (2007) all showed that farmers' experience influenced the adoption of agricultural technologies positively and significantly. Bashir *et al.* (2018), who discovered that farming experience was statistically important and favourably linked to the probability of adoption, recorded similar outcomes. Most farmers are afraid to adopt improved technology because due to the potential risk of failure they do not have prior experience in adopting new technology. Mohammed (2018) discovered that, contrary to the above results, farming experience was not a major factor affecting the implementation of improved maize technologies. Years of experience in farming could allow farmers to have the courage to adopt technology. Again, Baruwa, Kassali, & Aremu (2015) discovered that farming experience was not an important predictor of improved corn varieties being adopted.

Availability of labour

The availability and frequency of family work play a crucial role in determining the use and intensity of agricultural technologies. They are generally encouraged by the presence of active workers in rural homes to demonstrate an interest in attempting some agricultural technologies. (Shiferaw, Kebede, & You, 2008). The influence of the availability of labour on adoption depends, of course, on the characteristics of the technology to be adopted. Several adoption studies have discovered a positive effect on technology adoption by family labour, such as Alene et al (2000), Techane (2002), Bayissa (2010) and Solomon et al. (2011). On the other side, surveys of adoption by some other scientists like Akinola (1987) discovered an adverse connection between family size and the adoption of technology in Nigeria. Agwu's findings (2004) are consistent with that of Akinola. Agwu reported no important impact on the implementation of improved cowpea techniques in the size of the family.

Farm size

On the other side, in various adoption research, the effect of farm size on adoption and intensity of using some agricultural technologies is not consistently comparable. Some of the research showed that the variable had a positive impact on the choice to adopt. For example, in the Central highlands of Ethiopia, Alene et al (2000) researched determinants of adoption and use intensity of improved maize varieties. This study examines factors influencing the adoption and utilization intensity of improved maize varieties and found a significant positive effect. Agwu (2004) also discovered that farm size had affected the adoption of improved cowpea production techniques positively and

significantly. Similar findings from other investigators like Mulugeta (2011), Tadesse and Belay (2004) and Taha (2007), Solomon *et al.* (2011) recorded positive farm size connection with adoption. Farm size had a positive and statistically significant influence on the adoption of cowpea production technology, according to the findings of Bashir *et al*. (2018). The positive coefficient means a direct connection that improves the size of the farm, the adoption of techniques for cowpea production, and vice versa. In other words, the bigger the size of the farm, the greater the adoption potential.

Studies by Endrias (2003) and Abrhaley (2006) revealed, contrary to these findings, that farm size had a negative and significant impact on the adoption of improved technologies. The explanations given were the stronger tendency of smallholder farmers to intensify technology compared to bigger ones. With regard to the effect of farm size and land tenure on farmers' adoption behaviour, there is no coherent connection between these two variables between Uaiene et al. (2009) and Pattanayak et al. (2003).

Contact with extension services

Access to the extension service is a very important institutional factor that distinguishes farmers' adoption status. Extension services influence the attitudes, knowledge and skills of farmers that affect their production positively (Abebe, Bijman, Pascucci, & Omta, 2013). In the current situation, the extension scheme undertakes much of the delivery of agricultural technology. Regular extension agent visits expose farmers to new ideas and techniques information. Information availability promotes farmers to adopt new technologies that will increase their productivity. Consequently, the failure or success of farmers to access the service is reflected in their adoption of

technology and use intensity. Elias et al. (2013) researched the effect of the Smallholders' Farm Productivity Agricultural Extension Program and the findings showed that involvement in the extension improved the productivity of farmers by six percent. In its research on the effect of extension on the adoption of improved crop varieties, Bamire *et al*. (2010) indicated that farmers must have information on the attributes of an improved variety before they can consider whether or not to adopt it. Their research showed that households that had more access to extension facilities (84%) as a consequence of extension operations had a greater level of acceptance of improved varieties such as cowpea (57%) and thus had greater returns and earnings.

Idrisa (2009) has shown that access to extension facilities has a beneficial and substantial impact on soybean seed uptake. Similarly, the study resulting from Onu (2006) study on the influence of socio-economic factors influencing the adoption of alley farming technology revealed that farmers with access to extension services are 72 percent higher when adopting the technology than those who are not. In her research of female farmers' attitudes towards agricultural extension services, Ayaode and Akintonde (2012) also reported that extension services have beneficial impacts on females by raising their level of production and output by 67% as well as their income and earnings (69%). These studies have shown the importance of extension services in enhancing the productivity and income of women.

Income

The adoption of new technology is highly determined by the net benefit for the adopted or innovative farmer, thus including all expenses of using the improved technology (Foster and Rosenzweig, 2010). The wealth of farmers is

essential in technology implementation because rich farmers can better manage hazards that enable the implementation of improved technologies (Doss and Morris, 2000). Farm income is reported to have a positive effect on the adoption of agricultural technologies in many adoption researches. Studies by Alene (2000), Degnet and Belay (2001) and Minyahil (2008) have verified that farm income has a positive impact on agricultural technology adoption. The explanation behind the results is the improved purchasing power of those farmers with greater farm income that allows them access to technology. Ibrahim et al., (2016) also reported that income had a positive and significant impact on the adoption of improved technologies for cowpea production in Nigeria.

Access to credit

Access to credit to encourage the adoption of technology has been noted (Mohamed & Temu, 2008). According to Simtowe & Zeller (2006), access to credit encourages the adoption of risky technologies by reducing the liquidity limitation and improving the risk-bearing capacity of homes. This is because, with a borrowing choice, a family can end risk-reducing but inefficient policies for diversifying revenue and focus on riskier but effective investments (Simtowe & Zeller, 2006). However, in some nations where female-headed households are discriminated against by credit institutions, access to loan has been discovered to be gender biased, and as such they are unable to finance yield-raising systems, resulting in low adoption rates (Muzari *et al.*, 2013).

Several studies have noted the impact of credit access on technology adoption. Baruwa, Kassali, & Aremu (2015) indicated that access to credit had a major impact on the likelihood of adoption in Nigeria of improved corn

varieties. Ibrahim et al. (2016) also noted that access to credit had a positive impact on the adoption of cowpea technology in Nigeria. Similar results have been revealed by Mohammed (2018), who discovered that access to credit had a significant impact on the adoption of improved maize production methods in the northern Ghana municipality of Yendi. Contrary to these results, Ekepu & Tirivanhu (2016) revealed that access to credit had no important impact on sorghum legume rotation adoption.

Perceived characteristics of innovation

The theory of perceived characteristics assumes that there are five characteristics on which an innovation is assessed; that trialability can be tried, that observability can be observed, that it has an advantage over other technologies or the relative advantage of the current circumstances, that studying or using complexity is not excessively complicated, that it suits or is consistent in the conditions in which compatibility will be adopted. In relation to the five (5) perceived features, the voluntariness of use is another construction deemed necessary for this research. The detailed characteristics discussions are as follows:

Relative Advantage; The higher the degree to which innovation is viewed as superior to the notion or the one it replaces, the higher the speed at which innovation is adopted. It is assessed in terms of economic advantages, price cuts, suitability, social aspects, and satisfaction. The financial factor is one of the significant variables affecting users' adoption of technology or innovation (Fuglie & Kascak, 2001). The adoption level is anticipated to boost if the adopters get more advantages (Jeon, Han & Lee, 2006; Lin, Wang, Kao, & Cheng, 2007).

Compatibility; The degree to which innovation is considered to be in line with current values, previous experiences and prospective adopters' needs. Increased compatibility affects the adoption rate completely. Compatibility has been regarded as comparable in some studies on diffusion, comparative benefit and compatibility, although conceptually different (Moore & Benbasat, 1991).

Complexity; How people consider the complexity of innovation depending on their abilities. It is viewed that the less complicated technology is, the higher the adoption rate. Because of these limitations, complex innovation such as skills, technique, or expertise will cause adoption acceptance to slow down (Lin, Wang, Kao, & Cheng, 2007).

Trialability; The extent to which an innovation can be tested is limited. An increased likelihood of trialability increases adoption. Many surveys in different fields have been performed to define and understand the factors affecting the adoption of new technology by farmers (Pannell, Marshall, Barr, Curtis, Vanclay, & Wilkinson, 2006; Li, Liu, & Deng, 2010).

Observability; Talks about the visibility of innovation to others, producing positive outcomes when it is more noticeable as the rate of adoption will be higher. Results of some concepts are readily noted and conveyed to others, while some innovations are hard to define to others. Members of a social system perceive the observability of an innovation, is strongly linked to its adoption rate (Moore & Benbasat, 1991).

Image; Moore and Benbasat (1991, p. 195) describe image as ''the degree to which the use of technology is viewed in the social system to improve one's image or status''. Gounaris and Koritos (2008) indicated that, if they did so,

consumers would be more likely to embrace internet banking. Consequently, image is viewed as a social component. Any choice to enhance one's social image is highly attractive from a user view. It is presumed that this attribute is linked favorably to adoption (Moore and Benbasat 1991).

Voluntariness of use; Defined as the extent to which the use of innovation is viewed as mandatory or voluntary. Consideration must also be provided to whether people are free to enforce private acceptance or refusal choices when examining the dissemination of innovations (Moore & Benbasat, 1991).

Aubert and Hamel (2001) state that it is easier for people to adopt innovations introduced on a voluntary basis, and forcing adoption only leads to opposition. Thus, it is presumed that voluntariness is linked favorably to adoption. In itself, voluntariness dictates the displayed free will for the implementation of an innovation. Kishore and McLean (2007) conducted a survey on infusion reuse software and discovered that voluntarism had a significant adverse impact on the conduct of the infusion. Hsu, Lu, and Hsu (2007) also reported a substantial beneficial impact on acceptance from voluntary work. In general, it was seen that voluntarism had both negative and positive impacts on the adoption of innovation.

In conclusion, innovations will be adopted quicker than other technologies providing a more relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). The adoption process will also be accelerated by the willingness to use an innovation. Rogers added that it is hard to come up with a new concept, even if it has apparent advantages, so the

availability of all these innovation factors speeds up the process of innovation diffusion.

Challenges faced by farmers in the adoption of improved cowpea varieties

The adoption of technology among smallholder farmers was found to be very small, despite several attempts taken to promote access to agricultural information and enhanced techniques (Ajayi, Franzel, Kuntashula and Kwesiga, 2003; MOFA, 2010). The adoption of technology is a decision-making process that imposes certain limitations. These constraints have limited the use of improved varieties in regions largely were cowpea are grown. Some of these variables may include the Lack of documentation on improved cowpea varieties, lack of accessibility of seeds or unacceptable new varieties due to low market values or insufficiency of the farming system and crop variables (Kamara, Ellis-Jones, Ekeleme, Omoigui, Amaza, Chikoye and Dugje, 2010).

Kasirye (2013) identified two primary factors affecting the effective adoption of agricultural technology in developing nations as the accessibility and affordability of materials and the expectations of farmers that adoption will stay lucrative. The extent to which farmers are or are not risk-averse determines these factors (Foster and Rosenzweig, 2010; Carletto, Kirk and Winters, 2007). The above-mentioned expectations are driven by several variables, ranging from land accessibility and size, family labour, agricultural enterprise prices and profitability, and peer impacts.

According to Carletto, Kirk and Winters (2007) and DeJanvry, Dustan and Sadoulet (2010), the accessibility of cultivable land is one of the most emphasized limitations to the adoption of agricultural technology. Availability

of land is asserted to help reduce the liquidity limitations experienced by farming families and also decrease risk aversion. On the other side, large-scale land ownership can also promote testing of new agricultural technologies and also determine the pace of adoption as early adopters are more likely to be big landowners (De Janvry, Dustan and Sadoulet, 2010).

In their research on the economic analysis of cowpea production among women farmers in Askira / Uba Local Government Area, Modu, Putai and Petu-Ibikunle (2010), Borno State Nigeria has demonstrated that women's main limitations are insufficient capital and absence of access to credit. Others include the absence of formal loan organizations, lack of market outlets, transportation, production-period management problems, storage and pest and disease issue.

In their research of Small Farmers Constraint on Agricultural Development, Shashekala, Shakaraiah, Sumathu, Ravikumar, Kavitha and Gowda (2012) discovered that small-scale farmers face the constraint of improved seed non-availability, lack of easy credit services, early availability of improved production inputs, high manufacturing input costs and, where necessary, lack of technical advice. Amaza (2011) in his study on early adoption of improved cowpea in northern Nigeria reported lack of adequate seeds, poor quality seeds and inadequate information about the improved seeds to be the major limitation on the use of improved varieties of cowpea. Zongoma (2015) has acquired similar outcomes. He discovered that the respondents were primarily restricted by pests and diseases, high labour costs, insufficient market access, insufficient extension visits, and land tenure issues. He claims that improved cowpea with an early maturity period is highly susceptible to pests

and diseases because plants mature when the rains are still on and farmers are generally too busy with other plants to harvest than mature cowpea.

Ibrahim et al. (2016) also discovered that constraints on the adoption of cowpea production techniques were observed largely owing to the absence of inputs, mechanized services, finance, storage infrastructure, and insufficient information dissemination. Similar findings have been recorded by Agbamu (2006) who noted that the absence of capital, high input costs and labor were the main limitations for farmers in Kwara State, Nigeria, to adopt maize production techniques.

Mbavai, Shitu, Abdoulaye, Kamara, & Kamara (2015) also noted that desired, seed and fertilizer non-availability, high fertilizer costs, pests, and diseases have been identified as the main limitations facing farmers in adopting improved cowpea varieties in Northern Nigeria.

Conceptual Framework of the Study

Figure 3 shows the conceptual framework of stakeholder's preference and the adoption of improved cowpea varieties.

When improved varieties are developed, it is expected that the developed varieties meet the preference of stakeholders who are the beneficiaries of the varieties. This will determine the adoption or rejection of such varieties. From figure 3, it is expected that the socio-economic characteristics of stakeholders along the cowpea value chain will determine the adoption of improved cowpea varieties. Again, the socio-economic characteristics of the stakeholders also influence their preferred traits and characteristics of the improved cowpea varieties and also will determine their

level of participation in the development and release of improved cowpea varieties. Farmers perceived attributes of improved cowpea varieties and their preferred traits and characteristics of improved cowpea varieties will determine their level of adoption of such varieties. It is believed that if an improved technology has a less relative advantage over the existing one, its adoption will be low or will not be adopted at all and vice versa. In the same vain the adoption rates also depend on the preferred attributes of the improved varieties that meet stakeholder's demands.

Stakeholders level of participation in the development and release of improved cowpea varieties is also a key factor that facilitates the adoption of improved varieties. This will determine whether stakeholders are involved in the decision making in the development and release of improved cowpea varieties. Lastly, challenges faced by farmers can also influence the adoption of an improved cowpea variety. Challenges associated with cultivation of cowpea will determine if farmers are adopting or rejecting improved varieties even when the varieties meet their preference and needs.

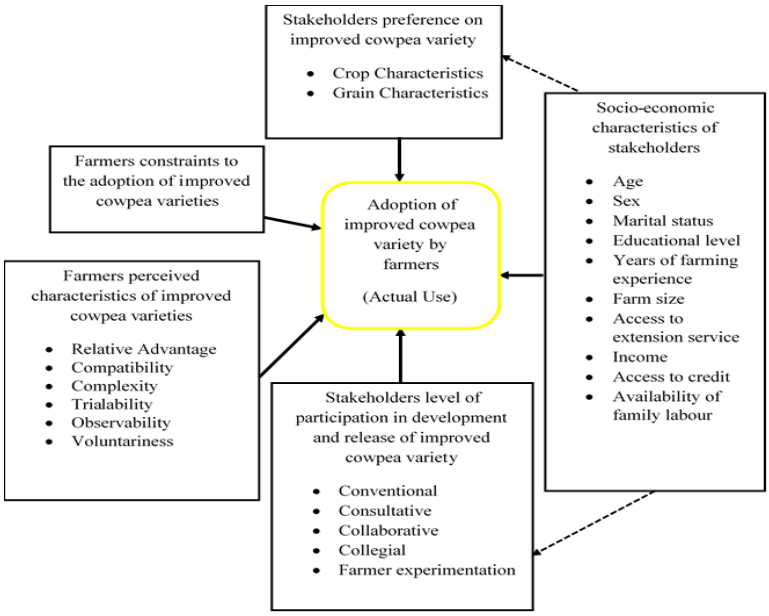

Figure 3: Conceptual framework of Adoption of improved cowpea varieties among farmers.
Source: Afful (2019)

Chapter Summary

This chapter reviewed related literature that is of significance to the study. The first part of the chapter considered the theoretical underpinnings of the study. The theories underpinning this study were, Diffusion of innovation theory by Rogers (2003), The expanded Rogers' attributes of innovation model by Moore and Benbasat (1991), and Stakeholders engagement theory by Donaldson and Preston (1995). The chapter brought readers to understand the status of Global, regional, and national cowpea production, concept of participation research, concept of perception, typologies and definitions of stakeholders, definitions and conceptualization of adoption, stakeholders' preference on improved cowpea varieties, stakeholders' participation in the development and release of improved cowpea varieties, adoption of improved

crop varieties, factors influencing adoption as well as challenges confronting adoption of improved cowpea varieties. The last part of the chapter considered the conceptual framework guiding the study.

CHAPTER THREE

RESEARCH METHODS

General Overview

This chapter describes the procedures and techniques used in collecting, managing and analysing the data. It also presents the research design, the population studied, the sample and sampling procedure, research instrumentation, pilot-testing, data collection procedure, data processing and analysis, empirical model specification and ethical consideration that will be used as well as the rationale behind the choice of these techniques for the study.

Research Design

A research design is a strategy that researchers adopt in order to answer questions validly, objectively, properly and economically. This shows two primary tasks for a study design (Kumar, 2011). The first concerns the identification and/or development of the procedures and logistical arrangements necessary to undertake a study, and the second highlights the importance of quality in these procedures to ensure their validity, objectivity and accuracy. Through research design, an operational plan can be conceptualized to undertake the different procedures and tasks required to complete the study, and it also ensures that these procedures are adequate to obtain valid, objective and accurate answers to the research questions (Kumar, 2011).

The study used a cross-sectional survey design primarily for the quantitative research method. A cross-sectional survey design was used to determine the status and inter-relationships of the research variables. This is because at one stage in time data was gathered (Kumar, 2011).

In general, survey design enables the researcher to generalize from a sample to a bigger population to create space for inferences about the features of the population, according to Babbie (1995) and Creswell (2011).

Description of the Study Area

The Northern region occupies an area of approximately 70,384 square kilometres which, in terms of land mass, is the largest region in Ghana and lies between latitude 9 ° 29' 59.99 "N and longitude 1 °00' 0.00" W. The region shares borders with the Upper East and West regions, the Brong Ahafo and the Volta regions, east Togo, and west Côte d'Ivoire. Apart from the north-eastern corner with the Gambaga escarpment and

along the western corridor, the ground is mostly flat. The Black and White Volta Rivers and their tributaries like the Nasia and Daka rivers drain the area (MoFA, 2011). Because of its closeness to the Sahel and the Sahara, the Northern region is much drier than the southern regions of Ghana.

The vegetation comprises mainly of grassland, particularly savannah with clusters of dry trees such as baobabs or acacias. There is a dry season between January and March. The wet season is between about July and December with an average annual rainfall of 750 to 1050 mm (30 to 40 inches). The highest temperatures are reached at the end of the dry season, the lowest in December and January (MoFA, 2011).

However, the Sahara's warm Harmattan winds commonly blow between December and early February. Temperatures may range from night time at 14 ºC (59 ºF) to daytime at 40 ºC (104 ºF) (MoFA, 2011).

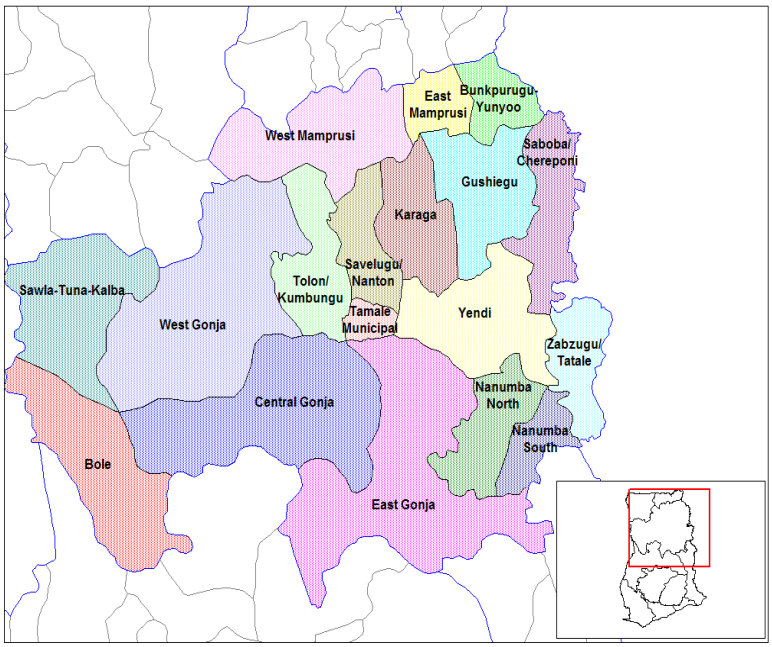

Figure 4: Map of the Study Area-Northern Region of Ghana.

The Study Population

The population for the study was major cowpea stakeholders (farmers, marketers, and consumers) in the Northern region of Ghana.

Sampling Procedure

Selection of farmers

Probability sampling (simple random and systematic) was used to select farmers from the four districts from the sixteen districts for the study. A list

of cowpea farmers from the four districts were obtained from the Ministry of Agriculture (MoFA) offices in each district to determine the sample size for the study.

A multistage sampling technique was employed in the selection of 415 cowpea farmers in the four (4) cowpea growing districts in the Northern region of Ghana. At the first stage of the sampling, simple random sampling was used to select four (4) cowpea districts namely Yendi, Savelugu, Nanumba North, and Nunumba South. Secondly, twenty (20) communities/villages, five (5) from each district were selected by simple random selection. Finally, the systematic random sampling was used to select 415 cowpea farmers from the selected twenty (20) communities/villages.

The sample size was determined using the formula given by Miller and Brewer (2003). According to Kotrlik and Higgins (2001), most surveys, studies or experiments generally use a maximum error margin of 5%, therefore, the basis for using an error margin of 5%.

The formula given by Miller and Brewer (2003) is:

$$n = \frac{N}{1+N(\alpha)^2}$$

Where, n = Sample size, N = population of cowpea farmers, α = error margin.

The sample size of 400 farmers was calculated using

$$n = \frac{11747}{1+11747(0.05)^2} = \frac{11747}{11748(0.0025)} = 399.97$$

The sample size of 415 farmers were based on the above sample size formula. The calculation was based on 5% margin error of precision and 10%

non-response rate was anticipated from non-respondents. Table 1 shows the summary of the sample size used for the study.

Selection of marketers

Non-probability sampling (snowball) was used to select marketers from the four (4) districts of the study. This sampling technique was used to draw an appropriate sample from the study areas.

Snowball sampling is the technique of using networks to select a sample, according to Kumar (2011) and Given (2008). In snowball sampling, the method starts with selecting a few people in a region and gathering from them the necessary data. In terms of the data being requested, this method continues until the necessary number or saturation point is reached (Kumar, 2011; Given, 2008; Cassell & Symon, 2004). Following this procedure, from each district, a farmer was asked to recommend a marketer to be interviewed. After meeting this first person, he/she also recommended a second marketer to be interviewed. This process continued until the stipulated sample size of 15 marketers from each district was attained. (see Table 1 for the summary of the sample size used for the study).

Selection of consumers

Convenience sampling procedure was also used to select 120 cowpea consumers from the study area. With this sampling procedure, respondents were asked whether he/she consumes cowpea. Informed consent was then sought

from the respondents to be interviewed when the person answers 'yes' to whether he/she consumes cowpea. This process was continued until the stipulated sample size for the study was reached.

Table 1: Summary of the Sample Size used for the study

District	Population of Cowpea Farmers	% of the Total Population	Sampled Cowpea Farmers	Sampled Cowpea Consumers	Sampled Cowpea Marketers
Nanumba North	2,080	17.5	75	60	15
Nanumba South	2,929	25	100	60	15
Savelugu	2,520	21.5	92	60	15
Yendi	4,218	36	148	60	15
Total	11,747	100	415	120	60

Source: Authors' Construct (2019)

An overall sample size of 595 major cowpea stakeholders was used for the study. This composed of 415 cowpea farmers, 120 cowpea consumers, and 60 cowpea marketers across the four (4) districts.

Data Collection Instruments

To obtain data from participants, a combination of content-validated questionnaires and structured interview schedules were created as tools for the data collection. According to Kumar (2011)**,** a questionnaire is a written list of issues reported by the participants. Respondents read the questions in the questionnaire, interpret what is anticipated, and then write down the responses. The only difference between a structured interview schedule and a questionnaire is that the interviewer asks the questions (and explains to them if necessary) in a structured interview schedule and records the responses of the respondent on

an interview schedule, and the respondents themselves record the answers in the questionnaire.

The instrument's face and content validity were ensured. Face validity was assured that the question or item on the study tool has a logical connection to the goals, While the validity of the content has been confirmed as to whether the items and issues cover the full range of the issue being measured. This was done by supervisors of this study.

The questionnaire was used to obtain data from some of the cowpea consumers and farmers who could read and complete the questionnaire on their own, while the structured interview schedule was used to obtain data from cowpea consumers, farmers, and marketers who were unable to read or write. The instruments consisted of questions that were both closed and open-ended.

The research instruments (questionnaire and structured interview schedule) for cowpea farmers composed of Part A to Part F, while that of the consumers and marketers compose of Part A, C and D.

(I). Part A: Demographic and farm-related characteristics of cowpea farmers and demographic characteristics of cowpea consumers and marketers

(II). Part B: Perceived attributes of current cowpea varieties produced and marketed in Ghana.

(III). Part C: Degree of participation of major stakeholders (farmers, consumers, and marketers) in the development and release of improved cowpea varieties

(IV). Part D: Stakeholders preferred traits and attributes of improved cowpea varieties to be developed

(V). Part E: Level of adoption of improved cowpea varieties

(VI). Part F: Challenges confronting adoption of improved cowpea varieties among farmers

The items in part A, were measured using open and close-ended items. Items in part B, C, D, E, and F were mainly measured using six-point Likert-type scale ranging from 1 (1) to five (5). Table 2 shows the summary of the Likert-type scales and their respective interpretations used in the instruments.

Table 2: Interpretations of Likert-type scales used in the study

Ratings	Interval or Range	Interpretation		
		Level of Agreement	Level of Involvement	Preference level
5	4.45 – 5.44	Strongly agree	Very high	Most preferred
4	3.45 – 4.44	Agree	High	Preferred
3	2.45 – 3.44	Fairly agree	Moderate	Fairly preferred
2	1.45 – 2.44	Less agree	Low	Less preferred
1	0.45 – 1.44	Least agree	Very low	Least preferred
~~0~~	~~0~~	~~Not sure~~	~~No involvement~~	~~Not sure~~

Source: Authors' Construct (2019)

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Pre-testing of Research Instrument(s)

Pre-testing of the research instrument(s) was done to ensure its reliability. Pilot testing of the instrument(s) was conducted in Techiman municipality in the Brong-Ahafo Region of Ghana. Pre-testing a research instrument entails a critical examination of the understanding of each question and its meaning as understood by a respondent. Thirty (30) cowpea farmers,

twenty (20) cowpea consumers and fifteen (15) cowpea marketers from Techiman municipality were used for the pilot study. The researcher, and four (4) trained enumerators assisted in interviewing the selected cowpea farmers, consumers, and marketers. The pilot study was conducted from 9th February 2019 to 15th February 2019.

The responses were coded into version 25 of IBM SPSS. The Cronbach's alpha reliability coefficient was used to determine the internal consistency of the items (Croasmun & Ostrom, 2011). This was done to check if items in various scales and sub-scales have the same underlying constructs in the three (3) different set of instruments.

A study instrument's reliability relates to the instrument's consistency, predictability, and precision. The higher the degree of consistency and stability of a tool, the more reliable it is. A scale or test is therefore reliable to the extent that repeated measurements under constant conditions will yield the same result (Moser & Kalton, 1986, p. 353). The reliability coefficients of the various constructs in the three (3) different set of instruments is shown in Table 3.

Table 3: Reliability Analysis of Subscale of the Research instruments using Cronbach's Alpha.

	Construct	Farmers (n=30		Marketers (n=15)		Consumers (n=20)	
		Alpha	No. items	Alpha	No. items	Alpha	No. items
1.	Perceived attributes of improved cowpea varieties						

a.	Relative advantage	0.842	8				
b.	Compatibility	0.995	5				
c.	Complexity	0.928	6				
d.	Trialability	0.975	5				
e.	Observability	0.996	4				
f.	Voluntariness	0.930	5				
	Overall perceived attribute of improved cowpea varieties	*0.961*	*33*				
2.	Participation in development and release of improved cowpea varieties						
a.	Conventional	0.945	6	-	-	-	-
b.	Consultative	0.996	5	-	-	-	-
c.	Collaborative	0.979	13	-	-	-	-
d.	Collegial	0.939	8	-	-	-	-
e.	Farmer experimentation	0.937	6	-	-	-	-
	Overall participation	*0.974*	*38*	-	-	-	-
3.	Preferred traits and attributes of improved cowpea varieties						
a.	Crop attributes	0.582	7				
b.	Grain attributes	0.518	4	0.751	4	0.632	4
4.	Reasons for adopting improved cowpea varieties	0.793	9				
5.	Challenges in the adoption of improved cowpea varieties	0.761	10				

Source: Pilot study, Afful (2019)

From Table 3 the Cronbach's alpha of the five (5) main constructs; Perceived attributes of improved cowpea varieties, Participation, Preference, Reasons for adoption, and Challenges in the adoption of improved cowpea varieties were computed. The first column shows the reliability coefficients of the farmers' questionnaires. The coefficients of all the construct were above 0.7

indicating that generally, farmers' questionnaire had very good reliability, with the exception of the subscale 'crop attributes' which had a relatively low coefficient of 0.582. According to Pallant (2013), Cronbach's alpha scale coefficient should ideally be above 0.7. However, the 0.518 coefficient of the subscale 'grain attributes' is due to number of items (see the first column on Table 3), since the Cronbach alpha coefficient is susceptible to the number of items in the scale, it is common to discover the values of 0.5 of Cronbach alpha in smaller scales (Pallant, 2013). Therefore, the 0.518 on 'grain attributes' subscale is relatively good since the number of items in the subscale is less than 5 since Pallant (2013) opined scales with small items less than 10 are likely to produce small Cronbach alpha coefficients.

The second and third column also presents Cronbach alpha coefficients of two (2) main construct; Participation and Preferred grain attributes for the marketers and consumers questionnaire. Cronbach alpha coefficients for the construct 'Participation' for both marketers and consumers' questionnaire was not able to compute because there was zero variance in the responses, indicating that all the responses under the construct were identical. However, the Cronbach alpha coefficients for the Marketers and Consumers instruments on 'Preferred grain attributes' construct was 0.751 and 0.632 respectively. The Cronbach alpha coefficients of 0.751 were good according to Pallant recommendation on Cronbach alpha coefficients. Again, the Cronbach alpha coefficients of 0.632 are relatively small but generally good due to the number of items under the construct (see the third column in Table 3).

Data Collection Procedure

Six (6) data enumerators were trained to help the researcher administer the research instrument to the sampled respondents from the selected districts. The content of the validated research instruments was vividly explained to the enumerators. Local dialects were used for respondents who won't be able to answer the questionnaire on their own to understand the questions and respond to them appropriately. A period of three (3) weeks was used to collect data from the four (4) districts (Yendi, Savelugu, Nanumba North and Nanumba South) of the study. Data collection was commenced from 25th May 2019 to 15th, June 2019.

Out of the 620 instruments distributed, 595 interview schedule and questionnaire were received (415 out of 440 questionnaires and interview schedule from the farmers were received). The response rate from the farmers, consumers, and marketers were 94%, 100%, and 100% respectively.

Data Processing and Analysis

The data were analysed using IBM SPSS version 25.0 software. Frequencies, percentages, means, standard deviation, chi-square, Kruskal-Wallis (*H*) test, different correlation coefficients, logistic multiple regression and Kendall's coefficient of concordance (*W*) was used to analyse the data.

Objective one (1) was analysed using means and standard deviation to describe the farmers perceived characteristics of improved cowpea varieties.

Objective two (2) was analysed using means and standard deviation to describe the level of participation of stakeholders in the development and release of improved cowpea varieties. Also, Kruskal-Wallis test was used to

compare differences in the level of participation among stakeholders in the development and release of new cowpea varieties.

Objective three (3) was analysed using frequencies, percentages, and means to rank farmers preferred crop attributes of improved cowpea varieties to be developed. Also, Chi-square test was used to compare differences in the preferred grain attributes of improved cowpea varieties among stakeholders.

Objective four (4) was analysed using percentages to describe the level of adoption of improved cowpea varieties among farmers' and also means and standard deviation to rank the main reasons why farmers adopt improved cowpea varieties.

Objective five (5) was analysed using different correlation coefficients (Spearman's rho, Biserial (r_{bi}), Rank Biserial (r_{rbi}), and Phi correlation (r_{φ})) to explore the relationships between the independents variables and adoption of improved cowpea varieties based on the level of measurement of the independent variables in relation to the dependent variable. Biserial coefficient of correlation (r_{bi}) is used to measure the degree of association between the nominal variable of artificial dichotomy and the ratio or interval level. This is almost comparable to the Point Biserial correlation (r_{φ}), but a natural variable (e.g. sex) must be the nominal dichotomy. Rank Biserial (r_{rbi}) is used to measure the degree of association between any nominal dichotomy (e.g. adoption of improved cowpea varieties: 1=adoption and 0=No adoption) and ordinal or ranked level measurements (e.g. Educational level). Logistic or logit regression model was also used to predict the best predictors of adoption of improved cowpea varieties.

Objective six (6) was analysed using Kendall's Coefficient of Concordance (W) to rank the challenges confronting the adoption of improved cowpea varieties among farmers

Empirical Model Specification

Analysis of challenges to adoption

Objective six (6) sought to examine the constraints cowpea farmers encountered within the adoption of improved cowpea varieties. Kendall's Concordance Coefficient (*W*) advocated by Kendall and Babington-Smith (1939) was used to determine the degree of agreement in the ranked challenges of adopting improved cowpea varieties. *W* is a measure of the raters' agreement evaluating a ranked set of issues (Steedle and Shavelson, 2009). It is used to evaluate the degree to which participants provide a common ranking on a problem with the same overall property in research. *W* limits must fall between zero (0) and one (1) if the ranks allocated by each respondent are presumed to be the same as those allocated by other participants and zero (0) if there is maximum discrepancy between the respondents' scores. For choice ranking, calculation of the complete ranked score for each item and calculation of *W* using the formulae;

$$W = \frac{12(S)}{m^2(n)(n^2-1)-mT} \quad \text{---------- (1)}$$

Where n is the number of objects, m is the number of variables and T is a correction factor, S is a sum-of-squares statistic over the row sums of ranks R_i and R is the mean of the R_i values computed first from the row-marginal sums of ranks R_i received by the objects:

$$S = \sum(R_i - R)^{-2} \quad \text{---------- (2)}$$

For tied ranks T is;

$T = \sum t_k^3 - t$, ---------- (3)

t_k = the number of tied ranks in each (k) of groups of ties. The sum is computed over all groups of ties found in all m variables of the data table, T = 0 when there are no tied values and the equation becomes;

$W = \frac{12(S)}{m^2(n)(n^2-1)}$ ---------- (4)

W is an estimate of the variance of the row sums of ranks R_i divided by the maximum possible value the variance can take. This occurs when all variables are in total agreement. Hence $0 \leq W \leq 1$; $W = 1$ represents perfect concordance/agreement and 0 indicates perfect disagreement in the ranking.

Friedman's Chi-square statistics (X^2) is given by;

$X^2 = m(n-1)\,W$ ----------(5)

This quantity is asymptotically distributed like chi-square with (n-1) degrees of freedom; it can be used to test W for significance. This approach is satisfactory only for moderately large values of m and n (Kendall and Babington-Smith, 1939; Steedle and Shavelson, 2009).

Binary logistic regression analysis

Both probit and logistic regression models can be used to determine the categorical probability of an event occurring given a selected number of independent variables. The difference that exists between logistic and probit

models lies in this assumption about the distribution of the errors. The logit model has a standard logistic distribution of errors where the probit model has a standard normal distribution of errors. Again, the estimated parameters in the probit results are between 50% and 60% smaller in absolute value than the corresponding parameter estimates in the logit results. Also, the probit regression model requires the independent variables to be linearly related. This assumption of the probit regression model will not be fulfilled with the use of both continuous and categorical variables so logistic regression is the recommended statistical procedure when these variables are used (Yuan & Lin, 2006).

According to Starkweather and Moske (2011), logistic regression does not involve a linear connection between independent variables, nor does it involve equal variance within each group, which also makes statistical analysis less stringent. Consequently, the decision to use the logistic regression model for the evaluation was based on its realistic standard normal error distribution. The logistic regression model was therefore used to predict the factors that influence the adoption of improved varieties of cowpea.

To examine the factors predicting the adoption of improved cowpea varieties, logistic regression was used to determine the probability of farmers' adopting improved cowpea varieties. The following model was used to calculate the odds ratio:

$$\ln(\text{ODDS}) = \ln\left[\frac{p\,(Y)}{1-p\,(Y)}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots\ldots\ldots \beta_i X_i \quad \ldots\ldots\ldots\ldots (1)$$

Therefore, from equation 1, the probability y=1 occurs varies according to the values of the explanatory variables and could be specified as;

Logit [P (Y =1)] = $\beta_0 + \beta_i X_i$ …… (2)

From equation 2, P (Y=1) is given by P (Y=1) = $\frac{u^{\{\beta_o+\beta_i X_i\}}}{1+u^{\{\beta_o+\beta_i X_i\}}}$

The function ln $[\frac{p\,(Y)}{1-p\,(Y)}]$ is the logit transformation (the log (odds) of the outcomes). $\beta_0, \beta_1, \beta_2, \ldots\ldots\ldots\ldots\ldots\beta_i$ (model) co-efficient, β_0 is the intercept. Also, $X_1, X_2 \ldots\ldots\ldots\ldots\ldots\ldots X_i$ are the predictor variables.

Additionally, $[\frac{p}{1-p}] = u^{\{\beta_o+\sum\beta_i X_i\}}$ where P is the probability that Y = 1 and 1-P is the probability that Y = 0 and u is the vector of the error term. In the following empirical model specified in equation 3, Y = 1 defines a cowpea farmer adopting improved cowpea varieties measured as 1 = adoption; Y = 0 define no adoption. The X's define the independent variables that explain the probability that a farmer adopting improved cowpea varieties measured as 1 = adoption and u_i is the error term:

Logit [P (Y_i =1)] = $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14} X_{14} + \beta_{15} X_{15} + \beta_{16} X_{16} + u_i$ …….. (3)

The dependent variable for the study is the adoption of improved cowpea varieties measured as 1= adoption and 0= no adoption.

Table 4: Independent variables and their prior expectation

Variable	Meaning	Description	Expectation
X_1	Sex	Dummy variable; 1 = Male and 0 =Female	Negative (-)
X_2	Age	Number of years	Positive (+)

X_3	Experience	Number of years in cowpea production	Positive (+)
X_4	Household Size	Number of people in the farmers' household	Negative (-)
X_5	Farm Size	Number of acres of farm	Positive (+)
X_6	Access to Credit	Dummy variable; 1= Yes and 0= otherwise	Positive (+)
X_7	Income	Estimated income from previous cowpea production season in Ghana Cedis	Positive (+)
X_8	Access to Extension Services	Dummy variable; 1= Yes and 0= otherwise	Positive (+)
X_9	Relative Advantage	Interval scale	Positive (+)
X_{10}	Compatibility	Interval scale	Positive (+)
X_{11}	Complexity	Interval scale	Positive (+)
X_{12}	Trialability	Interval scale	Positive (+)
X_{13}	Observability	Interval scale	Positive (+)
X_{14}	Voluntariness	Interval scale	Positive (+)
X_{15}	Marital Status	Dummy variable; 1= Married and 0 = Otherwise	Negative (-)
X_{16}	Educational Level	Dummy variable; 1 = Formal education and 0= Otherwise	Negative (-)

Source: Authors' Construct (2019)

Ethical Consideration

Before the research was conducted, the researcher sought~~ted~~ permission from the University of Cape Coast – Institutional Review Board (IRB), for ethical clearance (see Appendix G). Permission was also sought~~ted~~ from the Ministry of Food and Agriculture of the various districts to conduct the research. Written informed consent was sought from the participants after a brief

introduction of the purpose of the research. Participation in the study was also voluntary, and any cowpea farmer, marketer or consumer was free to withdraw from the study whenever they wanted. Respondents were also given the confidentiality of any information they provided during the interview. There were no names included in the instruments for information collection. Completed structured interview schedules and questionnaires were held only for the investigator and supervisors in a lockable location. Electronic data was encrypted from intruders.

Chapter Summary

This chapter discussed the methodology used in carrying out the study. It touched on the research design and description of the study area. The study employed quantitative methods approach. Moreover, the chapter also stated the sources of data, target population, sample and sampling procedure, and research instruments used. Finally, the chapter described the data processing and analytical tools used, model specification and some ethical consideration issues. The next chapter is the presentation of results and discussion of the data collected.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presents the results and discussions of the study. The first section looks at farmers' perceived attributes of improved cowpea The first section looks at farmers' perceived attributes

of improved cowpea varieties. The second section looks at farmers' participation in the development and release of improved cowpea varieties. The third section discusses the farmers' preferred traits and attributes of improved cowpea varieties to be developed, whiles the fourth section discusses the level of adoption of improved cowpea varieties and the reason for adoption among farmers in the study area. The fifth and sixth sections discuss the demographic and farm-related characteristics of the cowpea farmers, predictors the influences adoption of improved cowpea varieties and the constraints faced by farmers' in the adoption of improved cowpea varieties respectively.

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Attributes of Improved Cowpea Varieties as Perceived by Farmer's

Table 5 presents results on the six (6) main attributes of improved cowpea varieties. The six (6) main attributes studied were: (a) relative advantage, (b) observability, (c) voluntariness, (d) compatibility, (e) trialability and (f) complexity.

Table 5: Farmers Perceived Attributes of Improved Cowpea Varieties

Attributes of Improved Cowpea Varieties	$\bar{X}$	SD
Voluntariness (n=364)	3.84	1.32

Relative ~~Advantage (~~Advantage (n=406)	3.76	0.97
Observability (n=385)	3.56	1.31
Compatibility (n=379)	3.26	1.24
Complexity (Ease of Use) (n=374)	3.02	1.28
Trialability (n=379)	2.97	1.38
Overall Perceived Attributes	*3.48*	*0.95*

Scale on level of Agreement (1=least agree, 2=Less agree, 3=Fairly agree, 4=Agree, 5=Strongly agree). Source: Field survey, Afful (2019)

Voluntariness of improved cowpea varieties

Moore and Benbasat (1991, p.195) defined voluntariness as the ‘’level to which the use of innovation is viewed as voluntary or free will’’. The results in Table 5 show that farmers ‘Agree’ ($\bar{X}$= 3.84, SD= 1.32) that cultivation of improved cowpea varieties was on a voluntary basis, that is, they were not forced by government, scientist or any institutions such as NGO’s who sometimes give farmers seeds as gifts (see Appendix B). This indicates that farmers have a fair view that their decision to use or adopt an innovation such as the use of improved cowpea varieties should be on a voluntary basis. Aubert and Hamel (2001) reported that it is easier for people to adopt an innovation if it is implemented or introduced on a voluntary basis and forcing implementation only leads to opposition. Therefore, it is presumed that voluntariness is linked favorably to the acceptance of any practice or idea.

Relative advantage of improved cowpea varieties

Farmers in the study area 'Agree' ($\bar{X}$= 3.7, SD= 0.97) that the improved cowpea varieties have a relative advantage over the local cowpea varieties cultivated in the study area. The implication is that, farmers were sure that the improved cowpea varieties have the abilities of being more profitable than the local varieties, have more yields than the local cowpea varieties, improve their social prestige than cultivating local varieties, requirement of less pest and disease chemicals than local varieties, have better taste than the local varieties, have desirable colour and size than the local varieties and easier to store than the local varieties (see Appendix B). This also indicates that farmers have much information about the improved cowpea varieties hence are convinced about its relative advantage over the existing varieties. The results could be due to the fact that farmers who still grow traditional or local cowpea varieties are of the opinion that some traditional cowpea crops do not have desirable attributes such as good taste, colour, size, and ease of storage which the improved cowpea varieties sometimes lack (Asiedu-Darko, 2014).

Observability and compatibility of improved cowpea varieties

Farmers 'Agree' that the characteristics or features of improved cowpea varieties is observable ($\bar{X}$= 3.56, SD= 1.31). This implies that farmers were sure that the degree to which the characteristics of the improved cowpea varieties are easily observed and described with no difficulty in communicating the advantages and disadvantages to other cowpea farmers. The result could be due to the fact that some of the improved cowpea varieties have similar characteristics to the local ones during the growing stage which

sometimes makes it difficult for farmers to observe and understand the nature of the improved cowpea varieties at that growing stage. The observability or visibility of these improved cowpea varieties could be easily observed during the harvesting stage since Feder et al. (1985) reported that yield performance of new varieties is one of the characteristics of improved varieties that influence farmers' technological adoption behaviours. However, this assertion could only hold when farmers adhere to production techniques of improved cowpea cultivation of which farmers finds it difficult to practice. This has, however, made it somehow difficult for farmers to observe and describe the characteristics of the improved cowpea varieties to other cowpea farmers. Rogers (2003) opined that the rate of adoption will be greater if the innovation is more visible and produce positive results. Again, Moore and Benbasat (1991) asserted that the observability of innovation as perceived by members of a social system is positively related to its rate of adoption. Therefore, 'Agree' on the observability of the improved cowpea varieties to farmers could have a positive implications for the adoption of improved cowpea varieties among farmers.

Regarding compatibility of improved cowpea varieties, farmers 'fairly agree' ($\bar{X}$= 3.26, SD= 1.24) that improved cowpea varieties are well-suited with most of their cultural values, suitable with previously introduced production technologies, compatible with current agronomic practices and consistent with their farming system (see Appendix B). Therefore, even though improved cowpea varieties had the prospects for adoption by cowpea farmers, it is being considered to be comparatively advantageous and more profitable relative to current farmers' methods and are considered to be stable with socio-cultural

values and farmers' views. This shows a somehow positive direction towards the adoption of improved cowpea varieties in the study area. This is because Rogers (2003) noted that the greater the incompatibility of innovation with current deeply integrated cultural values, the less its adoption. The results also imply that farmers' see previous procedures to serve as norms or frameworks for the understanding of innovation as Rogers (2003) had assumed that outdated and current ideas are the primary mental instruments used by practitioners to evaluate and give significance to new thoughts.

Complexity and trialability of improved cowpea varieties

Complexity is defined as the level to which people find a practice to be complex based on their skills (Lin *et al*., 2007). From Table 5 the results show that farmers 'fairly agree' ($\bar{X}$= 3.02, SD= 1.28) that the production technologies of improved cowpea varieties are quite easy to understand and practice, less risky to cultivate, require minimal initial capital to produce and easy to store (see Appendix B). This is because improved cowpea varieties come with some specific production technologies such as line spacing, early application of fertilizer and herbicides (weed control), recommended sowing depth among others. This also implies that some farmers are of the opinion that using the enhanced cowpea crop varieties they would not afford the desired inputs such as fertilizers and other chemicals in their cowpea production (Giller *et al*., 2009). Lin *et al*. (2007) asserted that the less complex an innovation is, the higher the adoption rate.

Rogers (2003) defined trialability as the extent to which an innovation can be tested on a small basis. Regarding trialability of improved cowpea varieties, the results in table 5 show that farmers 'fairly agrees' ($\bar{X}$= 2.97, SD=

1.38) that cultivation of improved cowpea varieties need less effort to try out before planting on a full scale, the seeds are available to test before planting on full scale and have the opportunity to try out the seeds at different seasons (see Appendix B). Therefore, the result implies that farmers have the opinion that improved cowpea varieties can be try out on a smaller basis before its adoption and this will have a positive impact on the adoption of improved cowpea varieties. Therefore, it is probable that innovations that can be tested on a small basis will be adopted faster than non-innovations (Rogers, 2003).

Overall perceived attributes of improved cowpea varieties

From Table 5 farmers 'fairly agree' ($\bar{X}$= 3.48, SD= 0.95) on the overall (6) attributes of improved cowpea varieties in the Northern region of Ghana. The results show that farmers have mixed feelings about the overall attributes of the improved cowpea varieties. This indicates a somewhat positive influence on adoption of improved cowpea varieties in the study area.

Stakeholders' Participation in the Development and Release of Improved Cowpea Varieties

The second objective was to compare the degree of participation in the development and release of improved cowpea varieties among stakeholders. Table 6 presents the degree of participation in the development and release of improved cowpea varieties among stakeholders. The five (5) main levels or degree of participatory plant breeding as describe by Lilja and Ashby (1999) studied were: (a) conventional, (b) consultative, (c) collaborative, collegial, and (e) farmer experimentation.

The results show that almost all (99%) the stakeholders (farmers, consumers, and marketers) participated at the conventional level of development and release of improved cowpea varieties. The results further showed that stakeholders participation at the conventional stage of development and release of improved cowpea varieties ($\bar{X}$= 1.95, SD= 1.01), consultative ($\bar{X}$= 2.43, SD= 1.37), collaborative ($\bar{X}$= 2.21, SD= 1.27), collegial ($\bar{X}$= 2.24, SD= 1.27), and farmer experimentation ($\bar{X}$= 2.48, SD= 1.46) level were 'low'. However, 45.9 percent, 38.0 percent, 45.0 percent, and 39.7 percent of the stakeholders did not participate, at the consultative, collaborative, collegial, and farmer experimentation degree of development and release of improved cowpea varieties respectively.

Table 6: Degree of Participation in the Development and Release of Improved Cowpea Varieties among Stakeholders

Degree of Participation	Farmers (n=415)			Consumers (n=120)			Marketers (n=60)			All stakeholders (n=592)		
	No Participation (%)	Participation $\bar{X}$	SD	No Participation (%)	Participation $\bar{X}$	SD	No Participation (%)	Participation $\bar{X}$	SD	No Participation (%)	Participation $\bar{X}$	SD
Conventional	1.2	1.96	1.03	0.8	1.94	1.05	-	2.08	1.27	1.0	1.95	1.01
Consultative	46.5	2.46	1.43	45.0	2.29	1.26	50.0	2.38	1.42	45.9	2.43	1.37
Collaborative	37.8	2.22	1.31	40.0	2.07	1.17	43.3	1.90	1.11	38.0	2.21	1.27
Collegial	46.5	2.23	1.28	44.2	2.07	1.20	46.7	2.29	1.43	45.0	2.24	1.27
Farmer Experimentation	39.8	2.59	1.52	41.7	2.09	1.26	45.0	2.27	1.43	39.7	2.48	1.46
Overall Participation	*0.7*	*2.03*	*0.89*	*0.8*	*1.82*	*0.79*	-	*1.85*	*0.79*	*0.9*	*2.79*	*0.54*

Scale on level of Participation (1=Very low, 2=Low, 3=Moderate, 4=High, 5=Very high). Source: Field Survey, Afful (2019)

At the conventional degree of participatory plant breeding, scientist make breeding choices alone without structured communication with farmers and other stakeholders. The result shows that there was 'low' participation of individual stakeholders [Farmers ($\bar{X}$= 1.96, SD= 1.03), Consumers ($\bar{X}$= 1.94, SD= 1.05) and Marketers ($\bar{X}$= 2.08, SD= 1.27)] at this stage of participation in the development and release of improved cowpea varieties. In other words, farmers, marketers, and consumers do not make any contribution during the development and release of improved cowpea varieties. This implies that all the stakeholders did not involve in an organized communication with scientists or breeders concerning decisions in development and release of improved cowpea varieties.

In terms of consultative degree of development and release of improved cowpea varieties, Scientist make plant breeding decision with a systematic one-way communication with stakeholders. At this stage cowpea varietal preference and priorities of farmers may or will not be factored in during the final decision making among scientist. The result shows that, there was 'low' participation of individual stakeholders [Farmers ($\bar{X}$= 2.46, SD= 1.43), Consumers ($\bar{X}$= 2.29, SD= 1.26) and Marketers ($\bar{X}$= 2.38, SD= 1.42) in the development and release of improved cowpea varieties at the consultative stage. About 46 percent, 45 percent, and 50 percent of farmers, consumers, and marketers respectively did not participate at this stage of participatory plant breeding.

This gives the implication that scientists make cowpea breeding decisions alone with some level of organized communication with all the stakeholders. This shows that scientist or breeders rely on the opinions and

varietal preferences of stakeholders to a small extent during the development and release of new improved cowpea varieties.

Collaborative stage of participatory plant breeding involves activities such as; setting of goals for breeding process, selection of varietal preferences, collection of cowpea lines, selection of project site, multiplication of new cowpea lines and distribution of new cowpea lines with a two-way structured communication between scientist and stakeholders. The result shows that more than half of the stakeholders [farmers (62%), consumers (60%), and marketers (57%)] participation at the collaborative level. The results also show that, the level of participation of theses stakeholders were 'low' [farmers ($\bar{X}$= 2.22, SD= 1.31), consumers ($\bar{X}$= 2.07, SD= 1.17), and marketers ($\bar{X}$= 1.90, SD= 1.11)]. The result implies that, there was a weak link between scientists and stakeholders through a structured two-way communication in understanding each other's thoughts and priorities for the breeding of improved cowpea varieties.

Collegial level of participatory plant breeding involves setting of goals for breeding process, selection of varietal preferences, collection of cowpea lines, selection of project site, multiplication of new cowpea lines and distribution of new cowpea lines among stakeholders through a structured communication with scientist. At this level of participation farmers or stakeholders acquire data on the priorities of scientist through a structured communication. The result shows that less than half of the stakeholders [farmers (47%), consumers (44%), and marketers (47%)] did not participate at collegial level of development and release of improved cowpea varieties. The result further shows that, the level of participation in the development and release of

improved cowpea varieties of individual stakeholders [Farmers ($\bar{X}$= 2.23, SD= 1.28), consumers ($\bar{X}$= 2.07, SD= 1.20) and marketers ($\bar{X}$= 2.29, SD= 1.43)] at the collegial level were 'low'. This gives the indication that stakeholders rely on breeding protocols from scientist to a small extent during the development of improved cowpea varieties.

Farmer experimentation (no scientist participation) mainly involves collection of cowpea lines, selection of project site and multiplication of new cowpea lines without a structured interaction with scientist. The result shows that less than half of the stakeholders [farmers (40%), consumers (42%), and marketers (45%)] did not participate at this stage of participatory plant breeding. The result again shows that, the level of participation of individual stakeholders [Farmers ($\bar{X}$= 2.59, SD= 1.52), consumers ($\bar{X}$= 2.09, SD= 1.26) and marketers ($\bar{X}$= 2.27, SD= 1.43)] at the farmer experimentation stage of the development and release of improved cowpea varieties were 'low'. The 'low' level of participation of the individual stakeholders at the farmer or stakeholder experimentation (no scientist participation) gives the implication that farmers and other stakeholders do not experiment (multiplication of seeds) with and introduce new genetic material without any communication with scientists or breeders.

The results give the indication that stakeholders were not actively involved in the development and release of improved cowpea varieties and this can slow the adoption of these improved cowpea varieties. However, considering the advantages of participatory plant (cowpea) breeding FOA (2009) opined that, participatory plant breeding has the possible benefits of enhancing user preference and more effective distribution of study funding,

greater adoption rates, a close relationship with local cultures, empowering farmers' understanding and abilities, and overcoming the typical growth constraints of the science discipline.

Generally, the overall participation of stakeholders in the development and release of improved cowpea varieties was 'low' ($\bar{X}$= 2.79, SD= 0.54). Sperling *et al.* (2001) reported most participatory plant breeding programmes reviewed has observed degree of participation to be at the consultative level followed by collaborative type of participatory plant breeding. They stressed that this even happens at the very first stages of defining breeding goals. The reason for the disparity between this study and that of Sperling *et al*. could be due to the fact that participatory plant breeding is not well developed in the study area.

Differences among stakeholder participation in the development and release of improved cowpea varieties

Table 7 shows the results of the Kruskal-Wallis H test to determine whether a statistically significant difference existed among the overall participation of stakeholders in the development and release of improved cowpea varieties among stakeholders.

Table 7: Kruskal-Wallis H Test of Stakeholders Participation in the Development and Release of Improved Cowpea Varieties

Stakeholders	N	Median
Farmers	412	3.00
Consumers	119	2.92
Marketers	60	3.00
Total	591	3.00
Test Statistics		
	Value	
Krukal-Wallis H	2.144	
Df	2	
P	0.342	

n=595, p<0.05

Source: Field survey, Afful (2019)

From Table 7, the results showed that Farmers recorded a higher median score (*Md*= 3.40) than the marketers and consumers, who recorded (*Md*= 3.33) and (*Md*= 3.27) respectively. However, a Kruskal-Wallis H test revealed no statistically significant difference in the overall participation in the development and release of improved cowpea varieties among the three stakeholders (farmers, n = 412: consumers, n= 119: marketers, n= 60), *H* (2, n= 592) = 2.144, p= 0.342.

The study, therefore, accepts the first null hypothesis that stated that 'there was no statistically significant difference in the degree of participation among cowpea farmers, marketers and consumers in the development and release of new cowpea ~~varieties'~~varieties. The alternative hypothesis which stated the 'there was a statistically significant difference in the degree of participation between cowpea farmers, marketers and consumers in the development and release of new cowpea varieties' is rejected.

Stakeholders Preferred Attributes of Improved Cowpea Varieties to be Developed

The third objective of the study was to compare stakeholders preferred attributes of improved cowpea varieties to be developed. This objective was divided into two main sections. The first examined farmers preferred crop attributes of improved cowpea varieties to be developed whiles the second section compares the grain attributes of improved cowpea varieties to be developed.

Farmers preferred crop attributes of improved cowpea varieties to be developed

The results in Table 8 showed that 45 percent of farmers in the four districts prefer medium cowpea pod size with about 37 percent showing a preference for cowpea varieties with long pods. Concerning the shape of cowpea pods, 45 percent of the farmers prefers straight pod cowpea varieties to curved and coiled cowpea pods. The result is not in line with that of Horn *et al.* (2015) who reported that farmers in their study area prefer longer pods. They indicated that farmers prefer longer pods because longer pods usually set several seeds and are likely to be tender when cooked and consumed as a fresh vegetable. Horn *et al.* again reported that farmers usually prefer cowpea varieties which have straight pods.

Table 8: Descriptive Statistics of Farmers Preferred Crop Attributes of Improved Cowpea Varieties to be Developed

Attributes	F	%	$\bar{X}$	SD
Pod Size (n= 410)				
Shot	74	18.0		
Medium	186	45.4		
Long	150	36.6		
Shape of Pod (n= 392)				
Straight	178	45.4		
Curved	175	44.6		
Coiled	39	9.9		
Yield potential (n= 402)			4.75	0.77
Early maturing varieties (n= 393)			4.62	0.94
Drought tolerant (n= 402)			4.53	1.02
Pest and disease resistant (n= 405)			4.48	1.08
Plant morphology (High above ground biomass) (n= 401)			4.33	1.17
Tenderness of leaves (n= 404)			3.89	1.44
Varieties with more leaves (n= 405)			3.88	1.49

Scale on level of preference (1= Least preferred, 2= Less preferred, 3= Fairly preferred, 4= Preferred, 5= Most preferred). Source: Field Survey, Afful (2019)

From Table 8, it can be seen that yield potential ($\bar{X}$= 4.75, SD= 0.77) and early maturing cowpea varieties ($\bar{X}$= 4.62, SD= 0.94) were 'preferred' by farmers as an important trait of improved cowpea varieties to be produced. Drought tolerant varieties ($\bar{X}$= 4.53, SD= 1.02), pest and disease resistant varieties ($\bar{X}$= 4.48, SD= 1.08) and high above ground biomass varieties ($\bar{X}$= 4.33, SD= 1.17) was also ~~was~~ 'preferred' by farmers to be very important attributes of improved cowpea varieties to be developed. However, tenderness of leaves ($\bar{X}$= 3.89, SD= 1.44) and cowpea varieties with more leaves ($\bar{X}$= 3.88, SD= 1.49) were 'fairly preferred' among farmers as traits of improved cowpea varieties to be developed. Quaye *et al.* (2009) reported that farmers preferred

yield potential, tolerance to diseases and pest and plant morphology as very important crop attributes desired in new cowpea development. Hella *et al.* (2013) also reported that farmers in Malawi and Tanzania show a preference for cowpea varieties which early maturing, high yielding, resistant to pest and diseases, drought tolerance, more leaves and tenderness of the leaves. This indicates that some of the findings of this study are similar to that of Hella *et al*., Quaye *et al.*, and Horn *et al.* This implies that farmers from different places or countries have a preference for different crop attributes of improved cowpea varieties. For instance, tenderness of leaves and more leaves of cowpea is a very important attribute of cowpea varieties in some countries due to its diverse uses as food and fodder for animals respectively. Tenderness of leaves and more leaves of cowpea varieties were not regarded as very important crop attributes selected by farmers' to be attribute of improved cowpea varieties to be developed.

Stakeholders preferred grain attributes of improved cowpea varieties to be developed

To compare the preferred grain attributes of improved cowpea varieties to be developed among the stakeholders, a chi-square test of independence was conducted. Table 9 reveals the results of the difference that exist among stakeholders' preference for grain attributes of improved cowpea varieties. The results revealed that there was a statistically significant relationship between the stakeholders (consumers, marketers, and farmers) and their preference for texture of cowpea coat ($\chi^2 = 10.150$, $p = 0.006$). The results further show that majority of the consumers (86.2%), marketers (67.2%), and farmers (82.9%) prefer improved cowpea varieties which have smooth coat

seeds whiles 13.8, 32.8, and 17.1 percent of the consumers, marketers, and farmers prefer cowpea varieties with rough coat seeds respectively.

Additionally, there was a statistically significant relationship between the stakeholders and their preference for grain size (χ^2 = 13.819, p = 0.006). Further analysis showed that whereas 42.1 percent of the consumers and 37.3 percent of the marketers prefer larger sized cowpea varieties, whiles about 53 percent of the farmers prefers medium-sized cowpea varieties (Table 9). This implies that stakeholders prefer larger and medium grain size more than the cowpea with smaller grain size. The findings found empirical support from Egbadzor *et al.* (2013) who reported that farmers in the Volta Region of Ghana prefer large seeded cowpeas to smaller and medium sizes. The results again do not concur with empirical evidence from Langyintuo et al. (2004) on the study of cowpea supply and demand in West and Central Africa. They reported that consumers in Cameroon and Northern Ghana usually prefer larger undamaged cowpea grains than medium and small-sized cowpea grains. This implies that there has been a shift of preference for cowpea gain size from large to medium sizes among most stakeholders in Northern Ghana.

Table 9: Stakeholders Preferred Grain Attributes of Improved Cowpea Varieties to be Developed

Grain Attributes		Consumers (n=120)	Marketers (n= 60)	Farmers (n= 415)	x^2	p
Texture of the Coat	*Rough*	13.8	32.8	17.1	10.150	0.006*
	Smooth	86.2	67.2	82.9		
Eye colour	*White*	59.6	59.3	52.4	2.353	0.308
	Black	40.4	40.7	47.6		
Testa Colour	*White*	47.0	49.2	37.3	5.645	0.059
	Other Colours	53.0	50.8	62.7		
Minimum Insect Damage	*Most Preferred*	83.8	83.3	86.6	0.676	0.713
	Less Preferred	16.2	16.7	13.4		
Grain Size	*Small*	16.7	27.1	12.6	13.819	0.008*
	Medium	41.2	35.6	52.8		
	Large	42.1	37.3	34.6		
Cookability (Easy to cook)	*Most Preferred*	89.3	94.7	74.5	6.033	0.049*
	Less Preferred	10.7	5.3	25.5		
Cleanliness (Less debris)	*Most Preferred*	74.1	93.8	78.2	2.546	0.280
	Less Preferred	25.9	6.3	21.8		
Taste (Sweet taste grains)	*Most Preferred*	85.7	100.0	78.7	3.690	0.158
	Less Preferred	14.3	0	21.3		

*Significant at p< 0.05

Source: Field survey, Afful (2019)

The results regarding ~~stakeholders~~stakeholder's preference on cookability (easy to cook) of improved cowpea varieties, there was a statistically significant relationship between stakeholders and cookability of improved cowpea varieties ($\chi^2 = 6.033$, $p = 0.049$). The results further showed that all the stakeholders mostly prefer improved varieties which are easy to cook. For individual stakeholders, 89. 3 percent of the consumers, 94.7 percent of the marketers, and 74.5 of the farmers 'mostly prefer' improved cowpea varieties than cowpea varieties which usually takes a longer time to be cooked (Table 9). The results found empirical support from Egbadzor *et al.* (2013) who further reported that farmers and consumers prefer cowpeas which are easy to cook.

However, eye colour, testa colour, minimum insect damage, cleanliness, and taste did not show any statistically significant relationship among the stakeholders (Table 9). Though stakeholders show preference for black-eyed cowpea varieties (Langyintou *et al*., 2004) but the results of this study revealed that majority [consumers (59.6 %), marketers (59.3 %), and farmers (52.4 %)] of the stakeholders prefer improved cowpea varieties with white eye colour over varieties with black eye.

In terms of testa colour, the results show that majority [consumers (53.0 %), marketers (50.8 %), and farmers (62.7 %)] of the stakeholders 'mostly preferred' improved cowpea varieties with other colours such as brown, red, mottled and chocolate over varieties with white testa colour (coat colour). This finding concurs with that of Hella *et al.* (2013). They reported that the majority of consumers and traders in Malawi prefer cowpea varieties with dominant cowpea seed coat colours such as brown, red, and mottled (spotted). However,

the results of this study do not concur with that of Mishili *et al.* (2007), who reported that consumers in Ghana and Mali prefer cowpea varieties with brown skin colour. The results again show that all the stakeholders 'mostly preferred' improved cowpea varieties with minimum insect damage, clean from debris (less debris), and varieties which have a sweet taste. Quaye *et al.* (2011) also reported that cowpea preference by consumers and traders includes cleanliness (stone free and no dirt), easy to cook, taste, less or minimum weevil damage among other attributes.

The study, therefore, accept the second alternative hypothesis which stated that 'there is a statistically significant distinction in all the preferred grain attributes of new cowpea varieties to be developed among cowpea farmers, marketers, and consumers. The null hypothesis which stated the 'there is no statistically significant distinction in all the preferred grain attributes of new cowpea varieties to be developed among cowpea farmers, marketers, and consumers' is rejected.

Adoption of improved cowpea varieties among Farmers

This objective of the study sought to examine the adoption of improved cowpea varieties among Farmers in the Northern region of Ghana. Figure 5 illustrates the results ~~of~~ obtained.

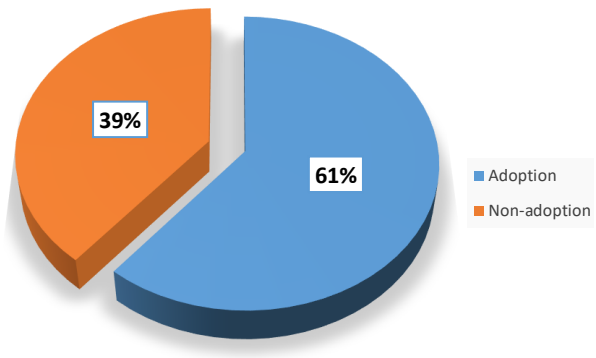

Figure 5: Adoption of improved cowpea varieties among Farmers

Source: Field survey, Afful (2019)

The results indicate that 61 percent of the farmers in the four districts in the Northern region of Ghana have adopted improved cowpea varieties. The finding is in line with Ibrahim *et al.* (2016) who found that about 72 percent of the farmers interviewed in Nigeria adopted improved cowpea varieties among other production technologies in cowpea production. Similar results were also reported by Lawal *et al.* (2005), who reported that improved varieties of cowpea seeds were highly adopted in some parts of Southwest Nigeria.

Reasons for adoption of improved cowpea varieties

This section presents results on the reasons why farmers adopted improved cowpea varieties. The results in Table 10 indicate the most desired characteristics of improved cowpea varieties.

Table 10: Descriptive Statistics of Reasons for adoption of improved cowpea varieties

Statements	$\bar{X}$	SD
It is high yielding	4.13	1.15
Improved cowpea varieties mature early	4.07	1.15
I earn a high income/profit from market sales	3.98	1.18
Improved cowpea variety is a household food security crop	3.93	1.25
Improved cowpea variety have diversified food products	3.85	1.31
Improved cowpea varieties are drought resistant	3.73	1.30
Improved cowpea seeds are available	3.15	1.36
Improved cowpea seeds are affordable	2.85	1.50
Cultivation of improved cowpea varieties requires less labour.	2.66	1.50

n= 415, Scale on level of Agreement (1=least agree, 2=Less agree, 3=Fairly agree, 4=Agree, 5=Strongly agree). Source: Field survey, Afful (2019)

Farmers in the Northern region gave high yielding ($\bar{X}$= 4.13, SD= 1.15), early maturity ($\bar{X}$= 4.07, SD= 1.15), high income ($\bar{X}$= 3.98, SD= 1.18), household food security ($\bar{X}$= 3.93, SD= 1.25), diversified food products ($\bar{X}$= 3.85, SD= 1.31), drought resistant ($\bar{X}$= 3.73, SD= 1.30) and availability of seeds ($\bar{X}$= 3.15, SD= 1.36) in decreasing order of importance as the main reasons for the adoption of improved cowpea varieties. The implication is that high yields, early maturity, and high income are the main reasons why farmers adopt or

cultivate improved cowpea and other improved crops because farmers perceive that improved varieties have market value than local varieties which are usually used for household consumption (Quaye *et al.*, 2009).

The result is supported by the empirical findings of Mbavai *et al*. (2015), who reported that most of the farmers considered high yield, high income, resistance to drought, early maturity, household food security, and diversified food products from cowpea as the main reasons why farmers grow cowpea varieties.

Demographic Characteristics of Cowpea Farmers

Demographic characteristics of farmers interviewed are presented in Table 11. The results revealed that the majority (about 85%) of farmers interviewed in the four districts were males. This implies that cowpea production is dominated by male in the study area. The survey revealed that the mean age of the farmers was 40 years with a standard deviation of 11.5. The minimum and maximum ages were 18 and 78 years respectively. It was obvious from the survey that the majority (81.4%) of the respondents who are cowpea farmers were within the economically active age (<20 – 49 years) group as the average age shows a relatively young population capable of engaging in various agricultural activities. According to Mignouna, Manyong, Rusike, Mutabazi, and Senkondo (2011); Kariyasa and Dewi (2011), age is considered to be a factor of adoption of improved technologies. Older farmers are supposed to have increased knowledge and experience over time and are able to evaluate the information of technologies than younger farmers. The age of a farmer influences the levels of information access and farming experience.

The majority (87.1%) of the farmers who were into cowpea farming in the four districts were married (Table 11). This result concurs with the findings of GSS (2014) that reported that about 87 percent of the population aged 12 years and older in the Northern region are married. Opara (2008) asserted that marital status also influences the desire to increase Opara (2008) asserted that marital status also influences the desire to increase productivity for family consumption and income is high among farmers who are married than their unmarried counterparts.

Regarding educational level, the study revealed that most (about 63%) of the respondents had no formal education. About 19 percent of the farmers had basic education qualification with about 13 percent attained secondary education level while only about 4 percent of the farmers had tertiary education qualification (Table 11). The finding support that of GSS (2014) who reported that about 63 percent of the people in the Northern region are non-literate. The finding of the study is however contrary to that of Gerken, Suglo and Braun (2001) who reported that 17 percent of small-scale farmers did not have formal education.

Variables	Categories	F	%	$\bar{X}$	SD
Sex (n=415)	Male	351	15.4		
	Female	64	84.6		
Age (Years) (n=391,	<20	3	0.8	40.3	11.5
Min=18 Max=78)	20 – 29	59	15.1		
	30 – 39	148	37.9		
	40 – 49	108	27.6		
	50 – 59	37	9.5		
	60 – 69	25	6.4		
	≥70	11	2.8		
Marital status (n=394)	Married	343	87.1		
	Not Married	51	12.9		
Educational level (n=395)	No Formal	250	63.3		
	Basic	76	19.2		
	Secondary	52	13.2		
	Tertiary	17	4.3		
Years of Experience in	1 – 10	200	49.3	8.4	7.8
Cowpea Production	11 – 20	119	29.3		
(n=406, Min=1 Max=45)	21 – 30	46	11.3		
	31 – 40	39	9.6		
	≥40	2	0.5		
Household Size (n=398,	1 – 5	115	28.9	8.4	4.3
Min=1 Max=20)	6 – 10	175	44.0		
	11 – 15	82	20.6		
	≥15	26	6.5		

Table 11: Summary Statistics of Demographic Characteristics of Cowpea Farmers

Source: Field survey, Afful (2019)

In terms of years of experience in cowpea production, a mean of about 8 years with a standard deviation of 7.8 was recorded among farmers

interviewed from the four (4) districts. The majority (about 79 %) of the farmers had between 1 – 20 years of experience in cowpea production with few (about 11 %) of the farmers having between 21 – 30 years of experience in cowpea production. About 10 percent of them had between 31- 40 years of experience in cowpea production, while only 0.5 percent had above 40 years of experience in cowpea production (Table 11). The mean years of experience in cowpea production can have a significant effect on the adoption of new and improved farming technologies in maize farming. Hudson and Hite (2003) asserted that socio-economic characteristics of farmers such as level of education, farm size, and farming experience influence the adoption of improved technologies positively.

The study revealed that the mean household size of the farmers was approximately 8 individuals with a standard deviation of 4.3. About 29 percent of the farmers had household sizes between 1 – 5 individuals. Most (61%) of the farmers had household sizes between 6 – 15 individuals, while only about 7 percent of the farmers had a household size of more than 15 individuals (Table 11). The large family size of the farmers may serve as a cheap and reliable source of labour for the production of cowpea and other staple crops.

Mignouna et al. (2011); Bonabana-Wabbi (2002) advocate that, household size can be used to measure labour availability which can influence adoption process because larger household has the ability to relax the labour limits required during the introduction of improved farming technologies.

Farm-Related Characteristics of Cowpea Farmers

Farm-related characteristics of cowpea farmers interviewed are presented in table 12. The study revealed that the mean farm size for cowpea production in the four (4) districts was 2.5 acres with a standard deviation of 0.5. The results in Table 12 show that the majority (89.1%) of the farmers had farms size for cowpea production below 5 acres. About 10 percent had farm sizes between 5- 10 acres, while only 0.8 percent had farm sizes between 11 and above 16 acres under cowpea production. This indicates that most of the farmers in the study area are smallholder farmers. This also gives the indication that cowpea farming in the study area is at the subsistence level.

Agwu et al. (2008) explained that small farm size could be a constraint to the adoption of improved technologies. Fundamentally, farm size influences the adoption costs, credit constraints, human capital, labour requirements, risk perceptions, tenure arrangements and more. Farm size can influence and in turn be exaggerated by the other factors affecting adoption (Lavison, 2013). According to Okwu and Iorkaa (2011), farmers with large farms sizes are wealthier, keener in searching for information on improved technologies and are better informed on innovations.

In terms of the number of cowpea farms, the mean cowpea farms were 1.3 with a standard deviation of 0.6. The majority (95.6%) of the farmers had between 1 – 2 number of cowpea farms with few (4.1%) of the farmers having between 3 – 4 cowpea farms (Table 12). This implies that farmers in the study cultivate cowpea at different locations and this may be due to limited land size in the study area.

Table 12: Summary Statistics of Farm-Related Characteristics of Cowpea Farmers

Variables	Categories	F	%	$\bar{X}$	SD
Farm Size (Acres) (n=403, Min=0.5 Max=19)	≤5	359	89.1	2.5	0.5
	5 – 10	40	9.9		
	11 – 16	3	0.7		
	>16	1	0.2		
Number of Cowpea Farms (n=365, Min=1 Max=6)	1 – 2	349	95.6	1.3	0.6
	3 – 4	15	4.1		
	≥5	1	0.3		
Access to Credit (n=380)	Yes	68	17.9		
	No	312	82.1		
Access to Extension Services (n=370)	Yes	241	65.1		
	No	129	34.9		
Land Title (n=401)	Own land	206	51.4		
	Family land	190	47.4		
	Cash rental	3	0.7		
	Leasehold	2	0.5		
Main Source of Labour (n=414)	Hired labour	157	37.9		
	Own labour	188	45.4		
	Family labour	57	13.8		
	Communal labour	12	2.9		
Cropping System (n=398)	Mono-cropping	219	55.0		
	Mixed cropping	155	38.9		
	Intercropping	17	4.3		
	Relay cropping	7	1.8		
Source of Cowpea Seeds (n=408)	Certified seed producers	104	25.5		
	Previous harvest	129	31.6		
	Open market	152	37.3		
	From colleagues	23	5.6		

Source: Field survey, Afful (2019)

Regarding access to credit among the farmers, the results show that about (82%) of the farmers do not have access to credit for their cowpea production, only 18 percent had access to credit (Table 12). This gives the indication that most of the farmers in the Northern region of Ghana use their own money or funds from elsewhere in the cultivation of cowpea.

The result again shows that about (65%) of the farmers were visited by an extension officer during the previous cowpea production season (Table 12). Access to extension services has been found to be one of the key factors in the adoption of improved cowpea production technologies (Dankyi et al., 2006). They also found that a well-organized extension system is very important to the effective transfer and adoption of technologies by farmers. Furthermore, the use of new techniques is often affected by the interaction of farmers with extension services, as they provide technical guidance to boost agricultural output. With the intensity of extension services provided to farmers, the level of adoption rises. Odoemenem and Obinne (2010), also reported that a steady meeting between the extension staff and farmers would enlighten them and raise awareness about the future benefits from enhanced agricultural technologies.

As far as the primary source of labor for cowpea production by farmers is concerned, the outcome in Table 12 indicates that about 45 percent and 38 percent of farmers use 'Own labour' and 'Hired labour' respectively as the

primary source of labor for their cowpea production. Few (14%) use 'Family labour' for their cowpea production. Regardless of the high average household size in the Northern region, it could be noticed that farmers in the region mainly do not use their family as labour for their cowpea production.

Cowpea is a crop suitable for every season cultivation due to its short maturity period. This makes it easy to cultivate under different cropping systems. Therefore, in terms of the types of cropping systems practiced by farmers in their cowpea production, the result shows that a little over half of the (55%) of the farmers practice mono-cropping with about 39 percent practicing mixed cropping. The result is similar to that of Ddungu (2013), who reported that about 50 percent of the cowpea farmers interviewed in Uganda practiced intercropping with about 45 percent practiced sole/mono-cropping. He also reported that few (2.8%) of the farmers practice rotational cropping system in their cowpea production while about 3 percent either intercrop & rotational or sole crop/Intercrop.

The study also revealed that about 37 percent of the farmers obtained their cowpea seeds from the open market with about 32 percent of the farmers using the cowpea grains obtained from the previous harvest as seed for their cowpea production. About one-fourth of the farmers obtain their seeds from certified seed producers. Lack of information on certified cowpea seeds and unavailability of the certified seeds coupled with the high cost of certified seeds could result in the usage of previously harvested seeds and seeds from uncertified sources.

Relationship Between the Adoption of Improved Cowpea Varieties, and

Relationship Between the Adoption of Improved Cowpea Varieties, and

Table 13 presents results on the relationship between the adoption of improved cowpea varieties, demographic characteristics, farm-related characteristics and the perceived attributes of improved cowpea varieties among farmers. Table 13 also shows the type of correlations coefficients based on the scale of measurement of the variables.

Four (4) of the demographic and farm-related characteristics had a statistically significant relationship with the adoption of improved cowpea varieties among farmers at 0.05 alpha level. The variables sex (female) (r_{φ}= -.104*) and experience in cowpea production (r_{bi}= -.211**) had a negative relationship with adoption of improved cowpea varieties. Access to credit (r_{φ}= .144**) and access to extension services (r_{φ}= .304**) had a positive relationship with the adoption of improved cowpea varieties. The results in table 13 again show that the adoption of improved cowpea varieties had a significant and positive relationship with all the six (6) perceived attributes of improved cowpea varieties among farmers at 0.01 alpha level. Relative advantage (r_{bi}= .331**), compatibility (r_{bi}= .307**), and observability (r_{bi}= .313**) was moderate while complexity (r_{bi}= .279**), trialability (r_{bi}= .271**), and voluntariness (r_{bi}= .210**) was low using Davis' convention.

Table 13: Correlation Coefficients of Adoption of Improved Cowpea Varieties, Demographic Characteristics, Farm-related Characteristics, and Perceived Attributes of Improved Cowpea Varieties among Farmers

Variable	Coefficients	P Value	Type of Correlation
Sex (1= Male, 0= Female)	- .104*	.044	Phi (r_{φ})
Age (Years)	- .028	.592	Biserial (r_{bi})
Experience in cowpea production (Years)	- .211**	.000	Biserial (r_{bi})
Household size	.049	.343	Biserial (r_{bi})
Farm size (Acres)	.091	.077	Biserial (r_{bi})
Access to credit (1= Yes, 0= Otherwise)	.144**	.006	Phi (r_{φ})
Income (GHC)	.037	.473	Biserial (r_{bi})
Access to Extension Services (1= Yes, 0= Otherwise)	.304**	.000	Phi (r_{φ})
Relative Advantage	.240**	.000	Biserial (r_{bi})
Compatibility	.269**	.000	Biserial (r_{bi})
Complexity	.254**	.000	Biserial (r_{bi})
Trialability	.212**	.000	Biserial (r_{bi})
Observability	.289**	.000	Biserial (r_{bi})
Voluntariness	.011**	.000	Biserial (r_{bi})
Marital Status (1= Married, 0= Otherwise)	.033	.523	Phi (r_{φ})
Educational Level (1= Formal Education, 0= Otherwise)	- .030	.559	Phi (r_{φ})

n= 415, p< 0.05*, p< 0.01**

Source: Field survey, Afful (2019) ~~Four (4) of the demographic and farm-related characteristics had a statistically significant relationship with the adoption of improved cowpea varieties among farmers at 0.05 alpha level. The~~

The negative and significant relationship between the adoption of improved cowpea varieties and sex (r_{φ}= -.104*) implies that male farmers are less likely to adopt improved cowpea varieties and vice versa. Fitsum (2003) reported that there was a negative and significant relation between fertilizer use intensity and female-headed households.

The study showed a negative and significant relationship between adoption of improved cowpea varieties and experience in cowpea production which gives the indication that farmers who have more years of experience in cowpea production are less likely to adopt improved cowpea varieties. However, these findings contradicts the empirical findings of Bashir et al. (2018), Agwu (2004), and Kolawole (2006) who all found that the farming experience was statistically significant and positively related with likelihood of adoption of improved cowpea production technologies in Nigeria.

The positive relationship between access to credit (r_{bi}= .144**) and adoption of improved cowpea varieties implies that farmers who had access to credit are more likely to adopt improved cowpea varieties than farmers who did not have access to credit. This findings is supported by Ibrahim et al. (2016) who reported that access to credit had a positive influenced on the level of adoption of cowpea production technologies in Nigeria.

The positive and significant relationship between access to extension services among farmers (r_{bi}= .304**) means that farmers who had access to extension services are more likely to adopt improved cowpea varieties than those farmers who did not have access to extension services. This assertion finds

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empirical support from Idrisa (2009) who reported that access to extension services had a positive and significant influence on the adoption of improved soybean seeds.

The positive and significant relationship between relative advantage (r_{bi}= .240**) and adoption of improved cowpea varieties even at 0.01 alpha level means that farmers who perceived that improved cowpea varieties are far better than the existing or local varieties are likely to adopt improved cowpea varieties more than those who do not. There was also a direct and significant relationship between compatibility (r_{bi}= .269**) and adoption of improved cowpea varieties. This implies that farmers who perceived that improved cowpea varieties are well-suited with most of their cultural values and are suitable with previously introduced production technologies are likely to adopt improved cowpea varieties more than does who do not. The positive and significant relationship between the adoption of improved cowpea varieties and complexity (r_{bi}= .254**) indicates that farmers who perceived that production technologies of improved cowpea varieties are easy to understand, practice, and requires less capital are likely to adopt improved cowpea varieties than those who perceive that production technologies of improved cowpea varieties are difficult to understand and practice.

Trialability had a positive and significant relationship (r_{bi}= .212**) with the adoption of improved cowpea varieties among farmers. This means that farmers who perceived that improved cowpea varieties can be tested on a trial basis are likely to adopt than those who do not. Regarding the observability of improved cowpea varieties, there was a positive relationship (r_{bi}= .289**) with adoption of improved cowpea varieties. This implies that farmers who are able

to observe and describe the characteristics of improved cowpea varieties are likely to adopt than those farmers who cannot easily observe and describe the characteristics of improved cowpea varieties. This finding finds empirical support from Rogers (2003) who reported that the adoption rate is strongly linked to the observability of innovation as perceived by prospective adopters. The direct and significant relationship between the adoption of improved cowpea varieties and voluntariness (r_{bi}= .011**) indicate that farmers who perceived that production of improved cowpea varieties should be on a voluntary basis are likely to adopt improved cowpea varieties than farmers who do not. This finding is in line with Aubert and Hamel (2001) who asserted that voluntariness is positively related to adoption.

Multicollinearity Assumption Test

Multicollinearity occurs when two or more independent variables basically measure the same behaviours. Highly collinear factors often result in very high standard mistakes and inflated regression estimates (Tabachnick & Fidell, 2013). Therefore, it was necessary to observe the collinearity between the independent variables in the model. To observe collinearity among independent variables, the Tolerance and Variance Inflation Factor (VIF) test was used. The tolerance statistics are the calculation of the variance in the model of each of the independent variables not explained by all the other independent variables in the model, whereas the VIF is the variance proportion in a multi-term model, separated by the variance of a single term model. The VIF quantifies the seriousness of multicollinearity. A higher tolerance value shows low rates of collinearity.

Results in Table 14 show the estimated tolerance and VIF of all the 16 independent variables.

Table 14: Collinearity Diagnostics Test showing VIF and Tolerance

	Tolerance	VIF
Sex	0.888	1.126
Age	0.614	1.668
Educational level	0.804	1.243
Years of experience	0.600	1.668
Household size	0.775	1.290
Farm size	0.734	1.362
Marital status	0.922	1.084
Access to credit	0.920	1.087
Income	0.845	1.183
Access to extension	0.932	1.073
Relative advantage	0.461	2.171
Compatibility	0.245	4.076
Complexity	0.245	4.084
Trialability	0.377	2.656
Observability	0.506	1.977
Voluntariness	0.630	1.587

n= 415. $p>0.05$. Factor (VIF) =Variance Inflation Factor

Source: Field survey, Afful (2019)

The tolerance and VIF values presented in Table 14 show there ~~is~~ wa~~s~~ere no significant multicollinearity that could affect resulting estimates of regression. The minimum and the maximum tolerance value were 0.245 and 0.932 respectively which is more than 0.10. Pallant (2013) suggested 0.1 tolerance value as a cut-off point in determining multicollinearity. Tolerance value less than 0.1 indicate levels of multicollinearity, hence that variable(s)

should be omitted from the logistic regression model. Also, the minimum and maximum VIF values were 1.073 and 4.084 respectively which is less than 10 indicating no significant multicollinearity since Pallant (2013) asserted that VIF values more than 10 indicate a concern of multicollinearity among the predictors.

Factors Predicting the Adoption of Improved Cowpea Varieties among Farmers

The fifth objective of the study was to identify the factors predicting the adoption of improved cowpea varieties. This study employed the Binary logistic regression model to assess the impact of a number of factors that influence farmers on the adoption of improved cowpea varieties. The model contained 16 independent variables.

From Table 15, the results of the Hosmer-Lemeshow Goodness of Fit Test and chi-square of the Omnibus tests of model coefficients showed a χ^2(df= 16, n= 273) = 89.674, p= 0.000 which is statistically significant. The Hosmer-Lemeshow Goodness of Fit Test also supports the model as being worthwhile. According to Pallant (2013), Hosmer-Lemeshow Goodness of Fit Test with significant value less than 0.05 is an indication of poor fit. Therefore, the Hosmer-Lemeshow Goodness of Fit Test for this study is a good one (p= 0.983). This implies that the expected probabilities did not deviate from the probabilities in a manner that was not aligned with the binary distribution model, and the model was sufficient for the purposes of analysis.

The model as a whole explained between 28.0% (Cox and Snell R-square) and 39.0% (Nagelkerke R-square) of the variances in the adoption of

improved cowpea varieties among farmers (see Appendix B for the model containing all the 16 predictors). Among the 16 predictors that were in the model, only four (4) of them produced a distinctive statistically significant contribution to the model at 0.050 alpha level as shown in Table 15. The best four predictors that produced a distinctive statistically significant contribution were; (1) years of experience in cowpea production, (2) farm size, (3) access to extension services, and (4) observability.

Table 15: Binary Logistic Regression Showing the Best Predictors of Adoption of Improved Cowpea Varieties in the Northern Region of Ghana

Predictors	B	S.E	Wald	Sig.	Odds Ratio	95% C.I for odd Ratio	
						Lower	Upper
Constant	-3.889	1.264	9.506	.002	.020		
Years of experience in cowpea production	-.117	.030	15.361	.000	.890	.839	.943
Farm Size	.280	.123	5.179	.023	1.323	1.040	1.683
Access to Extension services	1.840	.362	25.864	.000	6.298	3.099	12.801
Observability	.686	.183	14.048	.000	1.985	1.387	2.841
	Model Summary						
	Value		Sig.		-2 Log likelihood		
Cox & Snell R-square	0.280				255.024		
Nagelkerke R-square	0.390						
Ominibus test of model chi-square	89.674		0.000				
Hosmer & Lemeshow Test	1.937		0.983				

n= 273, p< 0.05. C.I= Confident Interval

Source:Field survey, Afful (2019)

Years of experience in cowpea production as a predictor of the adoption of improved cowpea varieties

Years of experience in cowpea production was the only demographic characteristics found to be significant but a negative predictor (β= -.117) of farmers to adopt improved cowpea varieties. This implies that farmers who had more years of experience in cowpea production less adopted the improved cowpea varieties. In other words, the lower the years of experience in cowpea production of farmers, the more they will adopt improved cowpea varieties. The results revealed that, for every additional year of experience in cowpea production, farmers less adopted the improved cowpea varieties 0.890 times given the odds ratio of 0.890 which is less than 1.

The outcome of this study is contrary to most studies on the adoption of agricultural technology studies. For instance, Agwu (2004) and Amaza *et al*. (2007) found that years of experience of farmers had a positive and significant influence on the adoption of agricultural technologies. Similar empirical findings were reported by Bashir *et al*. (2018) who found that farming experience was found to be statistically significant and positively related to the likelihood of adoption.

Farm size as a predictor of the adoption of improved cowpea varieties

Farm size was one of the two farm-related characteristics that were found to be significant and a positive predictor (β= .280) of the adoption of improved cowpea varieties as shown in Table 15. This implies that farmers with larger farms adopted the improved cowpea varieties than those with small farm size. This gives the indication that the larger the size of one's farm the more or the higher a farmer adopt an agricultural technology such as improved cowpea

varieties. However, the odds ratio (1.323) indicate that for a unit of farm size, farmers adopted an improved cowpea variety 1 more time. This again indicates that as farmers increase their land size for cowpea production, the higher they adopt improved cowpea varieties and vice versa.

The findings of this study find empirical support from Agwu (2004) and Bashir *et al.* (2018). Agwu did a study on Factors influencing the adoption of improved cowpea production technologies in Nigeria. He found that farm size had a positive and significantly influenced the adoption of improved cowpea production technologies. Bashir *et al.* study on the adoption of cowpea production technologies among farmers in Taraba State, Nigeria found that farm size had a positive and statistically significant influence on the adoption of cowpea production technologies. Contrary to these findings, studies by Endrias (2003) and Abrhaley (2006) revealed that farm size negatively and significantly affected the adoption of improved technologies.

Access to extension services as a predictor of the adoption of improved cowpea varieties.

Access to extension services was one of the two farm-related factors that were found to be statistically significant and positively (β= 1.840) influencing the adoption of improved cowpea varieties among farmers. The positive coefficient gives the indication that farmers with more extension contacts adopted improved cowpea varieties than those with fewer extension contacts. The odds ratio (6.298) further indicates that farmers who had access to extension contact adopted improved cowpea varieties about 6 times more than those who did not had access to extension services. The findings agree with that

of Idrisa (2009) who reported a positive and statistically significant influence on the adoption of improved soybean seeds.

Observability as a predictor of the adoption of improved cowpea varieties

Observability of improved cowpea varieties was the other perceived attributes of improved cowpea varieties that were statistically and positive (β= .686) predictor of the adoption of improved cowpea varieties. The positive coefficient indicates that, as farmers highly perceived that the characteristics of improved cowpea varieties are easy to observe and describe with no difficulty in communicating its advantages and disadvantages the higher the adoption of improved cowpea varieties and vice versa. The odds ratio (1.985) further implies that farmers who perceived that the characteristics of improved cowpea varieties are easy to observe and describe with no difficulty in communicating its advantages and disadvantages adopted the improved cowpea varieties about 2 times more. However, the results of this finds empirical support from Rogers (2003) assertion. According to Rogers, an innovation's observability is strongly linked to its adoption rate as perceived by prospective adopters.

Challenges Faced by Farmers in the Adoption of Improved Cowpea Varieties

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The sixth ~~(6)~~ objective of the study was to identify and~~y~~ rank the challenges faced by farmers in the adoption of improved cowpea varieties in the Northern region of Ghana. Table 16 presents the results of the ranked challenges faced by farmers' in the adoption of improved cowpea varieties. The mean ranks were computed using a ~~five point~~five-point Likert type scale. The mean ranks on Table 16 were arranged in decreasing order of importance that is a higher mean rank indicate the most challenge confronting adoption of improved cowpea varieties.

It was observed that the lack of credit facilities was ranked as the first challenge farmers face in the adoption of improved cowpea varieties with a mean rank of 6.43. The high cost of improved cowpea seeds was also seen as a major challenge to adoption and was ranked second with a mean rank of 6.20 (Table 16). Lack of information on most innovations or technologies poses a threat to its adoption. Lack of information on improved cowpea varieties present a challenge to the adoption of improved cowpea varieties and this was ranked the third highest challenge by farmers with a reported mean rank of 5.71 (Table 16). The lack of storage facilities among the farmers was also one of the topmost five challenges faced by farmers in the adoption of improved cowpea varieties and was ranked fourth with a mean rank of 5.61 (Table 16). Unavailability of improved seeds was ranked the fifth challenge faced in the adoption of improved cowpea varieties with a mean rank of 5.61 (Table 16).

Farmers ranked high incidence of pest and diseases and high cost of fertilizer as the sixth and seventh challenge with mean ranks of 5.44 and 5.36

respectively. The reason for the high cost of fertilizer not ranked as one of the topmost five challenges could be associated to the Planting for Food and Jobs programme by the Government of Ghana, which seeks to ~~subsidised~~subsidise the cost of fertilizer and certified seeds among farmers.

Table 16: Challenges Facing Cowpea Farmers

Variables	Mean Rank
Lack of credit facilities	6.43
High cost of seeds	6.20
Lack of information on improved cowpea varieties	5.71
Lack of storage facilities	5.61
Unavailability of improved seeds	5.54
High incidence of pest and diseases	5.44
High cost of fertilizer	5.36
Inadequate extension visits	5.34
Inadequate access to markets	5.29
Land tenure system	4.08
Test Statistics	Value
Kendall's W	0.066
Chi-square (x^2)	228.874
Df	9
P	0.000

n= 387, Source: Field survey, Afful (2019)

Scale on level of Agreement (1=least agree, 2=Less agree, 3=Fairly agree, 4=Agree, 5=Strongly agree).

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Inadequate extension visits, inadequate access to markets and land tenure system was ranked as least three challenges faced by farmers in the adoption of improved cowpea varieties with mean ranks of 5.34, 5.29 and 4.08 respectively.

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The results from the Kendall's coefficient of concordance (*W*) analysis 6.6% (0.066) agreement among the rankings of the challenges faced by farmers in the adoption of improved cowpea varieties in the four districts of the Northern region of Ghana with a Chi-square value of (228.874) with an asymptotic significance of 0.000 (Table 16).

The results are empirically supported by studies from Shashekala *et al*. (2012), who reported that small scale farmers are faced with non-availability of improved seeds, lack of easy credit facilities, untimely availability of improved production inputs such as improved seeds among others as the main challenges faced by farmers. Similar findings were reported by Ibrahim et al. (2016), who found that constraints to the adoption of cowpea production technologies were found to be mostly due to lack of inputs, mechanized services, finance, storage facilities and lack of adequate dissemination of information. Modu *et al.* (2010) also found that the major constraints of farmers are inadequate capital and lack of access to credit.

The study, therefore, accepts the third alternative hypothesis which stated that 'there was a statistically significant difference in the challenges confronting the adoption of improved cowpea varieties among farmers. The null hypothesis which stated 'there is no statistically significant difference in the challenges confronting the adoption of improved cowpea varieties among farmers' is rejected.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The three sections of this chapter are outlined: summary, conclusions, and recommendations. The first section is the summary of the study. Conclusions drawn on the basis of the research findings are provided in the second section of this chapter. The last section is the recommendations produced based on the findings of this study.

Summary

Cowpea is one of the world's commonly eaten legume which is a vital source of plant protein, including minerals and amino acids that improve human nutrition and health. It is the second largest food legume consumed in Ghana. Through global discussion on agricultural and rural development in Africa, there has been a broad consensus that the SDGs can be achieved if the rural economic conditions are improved. Cowpea is a significant crop for rural populations and its consumption can lead to enhance the protein requirement of poor families.

Varietal growth in Ghana has seen a great improvement in the release of several crop varieties including cowpeas. Although production of cowpeas has both monetary and significance to stakeholders, but there is a disparity between new cowpea varieties and what stakeholders prefer. This is due to the fact that varietal preference of the major cowpea stakeholders has not been duly acknowledged during the development and release of improved cowpea varieties. And this can affect the adoption of improved cowpea varieties

The overall objective of the study was to examine stakeholders' preference and adoption of improved cowpea varieties in the northern region of Ghana. In order to address the overall objective of this study, the following specific objective were set; (1) examine farmers' perceived attributes of current improved cowpea varieties produced and marketed in Ghana, (2) compare the degree of participation of stakeholders (farmers, marketers, and consumers) in the development and release of improved cowpea varieties, (3) compare stakeholders' (farmers, marketers, and consumers) preferred traits and attributes of new cowpea varieties to be developed, (4) examine farmers' adoption of improved cowpea varieties, (5) explore the factors predicting adoption of improved cowpea varieties among farmers, and (6) identify and rank the challenges confronting the adoption of improved cowpea varieties among farmers.

Cross-sectional survey design was used for the study. The target population for the study was major cowpea stakeholders (farmers, marketers, and consumers) in the northern region of Ghana. A multistage sampling technique was used to sample 415 cowpea farmers, while snowball and convenience sampling procedure was employed to sample 60 cowpea marketers and 120 cowpea consumers respectively. A content validated questionnaire and structured interview schedule was used as instrument for the data collection. The result of the study was analysed using frequencies, percentages, means, standard deviation, chi-square test, Kruskal-Wallis (*H*) test, correlation coefficient, logistic regression and Kendall's coefficient of concordance (*W*). The summary of the main findings in relation to the specific objectives is as follows:

The first specific objective seeks to examine Farmers perceived attributes of current improved cowpea varieties produced and marketed in Ghana. This objective was assessed based on the six (6) main perceived attributes of improved cowpea varieties namely relative advantage, compatibility, complexity, trialability, observability, and voluntariness. The results show that farmers highly agree that cultivation of improved cowpea varieties are on a voluntary basis, that is they were not forced by any institution or agency to cultivate improved cowpea varieties. However, they agree on relative advantage and observability. However, they fairly agree on compatibility, complexity, and trialability attributes of the improved cowpea varieties. Generally, farmers fairly agreed on the overall perceived attributes of improved cowpea varieties.

The second objective seeks to examine the degree of participation of stakeholders in the development and release of improved cowpea varieties. The findings show that there was low participation ($\bar{X}$= 1.95, SD= 1.01) of stakeholders' (farmers, marketers, and consumers) at the conventional level or degree of participation in the development and release of improved cowpea varieties. Again, stakeholders' (farmers, marketers, and consumers) participation at the consultative level ($\bar{X}$= 2.43, SD= 1.37), collaborative ($\bar{X}$= 2.21, SD= 1.27), collegial ($\bar{X}$= 2.24, SD= 1.27), and farmer experimentation ($\bar{X}$= 2.48, SD= 1.46) in the development and release of improved cowpea varieties was low. Generally, the results indicate that the overall participation of all the stakeholder in the development and release of improved cowpea varieties were low ($\bar{X}$= 2.79, SD= 0.54). A Kruskal-Wallis *H* test confirmed that there was no

significant difference among the stakeholder's participation in the development and release of improved cowpea varieties.

The third objective was to compare stakeholders preferred attributes of improved cowpea varieties to be developed. The results show that farmers prefer medium pod size (45.4%) and straight pods (45.4%). Again, the results indicate that farmers preferred cowpea varieties with the following characteristics; yield potential ($\bar{X}$= 4.75, SD= 0.77), early maturing varieties ($\bar{X}$= 4.62, SD= 0.94), drought-tolerant ($\bar{X}$= 4.53, SD= 1.02), pest and disease resistant ($\bar{X}$= 4.48, SD= 1.08), high above-ground biomass varieties ($\bar{X}$= 4.33, SD= 1.17), tenderness of leaves ($\bar{X}$= 3.89, SD= 1.44), and varieties with more leaves ($\bar{X}$= 3.88, SD= 1.49). However, regarding preference for the grain attributes among the stakeholders, the Chi-square test of independence revealed a statistically significant difference between the following attributes; the texture of the coat, grain size, and cookability.

The fourth objective was to examine the adoption of improved cowpea varieties among farmers. The results show that the majority (61%) of the farmers had adopted the improved cowpea varieties. Farmers identified high yielding ($\bar{X}$= 4.13, SD= 1.15), early maturity ($\bar{X}$= 4.07, SD= 1.15), high income/profit ($\bar{X}$= 3.98, SD= 1.18), household food security ($\bar{X}$= 3.93, SD= 1.25), diversified food product ($\bar{X}$= 3.85, SD= 1.31), and drought resistance ($\bar{X}$= 3.73, SD= 1.30) as the main reasons they are adopting improved cowpea varieties. Availability of seeds ($\bar{X}$= 3.15, SD= 1.36), affordability of seeds ($\bar{X}$= 2.85, SD= 1.50), and less labour requirement ($\bar{X}$= 2.66, SD= 1.50) were also identified by farmers to be some of the reasons for the adoption of improved cowpea varieties.

The fifth objective was to explore the factors predicting the adoption of improved cowpea varieties. Different types of correlation [Biserial ($r_{bi)}$), Rank Biserial (r_{rbi}), and Phi (r_{φ})] were run to look at relationships that exist between the adoption of improved cowpea varieties and the independents' variables. The results revealed that sex (r_{φ}= -.104*) and experience in cowpea production (r_{bi}= -. 211**) were the only demographic characteristics that had a negative and significant relationship with adoption of improved cowpea varieties.

Access to credit (r_{φ}= .144**) and access to extension services (r_{φ}= .304**) were also the only farm-related characteristics that had a positive and significant relationship with the adoption of improved cowpea varieties. All the six (6) perceived attributes variables [relative advantage (r_{bi}= .240**), compatibility (r_{bi}= .269**), complexity (r_{bi}= .254**), trialability (r_{bi}= .212**), observability (r_{bi}= .289**), and voluntariness (r_{bi}= .011**)] had a positive and significant relationship with the adoption of improved cowpea varieties.

Four (4) of the 16 predictors were statistically significant in predicting adoption of improved cowpea varieties. The four (4) predictors were years of experience in cowpea production, farm size, access to extension, and observability. The model as a whole explained between 28.0 percent and 39.0 of the variances in the adoption of improved cowpea varieties. Years of experience in cowpea production was a negative predictor of adoption of improved cowpea varieties whiles farm size, access to extension, relative

advantage, and observability was a positive significant predictor of adoption of improved cowpea varieties.

The sixth objective of the study was to identify and rank the challenges facing farmers in the adoption of improved cowpea varieties. The results revealed that farmers ranked the following as challenges they face in the adoption of improved cowpea varieties in order of importance; lack of credit facilities, high cost of seeds, lack of information on improved cowpea varieties, lack of storage facilities, unavailability of improved seeds, high incidence of pest and disease, high cost of fertilizer, inadequate extension visits, inadequate access to markets, and land tenure system. Kendall's coefficient of concordance revealed that only 6.6% of the farmers agreed with the ranking of the challenges.

Conclusions

Based on the specific objectives and findings, the following conclusions were made:

Farmers have a fair knowledge that cultivation of improved cowpea varieties are more profitable than the local varieties. They have fair knowledge that cultivation of improved cowpea varieties is compatible with their agronomic practices and are less complex to cultivate. Again, farmers have a fair idea that improved cowpea varieties can be easily tried on trial bases. However, they have a strong conviction that they were not influenced by government or any institution to cultivate improved cowpea varieties.

The participation of all the stakeholders (farmers, marketers, and consumers) at the conventional, consultative, collaborative, collegial, and

farmer experimentation degree of participation in the development and release of improved cowpea varieties were low, with no significant difference in participation among the stakeholders.

In terms of crop attributes, majority of the farmers show preference for medium pod and straight pods which are high yielding, early maturing, drought tolerant, and resistant to pest and disease. Also, attributes such above ground biomass, tenderness of leaves, and varieties with more leaves were preferred as the main attributes of improved cowpea varieties to be developed.

Regarding grain attributes, stakeholders' preferences such as the texture of the coat, grain size, and cookability differ significantly. Farmers preferred varieties with smooth seed coat, medium grain size, and easy to cook grains whiles Consumers and marketers preferred varieties with smooth seed coat, large grain size, and easy to cook grains.

The main reasons for farmers to adopt improved cowpea varieties were high yields, early maturity, high income/profit, household food security, diversified food products, and drought resistant. Availability and affordability of seeds and less labour requirement were the least reasons identified to be a factor for the adoption of improved cowpea varieties.

Female farmers are more likely to adopt improved cowpea varieties than their male counterpart. Farmers with less experience, access to credit, access to extension services are more likely to adopt improved cowpea varieties than farmers with more years of experience, no access to credit, and no access to extension services. Cowpea farmers who perceived that improved cowpea varieties have relative advantage over the local varieties are more likely to adopt

improved cowpea varieties than those who do not and vice versa. Cowpea farmers who perceived that improved cowpea varieties are less complex to cultivate are more likely to adopt improved cowpea varieties. Also, farmers who perceived that improved cowpea varieties are triable, have observable characteristics, and are voluntarily to cultivate are more likely to adopt improved cowpea varieties.

Years of experience in cowpea production, farm size, access to extension services, and observability of improved cowpea varieties were the best predictors of adoption of improved cowpea varieties. These five predictors significantly explained between 28.0 percent and 39.0 percent variance in the adoption of improved cowpea varieties.

Major challenges that limit the adoption of improved cowpea varieties are lack of credit facilities, high cost of seeds, lack of information on improved cowpea varieties, lack of storage facilities, unavailability of improved seeds, high incidence of pest and diseases with lack of credit facilities and high cost of seeds being the greatest challenges faced by farmers.

Recommendations

The following recommendations have been presented for policy consideration on the basis of the findings:

1. The Ministry of Food and Agriculture (MoFA), research organizations and non-governmental organizations working with farmers should intensify training and field demonstrations on the attributes of improved cowpea varieties, so that farmers will fully embrace such varieties.

2. Research institutions such as the Savanna Agricultural Research Institute (SARI), International Institute of Tropical Agriculture (IITA), West Africa Center for Crop Improvement (WACCI) and plant breeders from universities in Ghana should strengthen the participatory plant breeding (PPB) process particularly collaborative type of PPB which involves a two-way structured communication between scientist and major cowpea stakeholders. With this kind of PPB, breeding priorities and decision-making power concerning cowpea breeding is shared among scientist and stakeholders.
3. In breeding of new cowpea varieties, research institutions such as the Savanna Agricultural Research Institute (SARI), the International Institute for Tropical Agriculture (IITA), the West Africa Center for Crop Improvement (WACCI) and university plant breeders in Ghana should also incorporate preferred crop and grain characteristics of improved cowpea varieties. Breeding programmes in Ghana should focus on consumer preferences such as smooth texture of the coat, large grain size, and easy to cook grains in their breeding programmes.
4. Extension Agents should provide information concerning consumer preference for cowpea available to cowpea producers so that they will produce varieties that meet marketers' and consumers' preferences.
5. MOFA, research institutions, and other development agencies need to strive to increase the rate of adoption of improved cowpea varieties by taking into consideration reasons influencing farmers' decision to adopt such as high yielding varieties, early maturing, high income/profit, household food security, diversified food products among others.

6. MOFA need to strengthen extension delivery to farmers and take into consideration the years of experience and farm size of farmers to encourage the adoption of improved cowpea varieties.
7. MOFA, policymakers, and other development agencies should ensure that appropriate extension services is made accessible to farmers and inputs at subsidized prices to improve the adoption of improved cowpea varieties.

Suggestion for Further Research

1. The study should be extended or replicated in other cowpea growing areas.
2. Future studies should use Focus Group Discussion to obtain consensus on trait and attributes preferred by Stakeholders.

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APPENDICES

Appendix A: Summary of Demographic Characteristics of Consumers and Marketers

Variables	Categories	Consumers (n=120)		Marketers (n= 60)	
		%	$\bar{X}$	%	$\bar{X}$
Sex	Male	69.2		18.7	
	Female	30.8		81.7	
Age (Years)	<20	2.8	35.4	-	40.6
	20-40	73.6		56.4	
	41-61	18.9		41.8	
	>61	4.7		1.8	
Marital status	Married	82.9		84.2	
	Single	16.2		1.8	
	Widow/Widower	0.9		8.8	
	Separated/Divorced	-		5.3	
Educational status	No formal	48.7		74.6	
	Basic	15.3		17.0	
	Secondary	24.0		3.4	
	Tertiary	12.0		5.1	
Household size	<5	36.9	7.2	25.9	6.9
	5-10	45.3		63.8	
	11-16	12.3		8.6	
	>16	5.7		1.7	
Income (GHC)	<100	32.6	369.3	17.9	822.4
	100-500	47.8		48.2	
	501-1001	9.8		17.9	
	>1001	9.8		16.1	

Appendix B: Farmers Perceived Attributes of Improved Cowpea Varieties

Attributes of Improved Cowpea Varieties	n	$\bar{X}$	SD
Total Voluntariness	364	3.84	1.32
I wasn't forced by scientist to use improved cowpea varieties.	318	4.12	1.28
I wasn't forced by government to use improved cowpea varieties.	304	4.18	1.18
I wasn't forced by NGO's to use improved cowpea varieties.	309	4.14	1.18
I accepted to use improved cowpea varieties because it was given to me freely by researchers.	278	3.71	1.47
I voluntarily used improved cowpea varieties.	306	3.89	1.36
Total Relative Advantage	406	3.76	0.97
Improved cowpea varieties are more profitable than the local cowpea varieties.	381	4.14	1.05
Improved cowpea varieties have more yields than the local cowpea varieties.	386	4.13	1.08
Cultivating improved cowpea varieties has improve my social prestige than cultivating local cowpea varieties.	365	3.59	1.27
Cultivating improved cowpea varieties has improved my soil than the local varieties.	364	3.81	1.23
Cultivating improved cowpea varieties requires less pest and disease chemicals than the local cowpea varieties.	355	3.68	1.23
Improved cowpea varieties have better taste than the local cowpea varieties.	359	3.82	1.22
Improved cowpea varieties have desirable colour and size compares to the local cowpea varieties.	375	3.87	1.19
Improved cowpea varieties are easier to store than the local cowpea varieties.	348	3.39	1.36

Total Observability	385	3.56	1.31
I can easily observe the characteristics of improved cowpea varieties.	349	3.84	1.29
I can easily describe the characteristics of improved cowpea varieties.	359	3.66	1.31
I had no difficulty in communicating the advantages of the improved cowpea varieties to other cowpea farmers.	347	3.75	1.31
I had no difficulty in communicating the disadvantages of the improved cowpea varieties to other cowpea farmers.	337	3.59	1.41
Total Compatibility	379	3.26	1.24
Improved cowpea varieties are well-suited with most of my cultural values.	333	3.54	1.33
Improved cowpea varieties are more suitable with previously introduced production technologies by MOFA and other researchers.	345	3.312	1.36
Cultivating improved cowpea varieties are compatible with the agronomic practices in my farm.	340	3.32	1.37
Improved cowpea varieties are compatible with my current needs.	329	3.31	1.39
Cultivating improved cowpea varieties are consistent with my farming system.	318	3.31	1.49
Total Complexity (Ease of Use)	374	3.02	1.28
Production technologies of improved cowpea varieties are easy to understand.	334	3.36	1.38
Production technologies of improved cowpea varieties are easy to practice.	337	3.28	1.39
Improved cowpea varieties are less risky (i.e. crop diseases) to cultivate.	321	3.14	1.48
Improved cowpea varieties require less initial capital to produce.	279	2.87	1.49
Improved cowpea varieties require less labour to produce.	286	2.92	1.51
Improved cowpea varieties are difficult to preserve.	274	3.06	1.49
Total Trialability	379	2.97	1.38
I can easily use improved cowpea varieties on trial bases before deciding to use it on a full scale.	330	3.42	1.42
I did not have to spend very much effort to try out the improved cowpea varieties.	314	3.08	1.45
The improved cowpea seeds were available to me to adequately test before using it on a full scale.	285	3.13	1.49

I used the newly released improved cowpea seeds on a trial basis long enough to see its yields before cultivating on full scale.	279	3.11	1.54
I have the opportunity to try out the improved cowpea seeds at different seasons.	248	3.26	1.48
Overall Perceived Attributes		*3.48*	*0.95*

Appendix C: Participation of Stakeholders in the Development and Release of Improved Cowpea Varieties

		Farmers			Consumers			Marketers		
A.	**Conventional (No farmer, marketer or consumer participation)**	N	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD
1.	The project was just brought to us by the Researchers without my knowledge.	408	1.89	1.42	114	1.63	1.32	58	2.02	1.52
2.	I was informed about the initial development of improved cowpea varieties by the project officials.	409	1.96	1.43	119	1.95	1.51	60	2.05	1.51
3.	I was informed about the progress of the development of the improved cowpea varieties.	408	1.94	1.45	119	1.84	1.41	60	2.12	1.54
4.	I was informed about the release of improved cowpea varieties.	408	2.01	1.51	114	2.04	1.54	59	1.88	1.42
5.	I was informed on the benefits of the development and release of the improved	409	2.01	1.45	119	1.89	1.42	60	2.15	1.53

	cowpea varieties.									
6.	I was informed on the goals and objectives of the development and release of improved cowpea varieties	410	1.94	1.46	118	2.19	1.62	60	2.20	1.67
B.	**Consultative (scientists make the decisions alone but with organized communication with farmer's and other stakeholders)**	N	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD
1.	I was involved in the consultative meeting for the development and release of improved cowpea varieties	147	2.92	1.59	36	2.75	1.27	15	2.93	1.56
2.	I was consulted on the needs identification for the development and release of improved cowpea varieties	156	2.79	1.59	38	2.42	1.37	20	2.40	1.43
3.	I was consulted on the problems of the existing cowpea varieties in the market.	173	2.76	1.53	41	2.36	1.54	24	2.54	1.55
4.	I was consulted on my varietal preference of improved	167	2.74	1.54	44	2.59	1.45	21	2.42	1.47

	cowpea varieties to be developed.									
5.	The project team actively sought out my opinions, to provide a more complete picture of potential risks, impacts, and opportunities relating to the development and release of improved cowpea varieties.	158	2.82	1.54	44	2.84	1.61	24	2.54	1.35
C.	**Collaborative**	N	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD
1.	My decisions and views were incorporated during setting of goals for cowpea development and release process.	150	2.71	1.53	41	2.41	1.49	20	2.00	1.17
2.	My varietal preference was duly acknowledged in the development and release process.	147	2.73	1.52	41	2.36	1.37	21	2.23	1.33
3.	My decisions concerning the breeding programme was not overridden by the researchers.	150	2.38	1.64	32	2.43	1.50	21	2.00	1.37
4.	I was involved in the selection of varieties for the development of improved	132	2.33	1.49	34	2.12	1.38	17	1.94	1.24

	cowpea varieties.									
5.	I was involved in the collection of germplasm (cowpea lines) from different places.	128	2.19	1.44	33	2.12	1.38	18	1.72	0.96
6.	All the decisions taken during the cowpea development and release programme was jointly made between researchers and stakeholders (farmers', marketers' and consumers').	169	2.61	1.58	42	2.66	1.37	22	2.18	1.26
7.	There was a two-way communication during the cowpea development and release programme.	165	2.32	1.53	44	2.07	1.18	23	1.91	1.04
8.	I was involved in the selection of the project site (on-station and on-farm).	150	2.63	1.51	41	2.56	1.51	22	2.00	1.31
9.	I was involved in the monitoring and evaluation (M & E) during the testing of new improved cowpea varieties.	156	2.61	1.48	35	2.26	1.44	21	2.05	1.07
10.	I was involved in deciding which germplasm (cowpea lines) is acceptable for	139	2.37	1.49	33	2.45	1.46	20	2.05	1.14

	seed multiplication.									
11.	I was involved in the multiplication of new cowpea seeds throughout the district.	144	2.58	1.57	32	2.12	1.26	21	2.05	1.20
12.	I was involved in the distribution of new improved cowpea seeds.	152	2.46	1.53	38	2.13	1.39	20	1.80	1.00
13.	I was involved in the information dissemination of new improved cowpea seeds.	133	2.45	1.52	42	1.90	1.21	16	1.50	0.89
D.	**Collegial (farmers make plant breeding decisions collectively either in a group process or through individual farmers who are in organized communication with scientists).**	N	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD
1.	I/We decided with other stakeholders (marketers' and consumers') to set objectives on the production and distribution of new cowpea varieties.	165	2.41	1.54	57	2.0	1.29	21	3.00	1.55
2.	I/We obtained information about scientists	165	2.37	1.46	46	2.17	1.27	19	2.42	1.22

	priorities on varietal selection during the development and release of new improved cowpea varieties.									
3.	I/We followed scientist protocol in the selection of appropriate cowpea lines from different places.	159	2.56	1.41	47	2.31	1.44	21	2.57	1.43
4.	I/We used plant breeding protocol to made crosses between different cowpea line collected from different places.	161	2.39	1.39	43	2.32	1.39	20	2.65	1.30
5.	I/We used plant breeding protocol to select a number of new varieties for testing and multiplication.	140	2.47	1.47	44	2.34	1.98	19	2.78	1.27
6.	I/We used plant breeding proceedings to test for desirable varieties in replicated trials in different locations.	145	2.50	1.45	37	2.13	1.23	19	2.47	1.47
7.	I/We used plant breeding proceedings to multiple new cowpea varieties at different places (farmers' fields,	152	2.61	1.44	45	2.20	1.47	20	2.75	1.48

	demonstration fields, etc.).									
8.	I/We distributed the new introduced new cowpea varieties throughout our district and beyond with organised communication with scientists.	154	2.36	1.51	39	2.00	1.29	20	1.95	1.39
E.	**Farmer experimentation (No Scientist participation)**	N	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD
1.	I/We did not obtained any information or protocol from scientists or researchers on how to select cowpea lines for breeding purposes.	185	2.86	1.67	50	2.16	1.52	25	2.72	1.72
2.	I/We obtained the cowpea genetic materials (cowpea lines from different places) without any organised communication with scientists or researchers.	155	2.56	1.67	47	2.04	1.33	21	2.09	1.34
3.	I/We made crosses between different cowpea line collected from different places without any organised communication with scientist or researchers.	134	2.32	1.40	43	1.88	1.28	21	1.95	1.20

4.	I/We developed new cowpea varieties that meets our needs only without any information from scientists.	130	2.26	1.46	42	2.26	1.96	20	2.25	1.55
5.	I/We multiplied the new cowpea varieties at different places.	142	2.45	1.51	40	2.58	1.58	23	2.26	1.51
6.	I/We did not follow any protocol in the distribution of new introduced new cowpea varieties throughout.	134	2.49	1.64	38	2.28	1.52	16	2.12	1.62

Appendix D: Predictors of Adoption of Improved Cowpea Varieties

Predictors	β	S.E	Wald	Sig.	Odds Ratio	95% C.I for odd Ratio	
						Lower	Upper
Constant	-3.897	1.264	9.506	.002	.020		
Sex (1)	-.651	.503	1.676	.195	1.023	.195	1.397
Age	.023	.018	1.672	.196	1.013	.988	1.059
Years of experience in cowpea production	-.117	.030	15.361	.000	.890	.839	.943
Household size	.031	.043	.525	.469	1.031	.949	1.121
Farm Size	.280	.123	5.179	.023	1.323	1.040	1.683
Access to credit (1)	.630	.456	1.913	.167	1.878	.769	4.597
Income	.000	.001	.436	.509	1.000	.999	1.001
Access to Extension services	1.840	.362	25.864	.000	6.298	3.099	12.801
Relative Advantage	.112	.258	.188	.665	1.118	.674	1.856
Compatibility	.199	.249	.639	.424	1.220	.749	1.987
Complexity	-.082	.256	.102	.750	.922	.558	1.522
Trialability	.181	.187	.941	.332	1.199	.831	1.729
Observability	.686	.183	14.048	.000	1.985	1.387	2.841
Voluntariness	-.137	.152	.805	.370	.872	.647	1.176
Marital status (1)	-.164	.445	.136	.713	849	.355	2.031
Level of education (1)	-.533	.428	1.550	.213	.587	.254	1.358

Appendix E: Structured Interview Schedule for Cowpea Farmers

University of Cape Coast

College of Agriculture and Natural Sciences

School of Agriculture

Department of Agricultural Economics and Extension

Topic: Stakeholders Preference and Adoption of Improved Cowpea Varieties in the Northern Region of Ghana

STRUCTURED INTERVIEW SCHEDULE FOR COWPEA FARMERS

Dear Respondent,

My name is James Afful, the principal investigator from the University of Cape Coast, humbly request you to participate in this MPhil research which seeks to investigate ''Stakeholders Preference and Adoption of Improved Cowpea Varieties in the Northern Region of Ghana''. This research is purely for an academic exercise and designed to elicit and gather data on the above topic that will contribute to the production of a MPhil thesis. All information given will be used solely for this purpose. Your participation entails you being interviewed by the principal investigator or a research assistant, and whatever information you provide will be considered as confidential and will be treated as such. Please also note that your name or identity will not be mentioned in any part of the report. The principal investigator does not anticipate any risks or harm to you with respect to your involvement in this research project. Your voluntary participation is priceless and as such, you may decline to answer any question that you do not wish to respond to, and you can also withdraw from the interview any time that you feel uncomfortable. The interaction is expected to last for about 45 minutes. Thank you in advance for accepting to be part of this research project. Before we start the conversation, do you have any questions? Please feel free to ask any question during the course of the interaction and I or the research assistant will be glad to respond to them. Thank you once again.

Now, do you want to ask anything about the research? Yes ☐ No ☐

If **Yes,** please ask your question:

……
……
…….....

Do you [NAME:……] agree to participate in the study? Yes ☐ No ☐

If **No**, reason(s) for refusal:

……
……
…..

Signature/Thumbprint of Interviewee:_____

IDENTIFICATION

District: ……

Community: ……

Date of interview: ……(DD/MM/YYYY)

Name of enumerator: ……..

SECTION A

Demographic and Farm related Characteristics of Cowpea Farmers

Q1. Sex (i) Male [ ] (ii) Female [ ]

Q2. Please indicate your **age** at your last birthday ……. (in years)

Q3. Marital Status. a. Married [ ] b. Single [ ] c. Separated/Divorced [ ] d. Widow/Widower [ ]

Q4. Kindly indicate your highest **educational** qualification.

1. No formal Schooling/Education [ ]
2. Primary Education [ ]
3. Middle School Leaving Certificate/JSS [ ]
4. Senior Secondary School Certificate [ ]
5. GCE 'O' Level [ ]
6. GCE 'A' Level [ ]
7. Tertiary [ ]
8. Others (please specify)
   ……

Q5. Please indicates your total number of years of schooling……. (in years).

Q6. Kindly indicate your main occupation.

1. Farming [ ]
2. Other occupation [ ]

Q7. How long have you been working as a farmer?..... (in years).

Q8. How many years have you been growing Cowpea? …… (in years).

Q9. Please indicate the number of dependents (**Household size**)
……

Q10. What title(s) do you hold to the land you are using for your cowpea production a. Own land [ ] b. Family land [ ] c. Cash Rental [ ] d. Leasehold [ ] e. Share Cropping [ ] f. Others (please specify)
……..

Q11. Total number of land under cultivation of Cowpea (Acres)_____ Other Crops (Acres)_____

Q12. How many cowpea farms do you have? ……

Q13. What kind of cropping system do you practice in your cowpea production? a. Mono cropping [ ] b. Mixed cropping [ ] c. Intercropping [ ] d. Relay cropping [ ] e. Others (please specify)

_____

Q14. Indicate your main source of labour?

1. Hired labour [ ]
2. Own labour [ ]
3. Family labour [ ]
4. Communal labour [ ]
5. Others (please specify) ……

Q15. Did you have access to credit for the past cropping season? a. Yes [ ] b. No [ ]

Q16. What is your Main Source of funding?

1. Own [ ]
2. Friends [ ]
3. Money Lenders [ ]
4. Family members [ ]
5. Financial institutions [ ]

Q17. What was the total estimated income generated from last cropping season cowpea production? …… (in GH cedis)

Q18. Did you have access to extension services in the last cropping season? a. Yes [ ] b. No [ ]

Q19. How often did MOFA extension officer(s) contact you in the last cropping season?

1. Once a week [ ]
2. Once every two weeks [ ]
3. Once a month [ ]
4. Once every 3 months [ ]
5. Once every 6 months [ ]
6. Once a year [ ]
7. Others (please specify) ……...

Q20. What type of cowpea variety do you cultivate? a. Local/Landrace variety [ ] b. Improved variety [ ]

c. Both [ ] d. Not sure [ ]

Q21. If your answer in Q.20 is b. improved variety, please list the name(s) of the improved varieties you cultivate

(a)

_____

(b)_____

Q22. If your answer in Q20 is a. local/landrace, please list the name(s) of the improved varieties you cultivate

(a) _____

(b)_____

Q23. What is the source of your cowpea seeds for planting?

1. Certified seed producers [ ]
2. Previous harvest [ ]
3. From the open market [ ]
4. From colleagues [ ]
5. Other (please specify)
   ……

SECTION B

Farmers Perceived Attributes of Current Cowpea Varieties Produced and Marketed in Ghana

Please indicate your level of agreement on the following characteristics of Improved cowpea varieties in your district/area

0= Not sure 1= Least agree 2= Less agree 3= Fairly agree 4= Agree 5= Strongly Agree

	Characteristics of Improved Cowpea varieties	**Level of Agreement**					
A	**Relative Advantage**	**5**	**4**	**3**	**2**	**1**	**0**
1.	Improved cowpea varieties are more profitable than the local cowpea varieties.						
2.	Improved cowpea varieties have more yields than the local cowpea varieties.						
3.	Cultivating improved cowpea varieties has improve my social prestige than cultivating local cowpea varieties.						
4.	Cultivating improved cowpea varieties has improved my soil than the local varieties.						
5.	Cultivating improved cowpea varieties requires less pest and disease chemicals than the local cowpea varieties.						
6.	Improved cowpea varieties have better taste than the local cowpea varieties.						
7.	Improved cowpea varieties have desirable colour and size compares to the local cowpea varieties.						
8.	Improved cowpea varieties are easier to store than the local cowpea varieties.						
B	**Compatibility**	**5**	**4**	**3**	**2**	**1**	**0**

1.	Improved cowpea varieties are well-suited with most of my cultural values.						
2.	Improved cowpea varieties are more suitable with previously introduced production technologies by MOFA and other researchers.						
3.	Cultivating improved cowpea varieties are compatible with the agronomic practices in my farm.						
4.	Improved cowpea varieties are compatible with my current needs.						
5.	Cultivating improved cowpea varieties are consistent with my farming system.						
C	**Complexity (Ease of Use)**	**5**	**4**	**3**	**2**	**1**	**0**
1.	Production technologies of improved cowpea varieties are easy to understand.						
2.	Production technologies of improved cowpea varieties are easy to practice.						
3.	Improved cowpea varieties are less risky (i.e. crop diseases) to cultivate.						
4.	Improved cowpea varieties requires less initial capital to produce.						
5.	Improved cowpea varieties requires less labour to produce.						
6.	Improved cowpea varieties are difficult to preserve.						
D	**Trialability**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I can easily use improved cowpea varieties on trial bases before deciding to use it on a full scale.						
2.	I did not have to spend very much effort to try out the improved cowpea varieties.						
3.	The improved cowpea seeds were available to me to adequately test before using it on a full scale.						
4.	I used the newly released improved cowpea seeds on a trial basis long enough to see its yields before cultivating on full scale.						
5.	I have the opportunity to try out the improved cowpea seeds at different seasons.						
E	**Observability**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I can easily observe the characteristics of improved cowpea varieties.						
2.	I can easily describe the characteristics of improved cowpea varieties.						
3.	I had no difficulty in communicating the advantages of the improved cowpea varieties to other cowpea farmers.						

4.	I had no difficulty in communicating the disadvantages of the improved cowpea varieties to other cowpea farmers.						
F	**Voluntariness**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I wasn't forced by scientist to use improved cowpea varieties.						
2.	I wasn't forced by government to use improved cowpea varieties.						
3.	I wasn't forced by NGO's to use improved cowpea varieties.						
4.	I accepted to use improved cowpea varieties because it was given to me freely by researchers'.						
5.	I voluntarily used improved cowpea varieties.						

SECTION C

Extent of Participation of Farmers in the Development and Release of Improved Cowpea Varieties

Please indicate your **level of participation** in each of the following components or stages in the development and release of improved cowpea varieties.

Ratings	Level of Involvement
0	Not at all
1	Very low level
2	Low level
3	Moderate level
4	High level
5	Very high level

A.	**Conventional (No farmer, marketer or consumer participation)**	**Level of Involvement**					
		5	**4**	**3**	**2**	**1**	**0**
1.	The project was just brought to us by the Researchers without my knowledge.						
2.	I was informed about the initial development of improved cowpea varieties by the project officials.						
3.	I was informed about the progress of the development of the improved cowpea varieties.						
4.	I was informed about the release of improved cowpea varieties.						
5.	I was informed on the benefits of the development and release of the improved cowpea varieties.						
6.	I was informed on the goals and objectives of the development and release of improved cowpea varieties						

B.	**Consultative (scientists make the decisions alone but with organized communication with farmer's and other stakeholders)**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I was involved in the consultative meeting for the development and release of improved cowpea varieties						
2.	I was consulted on the needs identification for the development and release of improved cowpea varieties						
3.	I was consulted on the problems of the existing cowpea varieties in the market.						
4.	I was consulted on my varietal preference of improved cowpea varieties to be developed.						
5.	The project team actively sought out my opinions, to provide a more complete picture of potential risks, impacts, and opportunities relating to the development and release of improved cowpea varieties.						
C.	**Collaborative**	**5**	**4**	**3**	**2**	**1**	**0**
1.	My decisions and views were incorporated during setting of goals for cowpea development and release process.						
2.	My varietal preference was duly acknowledged in the development and release process.						
3.	My decisions concerning the breeding programme was not overridden by the researchers.						
4.	I was involved in the selection of varieties for the development of improved cowpea varieties.						
5.	I was involved in the collection of germplasm (cowpea lines) from different places.						
6.	All the decisions taken during the cowpea development and release programme was jointly made between researchers and stakeholders (farmers', marketers' and consumers').						
7.	There was a two-way communication during the cowpea development and release programme.						
8.	I was involved in the selection of the project site (on-station and on-farm).						
9.	I was involved in the monitoring and evaluation (M & E) during the testing of new improved cowpea varieties.						

10.	I was involved in deciding which germplasm (cowpea lines) is acceptable for seed multiplication.						
11.	I was involved in the multiplication of new cowpea seeds throughout the district.						
12.	I was involved in the distribution of new improved cowpea seeds.						
13.	I was involved in the information dissemination of new improved cowpea seeds.						
D.	**Collegial (farmers make plant breeding decisions collectively either in a group process or through individual farmers who are in organized communication with scientists).**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I/We decided with other stakeholders (marketers' and consumers') to set objectives on the production and distribution of new cowpea varieties.						
2.	I/We obtained information about scientists priorities on varietal selection during the development and release of new improved cowpea varieties.						
3.	I/We followed scientist protocol in the selection of appropriate cowpea lines from different places.						
4.	I/We used plant breeding protocol to made crosses between different cowpea line collected from different places.						
5.	I/We used plant breeding protocol to select a number of new varieties for testing and multiplication.						
6.	I/We used plant breeding proceedings to test for desirable varieties in replicated trials in different locations.						
7.	I/We used plant breeding proceedings to multiple new cowpea varieties at different places (farmers' fields, demonstration fields, etc.).						
8.	I/We distributed the new introduced new cowpea varieties throughout our district and beyond with organised communication with scientists.						
E.	**Farmer experimentation (No Scientist participation)**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I/We did not obtain any information or protocol from scientists or researchers on how to select cowpea lines for breeding purposes.						

2.	I/We obtained the cowpea genetic materials (cowpea lines from different places) without any organised communication with scientists or researchers.							
3.	I/We made crosses between different cowpea line collected from different places without any organised communication with scientist or researchers.							
4.	I/We developed new cowpea varieties that meets our needs only without any information from scientists.							
5.	I/We multiplied the new cowpea varieties at different places.							
6.	I/We did not follow any protocol in the distribution of new introduced new cowpea varieties throughout.							

SECTION D

Farmers Preferred Traits and Attributes of Improved Cowpea Varieties to be Developed

Please **tick** and **indicate your level of agreement** on preferred traits and attributes of improved cowpea varieties to be developed

0= Not sure 1= Least Preferred 2= Less Preferred 3= Fairly Preferred
4= Preferred 5= Most Preferred

	Statement		**Please tick your most preferred attributes**		**Level of Preference**					
			Yes	**No**						
	Crop attributes				**5**	**4**	**3**	**2**	**1**	**0**
1.	**Pods length**	Short								
		Medium								
		Long								
2.	**Shape of Pod**	Straight								
		Curved								
		Coiled								
3.	**Plant Morphology** (Do you prefer improved cowpea varieties which have high above ground biomass?).									
4.	**Pest & Disease Resistance** (Do you prefer improved cowpea									

	varieties which are pest and disease resistant?).									
5.	**Drought Tolerant** (Do you prefer improved cowpea varieties which are drought tolerant?).									
6.	**Yield Potential** (Do you prefer improved cowpea varieties which are high yielding?).									
7.	**Maturity Period** (Do you prefer improved cowpea varieties which are early maturing?).									
8.	**Number of leaves** (Do you prefer improved cowpea varieties which have more leaves?).									
9.	**Tenderness of leaves** (Do you prefer improved cowpea varieties which have tender leaves?)									
	Grain attributes		**Please tick your most preferred attributes**		**5**	**4**	**3**	**2**	**1**	**0**
			Yes	**No**						
10.	**Texture of the Coat**	Rough								
		Smooth								
11.	**Eye Colour**	White								
		Black								
12.	**Testa Colour (Coat Colour)**	White								
		Red								
		Brown (Deep)								
		Brown (light)								
		Mottled								
		Chocolate								
13.	**Insect Damage (*Bruchid* hole)** (Do you prefer improved cowpea varieties with minimum insect damage?)									
14.	**Grain Size**	Small								
		Medium								
		Large								

15.	**Cooking ability (**Do you prefer improved cowpea varieties which easy (soft) to cook?)							
16.	**Cleanliness (**Do you prefer improved cowpea varieties which are free from debris?).							
17.	**Taste (**Do you prefer improved cowpea varieties which is tasty (Sweet)?).							

SECTION D

Farmers Preferred Traits and Attributes of Improved Cowpea Varieties to be Developed

Please **tick** and **indicate your level of agreement** on preferred traits and attributes of improved cowpea varieties to be developed

0= Not sure 1= Least Preferred 2= Less Preferred 3= Fairly Preferred
4= Preferred 5= Most Preferred

	Statement		**Please tick your most preferred attributes**		**Level of Preference**					
			Yes	**No**						
	Crop attributes				**5**	**4**	**3**	**2**	**1**	**0**
1.	**Pods length**	Short								
		Medium								
		Long								
2.	**Shape of Pod**	Straight								
		Curved								
		Coiled								
3.	**Plant Morphology** (Do you prefer improved cowpea varieties which have high above ground biomass?).									
4.	**Pest & Disease Resistance** (Do you prefer improved cowpea varieties which are pest and disease resistant?).									
5.	**Drought Tolerant** (Do you prefer improved									

	cowpea varieties which are drought tolerant?).									
6.	**Yield Potential** (Do you prefer improved cowpea varieties which are high yielding?).									
7.	**Maturity Period** (Do you prefer improved cowpea varieties which are early maturing?).									
8.	**Number of leaves** (Do you prefer improved cowpea varieties which have more leaves?).									
9.	**Tenderness of leaves** (Do you prefer improved cowpea varieties which have tender leaves?)									
	Grain attributes		**Please tick your most preferred attributes**		**5**	**4**	**3**	**2**	**1**	**0**
			Yes	**No**						
10.	**Texture of the Coat**	Rough								
		Smooth								
11.	**Eye Colour**	White								
		Black								
12.	**Testa Colour (Coat Colour)**	White								
		Red								
		Brown (Deep)								
		Brown (light)								
		Mottled								
		Chocolate								
13.	**Insect Damage (*Bruchid* hole)** (Do you prefer improved cowpea varieties with minimum insect damage?)									
14.	**Grain Size**	Small								
		Medium								
		Large								
15.	**Cooking ability (**Do you prefer improved cowpea varieties which easy (soft) to cook?)									

16.	**Cleanliness (**Do you prefer improved cowpea varieties which are free from debris?).							
17.	**Taste (**Do you prefer improved cowpea varieties which is tasty (Sweet)?).							

SECTION E

Farmers Level of Adoption of Improved Cowpea Varieties

Q1. Do you cultivate improved cowpea varieties? a. Yes [ ] b. No [ ]

Q2. Did you adopt an improved cowpea variety in the last cropping season? a. Yes [ ] b. No [ ]

Q3. Please indicate your level of Agreement on the following statements using the following scale

1= Least agree 2= Less agree 3= Fairly agree 4= Agree 5= Strongly Agree

NO.	Statement	Level of Agreement				
		5	4	3	2	1
1.	I used recommended land preparation methods before planting improved cowpea variety.					
2.	I tested the improved cowpea seeds before planting.					
3.	I treated the improved cowpea seeds before planting.					
4.	I used the recommended planting dates to cultivate improved cowpea seeds.					
5.	I adopted recommended seed rates (seed per hole) when planting improved cowpea seeds.					
6.	I used recommended line spacing (seed spacing) when planting improved cowpea seeds.					
7.	I used recommended sowing depth when planting improved cowpea seeds.					
8.	I adopted early application of fertilizer when cultivating improved cowpea variety.					
9.	I adopted early herbicides (weed control) when cultivating improved cowpea variety.					
10.	I used recommended chemicals to control pest and disease during cultivation of improved cowpea seeds.					

11.	I harvested the improved cowpea seeds at the appropriate maturity dates.					
12.	I used recommended threshing methods to thresh the improved cowpea pods.					
13.	I sorted and graded the improved cowpea seeds.					
14.	I used the recommended packaging methods to store the improved cowpea seeds.					
15.	I used the recommended storage system to store the improved cowpea seeds.					

Q4. Please use the scale below to indicate your **level of Agreement** on your reasons for adopting improved cowpea varieties.

1= Least agree 2= Less agree 3= Fairly agree 4= Agree 5= Strongly Agree

NO.	Statement	Level of Agreement				
		5	4	3	2	1
1.	It is high yielding					
2.	I earn high income/profit from market sales					
3.	Improved cowpea varieties mature early					
4.	Improved cowpea varieties are drought resistant					
5.	Improved cowpea variety is a household food security crop					
6.	Improved cowpea varieties have diversified food products					
7.	Improved cowpea seeds are available					
8.	Improved cowpea seeds are affordable					
9.	Cultivation of improved cowpea varieties requires less labour.					

SECTION F

Constraints faced by Farmers in the Adoption of Improved Cowpea Varieties

1. Are you facing any challenges in the adoption of improved cowpea varieties in your locality? a. Yes [ ] b. No [ ]

2. Please indicate your level of Agreement on the following challenges/constraints you face in adopting improved cowpea varieties in your locality using the following scale.

0= Not Sure (NS) 1= Strongly Disagree (SD 2= Disagree (D) 3= Somewhat Agree (SWA) 4= Agree (A) 5= Strongly Agree (SA)

No.	Constraints	Level of Agreement					
		5	4	3	2	1	0

1.	Lack of information on improved cowpea varieties						
2.	Unavailability of seeds						
3.	High cost of seeds						
4.	High cost of fertilizer						
5.	High incidence of pest and diseases						
6.	Lack of credit facilities						
7.	Lack of storage facilities						
8.	Inadequate access to markets						
9.	Inadequate extension visits						
10.	Land tenure system						

THANK YOU VERY MUCH FOR YOUR EFFORT

Appendix F: Structured Interview Schedule for Cowpea Consumers

University of Cape Coast

College of Agriculture and Natural Sciences

School of Agriculture

Department of Agricultural Economics and Extension

Topic: Stakeholders Preference and Adoption of Improved Cowpea Varieties in the Northern Region of Ghana

STRUCTURED INTERVIEW SCHEDULE FOR COWPEA CONSUMERS

Dear Respondent,

My name is James Afful, the principal investigator from the University of Cape Coast, humbly request you to participate in this MPhil research which seeks to investigate ''Stakeholders Preference and Adoption of Improved Cowpea Varieties in the Northern Region of Ghana''. This research is purely for an academic exercise and designed to elicit and gather data on the above topic that will contribute to the production of a MPhil thesis. All information given will be used solely for this purpose. Your participation entails you being interviewed by the principal investigator or a research assistant, and whatever information you provide will be considered as confidential and will be treated as such. Please also note that your name or identity will not be mentioned in any part of the report. The principal investigator does not anticipate any risks or harm to you with respect to your involvement in this research project. Your voluntary participation is priceless and as such, you may decline to answer any question that you do not wish to respond to, and you can also withdraw from the interview any time that you feel uncomfortable. The interaction is expected to last for about 45 minutes. Thank you in advance for accepting to be part of this research project. Before we start the conversation, do you have any questions? Please feel free to ask any question during the course of the interaction and I or the research assistant will be glad to respond to them. Thank you once again.

Now, do you want to ask anything about the research? Yes ☐ No ☐

If **Yes,** please ask your question:

……
……

Do you [NAME:……] agree to participate in the study? Yes ☐ No ☐

If **No**, reason(s) for refusal:

……
……

Signature/Thumbprint of Interviewee:_____

IDENTIFICATION

District: ……

Community: ……

Date of interview: ……(DD/MM/YYYY)

Name of enumerator: ……..

SECTION A

Demographic Characteristics of Consumers

Q1. Sex (i) Male [ ] (ii) Female [ ]

Q2. Please indicate your **age** at your last birthday ……. (in years)

Q3. Marital Status. a. Married [ ] b. Single [ ] c. Separated/Divorced [ ] d. Widow/Widower [ ]

Q4. Kindly indicate your highest **educational** qualification.

1. No formal Schooling/Education [ ]
2. Primary Education [ ]
3. Middle School Leaving Certificate/JSS [ ]
4. Senior Secondary School Certificate [ ]
5. GCE 'O' Level [ ]
6. GCE 'A' Level [ ]
7. Tertiary [ ]
8. Others (please specify)
   ……

Q5. What is your main occupation?
……...

Q6. Please indicate the number of dependents (**Household size**) ……

Q8. What is your estimated monthly income ? …… (in GH cedis)

Q9. How often do you consume cowpea? a. Often [ ] b. Sometimes [ ] c. Not always [ ] d. Always [ ]

Q10. How many days in the month did you and your household consume cowpea or cowpea product?.....(days).

Q11. During the last 12 months, for how many months did you and your household consume cowpea or cowpea product?..... Months.

Q12. What type of cowpea variety do you consume? a. Local/Landrace variety [ ] b. Improved variety [ ] c. Both [ ] d. Not sure [ ]

Q13. If your answer in Q.12 is improved variety, please list the name(s) of the improved varieties you sell.

(a) _____

(b)_____

Q14. If your answer in Q.12 is local/landrace variety, please list the name(s) of the local/landrace varieties you sell.

(a) _____

(b)_____

SECTION B

Extent of Participation of Consumers in the Development and Release of Improved Cowpea Varieties

Please indicate your **level of participation** in each of the following components or stages in the development and release of improved cowpea varieties.

Ratings	**Level of Involvement**
0	Not at all
1	Very low level
2	Low level
3	Moderate level
4	High level
5	Very high level

A.	**Conventional (No farmer, marketer or consumer participation)**	**Level of Involvement**					
		5	**4**	**3**	**2**	**1**	**0**
1.	The project was just brought to us by the Researchers without my knowledge.						
2.	I was informed about the initial development of improved cowpea varieties by the project officials.						
3.	I was informed about the progress of the development of the improved cowpea varieties.						
4.	I was informed about the release of improved cowpea varieties.						
5.	I was informed on the benefits of the development and release of the improved cowpea varieties.						
6.	I was informed on the goals and objectives of the development and release of improved cowpea varieties						
B.	**Consultative (scientists make the decisions alone but with organized communication with farmer's and other stakeholders)**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I was involved in the consultative meeting for the development and release of improved cowpea varieties						

2.	I was consulted on the need's identification for the development and release of improved cowpea varieties						
3.	I was consulted on the problems of the existing cowpea varieties in the market.						
4.	I was consulted on my varietal preference of improved cowpea varieties to be developed.						
5.	The project team actively sought out my opinions, to provide a more complete picture of potential risks, impacts, and opportunities relating to the development and release of improved cowpea varieties.						
C.	**Collaborative**	**5**	**4**	**3**	**2**	**1**	**0**
1.	My decisions and views were incorporated during setting of goals for cowpea development and release process.						
2.	My varietal preference was duly acknowledged in the development and release process.						
3.	My decisions concerning the breeding programme was not overridden by the researchers.						
4.	I was involved in the selection of varieties for the development of improved cowpea varieties.						
5.	I was involved in the collection of germplasm (cowpea lines) from different places.						
6.	All the decisions taken during the cowpea development and release programme was jointly made between researchers and stakeholders (farmers', marketers' and consumers').						
7.	There was a two-way communication during the cowpea development and release programme.						
8.	I was involved in the selection of the project site (on-station and on-farm).						
9.	I was involved in the monitoring and evaluation (M & E) during the testing of new improved cowpea varieties.						
10.	I was involved in deciding which germplasm (cowpea lines) is acceptable for seed multiplication.						
11.	I was involved in the multiplication of new cowpea seeds throughout the district.						
12.	I was involved in the distribution of new improved cowpea seeds.						

13.	I was involved in the information dissemination of new improved cowpea seeds.						
D.	**Collegial (farmers make plant breeding decisions collectively either in a group process or through individual farmers who are in organized communication with scientists).**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I/We decided with other stakeholders (marketers' and consumers') to set objectives on the production and distribution of new cowpea varieties.						
2.	I/We obtained information about scientists' priorities on varietal selection during the development and release of new improved cowpea varieties.						
3.	I/We followed scientist protocol in the selection of appropriate cowpea lines from different places.						
4.	I/We used plant breeding protocol to made crosses between different cowpea line collected from different places.						
5.	I/We used plant breeding protocol to select a number of new varieties for testing and multiplication.						
6.	I/We used plant breeding proceedings to test for desirable varieties in replicated trials in different locations.						
7.	I/We used plant breeding proceedings to multiple new cowpea varieties at different places (farmers' fields, demonstration fields, etc.).						
8.	I/We distributed the new introduced new cowpea varieties throughout our district and beyond with organised communication with scientists.						
E.	**Farmer experimentation (No Scientist participation)**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I/We did not obtain any information or protocol from scientists or researchers on how to select cowpea lines for breeding purposes.						
2.	I/We obtained the cowpea genetic materials (cowpea lines from different places) without any organised communication with scientists or researchers.						
3.	I/We made crosses between different cowpea line collected from different places without any organised communication with scientist or researchers.						

4.	I/We developed new cowpea varieties that meets our needs only without any information from scientists.							
5.	I/We multiplied the new cowpea varieties at different places.							
6.	I/We did not follow any protocol in the distribution of new introduced new cowpea varieties throughout.							

SECTION C

Consumers Preferred Attributes of Improved Cowpea Varieties to be Developed

Please **tick** and **indicate your level of preference** on preferred traits and attributes of improved cowpea varieties to be developed

0= Not sure 1= Least Preferred 2= Less Preferred 3= Fairly Preferred
4= Preferred 5= Most Preferred

	Statement		**Please tick your most preferred attributes**		**Level of Preference**					
	Grain attributes		Yes	No	**5**	**4**	**3**	**2**	**1**	**0**
1.	**Texture of the Coat**	Rough								
		Smooth								
2.	**Eye Colour**	White								
		Black								
3.	**Testa Colour (Coat Colour)**	White								
		Red								
		Brown (Deep)								
		Brown (light)								
		Mottled								
		Chocolate								
4.	**Insect Damage (*Bruchid* hole)** (Do you prefer improved cowpea varieties with minimum insect damage?)									
5.	**Grain Size**	Small								
		Medium								
		Large								

6.	**Cooking ability (**Do you prefer improved cowpea varieties which easy (soft) to cook?)							
7.	**Cleanliness (**Do you prefer improved cowpea varieties which are free from debris?).							
8.	**Taste (**Do you prefer improved cowpea varieties which is tasty (Sweet)?).							

THANK YOU VERY MUCH FOR YOUR EFFORT

Appendix G: Structured Interview Schedule for Cowpea Marketers

University of Cape Coast

College of Agriculture and Natural Sciences

School of Agriculture

Department of Agricultural Economics and Extension

Topic: Stakeholders Preference and Adoption of Improved Cowpea Varieties in the Northern Region of Ghana

STRUCTURED INTERVIEW SCHEDULE FOR COWPEA MARKETERS

Dear Respondent,

My name is James Afful, the principal investigator from the University of Cape Coast, humbly request you to participate in this MPhil research which seeks to investigate ''Stakeholders Preference and Adoption of Improved Cowpea Varieties in the Northern Region of Ghana''. This research is purely for an academic exercise and designed to elicit and gather data on the above topic that will contribute to the production of a MPhil thesis. All information given will be used solely for this purpose. Your participation entails you being interviewed by the principal investigator or a research assistant, and whatever information you provide will be considered as confidential and will be treated as such. Please also note that your name or identity will not be mentioned in any part of the report. The principal investigator does not anticipate any risks or harm to you with respect to your involvement in this research project. Your voluntary participation is priceless and as such, you may decline to answer any question that you do not wish to respond to, and you can also withdraw from the interview any time that you feel uncomfortable. The interaction is expected to last for about 45 minutes. Thank you in advance for accepting to be part of this research project. Before we start the conversation, do you have any questions? Please feel free to ask any question during the course of the interaction and I or the research assistant will be glad to respond to them. Thank you once again.

Now, do you want to ask anything about the research? Yes ☐ No ☐

If **Yes,** please ask your question:

……
……

Do you [NAME:……] agree to participate in the study? Yes ☐ No ☐

If **No**, reason(s) for refusal:

……
……

Signature/Thumbprint of Interviewee:_____

IDENTIFICATION

District: ……

Community: ……

Date of interview: ……(DD/MM/YYYY)

Name of enumerator: ……..

SECTION A

Demographic Characteristics of Cowpea Marketers

Q1. Sex (i) Male [ ] (ii) Female [ ]

Q2. Please indicate your **age** at your last birthday ……. (in years)

Q3. Marital Status. a. Married [ ] b. Single [ ] c. Separated/Divorced [ ] d. Widow/Widower [ ]

Q4. Kindly indicate your highest **educational** qualification.

1. No formal Schooling/Education [ ]
2. Primary Education [ ]
3. Middle School Leaving Certificate/JSS [ ]
4. Senior Secondary School Certificate [ ]
5. GCE 'O' Level [ ]
6. GCE 'A' Level [ ]
7. Tertiary [ ]
8. Others (please specify)
   ……

Q5. What is your main source of income? ……

Q6. What was the total estimated monthly income generated from selling cowpea? …… (in GH cedis)

Q7. Please indicate the number of dependents (**Household size**)
……

Q8. How long have you been working as a cowpea marketer?.....(in years).

Q9. What is your role along the cowpea value chain?

1. Retailer [ ]
2. Wholesaler [ ]
3. Both [ ]

Q10. What type cowpea variety do you sell? a. Local/Landrace variety [ ] b. Improved variety [ ] c. Both [ ] d. Not sure [ ]

Q11. If your answer in Q.10 is (b). improved variety, please list the name(s) of the improved varieties you sell.

(a) _____

(b)_____

Q12. If your answer in Q.10 is (a). local/landrace variety, please list the name(s) of the local/landrace varieties you sell.

(a) _____

(b)_____

SECTION B

Extent of Participation of Consumers in the Development and Release of Improved Cowpea Varieties

Please indicate your **level of participation** in each of the following components or stages in the development and release of improved cowpea varieties.

Ratings	**Level of Involvement**
0	Not at all
1	Very low level
2	Low level
3	Moderate level
4	High level
5	Very high level

A.	**Conventional (No farmer, marketer or consumer participation)**	**Level of Involvement**					
		5	**4**	**3**	**2**	**1**	**0**
1.	The project was just brought to us by the Researchers without my knowledge.						
2.	I was informed about the initial development of improved cowpea varieties by the project officials.						
3.	I was informed about the progress of the development of the improved cowpea varieties.						
4.	I was informed about the release of improved cowpea varieties.						
5.	I was informed on the benefits of the development and release of the improved cowpea varieties.						
6.	I was informed on the goals and objectives of the development and release of improved cowpea varieties						
B.	**Consultative (scientists make the decisions alone but with organized communication with farmer's and other stakeholders)**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I was involved in the consultative meeting for the development and release of improved cowpea varieties						
2.	I was consulted on the needs identification for the development and release of improved cowpea varieties						

3.	I was consulted on the problems of the existing cowpea varieties in the market.						
4.	I was consulted on my varietal preference of improved cowpea varieties to be developed.						
5.	The project team actively sought out my opinions, to provide a more complete picture of potential risks, impacts, and opportunities relating to the development and release of improved cowpea varieties.						
C.	**Collaborative**	**5**	**4**	**3**	**2**	**1**	**0**
1.	My decisions and views were incorporated during setting of goals for cowpea development and release process.						
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3.	My decisions concerning the breeding programme was not overridden by the researchers.						
4.	I was involved in the selection of varieties for the development of improved cowpea varieties.						
5.	I was involved in the collection of germplasm (cowpea lines) from different places.						
6.	All the decisions taken during the cowpea development and release programme was jointly made between researchers and stakeholders (farmers', marketers' and consumers').						
7.	There was a two-way communication during the cowpea development and release programme.						
8.	I was involved in the selection of the project site (on-station and on-farm).						
9.	I was involved in the monitoring and evaluation (M & E) during the testing of new improved cowpea varieties.						
10.	I was involved in deciding which germplasm (cowpea lines) is acceptable for seed multiplication.						
11.	I was involved in the multiplication of new cowpea seeds throughout the district.						
12.	I was involved in the distribution of new improved cowpea seeds.						
13.	I was involved in the information dissemination of new improved cowpea seeds.						

D.	**Collegial (farmers make plant breeding decisions collectively either in a group process or through individual farmers who are in organized communication with scientists).**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I/We decided with other stakeholders (marketers' and consumers') to set objectives on the production and distribution of new cowpea varieties.						
2.	I/We obtained information about scientists' priorities on varietal selection during the development and release of new improved cowpea varieties.						
3.	I/We followed scientist protocol in the selection of appropriate cowpea lines from different places.						
4.	I/We used plant breeding protocol to made crosses between different cowpea line collected from different places.						
5.	I/We used plant breeding protocol to select a number of new varieties for testing and multiplication.						
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8.	I/We distributed the new introduced new cowpea varieties throughout our district and beyond with organised communication with scientists.						
E.	**Farmer experimentation (No Scientist participation)**	**5**	**4**	**3**	**2**	**1**	**0**
1.	I/We did not obtain any information or protocol from scientists or researchers on how to select cowpea lines for breeding purposes.						
2.	I/We obtained the cowpea genetic materials (cowpea lines from different places) without any organised communication with scientists or researchers.						
3.	I/We made crosses between different cowpea line collected from different places without any organised communication with scientist or researchers.						
4.	I/We developed new cowpea varieties that meets our needs only without any information from scientists.						

5.	I/We multiplied the new cowpea varieties at different places.						
6.	I/We did not follow any protocol in the distribution of new introduced new cowpea varieties throughout.						

SECTION C

Consumers Preferred Attributes of Improved Cowpea Varieties to be Developed

Please **tick** and **indicate your level of preference** on preferred traits and attributes of improved cowpea varieties to be developed

0= Not sure 1= Least Preferred 2= Less Preferred 3= Fairly Preferred
4= Preferred 5= Most Preferred

	Statement		**Please tick your most preferred attributes**		**Level of Preference**					
	Grain attributes		Yes	No	**5**	**4**	**3**	**2**	**1**	**0**
1.	**Texture of the Coat**	Rough								
		Smooth								
2.	**Eye Colour**	White								
		Black								
3.	**Testa Colour (Coat Colour)**	White								
		Red								
		Brown (Deep)								
		Brown (light)								
		Mottled								
		Chocolate								
4.	**Insect Damage (*Bruchid* hole)** (Do you prefer improved cowpea varieties with minimum insect damage?)									
5.	**Grain Size**	Small								
		Medium								
		Large								
6.	**Cooking ability (**Do you prefer improved cowpea varieties which easy (soft) to cook?)									

7.	**Cleanliness (**Do you prefer improved cowpea varieties which are free from debris?).							
8.	**Taste (**Do you prefer improved cowpea varieties which is tasty (Sweet)?).							

THANK YOU VERY MUCH FOR YOUR EFFORT

Appendix H: Ethical Clearance Letter

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309/ 0244207814
E-MAIL: irb@ucc.edu.gh
OUR REF: UCC/IRB/A/2016/403
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

C/O Directorate of Research, Innovation and Consultancy

22ND MAY, 2019

Mr. James Afful
Department of Agricultural Economics & Extension
University of Cape Coast

Dear Mr. Afful,

ETHICAL CLEARANCE – ID: (UCCIRB/CANS/2019/01)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted **Provisional Approval** for the implementation of your research protocol titled **Stakeholders Preference and Adoption of Improved Cowpea Varieties in the Northern Region of Ghana**. This approval requires that you submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

Please note that any modification of the project must be submitted to the UCCIRB for review and approval before its implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Samuel Asiedu Owusu, PhD
UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST
Date: 23/05/19