KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

ANALYSIS OF SOCIO-ECONOMIC FACTORS INFLUENCING HOUSEHOLD FOOD SECURITY AMONG SMALLHOLDER VEGETABLE FARMERS. A CASE STUDY OF TANO-SOUTH DISTRICT, BRONG-AHAFO REGION OF GHANA

BY

MAHAMA BOATENG SEIDU (B.Sc. Agriculture)

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FACULTY OF AGRICULTURE

College of Agriculture and Natural Resources

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DECLARATION

I, Mahama Boateng Seidu, do hereby declare that this submission is my own work towards the M.Phil. (Agricultural Economics) and that, to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree of the University except where due acknowledgement has been made in the text.

MAHAMA BOATENG SEIDU   ....

(STUDENT NAME)   SIGNATURE   DATE

PG3154709

DR. S. C. FIALOR   ....

(SUPERVISOR)   SIGNATURE   DATE

Certified by:

DR. D. AWUNYO VITOR   ....

(HEAD OF DEPARTMENT)   SIGNATURE   DATE

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Thank you, Almighty God.

DEDICATION

I dedicate this piece of work to my mother Anokyewaa Alima A. Boateng and to all

the Boateng family, for all their contributions

ABSTRACT

This study set out to investigate the socio-economic factors influencing smallholder vegetable farmers' household food security and food insecurity coping mechanisms in the Tano South district of the Brong Ahafo Region of Ghana. The data was obtained through personal interviews by the use of structured questionnaires. Descriptive statistics was used to identify the spread of the observations and the outlying values and distinctive patterns whiles the logistic regression model was used to determine the factors influencing household food security with twenty independent variables. Households applied short-term consumption and income coping strategies to cope with food shortages and income shocks. Using the Item Response Indicator (Bickel et al., 2000), the vegetable farmers could generally be considered food insecure without hunger. From the logistic regression, eight variables were found to be significant at the 1, 5, and 10 percent significance levels. And all the variables had their expected signs. Vegetable production represent a viable instrument for coping with food security because of the relatively short cycle of the crops in question, and thus help improve household resilience in the event of food shortage. Hence, direct measures for improving food security, such as access to credit to boost production and cultivating more than one type of vegetable crop, are likely to become priorities.

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CHAPTER ONE

INTRODUCTION

1.1   Background

Promoting the people basic needs and well-being or making the world free from hunger, malnutrition and poverty is the greatest challenge for especially less developed countries. The difficulty of achieving food security has been faced and given as the first priority in achieving the most fundamental human right in all developing countries.

In the last decade, attention has been focused on means of eliminating food insecurity and hunger worldwide. The 1992 International Conference on Nutrition and the 1996 World Food Summit both stressed the urgent need to reduce food insecurity and hunger. The 1996 World Food Summit specifically brought back to centre-stage in the development debate, the issue of hunger and food insecurity as both the cause and effect of poverty and slow growth. In reaction to these issues, the Millennium Development Goals were launched; bringing the international community to work together to achieve the set goals by 2015 (Migotto *et al.,* 2005). The first Millennium Development Goal is to eradicate extreme poverty and hunger. The targets here are to halve between 1990 and 2015, the proportion of people who suffer from extreme hunger and people whose income is less than $1 a day (FAO, 2005 a).

According to FAO (2005a), the achievement of these targets is very important to reducing hunger and poverty. This is because it is believed that hunger perpetuates poverty by reducing productivity and poverty in turns prevents people from producing or acquiring the food they need. Less than 10 years to the target year, available statistics still cast doubt on whether this goal could be achieved.

A progress monitoring report released by FAO (2005 b) indicated that even though most Millennium Development Goals could be achieved, eliminating hunger and poverty is a pre-requisite for achieving all the other targets of the Millennium Development Goals. Although, the percentage of hungry people in the world has fallen between 1981 and 2001, an estimated 852 million people worldwide are still chronically undernourished; among them are 170 million children under 5 years of age (IFPRI, 2001). Recent figures show more than one billion hungry people in the world with Africa and South Asia recording the highest levels of hunger (IFPRI/Global Hunger Index, 2001).

Ghana has remained a food deficit country for the past twenty-five years. This deficit is mainly in cereals, meat, fish and fats and oils. The production of root and tubers, industrial crops, fruits and vegetables have shown improvement in supply. (Gyamfi, 2006). Ghana produces 51% of its cereal needs, 60% of fish requirement, 50% of meat and less than 30% of the raw materials needed for agro-based industries (MoFA, 2007). Ghana had its fair share of global financial crisis which saw food prices soaring from 2006 in most part of the world. Prices for rice, maize and other cereals increased in Ghana by 20 to30 percent between the last few months of 2007 and the beginning of 2008 (Wodon *et al.*,2008). As result of the food price increases; 18% of the population whose income is less than the costs of the minimum food basket have become more vulnerable and less resilient to food insecurity (WFP, 2009).

Although the Ghanaian economy is endowed with numerous natural resources, ineffective production techniques, low yielding crop varieties, inadequate supplies of water, etc constrain to the achievement of food security in Ghana. Seasonal and unstable domestic production, high food prices and inflation, low household incomes, persistent high level of unemployment continue to threaten food security (Gyamfi, 2006).

The socio-economic characteristics and resources of individual households have been identified as basic factors influencing the food security status of households (Sanusi et al., 2006). Rural households continue to face poor economic conditions which impact on their living standard and food security situation. The returns to land in terms of output have been on the decrease especially where increased population and nonagricultural uses compete for land use. This further creates gaps in resource availability among the poor households. The impact of this is that the food situation gets worse; farms are being abandoned to the elderly or for off-farm jobs. The income from off-farm activities has not been proven to be adequate to meet households' needs (Akinsanmi and Doppler, 2005). This situation requires that the socio-economic conditions are known for a guided change to take place. The particular factors which affect households differently must also be examined and understood.

Effectively addressing the many causes of the food security problem in the country has been elusive (Nyanteng and Seini, 2000). However, the role of agriculture to supply adequate food for the rapidly increasing population has remained high on the agenda of various governments.

1.2   Problem Statement

Ghana's economy can best be describe as agrarian, with the agricultural sector contributing 24.6% of GDP and employs about 56% of the work force, mainly small landholders(GSS, 2012). Peasant farmers who reside in the rural areas of Ghana produce about 10% of the agricultural output (Cobbinah, 2006). In Ghana, about 75% of the population living in rural communities engaged in farming as their main

occupation (GSS, 2012). Though this high percentage of the national work force is engaged in farming, they do not produce enough to feed the ever-increasing populace. About 1.2 million people representing 5% of the Ghana's population are food insecure and about 2 million people are vulnerable to become food insecure (WFP, 2009). Available figures show that 507,000 (40%) people are vulnerable of becoming food insecure in the rural areas of Upper West, Upper East and Northern regions of Ghana. Up to 1.5 million people vulnerable of food insecurity live in the rural and urban areas of the remaining seven regions, with the largest share of them (11%) in

Brong Ahafo region. Despite farming activities being the main sources of income in Brong Ahafo Region, many households in most districts are experiencing problems in accommodating their food and nutritional needs. (WFP, 2009).

Given the role of agriculture in the Ghanaian economy, food insecurity and poverty could be attributed to the poor performance of the agricultural sector, which in turns creates food availability and accessibility problems at the household and national levels. In other words, the poor performance of the sector directly creates supply shortages and indirectly creates demand shortages by denying the households access to sufficient income

According to IFAD report (IFAD, 1996), household food insecurity is a seasonal problem in Ghana, occurring every year between February and July. The report indicates that the bulk of both rural and urban household's budget (over 70%) is spent on food. A major reason for this high spending on food is poverty and scarcity cycle: poorer households are forced by necessity and lack of storage facilities to sell their crops soon after harvest, when prices are low. During the dry season, they have to buy them back as food at a time when prices are at their highest.

Many governments, non-governmental organizations and research institutions are looking at alternative means to reduce, if not eliminate completely, the problem of food scarcity and ensure food security throughout the year. One of the agricultural objectives of Ghana government is to ensure food security for its citizens, throughout the year (MoFA, 2007). However, majority of the research that has been done so far relating to food insecurity in Ghana are very general and consider the problem from national or regional point of view. Little work has been done to understand the food security problem at the household level.

While the food security problem is recognized as a severe and major development challenge by Ghana government, adequate information on socio-economic factors influencing household food security and coping mechanisms for food insecurity is scanty. This calls for an urgent need to investigate the socio-economic factors influencing household food security and the coping strategies employed by rural households in order to aid design appropriate policies and programmes that are dedicated to help improve food security.

1.3   Research Questions

In order to examine the socio-economic factors influencing household food security and the coping mechanism of food insecurity, the researcher has identified the following questions:

   i.   What socio-economic factors influence household food insecurity?

ii.   What is the perception of farmers on vegetable production?

iii. What is the food security status of the vegetable farmers? iv.

What household coping strategies are employed to mitigate

food insecurity?

1.4   Objective of the Study

1.4.1   Main Objective

The main objective of the study is to investigate the socio-economic factors influencing household food security and the coping mechanism of food insecurity among smallholder vegetable farmers in the Tano-South District in the Brong Ahafo Region of Ghana.

1.4.2   Specific Objectives are;

i.   To identify and discuss the social and economic factors that influence vegetable farmers' household food security.

ii. Evaluate the farmers' perception on vegetable production.

iii. Measure the prevalence of food insecurity among vegetable farmers in the study area.

iv. Identify the coping mechanisms adopted by the households in addressing the food insecurity issues in the study area;

1.5   Hypotheses of the Study

H_0:   Socio-economic characteristics of farmers have no influence on their food security levels.

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H₁: Socio-economic characteristics of farmers have influence on their food security levels.

1.6   Justification of the Study

Food security has become an issue of increasing public concern. Reliable monitoring of food security and insecurity, and hunger contributes to the effective operation of government programmes as well as that of private food assistance programmes and other government initiatives aimed at reducing food insecurity. Identifying and characterizing the food insecure and the coping strategies employed is extremely necessary for designing and conducting action to improve their situation. It is therefore, hoped that the results of the study would bring to the fore some relevant issues, which would be useful to stakeholders in agriculture and other private sector and development partners operating in the study area.

The availability of updated baseline information on the food security situation in the country is meant to inform, guide and fine-tune ongoing and future interventions of all stakeholders, most importantly those of the government, whose mandate is to eradicate persisting hunger and achieve the Millennium Development Goals (MDGs). This was to be done by highlighting areas and population groups experiencing difficulties in accessing sufficient and nutritious food and provide recommendations regarding most appropriate assistance that would make a difference in their lives.

Governmental organizations such as MoFA, District Assemblies and Nongovernmental organizations like Agribusinesses, Farmers Based Organizations (FBOs), Civil Society Organizations (CSOs), Self Help Groups and development partners such as IFAD, World Food Program (WFP), Canadian International Development Agency (CIDA),

and other public and private sector development partners will find the findings of the study useful in planning for their developmental programmes.

This study, therefore, has both basic (academic) and applied (practical) purposes and will contribute to addressing the literature gap regarding food security and coping strategies employed by food insecure households. The information can be used to help the government's policy and development strategy on food security.

1.7   Organization of the Study

This thesis has five chapters and is organized as follows. The current chapter outlines the background of the study, statement of the research problem, objectives, justification as well as organisation of the study. Chapter two presents a review of related literature. Chapter three gives a description of the study area and outlines the research methodology which includes the methods and procedures employed to answer the research questions. Chapter four presents the results and discussion.

Finally, concluding remarks and recommendations are presented in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.0 General Overview

The purpose of this chapter is to review the related literature on food security and food insecurity coping mechanisms. It focuses on the concept of food security, determinants of food security, coping mechanisms of household food insecurity and the analytical models for household food security

2.1   The Concept of Food Security

The concept of food security has evolved over time. Food security as an issue became prominent in the 1970s and has been a topic of considerable attention since then (Maxwell *et al*, 1999). Food security is defined in different ways by international organisations and researchers (Kidane *et al*, 2005). Since the World Food Conference of 1974, definitions of food security focused on national food security or increase in food supply (FAO, 1996). After the 1943 Hot Springs Conference on Food and Agriculture, the concept of food security meant adequate and secure supply of food for all (FAO, 1996). Food security was understood in terms of availability and supply of cereals (Maxwell *et al*, 1999). The bulk of literature defined the concept of food security from a supply perspective. However, this kind of thinking was narrow and confined to production as the key to meeting food security demands. Definitions of food security evolved after the 1996 World Food Summit and the definitions of food security focused on achieving food security at the individual, household, national, regional and global levels when all people, at all times, have physical and economic access to sufficient,

safe and nutritious food to meet dietary needs (FAO, 1996). The focus of attention was

primarily on food supply problems with assuring the

availability, and to some degree, the price stability of basic foodstuffs at international

and national levels (Devereux *et al*, 2004).

A household is food secure when it has both physical and economic access to adequate

food for all members (Sharma, 1992). Food secure households are described as having

access to income through various sources such as remittances, off-farm employment

and other income-generating activities (Sharma, 1992). To ensure access to food

security, an adequate amount of food must be within the physical reach of vulnerable

households, whether sourced through own production or the market (Carletto *et al*,

2001; Malambo, 1992).

In the context of subsistence households, food security refers to the ability to establish

access to productive resources such as land, livestock, agricultural inputs and family

labour, to produce food (Diriba, 1995). Consistent with this, Bonnard (1999) points out

that with respect to the three components of food security, agriculture constitutes the

most important factor in availability – a primary factor in access, where livelihoods are

agriculture-based, and a complementary factor with regard to food quality and

processing. In attempting to describe the function of aggregate food at a national level

to household food security, Clover (2003) argues that food insecurity is no longer

simply seen as a failure of agriculture to produce sufficient food at a national level, but

instead as the failure of livelihoods to guarantee access to sufficient food at the

household level.

In explaining the concerns of food security policy makers, Diskin (1994) points out that

conventional wisdom among many policymakers who are concerned with food security

has been that high degrees of correlation exist between food availability and access, between food access and consumption, and between food consumption and nutritional status. In other words, increased food availability leads to increased access, which leads to increased consumption, which in turn leads to increased nutritional well-being. Due in part to this "wisdom", efforts to solve the nutritional problems facing African countries have largely focused on strategies for promoting agricultural production, and sometimes income generation, with the implicit assumption that increases in production and incomes automatically lead to improved food consumption and nutritional welfare. However, Diskin (1994) points out that evidence in the literature suggests that, in many cases, and for many reasons, assumptions of strong and straightforward linkages along the pathway from food production to nutrition outcomes are not well founded. Many factors, other than household food production and income, for instance, may affect rural food consumption, for example intra-household resource allocation patterns. In addition, many factors other than food consumption may affect nutritional status, for example infectious diseases.

2.2   Determinants of Food Security

Factors used to explain the differences in levels of productivity and food security between households include income, household land holdings, employment status, household productive asset endowments and household composition. A study carried out by Rukuni (1994) revealed that to ensure high productivity levels and sustainable food security among the poor, especially in low rainfall areas, on-farm productivity and income growth is essential.

2.2.1 Landholding

The most common asset in rural areas is landholding and this is a good indicator of poverty when income is unobserved (Ravallion, 1989). Households with small farms are prone to food insecurity. In addition, land quality has been found to provide a good amount of yield in communal farms. In most communal areas, lands are of relatively poor quality and require the use of chemical fertilizer (Rutsch, 2003).

2.2.2 Livestock

A study on livestock was conducted by Ndlovu (1989), who focused on the role of livestock in promoting food security in farming systems. Ndlovu (1989) found that livestock are important to food security as sources of manure, draught power, cash income, food (milk and meat) and as long-term investments. Zindi and Stack (1991) did a survey on the contribution of livestock to household's food security in communal areas. The most important livestock types in communal areas are cattle, chickens and goats, each of which serves different functions under different household circumstances. Cattle are generally regarded as an investment and a production input while small stock, especially goats, is viewed as a ready source of cash. Thus, FAO (1997) proposed a food based strategy to alleviate rural food insecurity that included small stock (goats and sheep) and vegetable gardens as well as formal agriculture, especially the rearing of poultry to improve household food security. FAO (1997) showed that small stock are easy to keep as they can survive in harsh conditions and are able to feed on low quality crops as compared to cattle.

2.2.3 Income Sources

Farm households derive their income from many sources including crop and livestock sales, wages, salaried labour, remittances and small enterprises. These small enterprises include basket making, brick making, curios, pottery and selling of fish. The contribution of each source to total income and its reliability varies greatly between households. Factors contributing to this variation include agro-ecological conditions, wealth and income levels (Jayne *et al,* 1994).

Off-farm labour is an important source of income for most smallholder farmers. Offfarm income is positively associated with higher and less variable total income (Jayne *et al*, 1994). Some studies have also shown that off-farm income has a positive effect on the adoption of expensive traction technology and good quality inputs, which results in high productivity levels (Zindi and Stack, 1991). Thus, it is clear that income diversification can have a positive effect on food access by increasing total incomes and under proper circumstances increasing investment in agriculture (Jayne *et al*, 1994).

Chopak (1989) carried out a study on family income sources and food security. The study focused on analyzing the food security status of households in natural regions of Zimbabwe and identifying alternative strategies for improving household food security in these areas. The three most important income sources during the hunger season were labour payments from off-farm employment, remittances (from family members employed), government transfer payments and pension funds.

2.2.4 Gender of Household Head

Men and women engage in different activities to obtain income. This is important in determining the impact of gender of household head on crop productivity and food

security. Studies have shown that women focus on the production of food crops, and that women's income from cash cropping and other sources is more likely to be spent on food than the men's income (Mattias *et al*, 1995). It has been argued that households with female heads are more likely to be food insecure than those with male heads.

In a study conducted in Kwazulu-Natal to assess the impact of land reform programme in South Africa, it was realized that it failed to integrate food security concerns and the needs of rural women. The study suggested that there are important differences within and between households headed by women and communities with respect to security levels and strategies to attain food security (Boyd and Turner, 2000).

2.2.5 Household Productive Asset Endowments

Access to food by communal farmers has been conceived as a function of entitlements, which includes a set of all alternative bundles of commodities that a person can obtain legally by using his or her endowments (Feleke *et al*, 2005). People may suffer if there is inadequate food because of lack of "entitlements" or access to food, implying that food insecurity should be analyzed in terms of the decline or failure of food entitlements of different socio-economic groups (Anderson, 1998). In other words, there can be food insecurity even without any fall in food availability due to a variety of other variables such as loss of endowments, loss of employment, a fall in wages, or unfavourable shift in terms of trade of food exchange for assets.

Ownership of other productive assets such as farm equipment (ploughs, cultivators, labour and draft power) may be reasonable *proxies* for food security status of households. Dione (1989) in Mattias *et al* (1989) showed that there is a positive relationship between agricultural equipment ownership and per capita grain production.

However, Sunderberg (1989) in Mattias *et al* (1989) used the same variables and found that there was no strong positive correlation between agricultural equipment ownership and the nutritional status of individual household members.

2.2.6   Other Issues that Impact on Household Food Security

May *et al* (1999) observed that households have various ways of achieving food security. In this regard, pensions and access to salaried labour has gained prominence. The FAO (1997) proposed a food based strategy to alleviate rural food insecurity that included conservation strategies, food assistance, production from agriculture and buying power of communal farmers. The FAO (1997) came across these indicators when they were assessing food insecurity in some southern African countries that were food insecure such as Namibia, Zambia, Lesotho, Mozambique and Zimbabwe. Abalu (1999) and May (2000) argued that agriculture is one of the main sources contributing to livelihood strategies and underpinning food security in the rural areas of most African countries. Some of the ways that food security can be enhanced in communal areas include conservation strategies, food assistance, production, purchasing power and feeding livestock from crops residues. This also follows Kirsten *et al* (1998) suggestion that increased agricultural production has a positive contribution to household food security and nutrition.

In terms of food security *per se*, the type, quality, diet and nutrition as well as the preservation and storage methods are important (Abalu, 1999). It is also important to integrate economic and political dimensions of food security. For example, issues of governance and decision making at both the community and household levels have an impact on food security (Kirsten *et al.,* 1998). Thus, power relations are the key to obtaining an adequate conceptual understanding of the opportunities and obstacles to

the goals of food security and improved agricultural production. Food security can be attained or enhanced if the governance and political structures are put in place to cater for the rural poor farmers.

2.3 Household Responses and Coping Strategies to Food Insecurity Situations

Various sources have attempted to define coping strategies. Devereux (2001) defines coping strategies as a response to adverse events or shocks. The definition by Snel and Staring (2001) captures the broad notion of coping strategies, namely that "all the strategically selected acts that individuals and households in a poor socio-economic position use to restrict their expenses or earn some extra income to enable them to pay for the basic necessities (food, clothing, shelter) and not fall too far below their society's level of welfare" (Snel and Staring, 2001). The latter definition implies that coping strategies involve a conscious assessment of alternative plans of action. The definition is based on the assumption that within the limited options available to households, the households are asset managers with freedom of choice in relation to their actions (Devereux, 1993; Ellis, 2003). This does not necessarily mean that their choice of strategies is always successful in achieving their intended objectives. In fact, the coping strategies often have unintended negative effects.

Ellis (2000) defines coping strategies as the methods used by households to survive when confronted with unanticipated livelihood failure. Coping comprises tactics employed when confronted by disasters, such as drawing down on savings; using up food stocks; receiving gifts from relatives; benefiting from community transfers; sales of livestock and other assets sales (Ellis, 2000). The strategies pursued by households

differ in several aspects, that is, within the household and between households (Majake, 2005; Maxwell *et al*, 2003). Due to varying degrees of wealth among households, different coping behaviours are adopted by households at different poverty levels. However, some coping strategies are common to all households, although the extent to which such strategies enable a household to remain afloat depend on the assets at their disposal (Devereux, 2001). Above all, the general tendency is that the lower the household asset status, the more likely the household would engage in erosive responses such as selling off of productive assets such as farm implements (Corbett, 1988; Devereux, 2001; Hoddinott, 2004).

2.3.1 Consumption and Income Coping Strategies

Households experience an income shock and a drop in consumption if at least one of the following events took place: a member loses his job; a member experiences a substantial drop in his earnings; serious illness; crop failure; loss of livestock and a family business experiences a substantial drop in revenue (Gaviria, 2001; Notten *et al* 2007; IFAD, 2007). According to IFAD (2007), coping ability can be defined as reducing fluctuations in income. Faced with an income or food shock, households may either protect their food consumption by purchasing or receiving food from other sources such as friends and relatives (Davies, 1993; Corbett, 1988)

Literature distinguishes between risk management (income soothing) and risk coping strategies (consumption soothing). The former attempts to reduce the ex-ante risk impacts e.g. through income diversification (Dercon, 2000; Busse, 2006). Households smooth income by making conservative production or employment choices and diversifying economic activities. In this way, households take steps to protect themselves from adverse income shocks before they occur (Murdoch, 1995). Risk

coping strategies deal with consequences (ex-post) of risk (Busse, 2006). Households smooth consumption by borrowing and saving, adjusting labour supply and employing formal and informal insurance arrangements. These mechanisms take force after shocks occur and help insulate consumption patterns from income variability (Murdoch, 1995). Risk-coping strategies involve self-insurance (through precautionary savings) and informal group-based risk-sharing (Dercon, 2000; Davies,

1993). Households can insure themselves by building up assets in "good" years, to deplete these stocks in "bad" years (Dercon, 2000). Households may modify their food consumption by reducing/modifying food or reduce the number of consumers (Dercon, 2000; Corbett, 1988). Consumption soothing strategies generally increase as income generating strategies come under strain (Dercon, 2000).

2.3.2   Shocks and Household Food Insecurity Coping Strategies

Shocks refer to sudden and unexpected occurrences (Davies, 1993, May and Woolard, 2007). The exposure to shocks triggers coping strategies and a household's coping capacity results in either failure or success to attain food security (Davies, 1993). The ability to respond to shocks is determined by the degree of vulnerability of a household (Ellis, 2003; Devereux, 2001). Households are vulnerable when they are unable to cope with and respond to risks, stresses and shocks (Ellis, 2003). The ability of households to respond to risks and shocks can be substantially weakened by multiple or successive shocks (Busse, 2006). Responses to shocks and the ability to cope with vulnerability depend on the level of available assets. The inability to buffer food security shocks leads households to draw on liquidity or assets (Busse, 2006;

Devereux, 2001).

Without doubt, drought, floods, conflicts shocks are the root causes of a substantial proportion of both acute and chronic vulnerability in most Africa countries (FAO, 2003; Dercon, 2000). Shocks can have persistent effects only in the presence of poverty traps (FAO, 2005; Baulch and Hoddinott, 2000). Potential shocks can affect growth of households due to the volatility that repeated shocks generate (Collier *et al*, 2006). Strategies to reduce vulnerability to shocks such as drought and other disasters should be based on a sound understanding of coping strategies (FAO, 2005; Busse, 2006). Work shocks, according to Gittinger *et al* (1990), occur when

quantity/availability of work changes abruptly, for example because of illness or the effects of drought on employment. This situation of vulnerability leaves the household more susceptible to "shocks" such as loss of income due to retrenchment (FAO, 2003; Dercon, 2000). Households may also suffer from food shocks as a consequence of periodic drought; changes in the composition of households and lack of access to alternative sources of income (Gittinger *et al*, 1990).

2.3.3   Food shortage and household food insecurity coping strategies

Different coping strategies are adopted within different societies but the general sequence of adoption of progressively desperate strategies is common (Majake, 2005; Maxwell *et al*, 2003; Corbett, 1988; Watt, 1983). Coping strategies of households are influenced by factors such as economic status, gender and age (Devereux, 2001) and are either erosive or non-erosive (Maxwell *et al*, 2003; Devereux, 1993; Watt, 1983). The continuum of coping strategies begins with a household head experiencing anxiety about food insufficiency, leading to decisions to reduce the household's food budget by altering the quantity or variety of food consumed by the family (Corbett,

1988; Maxwell *et al*, 2003; Ellis, 1998). As the situation worsens, adults in the household begin to experience hunger due to reduced food intake to protect children and in most severe circumstances, both children and adults experience hunger (Ellis, 2000). The strategies are typically adopted in a sequence beginning with those that cause the least discomfort, followed by progressive drastic measures (Corbett, 1988; Watt, 1983; Ellis, 1998).

2.4   Measurement of Household Food Security

Food secure households at the minimum are able to produce enough food at all times such that all members can lead a productive and healthy life. The food can either be produced or the household's agricultural production can generate enough income to purchase all the required food items. This means that food security can be measured in terms of both household actual food quantities produced from the family farm or the income generated from the production. The choice of method depends to a large extent on the availability and degree of analysis of food security. However, it should be noted that poor rural farming households produce to subsist and only that part of the produce which cannot be consumed (surplus) is marketed (Hoddinott and Yohannes, 2002)

Hoddinott and Yohannes (2002) outline four ways of measuring food security outcomes, namely individual intake, household caloric acquisition, dietary diversity and indices of household coping strategies. Each method of measuring food security outcomes entails different methods of collecting and analyzing the data.

Similarly, measures of household income can be derived as a lump estimate based on the recall of a household head over the past month, or as an aggregate of income from

an individual household member's activities, based on individual recall. Obviously, decisions regarding the measurement of indicators are critical to their eventual credibility, cost and interpretation (Riely *et al.* 1999).

Currently, the most common and well-recognized experiential food security assessment measures include the United States Food Security Core Module (FSCM) and the Coping Strategy Index (CSI).

The Coping Strategies Index (CSI) is an indicator of household food security that is relatively simple and quick to use, straightforward to understand, and correlates well with more complex measures of food security. A series of questions about how households manage to cope with a shortfall in food for consumption results in a simple numeric score. In its simplest form, monitoring changes in the CSI score can indicate whether household food security status is declining or improving (Maxwell *et al.* 2003)

The Food Security Core Module (FSCM) scale is designed to yield a single score (from 0 to 10) denoting severity of household food insecurity over the past twelve months. Different types of experiences and behaviours indicate insecurity as measured by the FSCM, and this score serves as a useful starting point against which to assess other country and subpopulation experiences (Coates, 2004).

In Free State Province (South Africa) a study was carried out to assess the contribution of rainwater harvesting and conservation practices to household food security. Crop production from water harvesting technology was measured by its contribution to household food or income requirements. Household food security was achieved by determining the family size which was then converted to adult equivalents. Household

adult equivalent (ADEQ) in the study was calculated based on household demographics following Aliber (2003).

After the determination of adult equivalent, the total household income was divided by the adult equivalent to determine the adult equivalent income (ADEQI), which is a proxy for the income available for each adult member of the household.

Percentage ADEQI is used as an indicator of the welfare or food security status of a household. As households become more "well off", they tend to spend less money as a proportion of the total household income (Woolard *et al*, 2005). Generally poor households (low income earners) spend a considerable proportion of their incomes on food. The expected results were how an increase in vegetable production would result in a reduction in the proportion of income used to acquire food (Aliber, 2003). The increased income would be generated from the sale of the vegetable produced enabling farmers to meet household food requirements.

2.5 Models of Food Security Analysis

2.5.1 Logistic Regression Model

A logistic regression was used by Kidane *et al* (2005) and Feleke *et al* (2005) to assess the causes of household food insecurity. These studies were done in Ethiopia and looked at the following 'Causes of household food insecurity in Koredegada Peasant Association, Oromiya zone,' and 'Determinants of food security in Southern Ethiopia'. Both studies involved assessing various indicators that could affect the dependent parameter food security. A logistic regression (binary or dichotomous) was used to

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investigate which independent variables affected food security. Among these variables included were continuous and categorical variables. The variables included in both studies were age of household head, gender of household head, wealth, farm size, cattle ownership, fertilizer application, education level of household heads, physical access to markets, household size, off-farm employment, on-farm income and per capita aggregate production (Feleke *et al*, 2005 and Kidane *et al*, 2005). These variables were chosen because the researchers felt that these could influence food security either positively or negatively. Among the variables included in both models, those identified as statistically significant determinants of household food security were technological adoption, farm size, land quality, household size, per capita aggregate production and access to market.

2.5.2 The Rasch Model

The Rasch model (Rasch, 1960), sometimes referred to as the one parameter logistic model (1PL), assumes the log-odds (logit) of the item response function is a linear function of θ and that the slopes of these linear functions are equal across all items.

$$\Psi_j(\theta) = \text{logit} \{P_j(\theta)\} = \alpha(\theta - \beta_j)$$

$$P_j(\theta) = \frac{1}{1 + \exp\{\alpha(\beta_j - \theta)\}}$$

Where θ = individual propensity, β_j = Difficulty of the item j, P = itemcategory response function

The intercepts ($-\alpha\beta_j$) are parameterized with a negative sign so that the parameters β_j can be interpreted as the difficulty of the item; items with large values of β_j have lower proportions of individuals endorsing them. Mokken

(1971) refers to models like the Rasch model as double monotonicity models.

A proponent of the Rasch model claims that any method of measurement should be specifically objective and the Rasch model is the only Item Response Theory (IRT) model that has this property (Johnson, 2004).

The Rasch model is restrictive because it does not allow for differences in the response loadings. This restriction greatly simplifies the computation of the model; however, it effectively sets the amount of item-specific variation to be equal across outcomes (Ribar, 2006).

2.5.3 Item Response Theory (IRT) Models

Item response theory (IRT) models are a class of statistical models used by researchers to describe the response behaviours of individuals to a set or categorically scored items. Although IRT models appear most often in the educational testing literature, researchers in other fields have successfully utilized IRT-like models in a wide variety of applications (Johnson, 2004).

The models typically rely on the following assumptions:

- Unidimensionality: There is a one-dimensional, unknown quantity associated with each respondent in the sample that describes the individual's propensity to endorse the items in the survey (or exam). Let θ_i denote the propensity of individual i.

- Conditional Independence: Given an individual's propensity θ, the elements of the item response vector for respondent i, $X_i = (X_{il}, ...X_{ij})^t$, are independent.

- Monotonicity: $\text{Pr}\{X_{ij} > t | \theta_i\}$ is a non-decreasing function of an individual's propensity θ_i, for all j and all t. Respondents with high propensities are more likely to endorse items than those with lowpropensities.

Typically a link function is assumed that relates the propensities of the survey respondents and properties of the items to the item response function $P_j(\theta)$, or item-category response functions $P_{jm}(\theta)$. The most common link functions utilized in IRT are the probit link function (i.e. the inverse of the normal cumulative distribution function) and the logistic link function:

$$\Psi_j(\theta) = \log\left\{\frac{P_j(\theta)}{1 - P_j(\theta)}\right\}$$

In IRT, the manifest variables are typically categorical and ordered and may be dichotomous/binary (e.g., "wrong/right" or "affirmed/not affirmed") or polytomous (e.g., "never, sometimes, often"), as opposed to the continuous manifest variables of factor analysis or the unordered nominal manifest variables of latent class analysis (National Research Council, 2006).

2.5.4 Non-parametric IRT Models

Many researchers have suggested using the total score as the independent variables in a non-parametric logistic regression as a way to examine the shape of the unknown response function $P_j(\theta)$. Ramsay (1991), for example, uses Kernel regression as a way to estimate $P_j(\theta)$. Although Douglas (1997) shows that this method consistently estimates both the shape of the item response function and the rank order of examinees, the method does not work well for small data sets (Johnson, 2004).

2.5.5 Two Parameter Logistic Model

Birnbaum (1968) introduces a model called the two-parameter logistic (2PL) model which generalizes the Rasch model by allowing the slopes to vary.

Specifically the 2PL assumes the following

$$\text{logit}\,\{P_j(\theta)\} = \alpha_j(\theta - \beta_j)$$

$$P_j(\theta) = \frac{1}{1 + \exp\{\alpha_j(\beta_j - \theta)\}}$$

The slope parameter, sometimes called the discrimination of the item, is a measure of how much information an item provides about the latent variable θ. As $\alpha \longrightarrow \infty$ the item response function approaches a step function with a jump at β_j; such item response functions are sometimes referred to as Guttman items (Guttman, 1950; cited in Johnson, 2004).

The 2PL model is not specifically objective in the sense of Rasch (1960). Namely, the differences between the logits of the response functions do not yield independent comparisons of individuals' propensities under the 2PL model. The comparison between two individuals depends on the item used for comparison through the discrimination parameter. However, if the discriminations are known then the comparison is independent of the item used to compare the two individuals.

2.5.6 Item Response Models for Polytomous Data

A number of questions on the food security survey are scored on a polytomous scale. However, in analysis the polytomous responses are collapsed to form dichotomous items. Although the collapsing of categories does not violate any of the core

assumptions of IRT (unidimensionality, monotonicity, conditional independence), it does throw away information that could prove valuable for the classification of individuals as food insecure and/or food insecure with hunger. The polytomous item is far superior in the amount of information it provides about the underlying propensityθ.

2.6 Choice and Validity of the IRT as a Measure of Food Security for the Study

The question of validity of the IRT propensity as a measure of food security and/or hunger really comes down to whether or not the latent construct measured by the items is associated with true food-security and/or hunger.

Clearly if true food-security is unrelated to the construct measured by these 10 (or 18) food-security items, then it really does not matter how well the item responses and the construct they measure adhere to any specific IRT model (Johnson, 2004).

The only way to be sure that the results from an IRT analysis of the food security items are an appropriate way to measure food-security is to perform some sort of validity study. A validity study for the food-security programme would likely be a difficult task. One such validity study might require monitoring a number of individuals over a twelve month period to determine if they were actually food secure, food insecure, or hungry (because they could not afford enough food) at some point during that twelve month period.

After that twelve month period the individuals in the validity sample would complete the food-security questionnaire. And finally, an analysis would be performed to determine what, if any, relationship exists between the propensity measured by the survey items and the true food security status of the individuals in the validity study.

Gulliford et al. (2004) tested the reliability and validity of the household food security scale and reported that it gives reliable and valid responses. They further stated that differing relative item thresholds compared with US data did not require alteration to the cut-points for classification of 'food insecurity without hunger or food insecurity with hunger. Alvarez et al.

(2006) carried out a study in 44 municipalities in the department of Antioquia, Colombia in 2003 and 2004, and reported that the scale can be considered a reliable instrument for assessing food insecurity in households.

Perez-Escamilla et al. (2004) also adapted and replicated the IRT in 2 independent survey samples. Their results indicated that the adapted version of the USDA food insecurity module is valid for the population of Campinas. This validation methodology has also been replicated in urban and/or rural areas of four additional states by the same authors and they arrived at similar results. More so, Gulliford et al. (2006) conducted item calibrations and subject scores from a one-parameter logistic model compared with those from either two-parameter logistic model or a model for differential item functioning and supported the use of the 18 household food security survey items to classify food security status of adults or children in any Englishspeaking country where food insecurity and hunger are even more frequent than in the United State of America. Item response models can be utilized to set out scores on the latent propensity scale, no matter which IRT model is utilized. Item response theory models are designed for the analysis of multiple discrete item responses, which is exactly what the food security survey contains (Johnson, 2004).

It is evident that, of these different types of variable models, IRT models are particularly appropriate for modelling the measurement of food insecurity using survey data. The

manifest variables or indicators of food insecurity in the food security survey are all either binary or polytomous and ordered. In addition, food insecurity may be viewed as an underlying continuous, unidimensional, but not directly observable quantity that varies from household to household. Higher values of food insecurity are indicated by higher probabilities of endorsing or affirming survey items that indicate higher degrees of not being able to obtain sufficient food due to a lack of economic resources (National Research Council, 2006). Based on the above assertions, the IRT model was used for this study.

CHAPTER THREE

METHODOLOGY

3.0   General Overview

The purpose of this chapter is to give a description of the study area and present the sources and methods used to collect the data for the study as well as the tools used in analyzing the data collected.

This part of the study is divided into three main parts. The first part gives the description of the physical, social and economic background of the study area. It also takes into consideration the land size and the topography, climatic conditions, geology and soils as well as the population. The second part focuses on the sources of data with brief explanation of sampling procedures and the data collection techniques employed while the third part concerns with the statistical, economic and the econometrical tools employed in the analysis of the data to achieve the set objectives of the study. This part also expands on the economic models being considered and finally provides a model

that can be used to estimate the food security function of the vegetable growers in the study area.

3.1 The Background of the Study Area

3.1.1 Location and Biographical Characteristics

Tano South District is one of the 22 Districts in the Brong Ahafo Region of Ghana. It lies between latitudes 7º00'N and 7º25' N and between longitudes 1º45 W and 2º15 W. It is bounded on the North and East by the Offinso and Ahafo-Ano South Districts, both in the Ashanti Region. On the South, it is bounded by the Ahafo-Ano North District, also in the Ashanti Region and on its West and South-West by Tano North District Assembly

The District has a total land area of 1,500 square kilometres, which is 3.8 percent of the total land area of the Brong Ahafo Region. The District Strategic Location as the entry point into Brong Ahafo Region from southern Ghana puts it in a unique position to attract tourists if that sector could be well developed. (*Source: Tano-South District Assembly, 2011*)
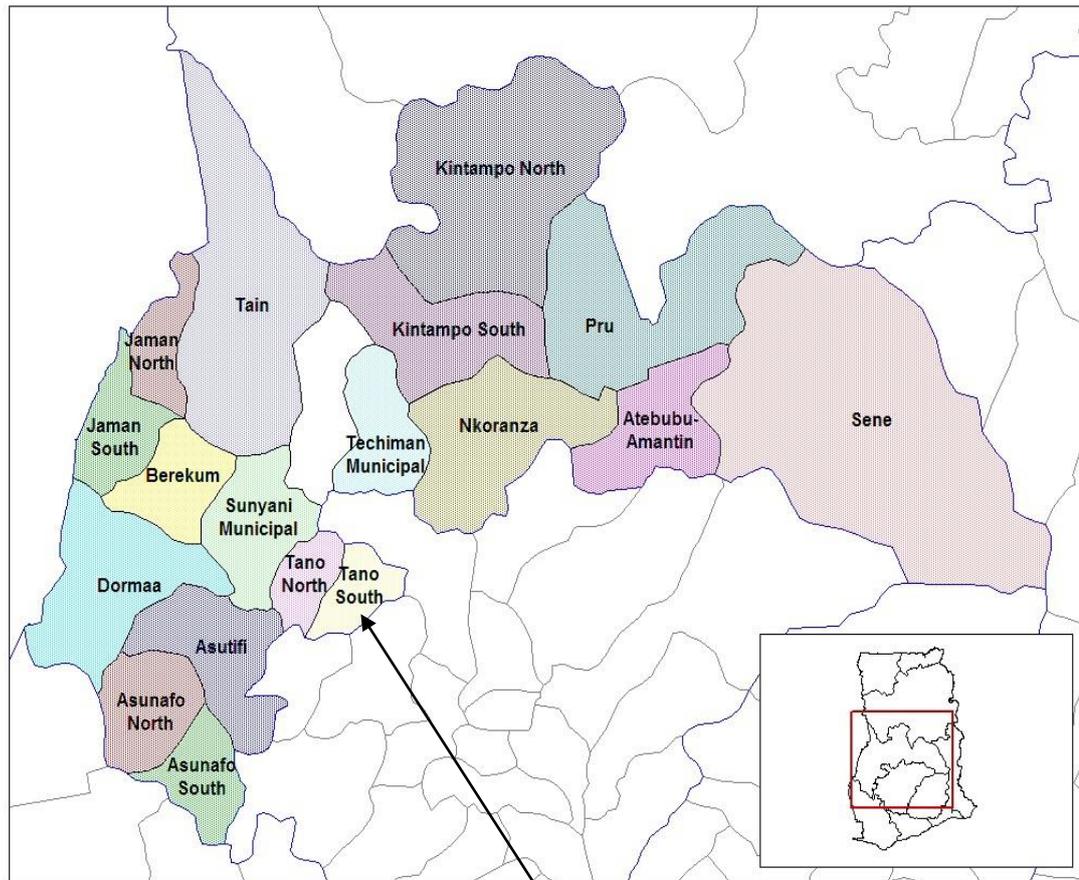
Figure 3.1: The map of Brong-Ahafo showing the study area

Sources: http://www.ghanadistrict.com

Being located in the moist semi-deciduous forest zone, the soils in the District basically consist of forest ochrosols and the rubrisol-ochrosols intergrades. They are alkaline and are more richly supplied with nutrients. They are more clayey and therefore have greater capacity to maintain water for plant use. They are therefore very ideal for the cultivation of forest crops like cocoa, coffee, oil palm and other crops like vegetables, plantain, maize, rice, cassava, beans and among others.

In addition to the vast fertile land which is suitable for the cultivation of a wide variety of cash and food crops, Tano South District has a fairly large expanse of forests with species such as Odum, Mahogany, Ceiba, Cassia and 'Akasaa' which can be explored for timber. *(Source: Tano-South District MoFA, 2011)*

The topography of the District is mostly made up of undulating land which rises gently from a height of about 270m to a peak of about 760m. The area to the East and South-East is bounded by the Ankaase-Techimantia-Bechem road and is fairly high rising between 360m and 760m in the Kwamisa area. River Subri, a tributary of Tano River, flows through Subriso No. 3 and Techimantia. The other important rivers in the district are Atobiaso in Derma, Moku in Techimantia and Dwomo, Kwasu in Bechem and Dwofo which is a tributary of Kwasu River is also in Bechem. The land is well drained and free from flooding. It is also ideal for vegetable and food crop farming.

The District lies in the Semi-equatorial climatic zone which experiences double maximum rainfall pattern. The first rainfall season is from April to June, with the heaviest in June and the second period is from September to October. The mean annual rainfall is between 1250 mm and 1800mm. The dry season is quite pronounced and occurs between the months of November and March each year. The mean monthly temperature ranges between 26ºC (in August) and 30ºC (in March).

Relative humidity is generally high, ranging between 75-80 percent in the Rainy season and 70-72 percent in the dry season.

The District lies in the moist semi-deciduous forest zone and has gross forest area of 1,322.52sqkm with about 157.45sqkm of this under forest reserve. However, there is a vast emergence of guinea savanna and this is found in areas like Techimantia and Subriso No. 3 where cattle rearing are predominant.

There are two main forest reserves namely; the Bosomkese Forest Reserve which covers a total area of 138.41sq km and Apaape Forest Reserve which also covers an area of about 19.04sqkm. In these reserves, one can find different tree species such as Odum,

Mahogany, Ceiba, Cassia and 'Akasaa'. These trees are of economic importance as they are used for lumbering, carving, chewing sticks, fuel wood and medicine. (*Source: Tano-South District Forestry Commission, 2011*)

3.1.2 Demographic and Socio-economic characteristics

The recorded population censuses of 1960, 1970 and 1984 of Tano District were 44692, 57662 and 92553 respectively. The population of Tano District from 2000 Census is 123,404, accounting for 6.8 per cent of the Region's total population. For the immediate preceding census, population increase was 33.3 per cent (1984 – 2000) and represents and inter-censal growth rate of 1.8 per cent which is lower, compared to both the Region's 2.5 per cent and the National 2.7 per cent.

The increase in population during this period may be due to improved road network which paves way for commercial activities especially the District Capital, Bechem. Also the thriving tomato farming activities at Techimantia and Derma areas and other food crops attracted farmers to the District especially due to a decline in the cocoa industry in the 1970s, farmers were turning to the production of food crops. Improved health delivery system is also a contributory factor to the increase in population.

Tano South District which is carved from Tano District recently has a population of 78,129 with growth rate of 1.8 percent according to 2010 population census (GSS, 2012).

In line with national standards, rural/urban classification of localities is population based on a population size of 5000 or more being urban and less than 5000 being rural. With this definition, only three (3) localities out of the lot are urban in the District. This shows predominance of rural localities in the District.The urban localities are Bechem

(15,591), Techimantia (15,261), and Derma (9,236). Someother relatively large settlements in the District are Dwomo (4,108), New Brosankro (3,019), Breme (2,579), Mansin (1,922) and Ankaase (1,742).

With respect to population distribution in the district, the high density areas are at Bechem, and Techimantia. This is due to the fact that people would want to enjoy higher and better social services and facilities associated with these areas. Other concentrations of population are Dwomo and Derma which are mainly due to the major farming activities taking place in these areas, apart from the provision of essential services.

Farming activities and accessibility also account for the relative population concentrations at Techimantia, Derma and Dwomo. The remaining population are nearly evenly distributed over the district. (GSS, 2012).

The population density for the district has been increasing over the years. The 1960 population density of 29.8 persons per square kilometre increased to 38.4 persons per square kilometre in 1970, 61.7 persons per square kilometre in 1984, and 82.2 persons per square kilometres in 2000.Compared to the regional population density figures of 15 persons per square kilometre in 1960, 19 persons per square kilometre in 1970, 30 persons per square kilometre in 1984 and 45.9 persons per square kilometre in 2000.

The district figures have been quite high when compared to the national and regional figures. The recent population density of the district from 2010 population census is 52.1 persons per square kilometre.

With the urban drift, labour is increasingly becoming difficult to come by especially during the major cropping season (April – July). At this point, demand becomes higher

for labour thereby pushing the price for weeding, harvesting and carting on the higher side. Casual labour 'By-day' in various parts of the District ranges from GH¢8.0 – GH¢12.0 (2012). Young school leavers and immigrants from the Northern regions of the country (tenant farmers) are usually the major source of labour.(GSS, 2012).

About 64% of the labour force is engaged in Agriculture depicting the fact that the major economic activity is predominantly farming. This is followed by commerce (16%), service (14%) and industry (6%) in that order. The proportion of labour force in agriculture has been declining over the years with increasing prominence of commerce and services.

Commercial activities in the District have increased with the establishment of major market centres at Bechem, Techimantia, and Derma. They all have both daily and weekly market days. Other factors such as improved road network, communication and financial institutions have also boosted commerce in the District.

The resource base of the district has facilitated the establishment of small scale industries like table sawmills (Bechem), wood carving (Techimantia and New Brosankro), weaving (Derma) and palm oil extraction (Mansin). (*Source: Tano-South District Assembly, 2011*).

3.2   Research Design and Methods of Data Collection

3.2.1   Research Design

This study used a descriptive survey design to assess the food security status and the coping strategies employed during food insecurity situations.

It involves collecting data through questionnaires and personal observation. In addition, the researcher used information through conversations with some of the key stakeholders in the agricultural sector in the district. The descriptive survey is concerned with relationships that exist, the direction of relationships, opinions that are held, and processes that are going on, effects that are evident or trends that are developing amongst the variables.

3.2.2 Target Population and Sampling Methods

The study targeted all vegetable-farming households in the study area. These include both men and women who farm on both full-time and part-time basis.

Multi-stage sampling procedures were used in deriving the sample for the study. Thus, a combination of simple random sampling and purposive sampling procedures were used. The sample that was drawn from the farmers' population was selected using simple random sampling. Here, a farmers name would be picked at random from the list of vegetable farmers in the study area. By random sampling, selecting individuals for observation is true representative of the population, and enabled the researcher to make some generalization at the end of the study, and it is also reliable (Best and Kahn, 1995).

Purposive sampling was used to select five vegetable growing communities based on their production levels and the vegetable farmers who were heads of households. Thus if a vegetable farmer is chosen at random but he/she is not the head of his or her household then that farmer would not be interviewed. This was to help the researcher to get first-hand information on the households since the heads of households are the

best household members who can give adequate report on the level of household food security, coping strategies and other relevant information needed for this study.

3.2.3 Sample Size and Data Collection

One major decision in the conduct of any research is for the researcher to decide on the size of the sample that will be representative of the population. In the view of Nwana (1992), certain definitive practices among social researchers can be adopted. One such a practice has to do with the relationship between population of a study and the sample that will be representative enough. Most researchers have also agreed that larger sample sizes are better than smaller sample size. However, majority of these researchers agree that the above assertion holds only when the sample is randomly chosen.

According to Best and Kahn (1995), there is no fixed number or percentage of subjects that determines the size of an adequate sample and argued that sample size may depend on the nature of the population, the data to be gathered, the type of analysis to be done and the funds available for the study. Nwana (1992) suggested that if the population is a few hundreds, a 40 percent or more sample size can be representative enough; if many hundreds, 20 percent sample will do; if the population is a few thousands, a 10 percent sample is recommended and if the population is several thousands, five percent or less will do. What can be deduced from Nwana's assertion is that for populations which have smaller sizes, higher percentage of the population should be used as the sample size; and for larger populations, smaller percentage of the populations should be used as the sample sizes.

Other people who write on how representative a sample size of any population looked at it in terms of the type of research. Fraenkel and Wallen (2000) suggested that for a

descriptive study (such as this), a sample with a minimum number of 100 elements is essential for correlational studies, a sample of at least 50 will be necessary to establish the existence of relationships, and for experimental and causal comparative studies, they recommended a minimum of 30 elements. Stevens (1996) recommended that for social science research, about 15 subjects or cases per predictor are needed for a reliable equation in regression analysis.

Considering all these assertions, a total of 230 heads of vegetable farming households were randomly selected from the district. For a descriptive study such as this where the population is about 1200 the use of sample size of 230 is therefore justified in view of the above observations.

From the preliminary survey that was previously conducted to pre-test the interview schedule, the researcher developed content validated interview schedule for the main research. The real data for the study was based on a survey of vegetable producers in the Tano South District. Five (5) field assistants, who were recruited and trained, assisted in the administration of the interview schedule. Two hundred and thirty subjects in the target group completed the schedule. The data was collected within a period of two months; September to October 2011.

3.3   Data Management, Processing and Analyses

In order to understand the parts and relationship, and to discover trends, the data were critically examined and cleaned to check for data errors. All the data were read thorough thoroughly in order to determine whether the responses obtained from the respondents are worthwhile and whether the questions have been answered properly. The responses

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were also carefully checked to determine how far they are with accuracy, consistency and appropriateness.

The answers to the questions in the interview schedule were numerically coded using the coding frame/scheme to facilitate easy in-putting and analyses. The codes were then transferred into computer software: Statistical Package for Social Sciences (SPSS) Version 12.0 and Excel depending on the type of analyses.

3.3.1   Methods of Data Analysis Used

Essentially, the study is socio-economic based on regression and descriptive research. It therefore made use of several statistical tools that were deemed necessary for the achievement of the set objectives of the study. Frequencies, means, percentages, modes, sums and standard deviations are simple statistical tools used to describe the data. Poate and Daplyn (1993) considered them as part of the first step in an analysis to explore data for distribution of responses. Frequency distributions and descriptive statistics were used to identify the spread of observations and to help spot outlying values and distinctive patterns of response.

3.3.2   Food Security Status Analysis

The food security classification of each household was measured using the 18-item household food security questionnaire approach adapted from Bickel et al. (2000) and Johnson (2004). This instrument has been shown to be a valid and reliable measure of food security status (Frongillo, 1999; Gulliford et al, 2004; Perez-Escamilla et al, 2004; Alvarez et al, 2006). The results of this instrument provided scores representing the food security status of the households. Using responses from the questionnaire, a food security scale score, ranging from 0.0 to 9.3 is calculated.

The food security scale score is then used to determine the household's food security category (Table 3.1). The food security status indicates whether the household is food secure, food insecure without hunger, food insecure with hunger (moderate or severe).

Households were therefore classified as food secured if they reported less than three food-insecure conditions and food insecure if they responded affirmative to three or more of the food security items. The food insecurity situation has further been classified into food insecure without hunger and food insecure with hunger depending on the household characteristic of having a child or not, the number of affirmative response to the food security items, and the type of items that the affirmative responses are made (Johnson, 2004).

Households without children were classified as food insecure without hunger if they reported three (3) to five (5) food-insecure conditions; whiles households with children were classified as food insecure without hunger if they reported three (3) to eight (8) food-insecure conditions, including conditions among both adults and children.

Table 3.1: Food Security Scale Values and Status Levels Corresponding to Number of Affirmative Responses

Number of "yes" responses		1998 Scale Value		Food Security Status Category
Household with child	Household with child no	Standard Computational Metric	Standard 0 – 10 Metric	
0	0	0.0*	0.0*	
1		1.4	1.0	
	1	1.7	1.2	Food secure
2		2.6	1.8	
	2	3.1	2.2	

3		3.4	2.4	
4		4.1	3.0	
	3	4.2	3.0	
5		4.8	3.4	Food insecure without hunger
	4	5.2	3.7	
6		5.4	3.9	
7		6.0	4.3	
	5	6.0	4.4	
8		6.6	4.7	
	6	7.1	5.0	
9		7.2	5.1	Food insecure with hunger, moderate
10		7.7	5.5	
	7	8.0	5.7	
11		8.3	5.9	
12		8.8	6.3	
	8	9.0	6.4	
13		9.3	6.6	
14		9.8	7.0	
	9	10.1	7.2	Food insecure with hunger, severe
15		10.4	7.4	
	10	11.1*	7.9*	
16		11.1	8.0	
17		12.2	8.7	
18		13.0*	9.3	

Source: *U.S. Census Bureau data from the Food Security.(Bickel et al., 2000).*

Also, households without children were classified as food insecure with hunger if they reported six or more food-insecure conditions; whiles households with children were classified as food insecure with hunger if they reported eight or more food-insecure conditions, including conditions among both adults and children. Households with children were further classified as food insecure with hunger among children if they reported five or more food-insecure conditions among the children (that is, in response to the last 8 items) (Johnson, 2004).

Thus; households classified as food insecure without hunger have reported multiple indications of food access problems, but typically have reported few, if any, indications of reduced food intake. All households classified as food insecure with hunger have

reported multiple indications of reduced food intake and disrupted eating patterns due to inadequate resources for food, although not all have directly reported that household members were hungry. This was followed based on the report by Nord *et al*. (2005), that in most households, children were protected from substantial reductions in food intake and ensuing hunger. However, in severe cases of food insecurity', one or more children in each household will also experience hunger on one or more days during the year because the household lacked money for enough food. In some of these households with more than one child, not all the children experienced hunger. Younger children, in particular, may have been protected from hunger (Nord *et al*. 2005).

3.4   Conceptual Framework for Household Food Security

Food security has been defined as a situation when all people, at all times, have physical and economic access to sufficient, save and nutritious food needed to maintain a healthy and active life (FAO, 1996). This definition implies that food security is a broad concept that is more than food production and food accessibility. In reality it revolves round four pillars namely, food availability, food accessibility, nutritional factors and stability of food supply (Gross *et al.,* 1999).The implication of this definition is that, achieving food security requires that the aggregate availability of physical supplies of food is sufficient, that households have access to those food supplies through their own production, through the markets (given sufficient purchasing power) or through other sources, and that the utilization of those food supplies is appropriate to meet the specific dietary needs of individuals households or individuals in the households. Figure 3.2shows the framework of food and nutrition security. Food accessibility is ensured when all households and all individuals within those households have sufficient

resources to obtain appropriate foods for a nutritious diet. It is dependent on the level

of household's resources-capital, labour and knowledge and prices.
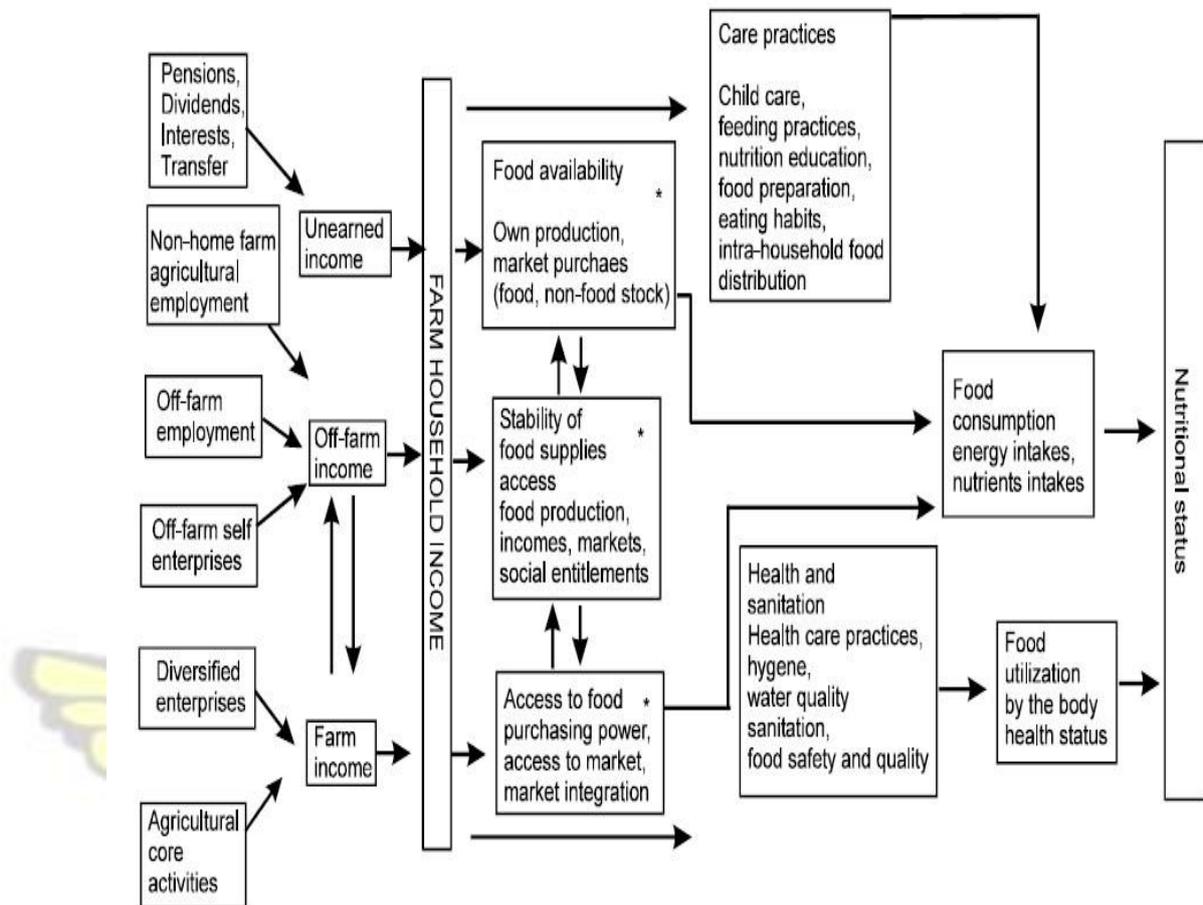
Figure 3.2: Conceptual Framework for Household Food security

SOURCE: Cambodia Food Security. December, 2010

3.5   Theoretical Models for Data Analysis

The main objective of the study is to determine the socio-economic factors influencing

smallholder vegetable farmer's household food security using a logistic regression

model. This model was fitted with twenty variables that help explain food security, of

which they were expected to give significant signs after data analysis. The logistic

regression was chosen for this study because of the nature of the response variable

which is dichotomous (Der and Everitt, 2002).

Regression analysis helps in determining the pattern of relationship between one or more of independent variables and the dependent variables (Manga, 2001).

The focus of the statistical analysis was to establish the set of predictor (independent) variables that best explained the variation in food security levels and returns from production based on the regression models specified below.

To study which variables were best predictors of household food security status (testing the hypothesis: the socio-economic characteristics of farmers have no influence on the food security levels of the farm households), a logistic regression equation was constructed with food security as the dependent variable. Using logistic regression analysis, odds ratios were determined for variables that were included in the model. The full model used in the multiple logistic regression included food security as the dependent variable and the independent variables were selected from the variables which were found to be significant at a = 0.05 in the Pearson's Correlation Matrix .

The following model was used in this study to determine factors affecting household food security (Hesketh and Everitt, 2000):

$$
\pi_i = E(Y_i) = \frac{1}{1 + e^{-(\beta_0 + \sum_j \beta_j X_{ij})}}
$$ -------- (1)

π_i Stands for the probability of household (*i*) being food secure and Y_i is the observed food security status of the household *i*, X_{ij} are the factors determining the food security status for household *i* and β_j stands for parameters to be estimated.

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Denoting $\sum_{j=1}^{k} \beta_n X_{ij}$ as Z, equation (1) can be written to give the probability of food security of household i as:

$$P_i = E\left(Y\right) = \pi_i = \frac{1}{1+e^{-z_i}} = \frac{1}{1+e^{-z_i}} \qquad ----------- \quad (2)$$

From equation 2, the probability of a household being food insecure is given by

$\left(1-\pi_i\right)$ which gives equation 3, which can be written as

$$1-\pi_i = \frac{1}{1+e^{z_i}} \qquad ----------- \quad (3)$$

Therefore the odds ratio, i.e., $\pi_i / \left(1-\pi_i\right)$ is given by equation 4 as

$$\frac{\pi_i}{1-\pi_i} = \frac{1+e^{z_i}}{1+e^{-z_i}} = e^{z_i} \qquad ------- \quad (4)$$

The natural logarithm of equation 4 gives rise to equation 5

$$\ln\left(\frac{\pi_i}{1-\pi_i}\right) = z_i = \sum_{k=n j=1}^{} \beta X_{ij} + \mu_i \qquad -------- \quad (5)$$

Rearranging equation 5, with the dependent variable (food security) in log odds, the logistic regression can be manipulated to calculate conditional probabilities as

$$\pi_i = \cfrac{\left[\dfrac{}{\displaystyle\sum \alpha_o} \right]_j}{\displaystyle\sum_{ij} e^{\alpha_{j=1}}}$$

$$\pi_i = \cfrac{\displaystyle\sum_j \alpha}{\displaystyle 1 + \sum_{ij} e^{\alpha_{j=1}}} \qquad \text{--------} \qquad (6)$$

Once the conditional probabilities have been calculated for each sample household, the "partial" effects of the continuous individual variables on household food security can be calculated by the expression

$$\frac{\partial \pi_i}{\partial \alpha_{ij}} = \pi_i \left[\alpha_i - (1 - \pi_i)\right] \alpha_j \qquad \text{--------} \qquad (7)$$

The "partial" effects of the discrete variables are calculated by taking the difference of the probabilities estimated when value of the variable is set to 1 and 0 $(\alpha_i = 0, \alpha_i = 1)$, respectively.

3.5.1 Empirical specification

The model is summarised as $\quad Log_e \left[\dfrac{1}{FSFS}\right] = Z_1 = \alpha_0 + \alpha_i \alpha_i + e$

For i, j =1, 2, 3,..., 20

Where;

Z_1 is the household food security status: β_0 is the constant, β_i is the regression coefficient of χ_i, which represents the independent variables (χ_1 to χ_{20}); and e is the error term.

The full model is stated as shown below:

$$Z_1 = \beta_0 + \beta_1 Gend + \beta_2 \text{Age} + \beta_3 M.stus + \beta_4 N.adult + \beta_5 N.child + \beta_6 Educ +$$

$$\beta_7 Exp + \beta_8 \text{Offarm} + \beta_9 L.Own + \beta_{10} L.size + \beta_{11} Fert + \beta_{12} A.agent +$$

$$\beta_{13} Labor + \beta_{14} \text{N.veg} + \beta_{15} Oth.crops + \beta_{16} A.funds + \beta_{17} F.gate +$$

$$\beta_{18} Assets + \beta_{19} Percept + \beta_{20} \quad \text{Veg.income} + \varepsilon$$

Table 3.2 Description of the Regression Model Variables

Variables	Variable Description	A priori E.
Z_1	Household food security status	
Gend	Gender of household head(1-male, 0-female)	+
Age	Age of respondents in years	+/-
M.stus	Marital status (Dummy; l if married, 0 otherwise)	+
N.adults	Number of adults in the household	+
N.child	Number of children in the households (Continuous variable)	-
Educ.	Number of years spent in the formal education	+
Exp.	Experience in vegetable production (in years)	+
Offarm	Off-farm income(1 if engaged in off-farm activity, 0 otherwise)	+
L.own	Land Ownership(1 if owned land, 0 otherwise)	+
L.size	Land size (continuous variable)	+
Fert	Fertilizer use (1-if fertilizer is used, 0 otherwise)	+
A.agent	1 if get access to change agents, 0 otherwise	+
Labor	Access to Labour(1 if labour is readily available, 0 otherwise)	+
N.veg	Number of different vegetables produced	+
Oth.crop	1 if cultivates other crops, 0 otherwise	+
A.funds	Access to Finance(1 if get access to credit , 0 otherwise)	+
F.gate	1 if sold at the farm gate, 0 otherwise	-
Assets	Wealth (1 if owned livestock, 0 otherwise)	+
Percept	Benefit perception index of vegetable production	+
Vg.income	Income from vegetables (in percentage of household income)	+
ε	Error term	

β_0	Constant	
$\beta_1 - \beta_{20}$	Unknown parameter	

3.5.2 Variables of the Study

This study looked at level of food security of the vegetable farming households as dependent variable. Much of the literature on food security focuses on developing and testing determinants of food insecurity at the household level (Maxwell, 1996). In line with the literature this study also investigates factors determining food security.

Twenty explanatory variables measured as continuous and discrete variables were identified to be major determinants of food security in this study. These variables were included in this model as they have been used in other studies to determine household food security. Feleke *et al* (2005) and Kidane *et al* (2005) adopted the same logistic regression model in their studies. These variables include gender of household head, age of household head, household size, education level of household head, technology adoption, farm size, land quality, per capita aggregate production, cattle ownership, wealth, off-farm work, physical access to markets and physical access to irrigation. These factors are a *priori* and are expected to have a positive or negative impact on food security.

The determinants of food security were carefully selected from the three facets within the framework of the general definition of food security mentioned above, as food availability, food access, and utilization. For example, food availability may be constrained by inappropriate agricultural knowledge, technology, policies, inadequate agricultural inputs, and family size. On the other hand, access to food and its utilization

could be constrained by economic growth, lack of job opportunities, and lack of credit, inadequate training, and inadequate knowledge (Hoddinott, 1999, cited in Haile *et al.*, 2005).

Gender of household head looks at the role played by the individuals in providing households' needs including acquisition of food. Household head can therefore be male or female. Therefore, gender of household head was coded as: 1 for males and 0 for females. Female headed households have higher dependency ratios which hinders household capacity to allocate labour to on-farm or other income-generating activities. Also female headed household tend to be older and have fewer years of education than male heads of household (FAO, 2012). The expected effect of this variable is positive.

Household size is one of the factors expected to have influence on food security status of households. The majority of farm households in the study area are small-scale semi-subsistence producers with limited participation in non-agricultural activities. Because land and finance to purchase agricultural inputs are very limited, increasing family size, according to the literature tends to exert more pressure on consumption than the labour it contributes to production. Thus a negative correlation between household size and food security is expected (Paddy, 2003) as food requirements increase in relation to the number of persons in a household. Amaza *et al.* (2006) also found households with large sizes to have higher possibility of being food insecure than those with smaller sizes. Household size is a continuous variable. It is measured in this study by the number of individuals who eat from the same pot under the care of the respondent household head in a household. The household size, measuring the number of members to feed, is an important determinant of its well-being and earning power.

Characteristics of the family members of a household are also important. Family size can also constitute a liability with regard to food consumption, and its composition has an impact. The presence of children in the family creates other demands in addition to food, making a household more vulnerable to food insecurity but less qualified in terms of earning capacity and heavy work. Amaza et al. (2006) reported that the larger the number of less active adults (e.g. old or unemployed) and children's, the higher the burden on the active members in meeting the cost of minimum household nutrition would be and, hence, the higher the level of food insecurity, and vice versa.

Fertilizer use is used by most studies as a proxy for technology Haile et al., (2005). According to the literature, subsistence farming, by its nature, is production for direct consumption. Any farm input that augments agricultural productivity is expected to boost the overall production. This contributes towards attaining household food security (Brown, 2004). Studies by Rutsch (2003) and Smith and Huang (2000) on "Role of fertilizer in agricultural productivity" found that fertilization of farmland can boost agricultural production and influence the food security status of a household. Fertilizer use was measured on the basis of whether or not a household uses fertilizer thus a dummy variable was used. A household that does not apply fertilizer took a value zero and a household that applies fertilizer took a value of one.

Education is an additional factor which is thought to influence the food security status of households. Educational attainment by the household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on fertilizer packs and diversification of household incomes which, in turn, would enhance households' food supply (Najafi, 2003). From their study, Amaza et al. (2006) suggested that the higher the educational level of the

household head, the more food secure the household and vice versa. This is expected because such households are assumed to have better food management techniques that will ensure equitable and all round supply of food. Educational attainment of a household head is considered by this study to be a qualitative variable. Educational attainment was therefore rated in ordinal variable with the households led by highest educated heads taking the highest value.

Farmland size is a continuous variable. This study expected farmland size to affect food security status of households positively. According to Najafi (2003), food production can be increased extensively through expansion or areas under cultivation. Therefore, under subsistence agriculture, holding size is expected to play a significant role in influencing farm households' food security. Amaza et al., (2006) showed in their study that households with larger farm sizes are more food secure than those with smaller sizes. The sample households cultivate fragmented plots with different sizes and fertility levels. Plot sizes are available in local units of measurement (acreage).

Land quality measures farmers' perception of the fertility of their farmland. Households were asked to indicate whether they consider their land fertile or not fertile, based on the number of times they apply fertilizer to their crop. Under optimal management, better land quality boosts crop production (Sah, 2002b). Stephen (2000) found that a decline in soil fertility negatively affects food security. It is expected that this study will find that land quality affects food security status or households positively.

Hofferth (2003), in his study, argues that the higher the age of the household head, the more stable the economy of the farm household, because older people have also relatively richer experiences of the social and physical environments as well as greater experience of farming activities. Moreover, older household heads are expected to have

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better access to land than younger heads, because younger men either have to wait for a land distribution, or have to share land with their families. A similar study by Obamiro *et al.* (2003) arrived at a similar conclusion regarding the relationship between age of a household head and household food security. Age of household head was measured in years.

Availability of a relatively larger labour force, regardless of farm size, can be an advantage to those households who strive to achieve food security, provided that the excess labour force is engaged in other income generating activities (Haile *et al.,* 2005). Chen (1991) also reported that labour availability is an important determinant of household productivity and food security, especially in subsistence-oriented households given the necessary landholding and rainfall. It is thus expected by this study that labour availability will affect food security positively.

FAO (1999) reports that employment in off-farm and non-farm activities are essential for diversification of the sources of farm households' livelihoods; it enables households to modernize their production by giving them an opportunity to apply the necessary inputs, and reduces the risk of food shortage during periods of unexpected crop failures through food purchases. Especially in Africa, diversification of sources of income has long been a survival strategy which allows household heads to reduce the risk of starvation for themselves and their families during periods of chronic or transitory food insecurity (Devereux 1993, cited in Haile *et al.,* 2005). In this study participation in off - farm and non-farm activities was measured by whether or not a household was engaged in those activities. A dummy variable was used. A household who engaged in off-farm and non-farm activities took a value of one and households who did not engage in those activities took a value of zero.

Agricultural extension agents are a critically important source of information for farmers, given that farmers generally have lower levels of education. Access to change agents enhances the chances of households having access to better crop production techniques, improved input as well as other production incentives and these go to affect their output vis-avis their food security status. Amaza et al. (2006) found a negative relationship between household's access to extension and the food insecurity status of households. This implies that households that had access to change agents have higher probability of being food secured than those that did not have access to change agent. In this study, access to change agents was measured by whether or not household had any kind of help be it information, training and inputs from any change agent in their farming activities. A dummy variable was used. A household who had access to any change agent in the area took a value of one and households who did not have access to change agent to a value of zero.

Wealth Status is another determinant of food security. The wealth status of the household is measured by the number of livestock owned, since livestock is the most important indicator of wealth in rural areas. A household level of farm resources e.g. livestock can be expected to affect its ability to withstand abrupt changes in production, prices, income or unforeseen events that create the need for additional expectations. Livestock provides not only food for the households but also a number of other products which could be sold or consumed by the household members to provide nutrition, income, traction and fuel. Products from livestock include draught power, meat, milk, eggs, manure which is used as fertilizer or fuel, fibre and hides.

When crop failure occurs because of rainfall shortage, the level of one's resources (livestock) is very important to combat food shortages (Kang'ara *et al*, 2001). The expected effect on food security is positive.

Access to market is measured by the amount of time (hours) required to reach the nearest local market. The longer it takes to get to the market, the less frequent the farmer visits the market and hence the less likely he/she to get market information. In this study, the distance to the market was used during the time the data was being collected. Using time would distort results as farmers were spending a lot of time reaching the marketing centre due to the poor nature of some roads. Also due to the perishable nature of vegetables, inadequate information about prices and market accessibility problems, most farmers may sell their produce at the farmer gate at relatively lower prices than when taken to the distant market. Expected effect of selling at farm gate is negative.

Sustainable Development Division of the Economic Commission for Africa posited that land tenure as one of the central factors determining food security. They also suggested that land is central in promoting rural livelihoods in Africa because access to land and security of tenure are the main means through- which food security can be realized because the livelihoods of over 70% of the population in Africa are mainly linked to land and natural resources exploitation (Sustainable Development Division of the Economic Commission for Africa, 2004). Given that land plays an important role in the livelihoods of the majority of Africans, food security and poverty reduction cannot be achieved unless issues of access to land, security of tenure and the capacity to use land productively and in a sustainable manner are addressed. Ownership of agricultural land for vegetable production is therefore considered in this study to be secured if the land is own land, family land or leased for a long period of time. A dummy variable was

therefore used where own land or family land took a value of one while cash rental or share cropping took the value zero.

Farming Experience refers to the number of years household head has engaged in farming. All things being equal, an experienced household head is expected to have more insight and ability to diversify his or her production to minimize risk of food shortage. Experienced farmer is also expected to have adequate knowledge in pest and disease management as well as good knowledge of weather. Research findings revealed a positive relationship between farming experience and food security status (e.g., Feleke *et al.,* 2003, Oluyole *et al.,* 2009). The expected effect of this variable on food security is, therefore, positive.

Financial services are recognized now as playing multiple roles in development so that improved access can have a far greater and more comprehensive impact on poor households. In addition to the virtuous production and investment cycle, financial services can smooth consumption and improve food security. Microfinance can contribute to poverty alleviation and food security through supplying loans, savings and other financial services that enhance investment, reduce the cost of self-insurance, and contribute to consumption smoothing (Meyer, 200 1).

Emphases on how financial services affect household food security, is found in a monograph from the International Food Policy Research Institute (Zeller et al., I997). The authors discuss three pathways or channels through which financial services affect food security. The first is through the familiar poverty-reducing path of improved income generation. The effects are expected to be two fold. First, there is the traditional argument that loans can temporarily enhance a household's productive human and physical capital. Second, savings and credit services can increase a household's risk-

bearing potential, leading to the adoption of more risky but potentially more profitable income-generating activities. The profitability and mix of productive activities may change, leading to increased income that contributes to the virtuous production and investment cycle.

In the second pathway, finance contributes to poverty reduction by decreasing the rural household's cost of self-insurance. Improved access to credit, savings, and insurance services can induce changes in household assets and liabilities. For example, the holding of "precautionary savings" in the form of non-remunerative physical assets, such as cash, jewellery, staple foods and livestock, may decline. The emergency sale of productive assets at low prices may decrease, and the storage of crops for later sale at higher prices may rise. The importance of more expensive informal financial services may decline. Reductions in the cost of stabilizing consumption will release resources to finance more consumption and investment.

The third pathway, consumption credit, represents the greatest divergence from the narrow production and investment-oriented view of finance. Households attempt to smooth consumption over time by adjusting their disposable income. In the event of adverse shocks, such as bad weather, accidents and illness, rural households use traditional consumption smoothing measures such as the emergency sale of assets, depletion of stocks and inventories, and grants and loans from family, relatives and the informal sector. Formal credit, savings and insurance services may help households' smooth consumption so they use fewer traditional methods, which are often inefficient and bind households into unproductive social relationships that discourage savings and wealth accumulation. A dummy variable was therefore used whereby a household who

had access to any form of financial services took a value of one and households who did not have access to financial service took a value of zero.

The logistic regression model was chosen as a method of analysis because it can estimate the probability of a certain event occurring and it accommodates a lot of variables (discrete and continuous) which can be ranked in a hierarchy to show which variables strongly affect the response variable. It also shows the association between the independent variables.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0   General Overview

This chapter covers the socio-demographic characteristics of the respondents, farmers'
perception on vegetable production, prevalence of food insecurity, coping mechanisms
of food insecurity and the determinant of food security status of respondents

4.1   Socio-Demographic Characteristics of the Respondents

4.1.1   Age

The age distribution of vegetable farmers was investigated in the study and presented
in Table 4.1. The findings brought to light that younger people are involved in vegetable
production than the elderly in the study area. The revelation is not surprising since
vegetable farming is a capital and labour intensive investment. The younger farmers
with their exuberant skills are expected to be more active than the elderly farmers. The
results reviewed that 85.2% of the respondents are in their youthful age (between 20
and 49 years). From these observations, it is important to note that making available the
necessary logistics and inputs, the farmers will be able to produce enough for the
market that would aid in solving the perpetual shortage of vegetables in the country
and support the food security of the households

4.1.2   Education

Table 4.1 revealed that most of the farmers (86.5%) had some form of formal education
but only few of them (3.5%) had tertiary education and under taking vegetable

production as part-time occupation. This may be attributed to higher graduate unemployment in the district and these unemployed youth see vegetable production as a lucrative venture.

Table 4.1:   **Socio-demographic Characteristics of the Respondents**

Variable	Category	Frequency	Percentage
Gender	Female	47	20.4
	Male	183	79.6
	None	14	6.1
	Non-formal	17	7.4
	Primary	38	16.5
Educational status	Middle/JHS	113	49.1
	SHS/GCE	22	9.6
	Post-secondary	18	7.8
	Tertiary	8	3.5
	Married/Co-habiting	206	89.6
Marital status	Never Married	7	3.0
	Widow	6	2.6
	Separated/Divorced	11	4.8
	20 – 29	44	19.1
	30 – 39	90	39.1
Age (years)	40 – 49	62	27.0
	50 – 59	29	12.6
	60 and Above	5	2.2
	1–5	9	3.9
Household size	6-10	81	35.2
	Above 10	140	60.9

Source: Field survey data 2011

In Ghana, it is generally believed that educational standard up to JSS or Middle School level is enough to make one literate. The impact of the level of education on agriculture stems from the fact that farmers who are literate, generally tend to adopt innovations quickly which increase total factor productivity of vegetables and for that matter, agricultural development in general (Adesina and Djato, 1996).

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4.1.3 Gender

Approximately 20 per cent and 80 per cent of household heads were female and males respectively. It is not surprising that majority of the farmers are males because vegetable production involves a lot of vigorous activities and physical strength which only the males are stronger enough to carry out most of the activities on the farm.

4.1.4 Marital Status

Marital status was considered in this study because it was important in assessing the time devoted to household activities and agricultural production in communal areas. A study by Zenda (2002) revealed that married people are able to share household activities such as agricultural production, herding of livestock, harvesting of fruits, fetching firewood and water. While households with single, divorced and widowed heads have to do all the household activities as they do not have all the support unless from children who are old enough to do some household activities.

In the study area, most of the households constitute of married couples followed by divorced, then single headed households and widowed families. About eighty-nine (89%) percent of the households are married people, 4.8% are divorced household, 3% are single headed households, and 2.6% are widowed.

4.1.5 Household Size

Majority of the households in the study area has larger household size of above ten (60.9%). According to literature, increasing family size tends to exert more pressure on consumption than the labour it contributes to production. Paddy (2003) revealed that food requirements increase in relation to the number of persons in a household. Amaza

et al. (2006) also found households with large sizes to have higher possibility of being food insecure than those with smaller sizes.

4.1.6   Annual Average Household Income

An analysis of income sources adds further insight into the income generation processes. Household income was calculated from the summation of all sources of income i.e. income coming from on-farm activities and non-agricultural labour. Onfarm income was derived from sale of vegetable crops and income from sale of other crops produced. Off-farm income included income from salaries, remittances and pension funds.

4.1.7   On- Farm Income

Vegetable crops had a high income because they are grown twice or more times per year and they mature early because of intensive cultivation practiced. Appendix VIII (table 5) shows that vegetables contribute a higher percentage (61.2%) of household income as compared to the other forms of income, whilst 26.7% of the total household income realized comes from the sale of other crops either as interplant or in rotation with vegetables.

4.1.8   Off-farm Income

Remittances for vegetable farmers in the district comes from members of households who are working in urban areas and are expected to look after those who take care of family households in the communal areas so that households can meet their food needs. Appendix VIII shows that 4.4% of the total household income realized comes from remittances. Although not expected to be large this is too low a percentage as the

remittances are less than 10 percent. This result is surprisingly low and may indicate a level of poverty in urban areas such that people in urban areas contribute very little to the income of households in the communal areas (Mushunje, 2006).

Casual labour is another source of income in communal areas. Farmers receive income for working in other people fields or homesteads. Appendix VIII shows that only about 4.2% of the household incomes come from casual labour. Very few people are employed as skilled labour in this area. It is not surprising to find that most of the smallholder farmers are poor. This is because the total household income is not the net household income (Mushunje, 2005). From this income farmers derive their subsistence money, money for agricultural inputs, school fees and to pay casual labour.

FAO (1999) reported that employment in off-farm and non-farm activities are essential for diversification of the sources of farm households' livelihoods. It enables households to modernize their production by giving them an opportunity to apply the necessary inputs, and reduces the risk of food shortage during periods of unexpected crop failures through food purchases (Devereux, 1993; Maxwell & Frankenburger, 1992).

4.1.9   Land Holdings and Labour Resources among the Respondents

A household's landholdings are a good indicator of its wealth and productive potential. Land ownership is, thus, important to the concept of food access. As productive capital, land provides the household with an ability to supply its own food and generate income. As a low - liquidity asset, it provides the household with a lastresort hedging mechanism against food entitlement failure. Access to and controls over land have impact on the household food supply, household income and family welfare.

It came to light from table 4.2 that 67.8 % and 84 % of respondents got access to land and labour respectively through hired or cash rental with only 17 % using their own land as against 6% family labour. The rest either obtained land through share cropping or use family land and labour from other sources (co-operative, caretaker and so on) were few (less than 3%).

Land is seen as a wealth creating and livelihood sustaining asset in the area. For a majority of rural households, land is the single most important source of security against poverty. The FAO (1996) stated categorically that in order for farmers to use land more efficiently and thereby make a greater contribution to food security , they need access to land, management control of land-based resources and the economic incentive that the security of tenure provides.

Table 4.2:   Land and Labour Resources

Variable	Category	Frequency	Percentage
Land holdings	Own land	39	17
	Family land	27	11.7
	Cash rental	156	67.8
	Share cropping	3	1.3
	Own land/Cash rental	1	0.4
	Family/Cash rental	3	1.3
	Cash rental/Share	1	0.4
Sources of labour	Family	14	6.1
	Care taker	2	0.9
	Hired	193	83.9
	Co-operative	4	1.7
	Family/Hired	6	2.6
	Family/Co-operative	1	0.4
	Care taker/Hired	6	2.6
	Family/Hired/Co-	4	1.7

Source: Field survey data 2011

4.1.10 Marketing of the Vegetables

From the field observation, all the vegetable producers in the study area produced to sell at least 93.8% of their produce irrespective of the size of their farm holdings. This goes to strengthen the assertion of Kwarteng and Towler (1994) that subsistence farming whereby farmers farm mainly to produce enough to feed themselves and their dependents rarely occurs these days as all farmers make great efforts to produce surplus for sale to generate income to purchase other commodities needed by the farmer and to meet other social obligations such as funeral expenses and church contributions.

Table 4.3:   Marketing Activities

Variable	Category	Frequency	Percentage
Place of sale	Farm gate	181	78.7
	House	4	1.7
	Local market	32	13.9
	Distant market	5	2.2
	Farm gate and Local market	6	2.6
	Local market and distant market	2	0.9
Main customer	Money lender	4	1.7
	Middle men	210	91.3
	Individual customers	10	4.3
	Seed dealer	1	0.4
	Money lender and individual customers	1	0.4
	Middle men and individual customers	4	1.7

Source: Field survey data 2011

From Table 4.3, it is revealed that over 78.7'% of farmers sell their produce at the farm gate and only a few (13.9%) sell their produce at the local market, in the distant markets

(2.2%). as well as in the house (1.7%). Private individuals and companies mostly come to buy the produce at the farm gate. These private individuals include middlemen and the moneylenders.

4.1.11 Vegetable Farmers' Contacts with Change Agents in the Study Area

The result in figure 4.1shows that only 24.3% of the 230 respondents had access to change agents. More than half (57.2%) of these respondents who ever had access to the change agents started working with the change agents for less than 6 years, 31.2% of them had been working with the change agents from six to ten years.
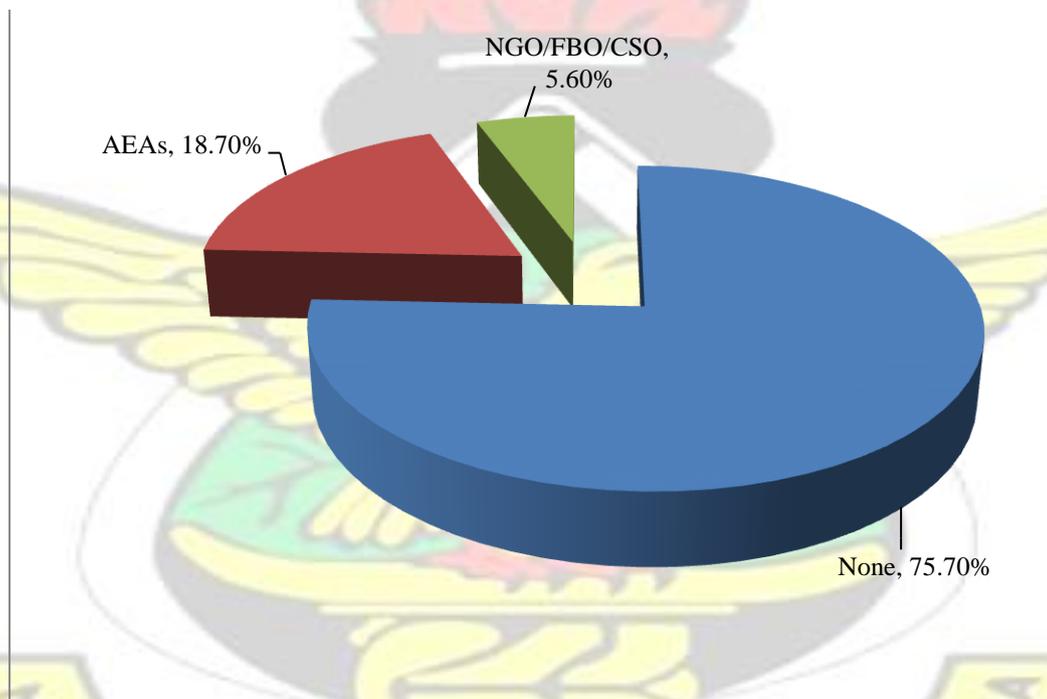
Figure 4.1:   Vegetable farmers' contacts with change agents in the study area
Source: Field survey data 2011

The main sources of technical knowledge for farmers are the research stations and research finding communicated to the farmers through MoFA, NGOs, FBOs and

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CSOs. An important attribute of extension education as illustrated by La Anyane (1985) is that it provides a technique for enhancing the changes for increasing production without any significant quantitative increases in the basic factors of production: land, labour and capital.

4.1.12 Financial Resource Availability for Vegetable Production

Finance plays a very important role in vegetable farming since it determines farmers' ability to secure vegetable farm inputs for the establishment and maintenance of farms. Access to credit for productive purpose can effectively reduce the vulnerability of poor households to food insecurity and improve their access to food. This therefore necessitates investigating access to finance and financial credits. From the findings of the study, personal savings from farmers form a major source of financial capital for establishing vegetable farms in the study area.

It is shown in Table 4.4 that credit source used by the respondents to finance their farming activities are mainly over dependence on their own resources. Out of the 230 respondents, 212 (92.1%) rely mainly on their own funds for farming purposes. Observation from the study revealed that vegetable farmers especially part-time farmers, largely financed their farming activities through their main occupational activities. Nevertheless, some of the vegetable farmers have never benefited from other sources of finance. Those who sourced finance from other sources are dolefully less than 50 percent of the respondents. The most worrying revelation from Table 4.4 is the funding from the banks (less than 15%) to the vegetable farmers

Markowski (2002) reported that rural clients usually turn to locally based informal sources such as family, friends or moneylenders, who lend only small amounts for short

period of time. Von-Pischke (2002) also reported that informal credit from suppliers and buyers is sometimes regarded as exploitative, but it is common in many countries and the broader context is often not considered. Unhealthy situation of this sort, where most vegetable farmers rely on their own resources for farming activities will render investment in agriculture to experience serious setbacks.

Table 4.4:   Financial Resources/Access to Finance

Variable	Category	Frequency	Percentage
Source of finance	Own saving	212	92.1
	Relatives and friends	62	27
	Bank	26	11.3
	Money lender	13	5.7
	NGO	0	-
	Co-operative/Credit union	7	3.0
Constraints to credit acquisition	High interest rate	168	75.3
	Cumbersome processing	203	91.0
	No collateral security	138	61.9
	No knowledge of credit	2	0.9
	sourceUnqualified for credit	8	3.6
	Lack of guarantors	21	9.4

Source: Field survey data 2011

The most revealing reasons for over reliance on personal savings for vegetable production include cumbersome loan processing procedures (91%). high interest rates (75.3%), and lack of collateral security (61.9%). Von-Pischke, (2002) indicated that in many countries, banking authorities require most types of loans to be collateralized with tangible property having a value that would permit loan recovery through repossession.

4.2   Farmers' Perception on Vegetable Production

The farmers strongly agree to the fact that vegetable production help strengthen the food supply system in the area (1.82), offer job opportunity to the local people (1.74), enhances the market supply system in the area (1.55) as well as improving standard of living (1.67), but some few respondents disagree to the fact that it improves nutritional value.

From table 4.5, benefit perception index of the vegetable farmers was found to be 1.57 (positive and more than one) which indicate that the farmers perceived vegetable production as a major tool in reducing household food insecurity and improvement in their standard of living.

Table 4.5:   Community Perception Indices of Vegetable Production

Statement	Percentage of Respondents					PI
	Strongly Agree (Score = 2)	Agree (Score = 1)	Neutral (Score = 0)	Disagree (Score = -1)	Strongly Disagree (Score = 2)	
Promotion of food security	84.3	13.9	0.9	0.9	0	1.82
Job opportunities	76.5	21.7	0.9	0.9	0	1.74
Enhancement of market supply system	60.9	35.7	0.9	2.6	0	1.55
Reduction of rural urban drift	59.6	35.2	0.9	4.3	0	1.50
Improvement in standard of living	75.2	20.0	1.7	3.0	0	1.67
Improvement in nutritional value	47.4	37.0	0.9	14.3	0.4	1.17
Average Perception Index						1.57

Source: Field survey data 2011

4.3 Prevalence of Food Insecurity

This section describe the survey responses collected using the household food security questions and transforming them into the data set needed for applying the measurement; applying the data to determine the food security status levels of each household; and determining, for those households that showed evidence of food insecurity with or without hunger, the severity level of the condition experienced (refer to table 4.6).

Table 4.6: Food Security Categories and Status Levels of Respondents

Number of "yes" responses		1998 Scale Value		Freq.	%	Food Security Status Category
Household with child	Household with no child	Standard Computational Metric	Standard 0 – 10 Metric			
0	0	0.0*	0.0*			
1		1.4	1.0			
	1	1.7	1.2	99	43	Food secure
2		2.6	1.8			
	2	3.1	2.2			
3		3.4	2.4			
4		4.1	3.0			
	3	4.2	3.0			
5		4.8	3.4	110	48	Food insecure without hunger
	4	5.2	3.7			
6		5.4	3.9			
7		6.0	4.3			
	5	6.0	4.4			
8		6.6	4.7			
	6	7.1	5.0			
9		7.2	5.1			Food insecure with hunger, moderate
10		7.7	5.5	18	8	
	7	8.0	5.7			
11		8.3	5.9			
12		8.8	6.3			
	8	9.0	6.4			

13		9.3	6.6			
14		9.8	7.0			
	9	10.1	7.2	3		Food
15		10.4	7.4		1	insecure
	10	11.1*	7.9*			with
16		11.1	8.0			hunger,
17		12.2	8.7			severe
18		13.0*	9.3			

Source: *U.S. Census Bureau data from the Food Security. (Bickel et al., 2000).*
Following the guide to measuring household food security by Bickel et al. (2000) and

Johnson (2004), the households of the respondents were accordingly classified under

food secured, food insecure without hunger and food insecure with hunger (Table

4.6).

Figure 4.2 gives the representation of the food security levels which indicates that 43

percent of the respondents were food secured in the study area, 48 percent of the

respondents were food insecure without hunger while 8 percent of them were

moderately food insecure with hunger with only 1 percent severity. Thus more than five

out of every ten farmers were food insecure. The World Health Organization estimated

that one-third of the worlds' population is well fed, one-third is under fed and one-third

is starving (Extreme Response, 2008). This result depicts a different situation among

the vegetable farming households in the Tano South District. Amaza et al. (2006) also

reported that 58% of sampled households in Borno State in Nigeria are food insecurity

by head count.
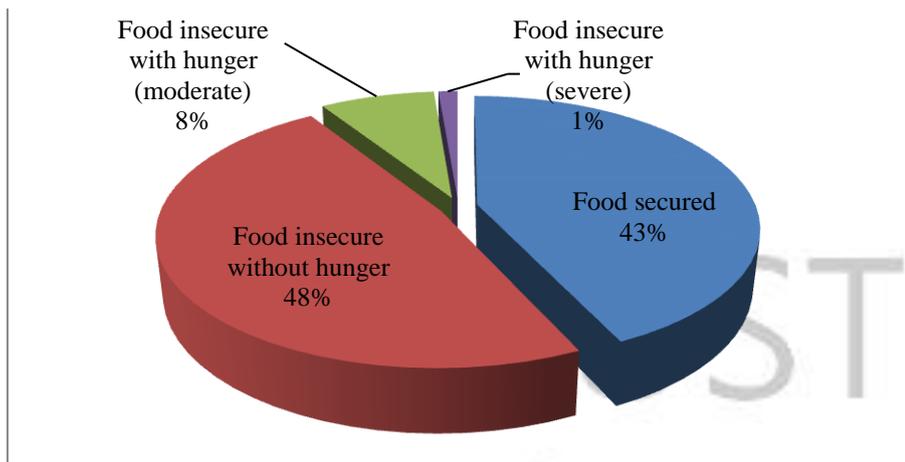
Figure 4.2: Classification of respondents' households into food security categories

Source: Field survey data 2011

FAO (1996) also indicated that every day, one out of five people in the developing world cannot get enough food to meet his or her daily needs. Unfortunately , this result has presented a different picture of the situation with higher and surprising number where almost 3 out of 5 respondents' households cannot get enough food to meet their needs . Markowski (2002) also reported that many poor households face transitory food insecurity, even if on average, over several years, their incomes are sufficient to provide a sustainable standard of living.

4.4 Consumption and Income Coping Mechanisms of Respondents

Many vegetable producing families experienced difficulties making ends meet and thus must develop strategies to cope with challenging demands for limited resources that will ensure food security. The study revealed that the respondents used multiple coping strategies during financial difficulties and food insecurity situations.

Prominent among the consumption coping strategies (From table 4.7a) are, crop rotation (91.3%), relied on less preferred and less expensive food as substitutes (71.3%), strategic reduction of food intake (41.3%), buying food on credit (40.4%) and borrowing food from friends and relative (19.1%). From table 4.6b, expenditure and income shock coping strategies include strategic reduction of spending (85.1%),sold livestock or household asset (66.9%), used owned cash reserves (59.1%), received financial support from friends and relatives (39.9%), and looking for off-farm and non-farm activities (33.7%).

Table 4.7.a: Food Shortage/Consumption Coping Strategies

Strategy	Frequency	Percentage
Relied on less preferred and less expensive food	164	71.3
Reduced food intake	95	41.3
Borrowed food, or rely on help from a friend or relative	44	19.1
Purchased food on credit	93	40.4
Crop rotation	210	91.3
Sent household members to eat elsewhere	3	1.3
Consumed seed held for next season	72	31.3
Sent household members to beg	1	0.4
Gathered wild food, hunt or harvest immature crops	18	7.9
Adults skipped meals for small children to eat	22	9.6

Source: Field survey data 2011

Table 4.7.b: Income and Expenditure Coping Strategies

Coping strategy	Frequency	Percentage
Borrowed money from relatives	71	34.1
Reduced spending on non-food items	177	85.1
Borrowed money from credit union	51	24.5
Sold livestock/household assets	139	66.9

Took on additional work	70	33.7
Reduced or stop debt payment	11	5.3
Received help from friends and relatives	83	39.9
Used owned cash savings	123	59.1

Source: Field survey data 2011

In order to lessen the risk of food insecurity in either own –supplied or purchased food supplies, crop rotation emerged as one of the main options in a farmer's management strategy against food security failure. Most importantly, the way in which household members allocate their time in pursuit of various means of earning a living needs to be brought to light. According to Deverux (1993), in Africa, diversification of sources of income has long been a survival for themselves and their families during periods of chronic or transitory food insecurity. In this study , households diversify their incomes by engaging in both off-farm and non- farm activities such as trading, working on farm as daily labourers, teaching, driving, fishing, and artisanship.

According to Zindi and Stack (1991), livestock contribute to household food security in communal areas under different household circumstances. In this study, livestock was used as income shock coping strategy to increase household income to ensure food accessibility.

4.5 Determinants of Food Security Status of Respondents

This part of the study provides the empirical findings. A logistic model was fitted to estimate the determinants of the factors that are perceived to affect the food security status of vegetable farmers. Table 1 (see appendix II) shows the descriptive statistics of the variables used in the regression models.

The regression results that show the determinants of the food security measures are shown in table 4.8. The table reports the coefficients as well as the marginal effects with the standard errors and the Z-values. As reported, a pseudo R^2 of 0.334 was obtained. The pseudo R^2 explains the proportion of variation in the observed values of the response variables explained by the regression. It summarizes the proportion of variance in the dependent variable associated with the independent variables, with larger pseudo R^2 values indicating that more of the variation is explained by the model. A pseudo R^2 of 0.334 therefore indicates that the degree of correlation between the dependent variable and the independent variable is 33.4%. The loglikelihood ratio statistics also computes the difference the log-likelihood function of the full model and restricted model. The value of the log-likelihood function is 104.67. The chi-square statistics was significant at 1% and therefore the hypothesis that the variables reported in the table had no effect on the household food security status is rejected and the full model retained.

Table 4.8: Determinants of Food Security Status of Respondents

Variable	Coefficients	Marginal effects	Standard error	Z-value
Gend	0.007	0.002	0.492	0.01
Age	0.027	0.006	0.023	1.15
M.stus	0.823	0.181	0.640	1.28
N.adults	0.168	0.040	0.137	1.22
N.child	-0.157	-0.037	0.131	-1.20
Educ.	0.106***	0.026	0.047	2.24
Exp	0.008	0.002	0.032	0.28
Offarm	1.272**	0.307	0.456	2.79
L.own	0.947*	0.232	0.488	1.94
L.size	0.399**	0.096	0.137	2.91
Fert	0.100	0.024	0.251	0.40
A.agent	0.359	0.088	0.448	0.80

Labor	0.187	0.445	0.541	0.35
N.veg	1.298***	0.313	0.343	3.78
Oth.crops	0.971*	0.217	0.549	1.77
A,funds	1.092**	0.263	0.388	2.81
F.gate	-0.186	0.045	0.431	-0.43
Asset	1.231**	0.283	0.395	3.13
Percept	0.827	0.200	0.515	1.60
Veg.income	0.024*	0.001	0.010	2.50
Pseudo $R^2$0.334				
Log likelihood -104.67				
Observation 230				

*** denotes significant at 1%, ** denotes significant at 5%, * denotes significant at 10%

Source: Field survey data 2011

From the regression results, variables such as gender, age, marital status, total number of adults in the households and number of children all had the expected signs. However these variables did not show any significant effect on the food security status of the households. As hypothesized, the effect of the level of education of the household head had a positive influence on the food security status of the households. This positive relationship was significant at 1%. The level of education of the household head as observed by Najafi (2003) is positively correlated to the food security status of the respondents. This is because a higher educational attainment could lead to awareness of the possible advantages of modernization which eventually leads to higher output. Amaza et al (2006) also observed that the higher the educational levels of a head of a household, the more food secure the household. This is expected because such households are assumed to have better food management techniques that will ensure equitable and all round supply of food. Also educated household head can take up off-farm occupation to increase household income to improve food accessibility.

Although the effect of experience in vegetable farming had a positive correlation with food security status as expected, the relationship was not significant. However, offfarm activities had positive and significant relationship with food security. The finding concurs with the report by FAO (1999) that it reduces the risk of food shortage during periods of unexpected crop failures through food purchases. Diversification of sources of income is also seen to have a survival strategy which allows household heads to reduce the risk of starvation for themselves and their families during periods of chronic or transitory food insecurity (Devereux 1993, cited in Haile *et al.,* 2005).

Land ownership and the size of land owned were also positively correlated to food security as expected. These associations were also both significant which confirms the findings of some researchers. Najafi (2003) revealed that food production can be increased extensively through expansion of areas under cultivation enhancing the food security status of a household. Amaza et al.*,* (2006) further observed that households with larger farm sizes are more food secure than those with smaller sizes.

The rate of fertilizer use, access to change agents, and the availability of labour all had the expected positive influence on food security status even though these relationships were not significant. The total number of vegetables cultivated by the farming household was positively correlated and significant even at 1%. This shows that the higher the number of vegetables cultivated, the more food secured the household since they able to diversify their revenue from vegetable production. The effect of cultivation of other crops was also seen to be positive and significant. This implies that, households who cultivates other crops aside the vegetable are more likely to be food secured than those who are engaged in vegetable production alone.

Another important variable is the access to finance by the farmer. The results show that access to finance positively and significantly correlated to the food security status of a farming households. This also concurs with findings of Meyer (2001) who observed that microfinance can contribute to poverty alleviation through supplying loans, savings and other financial services. Households' food security status was also positively and significantly influenced by the wealth status of the households. This is in line with Kang'ara et al (2001) who observed that animal products such as meat, milk, eggs etc. mitigates the effect of food shortages in times of crop failure. Another important of variable from the results is the proportion of household income from vegetable production. This was positive and significant at 10% indicating the higher the income the households acquire from vegetable production, the more food secured the household is. The effect of the perceived benefit of vegetable production was also

positive but not significant.
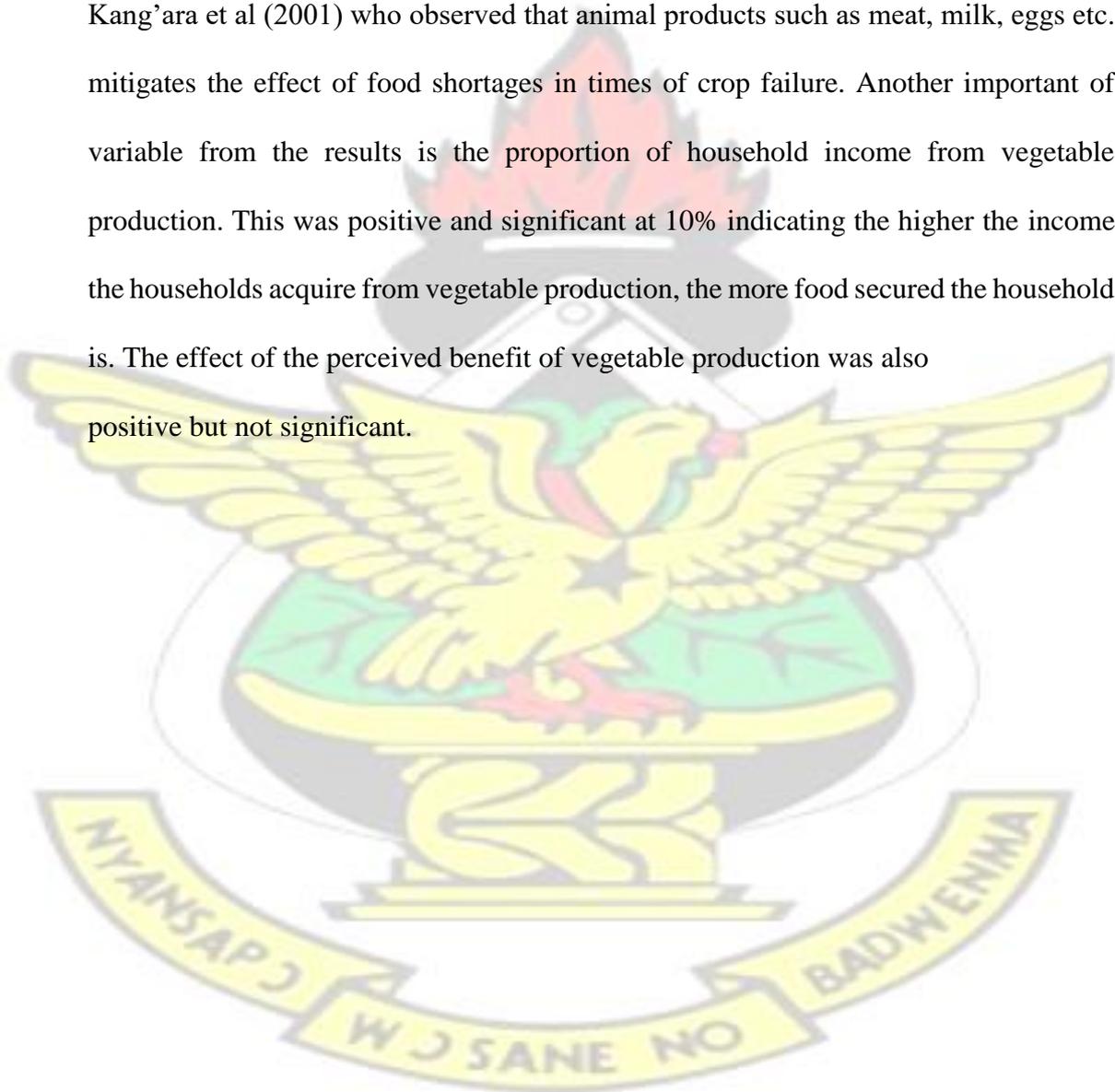
CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0   General Overview

This chapter presents the summary, conclusions and recommendations of the study. It also presents suggested areas for further studies.

5.1   Summary

Vegetables are the dominant crops produced by farmers in most communities in the Tano South District. The benefits derived from vegetable production and activities make it a pivotal sector for food security and improvement in their standard of living. The benefits of vegetable production in terms of food security and the coping strategies employed in mitigating food insecurity has not been empirically examined in these communities that are producing the vegetable. The study therefore broadly examined the level of food security and food insecurity coping strategies employed by farming households in the Tano South District of Brong Ahafo Region.

Specifically, the study sought to determine the socio-economic factors of the vegetable farmers that affect their food security status; evaluate the farmers' perception on vegetable production for household food security; measure the prevalence of food insecurity among vegetable farmers and, identify the coping strategies adopted by the households in addressing the food insecurity issues in the study area.

An interview schedule was used to collect data from 230 vegetable farmers from the district in the Brong Ahafo Region of Ghana. Descriptive statistics in the form of frequency, percentages and mean as well as regression (logistic and OLS regression)

were the statistical tools used to analyze the data. A summary of the major findings are as follows:

5.1.1 Farmers' Perception on Vegetable Production

Farmers perceived vegetable production as a major tool in reducing household food insecurity and improvement in their standard of living.

5.1.2 Prevalence of Food Insecurity and the Coping Strategies adopted by the Households

Food security was measured using the 18-item scale of Household Food Security Survey Module with a reference period of the 12 months prior to administration of the questionnaire. The households were classified under three main categories of food security status, namely, 'food secure', food insecure without hunger', 'food insecure with hunger'. Fifty-seven percent (57%) of the farming household were food insecure at the various levels of food insecurity. Some of the food insecure households who have children were able to sacrifice adults' food consumption to maintain adequate levels for their children.

5.1.3 Coping Mechanisms

Strategies adopted by farmers in curbing food insecurity situations among the vegetable producing households included three subsets of coping strategies: consumption strategies, expenditure strategies and income strategies. Consumption strategies included item such as buying food on credit, relying on less preferred foods as substitutes, strategic reduction of food intake, crop rotation, borrowed food from friends and relatives, consumed seeds held for next season, regularly skipping entire days

without eating due to lack of money, and restricting consumption of adults so children can eat normally. Expenditure strategies included items such as reduced spending or purchase of non- food items, reduced debt payment and strategic reduction of educational expenses in order to buy food. Income strategies included items such as selling household assets or livestock, borrowing money (from credit union or friends or relatives) and engaging in off-farm and non-farm activities.

5.1.4 Socio-economic Factors of the Vegetable Farmers influencing their Food Security Status

Logistic regression analysis was used to run for the dependent variables which is food security status of the vegetable farming households. Variables such as gender, age, marital status, total number of adults in the households and number of children all had the expected signs. However these variables did not show any significant effect on the food security status of the households.

The explanatory variables found to be influencing the food security status included level of education, land size, off farm activities, income from vegetables, number of vegetables produced, land ownership, cultivation of other crops and access to finance. Access to finance is important for the attainment of household food security but this is least available to the farmers.

5.2 Conclusions

The following conclusions were drawn from the study.

There is a high level of formal education among the vegetable farmers. In all, 86.6% of the respondents were educated up to at least JSS or Middle school level, this would enhance farmers' ability to receive, decode and understand information on new and proven technology that will enhance adoption. Adoption of innovations among these vegetable farmers would therefore be easier and this would step up productivity and for that matter, agricultural development.

The majority (89.6%) of the respondents were either married or co-habiting. There were small percentages (2.2%) that were above 60 years, most (85.2%) of the respondents were in their economically active ages (between 20-49 years). The youthfulness of the population means that the population has a high propensity to expand productivity if measures are taken. On the other hand, it also means that there are a high number of people for the labour force.

Almost all (99.6%) of the respondents were engaged in mixed vegetable crop production and these vegetables were either produced concurrently during each season or independently during different seasons. About four out of every five vegetable farmers produced at least three different kinds of vegetable in sequence. This is done as a strategy to manage food insecurity among the households.

Most (75.7%) of the vegetable farmers did not get direct access to technical knowledge from change agents. Even the few (24.3 %) of those who got direct access to information from change agents started not long ago. The principal change agent that the farmers have been working with is the Ministry of Food and Agriculture Frontline Staff (Agricultural extension officers). The fact that some of the farmers do not have direct contact with any change agent does not imply that they do not seek extension information. Notwithstanding, farmers are in quest for more information on the

vegetable enterprise from their fellow farmers in areas such as use of agrochemicals, preservation, storage, processing, marketing and record keeping. The pursuit for more information on these areas is necessitated by the fact that farmers want to increase income levels and sustain food security.

Land ownership by the vegetable farmers is mostly by cash rental (67.8%) and the fact that these farmers pay for the land every year caused them to acquire small portions and hence producing on small-scale bases. Vegetable farmers in the study area produce mostly on land sizes less than two hectares. The main source of labour was through hiring (83.9%) and few family members (6.1%) for the production of these vegetable in the study area. Other sources of labour include cooperative (1.7%) and caretakers (0.9%).

The respondents mainly self-financed vegetable farming activities. The findings further revealed that only a few of the vegetable farmers have ever accessed external finance in any way. Sources of finance that few of the vegetable farmers benefited from for their farming activities are relatives and friends (27%), banks (20%), money lenders (5.7%), and cooperatives/credit unions (3%), Most of these credits were not directly for the vegetable enterprise but rather used to resolve other financial obligations such as school fees, rent, purchasing of food for household consumption, and special unforeseen expenditures and extensive debt. Those who obtained credit were able to pay back promptly due to the fact that the creditors were readily available to take their money immediately the farmers harvest and sell the vegetables on the farm. Factors identified to be militating against effective sourcing of credit from both formal and informal financial institutions included high interest rates

(75.3%), lack of collateral security (61.9%) and cumbersome processing procedures (91%). Apart from the few respondents who obtained credit for their production, the farmers did not access any other financial services.

Though the vegetable farmers sold their produce at different places, most of them sold the bulk of their produce at the farm gate (78.7%). Some of these farmers sometimes took the vegetables to the local (13.9%) or distant (2.2%) market to sell where they derived more net income that helps them to improve on their food security and standard of living.

Using the IRT indicators (Bickel et al., 2000), the vegetable farmers in the Tano South District could generally be considered food insecure (57%). This could be due to lack of credit to expand production, high input cost, lack of technical advice from agricultural extension agents, marketing and land problems among others. These identified problems might account for the food insecurity situation among the respondents. Vegetable production generates enough income to the farmers since they have a short production cycle as compared to food crops, and farmers are expected to be more food secured. But this research gave a surprising revelation.

The households for the survey used different forms of strategies to cope with food insecurity situation in the area. To ensure food available, the households of the respondents mostly practice crop rotation (91.3%), relied on less preferred and less expensive food as substitutes (71.3%), strategic reduction of food intake (41.3%) and buying food on credit (40.4%). In order to ensure availability of income for food accessibility, respondents used the following strategies: Strategic reduction of spending (85.1%), sale of livestock or household assets (66.9%) and use of owned cash reserves (59.1%).

The overall predictors for the levels of food security were level of education of household head, land size, off farm activities, income from vegetables, number of vegetables produced, land ownership, cultivation of other crops and access to finance.

Any improvement in these variables especially access to financial services, income from vegetables, land size and the number of vegetables produced can go a long way to increase food security levels of the vegetable-farming households in the study area. The main findings of the empirical analysis indicated that the educational level of household head and number of vegetables produced were highly significant and thus have a great influence on food security status at the household level. The educational attainment by the household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on fertilizer packs and diversification of household incomes which, in turn, would enhance households' food supply. Also educated household heads have broad knowledge in nutrition regarding provision of proper and required food for the family, since they understand better the nutritional requirements of food with respect to family age, gender and workload. Above all, the higher the number of vegetables cultivated, the more food secure the household since they are able to diversify their revenue from vegetable production.

5.3 Recommendations

Based on the findings of the study and discussion the following recommendations are made to improve the farmers' food security and standard of living.

Vegetable crop productivity, including diversification of production by small holding farmers should be boosted by the District directorate of Food and Agriculture (MoFA) so that farmers can feed their families and secure a surplus to increase earnings. This would improve smaller farmers' agricultural output and thereby contributing to their food security and income generation.

There is an urgent need to strengthen the formation of formal and informal farmer associations to improve the incomes and business of their members. The farmer associations should be involved in various kinds of activities by trying to diversify the services and opportunities offered to its membership. They should investigate into an opportunity to organize a service cooperative, which would not be restricted to only income-generating activities, but also help farmers to save money for purchasing farm inputs in bulk and sell produce together. This would help in getting higher prices from buyers and better marketing terms. Recommendation for strengthening the farmers associations should focus on adapting policies, institutions and processes to better fit with members' needs. The ability of public service providers to respond to the needs expressed by farmers through their organizations heavily depends on both public and private agricultural services providers who are engaged in agricultural activities in the study area.

Another form of assistance that the financial institutions can give to these farmers is that they can act as wholesalers to selected microfinance institutions by providing commercial loans at competitive rates for on-lending to microfinance clients. The banks should make funds available to microfinance institutions through specialized investment funds that can be created to address this need. A number of NGOs and

forprofit organizations could also take up this initiative and offer loan funds to partner microfinance institutions.

Also, self-managed financial services associations could be established in the area to develop cost-effective delivery of financial services to the vegetable farmers. These financial service associations should be initiated, owned, and operated by the farmers themselves, and must be community based. This should be done with education to allow members to meet their small, short-term financial needs for income generation activities, social obligations, and emergencies without having to borrow from money lenders or rely on relatives.

Furthermore, vegetable gardens represent a viable instrument for coping with food security because of the relatively short cycle of the crops in question, and thus help improve household resilience in the event of food entitlement failure. From a purely economic standpoint, a loan used by a poor household to plant a vegetable garden is more likely to run into repayment difficulties since it will not generate sufficient cash if the crops grown are used exclusively to meet the household's food requirements. Hence, direct measures for improving food security, such as the crop rotation and cultivating more than one type of vegetable crop, are likely to become priorities, as considerable interest was shown by many of the farmers and many households in the surveyed communities.

The Ministry of Food and Agriculture's (MoFA) Block Farm Programme should be extended to the district to help increase vegetable production to ensure food security, generate employment in the rural communities and increase incomes of the small farm households. Also due to the perishable nature of vegetables, modern storage facilities should be set up in the district by the government to insulate farmers against postharvest

losses, resulting from increases in production to increase household income and ensure food security.

The government through MoFA should create an enabling environment which will ensure that the farmers' need for inputs can be met. This could be done through the provision of incentives for the input suppliers to provide a service efficient and productive inputs to farmers to make the investments in the vegetable enterprise economical thereby fighting the food insecurity situation that prevails among the respondents.

5.4   Recommendation for Further Studies

The study shows that about 57% of the sample households were food insecure yet they still survived. This could mean that there could be other factors or determinants that significantly affect household vegetable crop productivity and food security and therefore such salient factors such as technology availability, infrastructural development, tenure rights and many more should be taken into consideration in any future research.

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APPENDICES

APPENDIX I

QUESTIONNAIRE

Interview Schedule for Vegetable Farmers

Background Information

1. Village/ Community Name: ………………………………………………….

2. Sex   .1 Male [   ]   .2 Female [   ]

3. Age at your last birthday (in years)? …………………………………………….

4. What is your highest educational attainment? Please tick

   .1 Primary   [   ]   .5 Post Secondary   [   ]

   .2 Non-formal   [   ]   .6 Tertiary   [   ]

   .3 Middle School/ JSS   [   ]   .7 others (state)…………………………

   .4 SSS/ GCE (A/O level) [   ]   .8 None   [   ]

5. Are you the household head?   Yes [ ]   No [   ]

6. If No, what is your status? …………………………………………………….

7. Marital Status;   .1 Married/ Co-habiting [   ]   .3 Widow   [   ]

                     .2 Never Married   [   ]   .4 Separated/ Divorce   [   ]

8. Household size

       Number of adults (≥15) ………………………………………………

       Number of children (<15) …………...

9. How long have you been growing vegetables? ……………………………..years

10. Why were you interested in vegetable crop production?

…………………………………………..……………………………………

………………………………………………………………………

Information on Agro-enterprise

11.   Please indicate your category of vegetable farming

       .1 Full time [   ]   .2 Part-time [   ]   .3 Absentee farmer [   ]

12.   If part-time or absentee farmer, what is your main occupation?

       ………………………………………………………….

13.   Which vegetable is your main crop that you have been producing?
       …………………………………………………………………..

14.   Why do you choose this vegetable as your major crop?

       ……………………………………………………………………….

15.   What is the actual size of land you farmed on last year? ………………….acres

16.   Which of the following vegetable crops do you cultivate? Please indicate the
       acreage, cost, yield, amount sold and the unit price in each case.

	Type of Vegetable	Acreage	Cost involved	Yield/ unit	Price/ unit
1.	Onion				
2.	Carrot				
3.	Tomatoes				
4.	Green Pepper				
5.	Hot Pepper				
6.	Okra				
7.	Cabbage				
8.	Garden eggs				
9.	Shallot				
10	Lettuce				
11.	Reddish				
12.	Spinach				

(NB: Units in the form of oloka, paint rubber, black rubber, mini bag, Box, Kg, etc)

17.   Do you plant any other crop after the vegetable production? Yes [   ]
       …No [...]

18.   If yes, complete the table below

19.   For non-vegetable crops/ activities, state the type (s) of activities, cost, and yield
       and income derived from each activity for last year?

Types of Crop	Activities	Cost	Yield/ Unit	Income

20.   What is your other source (s) of income? (Tick and state amount per month) .1

       Non-agricultural activities [   ] GH ¢ …….2 Remittances   [   ] GH ¢……..

       .5 Others (specify) …………………… GH ¢ …………………..

       Community benefits

21. A list of statements about the benefits of vegetable production to your community
    are given below and followed by responses. The statements will be read to you,
    kindly give the response you think is appropriate.

**Key: Strongly Agree=4   Agree = 3   Disagree = 2   Strongly
Disagree = 1**

	Benefits	Rating					
		Yes	No	4	3	2	1
1	It helps strengthen the food supply system in the area						
2	It offers job opportunities to local people						
3	It enhances the market supply system in the area						
4	It reduces urban drift						
5	It improves standard of living						
6	It improves nutritional value						
7	Any other (specify)						

22.   Do you own any livestock?   Yes   [ ]   No   [ ]

23. If Yes, specify the type of livestock owned (i) ……..............

(ii)…………………… (iii)……………………(iv)……………………………….

24. Give reason(s) for keeping the livestock ……………………………………...

25. How much did you spend on the following last month? (Do not include production).

Pattern of Expenditure on;	Amount
Food expenditure (actual)	
Clothing	
Water	
Education	
Health	
Electricity	
Fuel (firewood, gas, etc)	
Garbage Collection	
Rent	
Funeral donation/ gift	
Transport	
Toilet Facility	
Remittances to others	
Others specify	
Total	

Food Security and Sufficiency

26. In general which of these statements best describes the availability of foods eaten in your household in last year?

.1 We always have enough and the kinds of foods we wanted [ ]

.2 We have enough to eat but not always the kinds of food wanted [ ]

.3 Sometimes we don't have enough we wanted [ ]

.4 Often we don't have enough of the kinds of food we wanted [ ]

27.   In order to have enough food and the kinds of food you want for your household would you need to spend.

.1 more than you do now   [   ]   .2 the same amount   [   ]

.3 Less than you do now   [   ]

28.   About how much would you need to spend each week on food to meet the food needs of your household……………………………Ghana cedis.

29.   The table below is supposed to help us assess the extent and severity of food insecurity of households in the last 12 months due to unavailability of food or inadequate money for food.

	Food (in) Security Items	Yes	No
1.	Were you worried that you would run out of food before being able to buy or receive more food?		
2.	Did you run out of food before having money to buy more? (Food bought did not last).		
3.	Did you run out of money to have a healthy and varied diet (could not afford to eat balanced meals).		
4.	Did you have to consume just a few foods because you run out of money? (Respondent ate less than should).		
5.	Were you unable to offer your children/ adolescents a healthy and varied diet because you did not have enough money? (child/ren did not eat balance meals).		
6.	Did any of the children/ adolescents not eat enough because there was no money to buy enough food? (child/ren did not eat enough).		
7.	Did you or any adult in your household ever reduce the size of meals or skip meals because there was no money to buy enough food? (Adult/s cut size/ skip meals).		
8.	Did you ever eat less than what you thought you should because there was no money to buy enough food?		
9.	Did you ever feel hungry but did not eat because there was no money to buy enough food (respondent hungry but didn't eat).		
10.	Did you lose weight because you didn't have money to buy enough food? (Respondent lost weight).		
11.	Did you or any other adult in your household ever go without eating for a whole day or have just 1 meal in a whole day because there wasn't money to buy enough food? (Adult did not eat for a whole day).		

12.	Did you ever reduce the size of meals of your children/ adolescents because there wasn't money to buy enough food? (child/ren cut size of meals).		
13.	Did your children/ adolescents ever have to skip a meal because there wasn't money to buy enough food? (child/ren skip meals)		
14.	Were your children/ adolescents ever hungry but you just couldn't buy more food?		
15.	Did your children ever go without food for a whole day because there was not money to buy enough food? (child/ren did not eat a whole day).		
16.	Adult/s cut size/ skip meals for ≥ 3 month in last year.		
17.	Adult/s did not eat whole day ≥ 3 month in last year.		
18.	Child/ren skipped meals ≥ 3 months in last year		

Consumption and Income shocks coping strategies

30. Please indicate some of the strategies you adopt during food shortage periods (*multiple responses*)

(a) .1 Relied on less preferred and less expensive foods   [   ]

(b) .2 Reduced food intake   [   ]

(c) .3 Borrowed food, or rely on help from a friend or relative [   ]

(d) .4 Purchased food on credit   [   ]

(e) .5 Crop rotation   [   ]

(f) .6 Sent household members to eat elsewhere [   ]

(g) .7 Consumed seed held for next season [   ]

(h) .8 Sent households members to beg   [   ]

(i) .9Went entire days without eating [   ]

(j) .10 Gathered wild food, hunt or harvest immature crops [   ]

(k) .11 Adults skipped meals for small children to eat   [   ]

(l) .12 Others (specify) …………………………………………..

31. Please indicate some of the strategies you adopt when you are faced with financial
    difficulty. *(Multiple responses).*

.1 Borrowed money from relatives   [   ]   .2 Reduced spending   [   ]

.3 Borrowed money from credit union [   ]   .4 Sold livestock   [   ]

.5 Reduced food consumption   [   ]   .6 Took on additional work [   ]

.7 Reduced or stop debt payment   [   ]   .8 Sold of other assets   [   ]

.9 Received help from friends and relatives [   ]   .10 Used own cash savings   [   ]

.11 others specify………………………………………….

32(a) How has the coping strategies assisted you in reducing food insecurity in your
    household? ....

    (b) How has vegetable production helped your household in ensuring food

security? ....

Production Factors

Land sources

33.   What title(s) of ownership do you hold to the land you use for farming?

       .1 own land   [   ]   .4 lease hold   [   ]

       .2 family land   [   ]   .5 share cropping   [   ]

       .3 cash rental   [   ]   .7 others (specify) …………

34.   What is the cost/ fee of renting an acreage of land per year in your area?

       ……………………………………………………………………………………

35.   Do you apply fertilizer to your crops?   Yes   [ ]   No [ ]

36.   If yes, how often do you apply fertilizer to your crops?

.1 Once every week [   ]   .2 every two weeks [   ]   .3 every three weeks [.4

Every month   [   ]   .   5 did not apply fertilizer [   ]

Labour Resources

37.   Kindly indicate your main source(s) of labour.
        .1 family   [ ]   .4 co-operative/ communal (Nnoboa)   [

        .2 care taker   [ ]   .5 others (specify)…………………….
        .3 hired   [ ]

38.   Are these source(s) of labour readily available?   Yes [   ]   No   [   ]

39.   What proportion/ percentage of labour is provided by your household on the
        farm?

        .1 (≥25%)   [   ]   .3 (≥50%)   [   ]

        .2 (≥75%)   [   ]   .4 (over 75%)   [   ]   .5 100% [   ]

40.   How much was paid for labour (man day)?   ………………… Ghana cedis

41.   How much was paid in kind labour? ………………………. Ghana cedis

42.   What is your source(s) of water for farming activities? *(Multiple responses)*

         .1 tube-well [   ]   .4 borehole/ tap water [   ]

        .2 dam   [   ]   .5 river/ stream   [   ]

        .3 Rain fed   [   ]   .6 others (specify) …………………………
Information Resources

43.   Which of the change agent(s) have you being working with in your vegetable
        production?

.1 None [ ]   .2 AEAs [ ]   .3 NGO/ FBO/ CSO: [ ]

44.   How long have you been working with this change agent?

……………………...

45.   How often do change agents get in contact with you during a farming season?

.1 Weekly   [ ]   .3 Monthly   [ ]   .5 Yearly   [ ]

.2 Fort nightly [ ]   .4 Quarterly   [ ]

46.   From what other sources do you get agricultural information or advice? *(Multiple responses).*

.1 fellow farmers   [ ]   .2 input suppliers   [ ]

.3 market providers   [ ]   .4 radio   [ ]

.5 television   [ ]

.7 print media   [ ]   (bulletins, brochures, leaflets, magazines, journals)

.8 others (specify) …………………………………………………..

47.   In what area(s) of vegetable production do you mostly need additional information or advice?

.1 vegetable production [ ]   .2 storage   [ ]

.3 Preservation   [ ]   .4 processing   [ ]

.5 marketing   [ ]   .6 record keeping   [ ]

.7 use of chemical   [ ]   .8 others (specify) ……………………

48.   Give reason (s) for your choice?   .1 to increase farm income [ ]

.2 to sustain food security for the family [ ]   3 increase output [ ] .

4 be abreast with modern technology [ ].   5 others (specify) ……………

49.   What are your main sources of seeds? *(Multiple response)*

.1 seeds saved (own seed) [   ]   .2 seed dealers   [   ]

.3 another farmer   [   ]   .4 grower association   [   ]

.5 change agents   [   ]   .6 others (specify) ……………………

50.   How long have you been using this source?
    .1 Less than one year   [   ]   .2 between 1-3 years   [   ]

    .3 Between 4-6 years   [   ]   .4 between 7-10 years   [   ]
    .5 Above 10 years   [   ]

51.   Why do you choose this main source?
    .1 no other choice   [   ]   .2 good price   [   ]

    .3 good quality   [   ]   .4 proximity   [   ]

    .5 reliable source   [   ]   .6 others (specify) …………………

Financial Resources

52 What is/ are your source (s) of finance for vegetable production during last year?
    (Multiple response)

    .1 own savings   [   ]   .2 relative & friends   [   ]

    .3 bank   [   ]   .4 money lender   [   ]

    .5 NGO   [   ]   .6 co-operative/ credit union   [   ]

    .7 others (specify) ………………………………………………..

53.   How much credit did you receive last year? ………………… GH¢

54.   What did you use the credit for? ………………………………………………

55.   Do you normally pay back the credit/ loan on schedule?

    .1 Always   [   ]   .2 scarcely   [   ]   .3 not at all   [   ]

56.   What   are   the   conditions   attached   to   the   loan?
    …………………………………...

57. Give reasons for your ability/ inability to pay back the credit/ loan as scheduled?…………………………..

58. What are your major constraints in credit acquisition? (Multiple reason)

    .1 high interest rate   [   ]   .2.cumbersome processing   [   ]

        .3 No collateral security   [   ] .4. Have no knowledge of credit source [ ]
    .5 Do not think I quality for credit [   ]

    .6 others (specify) …………………………………………………….

59. Which of the following other financial service (s) do you have access?

    .1 savings products   [   ]   .2 insurance services   [   ]

    .3 housing loans   [   ]   .4 pensions services   [   ]

    .5 emergency & other private [   ]   .6others(specify)………………

Marketing Activities

60. Where do you mostly sell your vegetables?

    .1 farming gate   [   ]   .2 house   [   ]

    .3 local market   [   ]   .4 distant market   [   ]

    .5 export   .6 others (specify) ………………………………

61. Whom did you sell the vegetables to last season?

    .1 money lender   [   ]   .2 middle men   [   ]

    .3 individual consumers   [   ]   .4 exporter   [   ]

    .5 others (specify) ……………………………………………………………..

62 How far is the market (s) for the sale of your farm produce from your village? ………………………….km

Thanks for your time and co-operation

Descriptive Statistics of the Regression Variables

Table 1: Descriptive Statistics of the Regression Variables

Variable	Definition	Mean	S.d
Gend	1 if male, 0 otherwise	0.79	0.41
Age	Age of respondent (in years).	38.00	9.64
M.stus	1 if married, 0 otherwise.	0.90	0.31
N.adults	Number of adults in the household	3.17	1.53
N.child	Number of children in the households	3.34	1.52
Educ	Number of years spent in the formal education	8.29	4.17
Exp	Experience in vegetable production (in years)	11.20	6.60
Offarm	1 if engaged in off-farm/non-farm activities, 0 otherwise	0.21	0.41
L.own	1 if owned land, 0 otherwise	0.17	0.38
L.size	Land size	3.23	1.71
Fert	1 if fertilizer is applied, 0 therwise	2.10	0.84
A.agent	1 if get access to change agents, 0 otherwise	0.22	0.42
Labor	1 if labour is readily available, 0 otherwise	0.87	0.33
N.veg	Number of different vegetables produced	1.41	0.63
Oth.crop	1 if cultivates other crops, 0 otherwise	0.77	0.42
A.funds	1 if get access to financial services , 0 otherwise	0.38	0.49
F.gate	1 if sold at the farm gate, 0 otherwise	0.42	0.50
Asset	1 if owned livestock, 0 otherwise	0.61	0.49
Percept	Benefit perception index of vegetable production	1.57	0.41
Veg.income	Income from vegetable production (in percentage of household income)	62.48	24.79

APPENDIX III

Reasons for Interest in Vegetable Crop Production

Figure 1: Reasons for Interest in Vegetable Crop Production
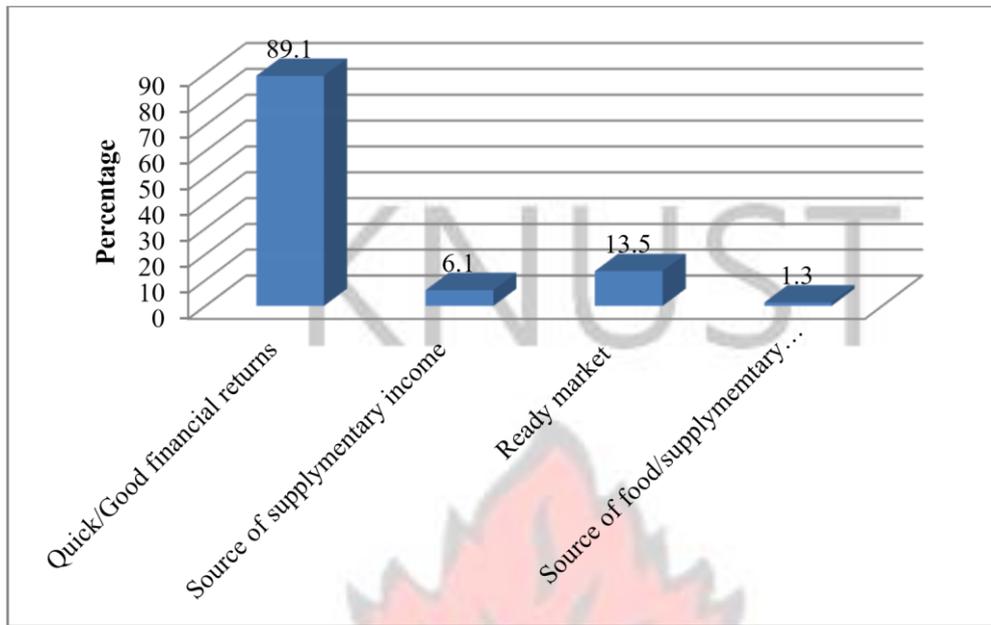
APPENDIX IV

Livestock Ownership of Respondents

Table 2: Livestock Ownership of Respondents

Variable	Category	Frequency	Percentage
Livestock ownership	Yes	141	61.3
	No	89	38.7
Types of livestock owned	House fowls	101	73.7
	Goats	64	46.7
	Sheep	61	44.5
	Cattle	2	1.5
	Pig	1	0.7
	Guinea fowl	1	0.7
	Turkey	1	0.7
Reasons for keeping livestock	Support meat requirement	103	44.8
	Support family income	127	55.2

APPENDIX V Years of Contact and Frequency of Contact with Change Agents

**Table 3: Years of Contact and Frequency of Contact with Change Agents**

Variable	Category	Frequency	Percentage
Period of contact	NR	17	29.8
	5 or less	27	47.4
	6 – 10	10	17.5
	11 – 15	2	3.5
	16 – 20	1	1.8
Frequency of contact	NR	5	8.8
	Weekly	0	-
	Fort night	4	7.0
	Monthly	29	51.0
	Quarterly	14	24.6
	Yearly	5	8.8

APPENDIX VI Access to Information by the Respondents Table 4: Access to Information by the Respondents

Variable	Category	Frequency	Percentage
Source of Agricultural information	Fellow farmers	212	93.0
	Input suppliers	115	50.4
	Market providers	36	15.8
	Radio	146	64.0
	Television	101	44.3
	Print media	4	1.8
Areas of information needs	Vegetable production	119	51.7
	Storage	26	11.3
	Preservation	10	4.3
	Processing	0	-
	Marketing	83	36.1
	Record keeping	30	13.0
	Use of chemicals	68	29.6
Reasons for information needs	Increase farm income	122	53.0
	Sustain food security for the family	134	58.3
	Increase output	50	21.7
	Abreast of modern technology	8	3.5

APPENDIX VII

Main Sources of Seeds for Vegetable Farmers

Figure 2: Main Sources of Seeds for Vegetable Farmers
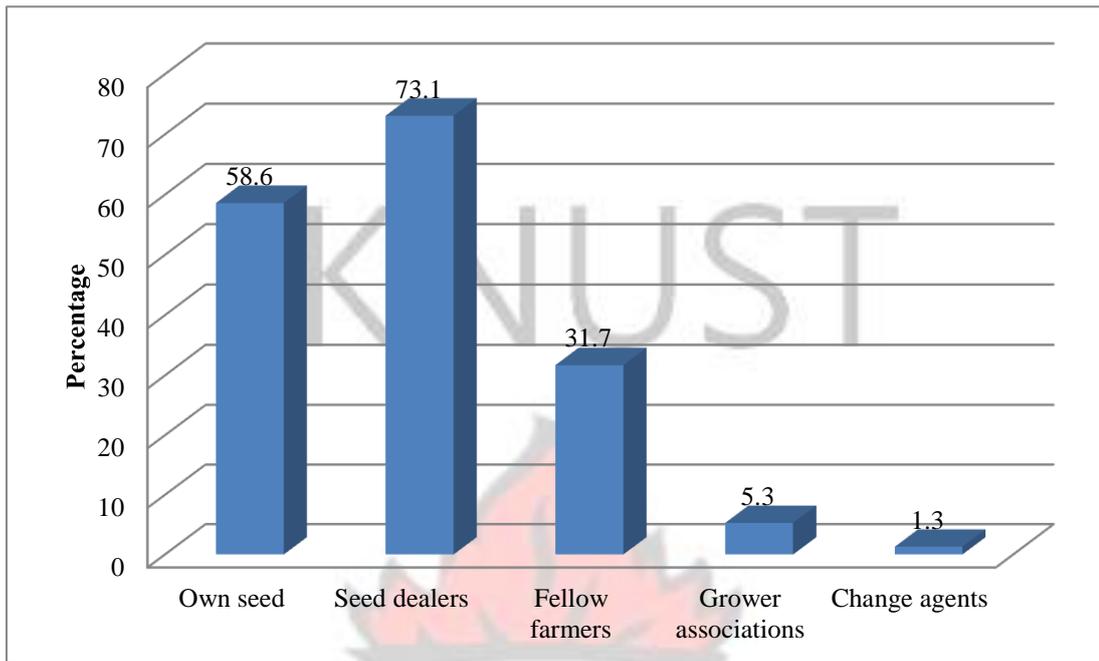
APPENDIX VIII

Annual Average Household Incomes

Table 5: Annual Average Household Incomes

Category	Amount	Percentage
Vegetables	706.45	61.19
Other Crops	307.93	26.67
Off-farm	48.26	4.18
Remittance	50.97	4.41
Other sources	40.96	3.55