CONSTRAINTS TO THE ADOPTION OF THE YAM MINISETT TECHNOLOGY IN THE NORTHERN REGION, GHANA.

BY

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DECLARATION

I, GORDON KUNATIGHR EKEKPI, do hereby declare that this research work is entirely my own endeavour, produced under supervision, and that no part has been presented for another degree elsewhere.

....

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....

Dr. P. B ATENGDEM

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To:

Monica, my beloved,

and

Naamwintome,

Naamwinkum,

Bunudon,

Ziem,

and

Naab.

NI BARKA!

NI YAANI YOO!

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ABSTRACT

The development and transfer of the yam minisett technology has the potential to be the solution to the problem of unavailability and high cost of planting material (seed yam) in the yam production industry. However, the adoption of this technology by farmers in the Northern Region has been reported as quite low.

This study was therefore conducted to determine the constraints to the adoption of this potentially useful technology.

This survey research was undertaken in four purposively sampled districts of the Northern Region, namely, East Gonja, Gushiegu-Karaga, West Gonja and Yendi Districts. By means of the purposive sampling technique, 120 farmers, the recipients of the technology, and 40 agricultural extension agents (AEAs), the technology transfer agents, constituted the sample for the study. The study employed interview schedule and questionnaire to farmers and extension agents respectively to obtain responses to specific variables to meet the research objectives. Focused group interviews and discussions were also held with representatives of all stakeholders (farmers, subject matter specialists, researchers, extension agents and agricultural administrators) in the agricultural development sector. Relevant departmental documents were also consulted to validate information gathered.

From the data, an in-depth analysis of the technology itself and the extension delivery of the technology to farmers was made. Using the farmers' criteria of quality seed yam, the technology was assessed and found to be no better alternative to the traditional seed yam production methods. The quality of seed yam produced through the technology did not meet the farmers' criteria.

The extension delivery process was observed to be such that the farmer was just but a recipient of the technology. There was poor farmer-involvement in the problem identification and diagnosis with respect to seed yam production. In this regards, the extension organisation in promoting a "production-technology" oriented approach, through its agricultural extension agents, "imposed" on farmers a pre-formulated or prescribed solution to the problem of inadequacy of planting material in the yam production sector - a problem which farmers in Northern Region did not recognise as a need.

From the analysis of the technology itself and its delivery process, a wide range of factors were noted to have contributed to its low adoption rate in the Northern Region. These constraints were catalogued into five broad categories, including Social factors, Economic constraints, Environmental issues, Institutional factors and Technological constraints.

It is therefore the recommendation of this research that the paradigm of "farmer-participatory", "problem-solving" and "demand-driven" technology development and transfer should be applied to the letter as this would be most appropriate to solving farmers' identified problems. The "production-oriented" approach may not be appropriate in addressing farmers' specific difficulties. The active participation of the target group in the technology development and transfer processes embodied in participatory technology development is crucial in enhancing the adoption of agricultural technologies. In addition, a conducive policy environment, which ensures the availability of production-enhancing inputs at affordable prices together with incentives for production, are nonetheless essential.

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LIST OF ABBREVIATIONS USED.

ADRA:	Adventist Development and Relief Agency
AEA:	Agricultural Extension Agent.
AGDP:	Agricultural Gross Domestic Product.
ARD:	Agriculture and Rural Development.
ARI:	Animal Research Institute.
ASRP:	Agricultural Sector Rehabilitation Project.
BMTRM:	Bi-monthly Technical Review Meetings.
CIDA:	Canadian International Development Agency.
CTA:	Technical Centre for Agricultural and Rural Co-operation.
DDA:	District Director of Agriculture
DDO:	District Agricultural Development Officer.
FAO:	Food and Agriculture Organisation
FLS:	Front-line Staff.
FSR:	Farming Systems Research.
GDP:	Gross Domestic Product
GEPC:	Ghana Export Promotion Council.
GGADP:	Ghanaian-German Agricultural Development Project.
GGAEP:	Ghanaian- German Agricultural Extension Project.
GGLDP:	Ghana Grain and Legume Development Board.
GTZ:	Deutsche Gesellschaft für Technische Zusammenarbeit (GmbH) (German Agency for Technical Co-operation)
ICRA:	The International Centre for Development-Oriented Research in Agriculture.
IFAD:	International Fund for Agricultural Development.
IIED:	International Institute for Environment and Development
IITA:	International Institute for Tropical Agriculture.
ILEIA:	Information Centre for Low-External-Input and Sustainable Agriculture.
IRDC:	International Rural Development Centre.
ISNAR:	International Service for National Agricultural Research.
ISSER:	Institute for Statistical, Social and Economic Research.
ISTRC-AB:	International Society of Tropical Root Crops-Africa Branch.
LEISA:	Low-External-Input for Sustainable Agriculture.

MoFA:	Ministry of Food and Agriculture.
MTADP:	Medium-Term Agricultural Development Programme.
NAEP:	National Agricultural Extension Project.
NAES:	Nyankpala Agriculture Experiment Station
NARP:	National Agricultural Research Project.
NGO:	Non-governmental Organisation.
NRCRI:	National Root Crop Research Institute.
O. A.:	Operational Area.
°C:	Degree Centigrade.
PCU:	Programme Co-ordinating Unit
PPMED:	Policy Planning, Monitoring and Evaluation Department.
RAEO:	Regional Agricultural Extension Officer.
RELC:	Research-Extension Liaison Committee.
RPCU:	Regional Planning Co-ordinating Unit.
SADEP:	Smallholder Agricultural Development Project
SARI:	Savannah Agricultural Research Institute.
SG 2000:	Sasakawa Global 2000.
SMS:	Subject Matter Specialist.
SPSS:	Statistical Package for the Social Scientist.
SRDP:	Smallholder Rehabilitation and Development Programme.
TAAP:	Tamale Archdiocese Agricultural Project.
T&V:	Training and Visit.
TOT:	Transfer of Technology
UAES:	Unified Agricultural Extension Service.
UES:	Unified Extension System.
UNO:	United Nations Organisation.

PART ONE:

BACKGROUND

CHAPTER ONE:

INTRODUCTION AND BACKGROUND

1.0: INTRODUCTION

Agriculture is facing a crisis in many parts of the developing world. In most sub-Saharan African countries, there has been a negative trend in agricultural productivity; with real increases in production having been achieved largely through expansion of cultivated land areas and increases in stock numbers (Spore, 1994). The need to increase productivity of sub-Saharan agriculture is urgent since the basic food production in many countries cannot keep pace with the growth of the population (Pickering, 1989; Dapaah, 1994). Ghana's agricultural productivity has averaged 2.1% per annum since 1985 against a background population growth rate of 2.6%-3.2% per annum (Korang-Amoakoh, Donkoh and Amoah, 1994).

Ghana depends on agriculture for economic growth and the well-being of its people. Agriculture contributes over 40.6% of the Gross Domestic Product (GDP) (Institute for Statistical, Social and Economic Research (ISSER), 1997), accounts for about 70% of merchandised exports and employs 66% of the human labour force (Dapaah, 1994). About 70% of the population lives in rural areas where they depend directly or indirectly on agriculture and related activities for their livelihood. If sustained economic growth is to be achieved, and the people enjoy higher standard of living, agriculture must become productive. This cannot be achieved without the help of new agricultural technologies for which agricultural research and extension are responsible.

1.1: BACKGROUND.

Causes of the low agricultural productivity in Ghana are many, including a deteriorating resource base of the farmer vis-à-vis astronomical price increases in basic agricultural inputs, natural hazards for example drought and bush fires, the inappropriateness of some agricultural technologies delivered, or even poor linkages between the users of the technologies - the farmers and extension services - whose responsibility it is to disseminate knowledge to farmers for improving productivity. Eponou (1996) indicated that institutionalised agricultural research and extension have not had beneficial impact on the millions of small farmers in Africa as has been expected. He further stated that yields of basic staples have stagnated, and the natural resource base progressively deteriorates under increasing pressure of population growth. The State of the Economy of Ghana in 1996 indicated that there has been a prevailing underlying deficiency in food production and supply from year to year due to poor technology, outmoded land acquisition laws, and continued reliance on rain-fed agriculture (ISSER, 1997).

To ensure food security in the Ghanaian situation, there is the need for more intensive and technologically advanced agricultural production. This calls for effective collaborative linkage between farmers on the one hand, and extension and research on the other, in the development, transfer and application of appropriate agricultural technologies.

In recent years, both research and extension have intensified efforts in developing effective linkages with their target group, the farmer. The national agricultural research systems have embarked upon on-farm, client-oriented research efforts with the goal of producing technologies that are relevant for resource-poor farmers operating in various agro-ecological zones. The Farming Systems Research (FSR) is the main methodological approach used by the Savannah Agricultural Research Institute (SARI), Tamale, and other research institutions in the Northern Region. In the same vein, the agricultural extension service of the Ministry of Food and Agriculture (MoFA) has evolved the farmer participatory approach to planning annual agricultural extension programmes. Korang-Amoakoh, et al. (1994) indicated the need for farmer-focused extension, which would assist farmers to identify farm-related problems so that they may be solved with their active involvement. These two linkages are not only complementary and vital in the development and delivery of appropriate technologies, they are also relevant in ensuring rapid feedback from farmers about technologies that have been introduced. Merrill-Sands and Kaimowitz (1990) indicated that direct links between research institutes and their clients, the farmers and technology transfer agencies - are vital for technology development and ensure rapid feedback.

However, feedback mechanisms in technology development and transfer in some cases leave much to be desired. Eponou (1996) observed that the feedback from extension agents and farmers is key to the relevance of future technologies but that this is often weak. This sometimes accounts for inappropriate technologies being developed by research and promoted by extension resulting in low and at times no adoption of these technologies.

An area of major concern to this researcher is the yam minisett technology (Okoli, Igbokwe, Ene, and Nwokoye, 1982) that has been developed and introduced to improve upon the efficiency of seed-yam production by farmers.

1.2: STATEMENT OF THE PROBLEM

Root and tuber crops constitute one of the most important staple foods in the tropical world. Dapaah (1994) indicated that no continent depends as much on roots and tubers in feeding its population, as does Africa. He further observed that root and tuber crops, mainly cassava and yam are important in the food and nutritional status of citizens in a significant number of countries in sub-Saharan Africa. Prominent among this group is yam. West and Central Africa produce and consume over ninety percent of the world's yams, a primary staple for tens of millions of people (International Institute for Tropical Agriculture (IITA), 1988/89).

In Ghana, root and tuber crop production ranks third to cereals and legumes in total annual agricultural output. Among the root and tuber crops, yam (*Dioscorea sp.*) ranks second to cassava in annual yields and it contributes 16.6% of Agricultural Gross Domestic Product (AGDP) thereby placing third to cassava and cocoa (Asuming-Brempong, 1994; Medium-term Agricultural Development Programme (MTADP), 1991). Yam is also one of the major non-traditional export crops (Asuming-Brempong, 1994). Exporters of yam have gained popularity by capturing the European markets with good quality early season white guinea yam (Ghana Export Promotion Council (GEPC), 1991). Asuming-Brempong further observed that among the horticultural crops exported, yam export comes only after pineapples in importance, both in value exported and product value. Not only is yam an important contributor to national agricultural output, it plays an important role as a food crop in many homes and an important cash crop of many farmers. Dapaah (1994) and Shirazu (1998) noted that the food deficit experienced in the country would have been drastically reduced if concerted efforts were made by all stakeholders in the agricultural sector to increase the productivity of root and tuber crops.

Over the years, the yam industry, though profitable (Acquah and Evange, 1994; Asuming-Brempong, 1994) has been adversely affected by a number of factors, notably the unavailability of planting material and high production costs which are also associated with the unavailability of good quality seed yam; among others (Acquah and Evange, 1994; Alvarez and Hahn 1984; Okoli, 1981; and Tetteh and Saakwa, 1994).

Traditionally, yam is propagated vegetatively by means of small, whole tubers, called seed yam or pieces of tubers known as "setts" (Coursey and Booth, 1977). The seed yams weigh between 500-1500 grammes and it is these that are planted to obtain large marketable ware yams. Yam planting material (seed yam or yam setts) are often difficult to obtain, expensive and at times of low quality (Akorada and Okonmah, 1982; Gbedolo, 1980). Okoli (1981) also noted that the low seed-tuber ratio in yam production is considered a major factor for the high cost of planting materials.

Due to short supply of seed yam, farmers at harvest have to reserve some portion of their yam as the subsequent season's planting material. Akorada and Okonmah (1982) asserted that between 10%-30% of the previous crop yield is stored as setts for the next season's planting. Nwosu (1975), and Ogbu and Okereke (1990) also observed that planting materials constitute at least 33% of yam production costs. This therefore reduces the amount of ware yams available to the farmer for sale or his reserves for family consumption. Madukwe (1995) observed that the traditional methods of seed yam production have some economic disadvantages as it encourages competition between edible/saleable tubers and the tubers used as planting material. Hence the farmer faces a "two-edged problem": his income in the current season is reduced if most ware yam is used for seed; and / or his income in the next season is reduced if most ware yam is sold or eaten.

To reduce the constraint of planting material and improve upon traditional seed yam production methods thereby enhancing increased food production as well as farmers' income, research developed the yam minisett technology. During the 1980s, researchers worked together to modify and popularise the minisett technology for producing high quality, low-cost and abundant planting material to relieve farmers of the traditional need to set aside one quarter of each crop to use as seed for the next. With this method farmers can produce 40,000-100,000 seed yams per hectare (IITA, 1993). While farmers would ordinarily use setts weighing 500 grammes and above, Gibe (1993) indicated that the most economic sett-size for farmers was found to be 125 grammes; and this is achievable through the yam minisett technology. Research has therefore made efforts at saving part or all tubers used as planting materials for human consumption. The yam minisett technology therefore responds to the call for more intensive and technologically advanced agricultural production to ensure food security in the Ghanaian situation.

In the Northern Region of Ghana, yam is the most widely and commercially produced root crop. The region is also the main source of supply of the crop to other parts of the country. Agricultural extension service of the Ministry of Food and Agriculture has over the years been making efforts to disseminate the yam minisett technology to yam farming communities in the region. To enhance the efforts of extension services in the light of problems faced by farmers in obtaining adequate seed yam, the erstwhile Crop Services Department with the support of the Root and Tuber Crop Improvement sub-programme of the Smallholder Rehabilitation and Development Programme (SRDP) established, in 1994, twenty-five seed nurseries in the region. Training of both front-line extension agents and farmers was also carried out extensively to man these nurseries and disseminate the technology to farmers (SRDP, 1994). However, the adoption rate of the technology has been reported as low or even nil in some communities, hence recent calls for the reintroduction of the technology in the region (Langyintuo, Eledi, Bimpong, and Asare, 1997).

The adoption of modern agricultural practices at farm level refers to the degree of use of the new technology in the long-run equilibrium when the farmer has full information about the new technology and its potential (Hailu, 1990). Literature is replete with how various factors do affect technology adoption behaviour of farmers. Akoroda (1994) observed that what is known to be practicable or applicable on-farm has not been adopted. The factors responsible for this range from poor awareness of the technology to the degree of and stability of benefits that accrue from the use of the technology. Hailu (1990) also indicated that the adoption of new agricultural technologies is determined essentially by the production objectives of the individual farmer, his decision being derived from the maximisation of the expected utility subject to, among other restrictions, his choice between traditional and modern technologies.

While Ministry of Food and Agriculture is pursuing efforts to reintroduce the yam minisett technology in the Northern Region, there is no documented evidence of the problems farmers face in adopting the technology. It is the desire of this researcher to investigate and critically examine the causes of the low adoption rate of the technology in some selected districts in the region where it has been introduced.

1.3: RESEARCH QUESTION

This study seeks to address the following questions:

i. Is the low adoption rate of the yam minisett technology due to the inferiority of seed yams produced by the technology to those produced by the traditional methods?

ii. Is the low adoption rate of the technology the result of the inappropriateness of the extension approach used to promote the technology?

iii Is the low adoption rate of the yam minisett technology due to the socio-economic environment in which the farmer finds himself?

1.4: HYPOTHESIS

The study postulates three issues causing the low adoption of the yam minisett technology:

i. The yam minisett technology is not a better alternative to the traditional seed yam production methods in the Northern Region.

ii. The extension approach used in promoting the technology is inappropriate, and,

iii. The farmers' socio-economic environment contributed to the low adoption rate of the yam minisett technology.

1.5: OBJECTIVES

1.5.1: Broad Objective

To identify and analyse the causes of the low adoption rate of the yam minisett technology by yam farmers in the Northern Region with the view of determining whether the low adoption rate is related to the farmers' perception of the quality of the technology in comparison with their traditional seed yam production methods.

1.5.2: Specific Objectives

i. To examine the method(s) of production of seed yam and availability of seed yam to farmers in the region.

ii. To find out farmers' criteria for assessing seed yam quality

iii. To determine farmers' perception of the comparative quality of seed yam produced by the traditional methods and the yam minisett technique.

iv. To identify the levels of knowledge of yam farmers about the yam minisett technology.

v. To find out the effectiveness of the method(s) of technology transfer used by extension agents for the yam minisett technology.

vi. To identify the factors that militate against the adoption of the yam minisett technology.

1.6: KEY CONCEPTS

This section defines some key concepts used in the study. These include Adoption, Technology, The Yam Minisett Technology, Technology Transfer and Technology Delivery, Innovation, and Feedback.

i. ADOPTION

This is the acceptance and continuous use or practice of an idea or skill that has been learned. The concept adoption can also be applied to the discontinuous use of the practice of new idea. Literature however, indicates adoption as comprising five sequential steps:

- Awareness: the individual first hears about an innovation.
- Interest: the individual seeks further information about the innovation he has heard of.
- Evaluation: the individual weighs up the advantages and disadvantages of using the innovation in his own circumstances.
- Trial: the individual tests the innovation on a small scale in his own situation.
- Adoption: the individual applies the innovation continuously on his desired scale. (Bohlen, 1966; Lionberger, 1968; Maunder, 1972; Rogers, 1962; van den Ban and Hawkins, 1996).

ii. TECHNOLOGY

This is the combination of knowledge, inputs and management practices which are deployed together with productive resources to produce a desired output (Reijntjes, Haverkort, and Waters-Bayer, 1992).

iii. THE YAM MINISETT TECHNOLOGY

This involves the selection of healthy yam tubers (referred to as "mother seed yam"), and cutting these into many minisetts weighing between 25 and 70 grammes, cylindrical in shape with each bearing the periderm (outer skin). These minisetts are then treated with fungicides, pre-germinated in nurseries before transplanting them on ridges in the field to produce seed yams for planting.

iv. TECHNOLOGY TRANSFER AND TECHNOLOGY DELIVERY

These generally refer to the process of bringing research results in the form of new agricultural technologies and new information to farmers and supplying research with information on farmers' needs, production constraints and feedback on the technologies (Eponou, 1996).

v. INNOVATION

This is an idea, method, practice or technique perceived as new by an individual (Adams, 1982).

vii. FEEDBACK

This refers to the response elicited from a receiver of a message that has been communicated to him. In this context it refers to the farmers' response or reaction to the technology that has been introduced to them.

1.7: THEORETICAL FRAMEWORK OF THE STUDY

A brief theoretical framework, which forms the basis of the study, is discussed in this section. The study is developed on the theoretical foundations of issues captured under the following contexts and concepts:

⇒ Adoption behaviour (of potential adopters)

⇒ Characteristics of technologies

⇒ Agencies/Agents and technology transfer/dissemination

TECHNOLOGY ADOPTION BEHAVIOUR

1.7.1 Adoption Behaviour

Literature is replete on how various factors do influence technology adoption behaviour of farmers. A number of factors influence the farmer to the extent that he accepts(adopts) or rejects the technology. Thus according to Akorada (1994), what is known to be practicable or applicable on-farm may not be adopted.

Factors responsible for this range from the degree of awareness of the technology by the farmer to the degree of and stability of benefits that accrue from the use of the technology (Hailu, 1990). He further noted that the decision of the farmer to adopt or not to adopt is conditioned by a set of internal and external factors, including the economic characteristics and technical attributes of the technology in question, as well as a range of personal and socio-economic characteristics of the potential adopter. The determinants of adoption as outlined by Hailu have earlier been elaborated in various forms by Rogers(1962); Lionberger(1968); Effionayi (1975); Swanson, Röling, and Jiggins (1984); Osuntogun, Adeyemo and Anyanwu (1985), and lately by van den Ban and Hawkins (1996).

Emanating from the various literature, and based on Hailu's (1990) Innovation Adoption Behaviour Model, the Adoption of a technology **(A_t)** can be viewed as a variable which is a function of:

- the technical characteristics of the technology **(C_t)** itself as perceived by the potential adopter,
- internal factors **(I_f)** to the potential adopter.
- external factors **(E_f)** that influence the potential adopter and the technology as well.

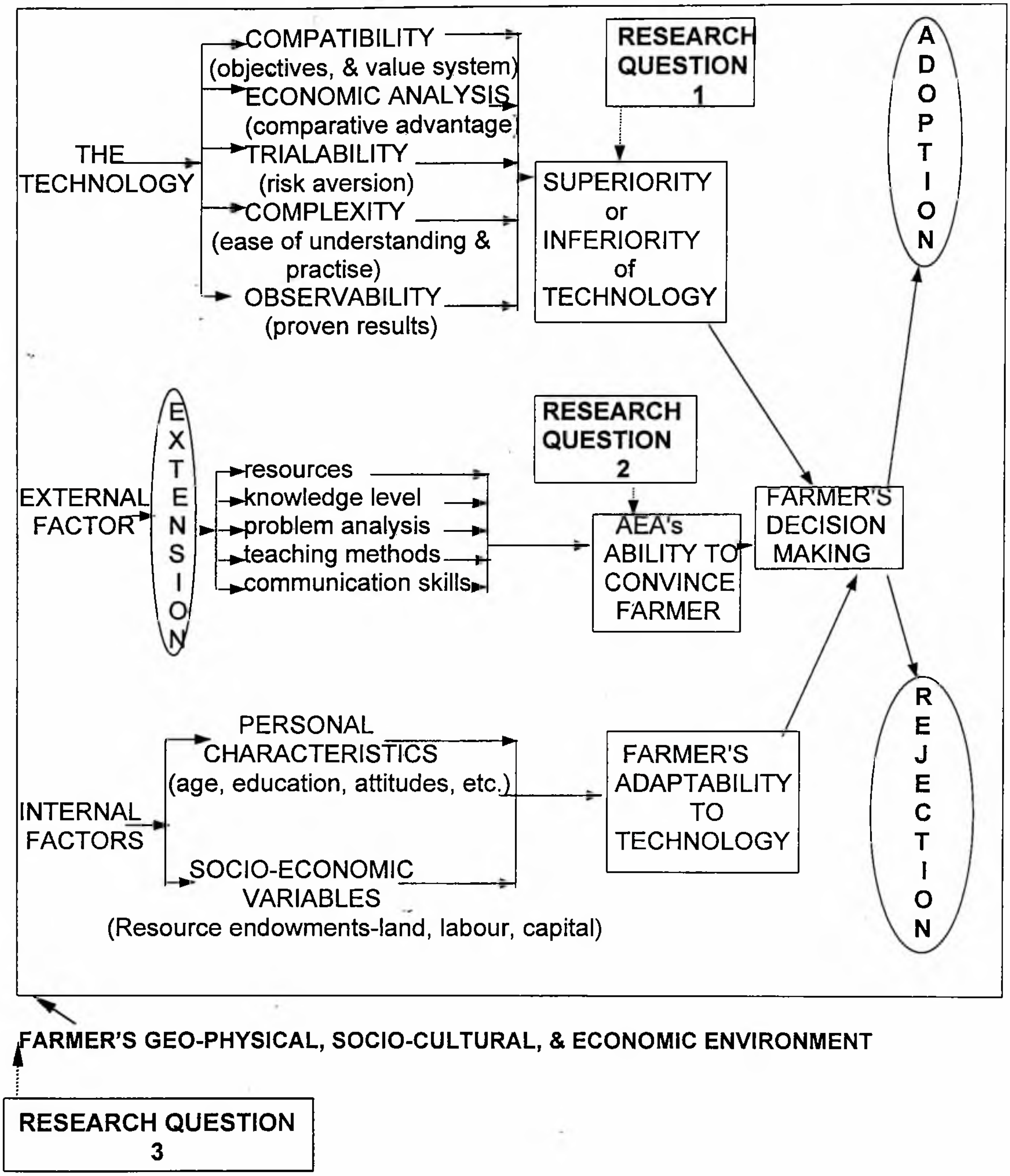
Thus:

$$A_t = f(C_t + I_f + E_f).$$

Simultaneously, the technical characteristics of a technology **(C_t)** and internal factors **(I_f)** of the potential adopter, interacting within a broad geo-physical, political, social and economic external environment **(E_f)** do influence the farmer to either accept or reject the technology that has been introduced to him.

In a diagrammatic form, the determinants of technology adoption behaviour can be illustrated thus:

TECHNOLOGY ADOPTION BEHAVIOUR MODEL.
MODIFIED FROM HAILU (1990).



The adoption or rejection of a technology is the consequence of the farmer's assessment of the technology based on its inherent characteristics vis-à-vis the impact of external and internal factors on the farmer himself. The technology adoption behaviour model is briefly described here:

A THE TECHNOLOGY

Based on the technical characteristics of the technology which include its relative advantage, compatibility, complexity, trialability and observability, the farmer may judge the technology as either being superior or inferior to what he already knows or does. His decision to adopt or reject the technology is highly influenced by the combined effect of these inherent attributes of the technology as he perceives them within the prevailing geo-physical, political, social and economic environment. Rogers (1962) stated that that the characteristics of an innovation not as seen by the experts but as perceived by the potential user is what really matters in influencing its rate of adoption.

On the basis that the inherent characteristics of a technology can influence its adoption rate, the first **RESEARCH QUESTION (1)** is asked: Is the low adoption rate of the yam minisett technology due to the inferiority of seed yam produced by the technology to those produced by the traditional methods? The farmers' assessment of the inferiority or superiority of the yam minisett technology in relation to his current practices is being sought by this research.

B THE EXTENSION ORGANISATION

The extension organisation/agent, whose responsibility it is to disseminate new ideas, practices, and knowledge to the farmer to enable him improve upon his productivity, is a major external factor influencing the farmer's decision-making with regards to his farm practices.

Within the prevailing geo-physical, political, social and economic milieu, the availability of resources to allow frequent extension agent-farmer contact for technology delivery, the agent's knowledge level about the technology being transferred, and the agent's ability to diagnose the farmer's felt need are critical factors that can enhance or inhibit the adoption of the technology. The choice of extension teaching method and the ability to communicate effectively cannot be compromised in trying to influence the adoption of technologies. Whale (1989), indicated that a technology is transferred if, a) the information is conveyed such that it fulfils a particular need of the client, and b) it can be effectively applied by the client to his own situation.

With this knowledge on the role of the extension organisation in influencing the technology adoption-decision behaviour of farmers, the **RESEARCH QUESTION (2)** is most appropriate, i.e.**:** Is the low adoption rate of the technology the result of the inappropriateness of the extension approach used to promote the technology? The farmer's decision as to adopt or reject the technology depends to a large extent on the extension agent's ability to convince the farmer. Van den Ban and Hawkins (1996) observed that the message has to be presented such that the client understands it and he is assisted to balance the advantages and disadvantages of the new practice.

C. *INTERNAL FACTORS*

Internal factors to the potential adopter, comprising the farmer's psycho-social, socio-economic and socio-cultural characteristics, influence the farmer's ability to adapt to the demands of the technology that he is exposed to; hence his decision as to either accept or reject the technology.

Psychosocial characteristics

Inherent personal variables, notably age, educational status, attitudes and interests are forces to reckon with in technology adoption behaviour by the individual. Fliegel (1984) noted that each farmer, male or female, young or old, more or less educated, is ultimately a unique individual with a host of characteristics that may well affect how information is received, processed and either used or not used in the production process.

Socio-economic parameters

Personal resource endowments of the potential adopter, including land, labour and capital, may permit the adoption or rejection of a technology introduced to the farmer depending on their availability and suitability for the technology involved. A technology may be rejected due to the inadequacy of the farmer's resources, making him incapable of meeting the requirements of the technology in question.

Socio-cultural environment

The ability of the farmer to adapt to the demands of a technology is also largely influenced by the farmer's immediate socio-cultural circumstances, notably, his norms, values and taboos which to a greater extent are also dictated by his larger social environment.

GEO-PHYSICAL, POLITICAL, SOCIAL, AND ECONOMIC ENVIRONMENT

The performance of the technology, i.e. its superiority or inferiority compared to the farmer's current practices, the agricultural extension agent's ability to convince the farmer to accept the technology, and the farmer's ability to adapt to the technology are all influenced by the prevailing geo-physical, political, social, and economic environment of the farmer.

Geo-physical environment

In examining technology adoption behaviour at the farm level, there is need to consider the constraints relating to the bio-physical environment that cause differences in the type and productivity of farming systems. Environmental and agro-climatic conditions like rainfall pattern and distribution, soil and its characteristics, as well as prevalence of pests and diseases, do influence the adoption rate of technologies. A farmer may be willing to adopt a technology but where these pose a threat or limitation to the sustainability of the practice, the technology may not be adopted. Agro-climatic conditions also do influence the economic performance of innovations.

Political and economic environment

The prevailing political and economic environment of the farmer largely affects the performance of the technology, the extension organisation and its agents, as well as the farmer's ability to adapt to the demands of the technology. Government policies, agricultural input and output market situations and the availability of credit have quite remarkable effects in this direction. The existence of suitable and efficient marketing system and appropriate government policies that continuously adapt to farmer's changing situations are indispensable in promoting the adoption of agricultural technologies. To a large extent economic policies can influence the applicability of a technology and the farmer's ability to appropriately assess the superiority or inferiority of the technology he is exposed to.

Beneficiary assessment of the extension service in Ghana indicated that the lack of well defined and articulated agricultural policies and strategies, and the lack of access to credit, among other things, contributed to the relatively low rates of adoption of technologies disseminated by extension staff (National Agricultural Extension Project (NAEP), 1997).

Social environment

The individual's larger society, with its norms, values and taboos, influences his decision to either accept or reject a technology that has been introduced to him. The superiority or inferiority of a technology as assessed by the farmer is influenced by what society with its value system adjudges it to be. The AEA's ability to convince the farmer depends on if he acts within the dictates of the farmer's social environment, conforming to its laws, norms, and taboos and giving technical recommendations that are of value to the farmer and the society at large. The farmer's ability to adapt to the technology depends on the influence of his larger social set-up on him. McCreary (1989) indicated that the individual relates to his society like a single cell to the whole organism of which it is part, therefore an attempt to change may find oneself either at odds with society that does not lend itself to change, or he succeeds in his change effort in response to the changing society to which he belongs.

With this theoretical framework, the model illustrated shows how the determinants of adoption simultaneously act in influencing the farmer's assessment of a technology thereby leading him to either adopt or reject the technology that has been introduced to him.

The possible delimiting effect of the socio-economic environment on the adoption of the yam minisett technology in the Northern Region begets the third **RESEARCH QUESTION i.e.:** "Is the low adoption of the yam minisett technology due to the socio-economic environment in which the farmer finds himself?" This seeks to find out factors that militate against the adoption of the yam minisett technology in the Northern Region.

1.8: SIGNIFICANCE OF THE STUDY

Research has played a major role in developing the yam minisett technology. If well applied this technology should ensure adequate seed production by farmers thereby enhancing, not only increased food production, but increased farm incomes in the long run. Agricultural extension agents have disseminated the technology to farmers for application. Regrettably, it has been recorded that the adoption rate of the technology in the Northern Region is low (Langyintuo, et al, 1997). While this may be indicative enough as feedback on the technology and the method of transfer employed, no research work is known to have been done in the study area to reveal the real causes of the low adoption rate of the technology. This reflects the traditional "one-way", "top-down", "take-it" or "leave-it" technology development and transfer with its poor linkage and feedback mechanism.

Souder (1980), as cited by Merrill-Sands and Kaimowitz (1990), in his study on the impact of linkage between technology developers and users on technology performance, indicated that in projects with severe linkage problems, they (the projects) failed altogether; those with mild linkage problems had partial success, while those with successful linkage had complete commercial success. Merrill-Sands and Kaimowitz (1990) also indicated that linkage problems do not only reduce efficiency, they also impair performance and diminish the impact of agricultural research and technology delivery.

Eponou (1996) observed that the lack of relevance and poor quality of technologies produced by research systems is partly due to the poor linkage between research and its clients, the farmers and extension. He further indicated that to develop relevant technologies for the client groups, research must capitalise on farmers' knowledge and obtain systematic feedback from farmers and extension agents concerning priority problems and the relevance of proposed solutions.

Gilbert, Norman and Winch, (1980), identified four major problems facing technology development, adaptation and transfer. These they indicated as: (a) the lack of knowledge and understanding of the farming systems, (b) insufficient feedback from farmers to research programmes, (c) insufficient understanding of the environment within which the farmers work, and d) the lack of mechanisms for testing and adapting technologies on farmers' fields. They noted that these problems can be alleviated by developing and strengthening extension activities in their interaction with farmers and research.

This study, it is anticipated, would therefore:

i provide adequate feedback about the yam minisett technology from farmers and extension agents to research for modification to be adaptable to the farmers' situation,

ii. provide sufficient understanding of the environmental context within which yam farmers of Northern Region operate, and

iii. provide extension service with a feedback on the impact of the method of technology transfer employed.

It is also anticipated that this would prompt a more detailed and wider investigation on farmer feedback mechanisms on this and other technologies that may suffer the same fate of low or non-adoption; thereby paving the way for more collaborative interaction between farmers on the one hand and extension agents and researchers on the other.

CHAPTER TWO:

THE NORTHERN REGION: AN OVERVIEW

2.0: INTRODUCTION

This chapter gives an overview of the Northern Region where the study was carried out. Besides the geo-physical and agro-climatic characteristics, an attempt is made at outlining general socio-economic features and agricultural development in the region. Yam production, its contribution to the socio-economic development of the region and constraints to agricultural production are discussed. Contributions to agricultural development in the region of various agricultural projects and the Ministry of Food and Agriculture (MoFA) are also highlighted.

2.1: GEO-PHYSICAL AND AGRO-CLIMATIC CHARACTERISTICS

The region's geo-physical and agro-climatic characteristics discussed include:

⇒ *location and population*

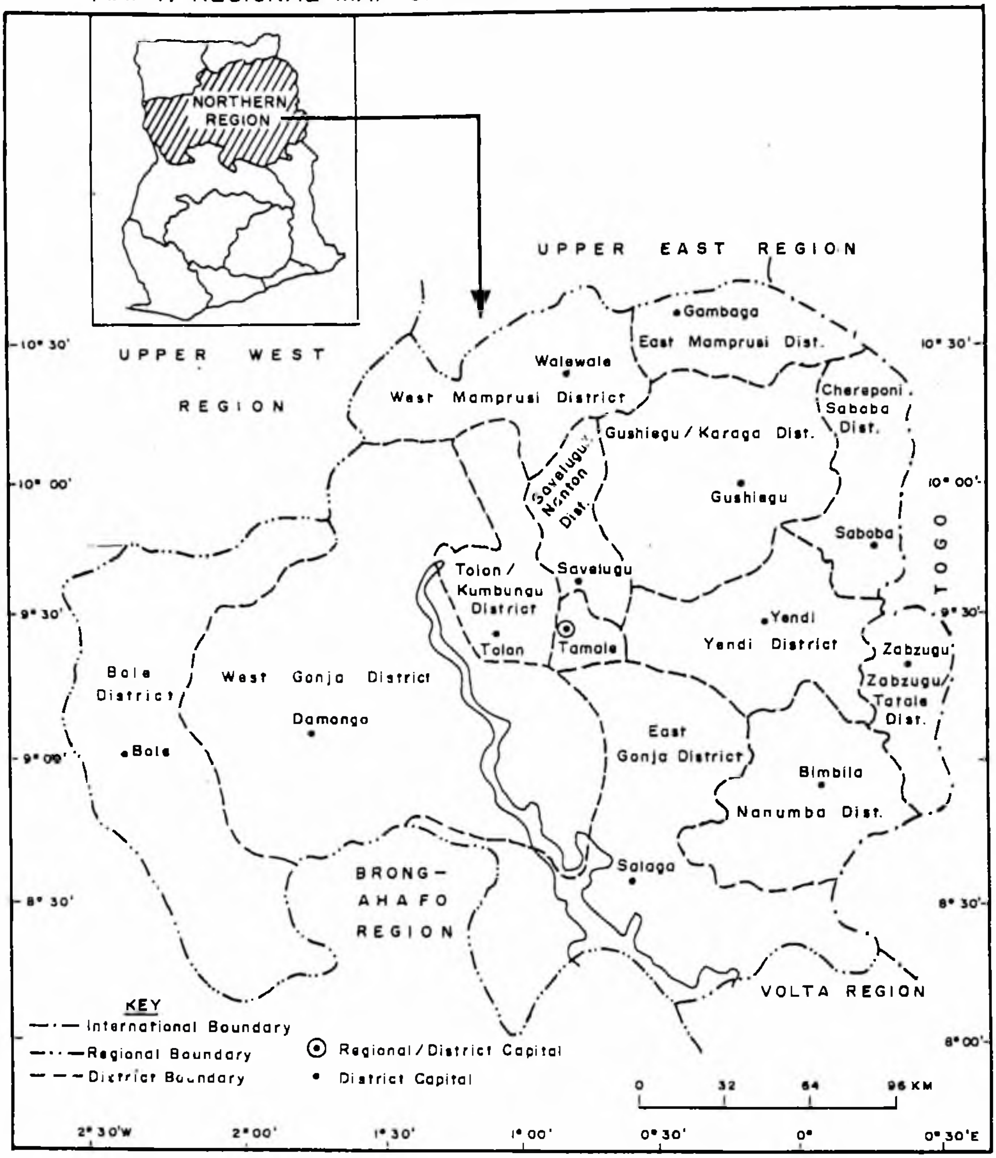
⇒ *climate and vegetation, and,*

⇒ *topography, soils and drainage*

2.1.1: Location and Population

The Northern Region lies between latitudes 8^0 15'N and 10^0 30'N and longitudes 0^0 30'E and 2^0 45'W, occupying a land area of about 70000 square kilometres. It thus occupies about 30% of the total land area of Ghana (Map 1).

MAP 1: REGIONAL MAP OF GHANA SHOWING THE STUDY AREA



Based on the 1984 population figure of 1,164,583 and a growth rate of 3.4% per annum, the region's population can be estimated to be 1.8 million in 1997. The region's population growth rate of 3.4% per annum is far above the national growth rate of 2.6% per annum (Regional Planning Co-ordinating Unit (RPCU), 1995).

The population is predominantly rural, with about 95% of all settlements in the region containing fewer than 500 people. The population distribution is quite uneven, with the density varying from some of the least densely populated areas to the western and eastern sectors with a density of 4 persons per square kilometre to over 70 persons per square kilometre in the central and some urban areas, for example Tamale-Savelugu area (RPCU, 1995).

2.1.2: Climate and Vegetation

The Northern Region lies wholly within the Guinea Savannah vegetation zone and experiences a uni-modal pattern of rainfall. The rainy season, though punctuated by drought conditions, lasts from May to September with a mean precipitation of about 900 mm (Nabila, 1988). The rainfall pattern is very erratic and unpredictable. The 5-6 months rainy season is followed by 6-7 months of dry season often characterised by bush fires and severe north-easterly harmattan winds. Lowest temperatures (about 15^0C) are recorded in December/January when the dry, cold harmattan winds blow from the Sahara Desert. Highest temperatures (about 37^0C) are experienced around March/April.

The undisturbed vegetation of the region consists of a fire proclimax tree savannah with changing species composition, going across the entire region. The vegetation cover is principally Guinea Savannah with grasses interspersed with short trees. Common tree species are *Butyrospermum parkii* (Dawadawa), and *Parkia sp.* (Shea tree) and *Bombax sp.* (Sipkens & Nabila, 1987). The vegetation is however denser to the southern sector of the region but opens out northwards.

2.1.3: Topography, Soils and Drainage

The topography of the region is described as fairly flat with gentle, undulating low relief, between 12-180m with the exception of the Gambaga Scarp (400-460m) (Food and Agricultural Organisation (FAO), 1967) to the north-eastern sector of the region. Tributaries of the Black Volta, White Volta, and Oti Rivers which flow into the Volta Lake traverse the region. About 80% of these tributaries dry out in the 6-7 month-long dry season.

Soil types of the region are generally classified as Savannah Ochrosols, with the Tinguli and Nyankpala Series found on the upper slopes. The soils of the valley-bottoms are described as Savannah Gleisols, exemplified by the Volta Series (Nabila, 1988).

2.2: SOCIO-ECONOMIC PROFILE OF THE NORTHERN REGION

The socio-economic profile of the region being discussed here includes:

- ⇒ *the role of agriculture in the region,*
- ⇒ *land ownership and tenure,*
- ⇒ *agricultural potential of the region,*
- ⇒ *farming systems, and,*
- ⇒ *gender in agriculture in the region.*

2.2.1: The Role of Agriculture

The economy of the region is based principally on agricultural production. About 90% of the population is engaged in agricultural production (MoFA, 1997), more on subsistence rather than commercial levels. The average farm holdings rarely exceed three hectares. Until recently, agricultural activities were considered as part of the culture of the people. This probably accounts for the small nature of the farm holdings. Producing food for the household is the primary objective of the smallholder farmers in the region. However, the sale of agricultural produce has more than a residual function as the household members have cash needs. Odonkor (1994) observed that the distinction between consumption crops and cash crops is not dramatic, because production levels of all crops leave a significant surplus for sale.

2.2.2: Land Ownership and Tenure

All lands in the Northern Region except those acquired by government are vested in the hands of the chiefs, the traditional rulers/heads of the area. Direct ownership is in the hands of clans, families, and individuals. Land tenure is characterised by communal ownership whereby natives derive their landuse rights through birth into the community (Nyankpala Agricultural Experiment Station (NAES), 1989). Access to land is through inheritance or lease and the conditions of lease vary from one traditional area to another. Non-natives can obtain usufruct rights from the village chief or the elders. Usufruct rights to land do not automatically include the right to economic trees like the dawadawa and shea trees. In the Northern Region, customary law does not allow women to own land (NAES, 1989).

2.2.3: Agricultural Potential of the Region

The Northern Region is endowed with unique characteristics, giving it a comparative advantage over other regions in the agricultural production sector. Some of these characteristics include:

- large arable land with relatively uniform vegetation cover,
- generally flat land with gentle undulating relief, suitable for both hand and mechanical cultivation,
- various soil types suitable for a variety of cereals and other crops, and.
- a strong virile and large labour force (RPCU, 1995).

But for the high population density of the urban and peri-urban mid-portion of the region, extreme pressure on land common elsewhere in Ghana, is unknown in the region.

In spite of the unreliable, erratic rainfall pattern often punctuated with drought conditions experienced, these unique features of the region permit a large portion of Ghana's food grains to be produced in the region (Kasei & Afuakwa, 1991). A large proportion of the nation's millet, sorghum, rice, yam, and food legumes and also some amount of maize are produced in the region. The region leads all other regions in annual cereal crop output, hence it is often referred to as the "grain basket" of the nation. For crops like cotton, rice, yam, and shea-nuts, the region produces more than half of the national output (RPCU, 1995). However the erratic rainfall pattern sometimes results in low crop yields leading to food shortages.

The Guinea vegetation cover makes Northern Region amenable to the raising of all classes of livestock and poultry. The average farm family raises various types of livestock and poultry. These include cattle, sheep, goats, poultry and guinea fowls. According to Runge-Metzger and Diehl (1993), the traditional role of livestock indicates that different species serve various purposes in the household. While cattle are kept in order to meet expensive cash outlays (e.g. funerals), accumulate wealth, and insure against crop failures, small ruminants (sheep and goats) are sold to equalise fluctuation of annual income, satisfy immediate cash needs, and greet important relatives and authorities. Poultry on the other hand are used for welcoming visitors and as presents for relatives, for religious sacrifices, and generate smaller denominations of cash needs. Northern Region, together with the Upper-East and Upper-West Regions as Northern Ghana, supply the rest of the country with livestock and livestock products (Atengdem, 1997).

2.2.4: Farming Systems

The main farming system prevailing in the region is mixed farming. Besides crop production the average farm family raises a wide variety of livestock and poultry as indicated in Section 2.2.3. With regards to crop production, semi-permanent to shifting cultivation is practised in the eastern and western sectors of the region where land is not yet a constraint due to the relatively low population density. Permanent cultivation is rather common to the mid-portion and peri-urban zones where the population density is relatively higher. Major crops under cultivation in the region include: sorghum, millet, maize, groundnuts, cassava, yam, rice, cowpea and cotton.

Mixed cropping is dominant in both shifting and permanent cultivation situations in the region. Over 90% of all crop cases are cultivated in mixtures (Hailu, 1990). This, besides making maximum use of land space, obviously is in response to the erratic rainfall pattern, since the average farmer would wish to avoid total crop failure. While two crop mixtures are most common, three crop mixtures, for example sorghum/maize/cowpea, can occasionally be observed.

Sole cropping activities in the region are the relatively large commercial rice and maize farms. While the maize farms are often sited along major routes and around urban settlements, commercial rice farms are located in the valley basins of tributaries of the Black Volta, White Volta and Oti rivers, for example the Nabogu, Katanga and Nasia valleys. These commercial farms are owned by wealthy businessmen and civil servants from the cities who have access to credit and inputs like fertiliser (Nabila, 1988). Commercial yam farms can also be found in the sparsely populated southern sectors of the region, but more often than not, they are inter-cropped with cassava.

To a greater extent, agriculture in the Northern Region is predominantly smallholder, traditional, and rain-fed. Most farming practices involve the traditional labour-intensive type characterised by the use of the hoe and cutlass. However, animal traction is on the increase while mechanised farming is limited to the few businessmen and civil servants who engage in commercial rice and maize production.

2.2.5: Gender in Agriculture.

In the Northern Region, like the rest of the country, men head most farm-families and they make major decisions about agriculture in the family. There are however woman-headed households in special circumstances (e.g. loss of spouse) and in such cases the women make decisions.

Though customary laws in the Northern Region do not allow women to own land, both men and women undertake agricultural activities. Women play a vital back-up role in providing assistance on men's farms. They participate in all farming tasks and are given a portion of the produce in return. However, there appears to be a clear role division in these activities. While women are involved in planting, harvesting, handling, processing and marketing of agricultural produce, field preparation for cropping and other high energy-demanding operations are the preserve of men.

In another dimension, while men may be concerned with staple and cash crop production, women do the cultivation of some specific staples. On women's farms, priority is given to those crops which will serve as soup ingredients for the household cooking for example, okro, pepper, groundnuts, leafy vegetable crops, bungu and neri. Any surplus is sold as the need arises, since cash is rarely kept for more than a few days (Odonkor, 1993).

Generally, women contribute over 60% of the labour requirement for agricultural production in the farm family. In the country as a whole, it is estimated that 70% of food is produced by women (MoFA, 1989).

In the livestock sector, both sexes may be involved but it is the preserve of the man to stand as owner of the livestock and poultry of the family. It is he who takes major decisions on their sale. He engages in their being marketed, but proceeds are given to the rightful owner who pays him a compensation (Atengdem, 1997). While the men are more concerned with cattle rearing, the women prefer small ruminants and local poultry keeping. Odonkor (1994) noted that the sale of livestock is heavily relied upon to supplement the financing of supplementary foodstuff and farming inputs. It is an accepted part of the survival strategy of most households in the Northern Region. The sale of livestock is an indicator of a precarious financial situation of the household.

2.3: YAM PRODUCTION IN NORTHERN REGION.

Root and tuber crops play a key role in the world's food supply. Dapaah (1994) observed that they are important in the food and nutritional status of citizens in a significant number of countries in sub-Saharan Africa. Among the roots and tubers grown in Africa and West Africa in particular, yam ranks second to cassava in output levels. In Ghana, roots and tubers, mainly cassava, yam and cocoyam, constitute nearly 55% of Agricultural Gross Domestic Product (AGDP) (ISSER, 1997), and the calorific content of the diet of the rural population (Rep. of Ghana, 1992). Roots and tuber crops therefore play a major role in food security in Ghana. Yam specifically contributes 16.66% to AGDP (MTADP, 1991; Asuming-Brempong, 1994).

Yam production trends in Africa indicate that between 1960 and 1977, there was a gradual increase in production; and Ghana was one of the major exporting countries. Production however began to fluctuate from 1977 to 1980, with a steady decline afterwards (Langyintuo, 1989).

The role of yam in the household

In the Northern Region, yam production far exceeds the production of all other root and tuber crops. The primary role of yam production in the Northern Region is to provide food for the household. Chandra (1994) observed that because some yield components of tropical root and tuber crops can be harvested and consumed from about half way through their crop duration, they are potentially able to supply food for over a long period during crop growth, a very desirable characteristic for subsistence and semi-subsistence smallholders. Both at the first harvest, where early-maturing varieties are “milked”, and at the second (final) harvest, yam is a major source of food supply to the average household in Northern Region. The first harvest, according to Langyintuo (1989), is crucial as it serves as food to bridge a hunger gap that often occurs between June and August.

The second role yam production fulfills in the region is the provision of income to meet the cash demands of the household. The sale of agricultural produce in the region has more than a residual function since the household members have cash needs which they have to meet. Yam ranks second to cotton as a commercial crop in the region. Besides providing food for the farm household, yam farming has been substantially commercialised, with over 50% of the regional output being transported and sold outside the region. Runge-Metzger and Diehl (1993) observed that since long, a well established marketing chain exists to the south of Ghana. For the last three years annual total acreage for the region ranged between 3500 and 4000 hectares while productivity ranged from 10.3 to 10.9 metric tons per hectare (MoFA, 1997).

Yam cultivation is also closely bound to local tradition and culture, hence the existence of the yam festival observed annually by the indigenous people. By this festival, the first harvest (milked yam) is offered to the "gods" of the family as thanksgiving for having witnessed the beginning of a "new" year. In the yam zone of Africa, yam plays a vital role in traditional culture, rituals, and religious life of the people (Hahn, Osiru, Akorada, & Otoo, 1995; Langyintuo, 1989).

Regionally, yam production is mostly by the individual smallholder with an average hectare of about 0.25, which represents about 5.3% of total cropped area (Langyintuo, 1989).

Yam Production Systems

Two distinct yam production systems can be observed in the region. In the sparsely populated sections of the region, notably Salaga, Bimbilla, Zabzugu and Damongo areas, farmers practise the bush fallow system since virgin and long-fallow lands are known to be suitable for yam. Acreages cultivated here far exceed the average for the region mainly due to the availability of large arable land with low population density. In the rather densely populated mid-portion of the region, around Tamale and Savelugu, acreages cropped to yam are much smaller due to pressure on land; and the holder practices crop rotation. In this area, yam is rotated with grain crops and it is mostly the first in the rotation cycle.

It may even be intercropped with cereals and legumes, with cassava often planted as a border crop.

Land clearing and mounding for yam production in the region often starts with the residual rains of the preceding season, around October. Where the farmer fails to raise his mounds before the soil dries up, mounding extends to the onset of the first rains of the ensuing season. Planting of setts and capping (mulching) is done soon after the desired number of mounds is raised. Field sanitation and maintenance in yam generally involve weeding and staking. For the fairly large holdings, staking is rarely done; but it is done on smaller holdings depending on the availability of staking materials.

Seed yam production

Yam production is principally by two main methods: the tapping (sometimes referred to as "milking" or the "first harvest" or the "double harvest") and the non-tapping methods. The two methods are practised simultaneously on the same field. With the first, the objectives of the farmer are three-fold: first to provide food; second to produce seed yam for the subsequent season. This second objective is often the dictating factor as the farmer has to ensure he gets seed yam for the next season; and thirdly to provide income. According to Langyintuo (1996), the savannah ecosystem being a less food secure zone, farmers considered the provision of early season food to bridge a hunger gap between June and August an important advantage of the double-harvesting system of yam production. Other advantages of the method enumerated by Langyintuo (1996), include availability of more seed yam, more income (to enable the farmer meet farm input and other farm operation costs), and the availability of whole tubers for planting, in descending order.

The tapping system, specifically for early maturing varieties, is the main method by which seed yam is produced in the region. It involves harvesting the developing tubers - which can be used for food or sold, while the plants are earthed up to generate smaller tubers to be harvested as seed (the second harvest) at the end of the season. This conforms with Nwosu's (1975) description of the traditional seed yam production method.

In the Northern Region, tapping or "milking" of yam occurs between July and August, but this depends on the rainfall pattern. The farmer would normally not tap his yam crop when there is a dry spell. In this situation, the farmer in an effort to secure seed yam, cuts up ware yam into 200-500 gram sizes which he cures by burial in the mound till harvest. Thus, besides the double harvesting method, small tubers from multiple tubering varieties as well as cuttings made from late maturing yam varieties serve as seed yam for the subsequent season.

It is however normal to have reported cases of seed yam shortage after a poor rainfall distribution. In the non-tapping system, a single harvest is made at the end of the season. Ware yams are harvested along with the seed yam (second harvest) of the tapping system.

2.3.1. Gender Role in Yam Production

Yam production is labour-intensive. Thus it is noted to be the preserve of men. However, women contribute over 50% of labour in the yam production cycle. They provide labour that does not demand much physique. At the land clearing stage, women are responsible for burning unwanted shrubs and trees which would otherwise shade the yam crop. The killed trees do serve as stakes for the crop. At the planting stage women distribute seed yam on the mounds for the men to plant. While they may not directly harvest the yam crop, it is the women who cart the yam produce by head portage to the storage site and home. Women do the sale of yam on small-scale basis for the household. Large-scale yam marketing is done directly by men who transport the yam by hired trucks to larger cities for sale or the yam is sold through middle women.

2.3.2. Constraints to Yam Production in the Region:

Most of the arable land of the region is amenable to yam production. There also exist a great demand for the crop both for local consumption and for export outside the region; but the high cost of production is the major limiting factor. In his study, Langyintuo (1996) noted that yam farm-sizes are limited by general cash flow problems, availability of seed, availability of labour, and suitable land for yam cultivation in the savannah zone.

Yam production, on the whole, is more expensive than the cultivation of other root and tuber crops. Coursey (1967) observed that in Ghana 55-67 man-days are required to produce a ton of yam. In the Northern Region, yam cultivation is the most labour-intensive crop enterprise. Total labour requirement amounts to

255 man-days per hectare with soil preparation and harvesting accounting for nearly 60% of the labour (Donhauser, Baur, & Langyintuo, 1992). Onwueme (1994) also noted that one of the most severe constraints to the yam production system is the amount of labour and tedium required to produce the crop. He indicated that from land preparation to harvest, yam cultivation entails little application of scientific principles but manifests an art form handed down from progenitors. Yam production system is replete with unscientific labour-intensive practices. Labour is expensive but rather unavailable at the peak periods of the yam production cycle, - land clearing and mounding stage (Tetteh, and Saakwa, 1994). Towards the end of the season most of the youth do migrate outside the region in search of jobs only to return at the onset of the rains for the ensuing season.

Availability and cost of seed yam is the second major constraint to yam farmers, especially for the beginner. Seed yam multiplication ratio by the traditional method is low - 1:4 to 1:8 as reported by Alvarez and Hahn (1984), though laborious, time-consuming, and demanding a lot of skill (Gyansa-Ameyaw, 1987). Yam planting material as a constraint to yam farming is inherent in its high cost as a factor of production. According to Okorji and Obiechina (1993), seed yam cost constitutes up to 62% of total outlay in south-eastern Nigeria. Acquah, and Evange (1994) observed that the tapping method is inherent with extra costs due to the double harvesting and maintenance; and where portions of ware yams are used as seed, it potentially reduces the output of ware yams which would otherwise have been available for consumption or sale. The traditional seed yam production methods have some economic disadvantages as it encourages competition between edible/saleable tubers and the tubers used as planting material (Madukwe, 1995). Tetteh and Saakwa (1994) stated that any new technology that would provide cheap planting materials (...and reduce human labour) to farmers would greatly increase yam production in Ghana.

Reducing the constraints of planting material through rapidly producing cheap and healthy planting material by the yam minisett technology will take advantage of opportunities to expand yam production in the Northern Region.

Other problems encountered by farmers in yam cultivation in the region include finance (lack of credit), unreliable weather conditions, poor storage facilities resulting in damage by stray animals, pests and diseases, as well as marketing problems due to inaccessibility of production centres due to poor road network within the region.

Dapaah (1994) noted that if Ghana were to be able to increase the productivity of roots and tubers from five tons per hectare to eight tons per hectare as contained in the Medium Term Agricultural Development Programme (MTADP) through the collective and co-ordinated efforts of all stakeholders in agricultural development, there would have been significant reduction in the food deficit that the country is now experiencing.

2.4: AGRICULTURAL DEVELOPMENT IN THE NORTHERN REGION

In spite of the proven and potential resources in agriculture, the Northern Region lags behind other regions in socio-economic development; and it remains amongst the least developed regions in the country (RPCU, 1995). In an effort to enhance agricultural development, which is the main contributor to the socio-economic development of the region, various programmes, government and quasi-government, as well as parastatals continue to be launched. Initial efforts in the early 1970s advocated mechanised and commercial rice and maize farming. These efforts failed as they tended to benefit the "petty bourgeoisie in power" rather than the peasant farmer (Atengdem, 1997). Obimpeh (1997) also indicated that these early agricultural schemes were ad hoc, inadequate and inconsistent with micro-economic, fiscal, trade and commercial policies, and tended to favour urban dwellers at the expense of our rural people who are responsible for the bulk of agricultural production on which our national economy depends. Nabila (1988) earlier noted that these commercial farms were owned by wealthy business men and civil servants from the cities who had access to credit and farm inputs such as fertiliser.

To redress the situation, most agricultural programmes were redesigned to involve a more comprehensive integrated agricultural and rural development approach with a focus of improving the productive capacity and incomes of small farmers.

Specific projects/programmes launched within the region include:

- The Ghanaian-German Agricultural Extension Project (GGAEP) (1989-1994): this was a follow-up to the Ghanaian-German Agricultural Development Project (GGADP, 1974-1989), a sequel of the Ghanaian-German Fertiliser Project - Northern and Upper Regions (GGFP, 1970-1974).

- The Smallholder Agricultural Development Project (SADEP) (1996-2000): a follow-up to the Smallholder Rehabilitation and Development Programme (1988-1996): funded by the government of Ghana and the International Fund for Agricultural Development (IFAD).

Other projects of rather nation-wide dimension that the region benefited from include:

- Sasakawa Global 2000 (S.G. 2000) (1986, on-going): sponsored by an international Non-governmental Organisation (NGO).
- Ghana Grain and Legume Development Board (GGLDB) (1979-1996): sponsored by Canadian International Development Association (CIDA).
- Agricultural Sector Rehabilitation Project (ASRP) (1987-1989): sponsored by the World Bank.
- National Agricultural Extension Project (NAEP) (1992, on-going): sponsored by the World Bank.

Multiple and diverse as the aims of these projects/programmes were, their primary objective alongside that of the Ministry of Food and Agriculture through which their extension components were operated was to achieve sustained increase in agricultural production and improve the incomes of smallholders through enhanced adoption of agricultural technologies suitable to their agro-ecological environment and socio-economic conditions.

A number of Non-governmental Organisations (NGOs) do also play a major role in enhancing agricultural development in the Northern Region, though in most cases they may be district, community, or area specific. Notable amongst these are:

- Tamale Archdiocese Agricultural Project (TAAP): run by the Catholic church
- Presbyterian Agricultural Stations (Mile 7-Tamale,and Langbinsi)
- E. P. Church Agricultural Programmes (Yendi, Saboba and Chereponi)
- Action Aid: a British NGO
- Adventist Development and Relief Agency (ADRA): a church project.
- Agricultural Rural Development (ARD): an Iranian NGO dealing with subsidised credit-based tractor services to farmers.

2.4.1: Agricultural Research in Northern Region:

The region has witnessed extensive promotional research in agriculture carried out by the Savannah Agricultural Research Institute (SARI) formerly Nyankpala Agricultural Experiment Station (NAES) and the Animal Research Institute (ARI) both located in Nyankpala. Research was formerly geared towards breeding new varieties of crops and animals to increase production.

In recent years, however the focus of agricultural research has changed, leading to some research being conducted on farmers' fields. Subedi (1997) indicated that traditional knowledge is often neglected in agricultural research and development, and the price paid for this omission is that new technologies are often adopted with little enthusiasm and resolve. Since the early 1990s, agricultural research institutions have been using Farming Systems Research (FSR) tools as their research methodology with the aim of identifying problems together with the beneficiaries and seeking solutions to these problems together.

In 1993, the Farming System-Oriented Agricultural Research in Northern Ghana was established as a project in the Savannah Agricultural Research Institute (SARI).

The objective of the project was to develop more efficient agricultural research system in order to increase adoption of agricultural innovations, thereby contributing to the overall goal of increased agricultural production and productivity and the establishment of the natural resource base for sustained production (Helmut & Bisset, 1996). In this regards, SARI and other research institutions in the region adopted Joint Annual Planning Sessions, involving all stakeholders in agricultural development, including farmers, MoFA personnel and NGOs, as the main problem identification process in addition to formal and informal surveys conducted by research staff and reports from MoFA and NGOs.

2.4.2. Agricultural Extension in Ghana

Agricultural extension in the Northern Region, like the rest of the country, is offered mainly by government with some NGOs supplementing the efforts of the government. Under the government system, two broad categories are identifiable: the general agricultural extension service operated by the Ministry of Agriculture, and Non-governmental Organisations and Projects; and the specialised extension service for cotton-the main cash crop in the region, which is operated by the Ghana Cotton Company, a parastatal.

For the purpose of this research, an overview of the general extension system from the national perspective is made.

Agricultural Extension Delivery in Ghana: An Overview:

The Agricultural extension service has been an active feature of agricultural development in Ghana since the early 1900s (Rep. of Ghana, 1992). It has however, undergone several changes and transformations since independence, obviously in response to changes of governments, policy directives and the farmers' demand for technical knowledge. From independent, uncoordinated extension activities as pertained in collectivised agricultural organisations, to multi-departmental approaches to extension, interspersed with bilaterally and multilaterally sponsored agricultural projects, agricultural extension service in Ghana has since 1992 assumed a unified agricultural extension system using a Training and Visit (T&V) management tool under the National Agricultural Extension Project (NAEP). The primary objective of this system is "to achieve sustained increases in agricultural production and improve upon the nutrition and incomes of smallholder households through enhanced adoption of technology using one front-line agent who has been multidisciplinarily trained" (Korang-Amoakoh et al., 1994).

Pre-NAEP Era

Prior to the Unified Extension System (UES), extension planning and delivery was perceived as the sole responsibility of officials of the Ministry of Agriculture. Agricultural extension personnel, guided by targets set at the national level, determined what was needed to address farmers' constraints which were equally perceived and identified by same (i.e. the planners). Agricultural extension programmes were planned at national headquarters in consultation with Regional Agricultural Extension Officers (RAEOs) and executed at district level by district and village extension officers (Rep. of Ghana, 1992). At the operational level, the extension agent was involved in multidimensional roles, including an advisory role, credit administration and recovery, produce marketing and other social services such as farm input distribution.

Involvement of the target group in extension programme planning was viewed as an unimportant. The farmer was seen as a receiver of technologies to improve upon his productivity. In an earlier observation, Twum-Barimah (1977) indicated that agricultural plans and programs had not been produced with the involvement of the people whose lives were to be affected as a result of the execution of those plans. Frémy (1994), in his observation about sub-Saharan extension service, noted that farmers were not considered as clients or partners but people who had to be instructed, hence the 'top-down' extension practices were common to most public and parastatal extension systems.

Modified T&V System of Ghana

The National Agricultural Extension Project (NAEP) brought a change in approach to extension delivery in Ghana. There was a shift of opinion with regards to the centre-biases of extension. One of the specific objectives of NAEP was to increase the involvement of farmers in defining agricultural extension programmes and setting priorities in adaptive research. Korang-Amoakoh et al. (1994) indicated that there was the need for farmer-focused extension that would assist farmers to identify farm-oriented problems so that they could be solved with the farmers' active involvement.

Obviously this change in view on the role of extension in the extension delivery process was to ensure the delivery of technologies most appropriate to farmers' situation and needs thereby promoting adoption of the technologies. Frémy (1994) stressed that there is the need to listen to and learn from farmers, to assess their practices, identify their needs, and find solutions that are relevant to farmers' needs and constraints. Increasing farmers' involvement in the development of strategies to address their difficulties that have been collaboratively diagnosed, improves the efficiency of the extension delivery process (FAO, 1994).

The T&V management tool adopted by the NAEP emphasised field and farmer oriented extension activities. Extension agents must attempt to understand farmers' production conditions and constraints in order that appropriate recommendations are formulated (Benor & Baxter, 1984). This new approach therefore emphasised a shift from the traditional "supply-driven", "supervisory", "top-down", "technology-packaged" extension delivery system to a system that is "demand-driven", "bottom-up", "farmer-determined" and "participatory" (Rivera, Seepard & Pletsch, 1989).

Besides the field and farmer oriented extension service that the T&V management tool of NAEP emphasised upon, Benor and Baxter (1984) enumerated other characteristics of the extension service to include:

- Single-line of command: the extension service operates under a single line of technical and administrative command, contrary to the multi-departmental approaches to extension.

- Concentration of effort: The multiple tasks that the extension agent used to perform including administration and recovery of credit, input supply and market information provision were all relinquished to allow for concentration of effort on extension technology delivery.

- Time-bound work: messages and skills are taught to farmers in a regular, timely fashion to permit the best use of resources at the farmers' disposal.

- Regular continuous training: Extension field staff undergo regular and continuous training by Subject Matter Specialists (SMS) on monthly basis to teach and discuss specific production recommendations required by farmers.

- Linkages with research: At seasonal and monthly workshops as well as joint field trips, extension and research personnel with farmers diagnose production constraints and evolve appropriate recommendations that are adopted by extension workers to make the best use of the local specific environment and farmers' resources.

Agricultural extension planning and delivery under the NAEP was therefore decentralised into five agro-ecological zones; with the establishment of Research-Extension Liaison Committees (RELCs) as supervisory and implementing bodies. The RELCs comprise personnel from agricultural research institutions in the respective zones, Ministry of Food and Agriculture, as well as representatives of identifiable farmers' groups/organisations, agriculture-related NGOs and agricultural input marketing firms.

The objectives and tasks of each RELC include:

- to review the performance of extension during the previous year, including adaptive trials and the farmers' response to these,
- to review the extension programme and develop pre-seasonal training programme for the front-line staff (FLS),
- to assess the relevance of extension recommendations and farmers' response to them,
- to select resource persons for SMS workshops and assess their performance,
- to review research programmes of research institutions in the zone in line with the farming systems and adjust where necessary,
- to review the implementation of adaptive trials under the National Agricultural Research Project(NARP) in the zone and address problems on the ground, and
- to organise Bimonthly Technical Review Meetings(BMTRM) and AEA training programme according to felt needs.

2.4.3. Agricultural Extension in Northern Region

Alongside the national agricultural policy and the extension delivery system outlined, agricultural extension planning and delivery in the Northern Region assumed a holistic approach. Constituting Zone II of the five agro-ecological zones into which the country has been divided under NAEP, the region has since 1994 had in place the Research - Extension Linkage Committee (RELC) which oversees annual joint planning and review of research and extension activities which will enhance easy flow of information from research to extension and vice-versa. This also has given room for the participation of all sectors of the farming communities in the region including farmers, NGOs, agriculturist from MoFA, research and agricultural institutions of higher learning in planning agricultural programmes for the region. These institutions and farmers' representatives have been actively involved in problem identification, analysis and research approaches to be used in finding solutions to identified problems.

The strong participation of all stakeholders in agricultural development demonstrate the importance attached by all to the quest for sustainable solutions to farmers' problems which hinder agricultural productivity (Langyintuo, et al., 1997).

The planning of agricultural extension programmes in the northern agro-ecological zone like the rest of the country occurs in four stages:

- Operational Area (OA) level planning: at this level, the responsible agricultural extension agent(AEAs) with his farmers collaboratively analyse their farming situation and arrive at constraints to productivity.

District Level Planning: The District Director of Agriculture (DDA) together with the District Agricultural Development Officers (DDO) and all agricultural extension agents and farmer representatives collect and collate farmers' constraints identified at the front-line operational level.

- SMS Centre Level Planning: The Northern Region as an agro-ecological zone has been subdivided into six Subject Matter Specialist (SMS) centres. The SMS centre may comprise one or more contiguous agricultural districts. These include:
    1. Tamale SMS Centre: made up of Tamale, Savelugu/Nanton, and Tolon/Kumbungu Districts,
    2. Walewale SMS Centre: West Mamprussi, East Mamprussi, and Gushiegu/Karaga Districts,
    3. Yendi SMS Centre: Yendi, Saboba/Chereponi, and Zabzugu/Tatale Districts,
    4. Salaga SMS Centre: East Gonja, and Nanumba Districts,
    5. Damongo SMS Centre comprising West Gonja District, and
    6. Bole SMS Centre made up of Bole District.

Each SMS Centre has a full compliment of Subject Matter Specialists (SMSs) from the relevant agricultural disciplines. At this level of planning, DDAs, SMSs, DDOs, and AEAs together with farmers draw up the agricultural extension program for the centre. An important outcome of this planning stage is the training need requirements of the AEAs to enable them address problems identified at the operational area (O. A.) level.

- Zonal Level Planning: The RELC, comprising representatives of all stakeholders in agricultural development in the region as a whole - farmers, agricultural-related NGOs, agriculturists, researchers, agricultural institutions of higher learning - reviews the preceding performance of the extension programmes, collate and fine-tune current extension programmes developed from all six SMS centres for the purpose of condensing them into a zonal plan within which the ensuing annual extension training programmes and activities are outlined for the zone.

The zonal level plan therefore stands as a blue print for all agricultural activities in the region-notably monthly training topics on which agricultural extension agents are trained. This is the basis for extension message delivery for the year. On-farm adaptive trials aimed at developing appropriate technologies to improve upon the farming systems of the region are also an important component of the zonal agricultural extension and research programme.

Through this four-tier programme planning process, RELC facilitates the flow of information between research and extension and the vice-versa; while aiming primarily at ensuring increased farm-level productivity through development and delivery of appropriate technologies (Langyintuo, et al., 1997).

Extension Delivery at the Operational Level

a: Working with contact groups:

An operational area is a sub-district of the agricultural district within the extension organisation with an agricultural extension agent (AEA) in charge of extension message delivery. To ensure effective message delivery, the extension agent further subdivides his operational area into eight contact villages; a contact village comprising one or more villages. In each contact village the agricultural extension agent works with two farmer contact groups each comprising eight to twelve farmers. These contact groups therefore constitute the focus of extension message delivery at the operational level. It is assumed that there will be a "spill-over" or "trickle-down" effect of extension messages from members of these contact groups to non-contact group farmers in the community.

Working through contact groups as recommended by the T&V system permits a wider coverage since there is a fairly low agricultural extension agent to farmer ratio in the Northern Region and in the country as a whole. The agricultural extension agent to farmer ratios are 1:1252 and 1:1504 for the region and the country respectively.

b: Visiting schedules

Through a fixed visiting schedule arranged on a yearly planner, contact between the agricultural extension agent and a contact group for technology delivery is made on fortnightly basis while the agent attends a day's consultative meeting with his supervisor at the end of every fortnight's round of visits. A regular monthly training programme is also scheduled for all agents within the district to attend. Monthly training topics are often selected on specific time-bound messages required by farmers to address specific needs identified at the planning stage of the extension programmes.

Impact of Extension Delivery in Ghana

Beneficiary assessment report of extension services provided by the MoFA indicated among other things that the RELCs have fostered active interaction among research, extension and farmers, allowing field diagnosis of farmers' problems, thus making research and extension programmes more relevant to the needs of farmers. The report further indicated that there had been regular programmes for farmer training and improved technology dissemination by extension staff (NAEP, 1997). There has therefore been a positive development in the delivery of extension services since the inception of the Unified Agricultural Extension System (UAES). The report also noted that there had been general satisfaction by clients on the benefits of the service, while MoFA staffs are confident of their knowledge and skills.

2.4.4: Constraints to Expanded Agricultural Development in Northern Region

Notwithstanding the natural resource endowments that make Northern Region amenable to arable farming, expanded agricultural development is constrained by a number of factors. Notable among these are:

- The unreliable rainfall in terms of onset, duration, distribution and amount. Erratic rainfall distribution results in poor crop yields leading to food shortages.
- Second to this is the poor condition of the regional road network that hampers smooth movement into the productive hinterland and access to market centres with agricultural produce.
- The unavailability and astronomical costs of farm inputs and services in rural areas coupled with the lack of credit facilities further aggravate the poor condition of the rural smallholder. Beneficiary assessment

report of National Agricultural Extension Project (NAEP) indicated among others that the lack of and cost of farm inputs contributed to the low adoption of agricultural technologies promoted by agricultural extension (NAEP, 1997).

- Poor storage and marketing facilities contribute to the 20-30% post harvest losses in food grain often recorded for the region.
- The high illiteracy rate of the region also adversely affects the socio-economic development of the region.

2.5: SUMMARY

This chapter in broad terms has outlined geo-physical and agro-climatic conditions of the region, indicating its potential for agriculture and agricultural production. The role of research and extension in the agricultural development of the region has also been highlighted. A brief outline on the constraints to agricultural development is also given. The need to improve upon yam production system in the Northern Region has also been elaborated since it is one of the major commercial crops in the region while contributing immensely to food security in most farm families.

The Regional Planning Co-ordinating Unit (RPCU, 1995) of Northern Region, noted that in spite of proven and potential resources, particularly in agriculture, the region lags behind other regions in socio-economic development and it remains amongst the least developed regions in the country.

CHAPTER THREE:

LITERATURE REVIEW

3.0: INTRODUCTION

This chapter dwells on literature and documentary expositions on the traditional methods of seed yam production as well as improved methods available and/or introduced to farmers. Efforts are also made to review the determinants of the adoption behaviour of the individual farmer and the various extension teaching methods and the communication processes as they influence the adoption of innovations.

3.1: SEED YAM PRODUCTION METHODS

Both traditional and improved seed yam production methods have been widely documented. The ensuing sections review those methods that are relevant to the study.

3.1.1: The Traditional Methods

Two main traditional seed yam production methods are being practised in the northern region. These are:

⇒ *The Double Harvesting Method, and,*

⇒ *The Anambra Seed Yam Production System.*

a) The Double Harvesting Method

One of the traditional methods of seed yam production involves two separate harvests. The double harvesting method, as it has come to be called, is the most commonly practised among yam farmers. In this method, the "first harvest" involves the separation of the main tuber from the cormous structure at the head region. This is termed "topping" or "milking" (Onwueme, 1978). Nwosu (1975) observed that the method entails the removal of the developing tuber for food early in the season; while the parent plant is left to form a new tuber. This activity is often carried out four to five months after planting, and when the farmer is assured of adequate rainfall. The cormous structure forming the base of the growing stem is earthed up for growth to continue. Due to the undisturbed shoot system, small tubers are then formed and these are harvested ("second harvest") at the end of the growing season. The product of the second harvest constitutes the seed yam for the subsequent season as they possess well developed buds and are well lignified (Deh, 1994). According to Langyintuo (1996), the double harvesting method is variety dependent; only early maturing varieties of *Dioscorea rotundata* are pricked. He further noted that most farmers plant these varieties to over a third of their total yam fields.

This method of seed yam production has been used by yam farmers for a long time with only minimal changes in technique (Coursey, 1967). Onwueme (1978), and Oyoku (1982) saw the traditional double harvesting method of seed yam production as too laborious a process with very low multiplication ratios. Alvarez and Hahn (1984), observed multiplication ratios of 1:4 to 1:8. Gyansa-Ameyaw (1987) indicated that the method was very laborious and time consuming, requiring a lot of skill. They therefore saw the traditional double harvesting method as inefficient.

Langyintuo (1996) however observed and ranked the advantages of the double harvesting method as:

* the provision of early season food
* the production of more seed yam
* more income, and
* the availability of whole tubers for planting; in descending order.

He further noted that as a less food secure zone, farmers of the savannah ecosystem consider the provision of early season food to bridge a hunger gap between June and August--a period when food grain available to most households fall short of requirements. The sale of produce from the first harvest of yam yields income to enable the farmer to finance other farm operations within the season. Deh's statement (1994) that this primitive method has been abandoned by most farmers stands to be challenged since most farmers in Ghana still depend on it as their main method of seed yam production. Besides, rural peoples' knowledge is a valuable resource and needs to be intensively and extensively studied and "incorporated" into formal research and extension practice in order to make agricultural and rural development more "sustainable" (Scoones and Thompson, 1993). Jones (1990), as cited by Atengdem (1997), observed that farmers on their farms "'.create, store, transform, test and disseminate agricultural knowledge and information, ...and they also process and use a store of indigenous technical and managerial knowledge and information about agriculture, which they are able to modify and to enlarge". Thus they can be a source of knowledge and information not only to each other, but also to research workers and other professional agriculturists.

b: The Anambra Seed Yam Production System

In this system small yam setts weighing between 70-100 grams are planted directly in the field at the spacing of 100 cm by 50 cm. At harvest, seed yams obtained weigh between 200-500 grammes (IITA, 1975; Onwueme, 1978). This system is said to have been used largely by farmers of Anambra State of Nigeria. Gyansa-Ameyaw (1987) reported that this system has been adopted by countless farmers across the West African Sub-region. Though Nwosu (1975) earlier claimed that the system was lucrative due to the high dividends it brought to farmers who depend on it, Deh (1994) indicated that the disadvantages of the method far outweigh the benefits. Deh enumerated the disadvantages as:

(a) Large amount of planting material required with a low multiplication ratio of 1:2 to 1:10.

(b) Non-uniform sprouting and field establishment due to the direct field planting.

Due to the persistent gradual decline in yam production in the West African sub-region, with the short supply of seed yam having been identified as a major contributing factor (Nwosu, 1975; Coursey, 1984), research evolved technologies concerning seed yam production to improve upon these indigenous methods.

3.1.2: Improved Seed Yam Production Methods

Deh (1994) listed seven improved seed yam production methods, including:

* Root and vine cuttings
* Sprouted tuber segments and excised plantlets
* "New propagation Method"

* Slip propagation
* Propagation by bulbuls
* Tissue culture methods and
* The Yam Minisett / Microset technology.

Of primary interest to this study is the yam minisett technology since it is the one that has been widely introduced in the study area.

The Yam Minisett Technology

During the 1980s, researchers worked together to modify and popularise the yam minisett technology for producing high-quality, low-cost and abundant planting material to relieve farmers of the traditional need to set aside one-quarter of each crop to use as seed for the next season. With this method farmers can produce 40,000-100,000 seed yam per hectare.

The objective of research to increase the number of plants obtainable from a particular tuber gave rise to the yam minisett, often weighing between 29 grammes and 70 grammes (Okoli, et al., 1982). The yam minisett technology was evolved at the National Root Crop Research Institute (NRCRI) in 1982 and later modified at International Institute of Tropical Agriculture (IITA) as a production package for commercial seed yam production.

The technology as reviewed by Deh in 1994, starts with the selection of clean healthy yam tubers--referred to as "mother seed yam"--usually weighing between 500 grams to 1000 grams after the tubers have overcome a substantial period of dormancy to attain the ripe physiological age. Yam minisetts weighing about 25 grammes are then cut from the mother yam, assuming cylindrical shapes; each bearing a periderm or the outer skin and is capable of sprouting. Freshly cut pieces are then treated with a water suspension containing wood ash, insecticide, fungicide and nematicide. Treated setts are air-dried in the shade for a few hours to allow cut surfaces to heal. The setts are nursed in well prepared seed beds or wooden boxes or even baskets containing sawdust. At the nursery, watering is done judiciously. The minisetts sprout in three to four weeks time after which they are transplanted in the field on prepared ridges at a spacing of 25 cm to 30 cm by 1000 cm. Ridges may be mulched with straw or plastic sheets. Cultural practices on the field is limited, mainly to control weeds. Seed yams weighing between 800-1000 grammes are ready for harvest five to six months after planting, depending on the variety. It is these that are preserved for planting in the ensuing season. It is however possible to even obtain from the yam minisett technology average size ware yams that are quite amenable to the requirements of the export market (Deh, 1994).

Though the yam minisett technology is assumed as a package for commercial production of seed yam, it is proclaimed to be an appropriate and practicable technique for the rapid multiplication of seed yam within the scope of the smallholder farmer (Gyansa-Ameyaw, 1987). With the amount of planting material reduced, it is said to be simple and easy to adopt.

According to Otoo, Osiru, Ng, & Hahn (1987), the main advantages of the yam minisett technology include:

* Large quantities of seed yam are produced.
* Better management of the field since the plot size is small.

* Easier harvesting, and
* Small whole tubers are harvested for storage.

Madukwe (1995) also observed that the technology involves reduced cost of planting material and cost of staking, increased plant population due to reduced spacing, with more setts got from ware tubers, as well as lending itself to tractorisation.

Against the background of inadequate planting material in the yam production system, the development of the yam minisett technology is a significant breakthrough in alleviating the problem. However, it has been widely observed that despite the comparative advantages, the adoption of the technology by smallscale farmers to boost yam production has been far from encouraging (Banchimann & Winch, 1979; Iwueke, Mbata, & Okereke, 1983; Langyintuo et al., 1997; Okorji, 1986; Okorji & Obiechina, 1993). Why this technology is not adopted in the Northern Region is what this research seeks to know.

3.2: ADOPTION OF INNOVATIONS

An innovation is a new idea, method, practice, or technique which provides the means of achieving sustained increases in farm productivity and income (Adams, 1982). He further indicated that a practice or an idea might be new to an individual but not new to the other if the latter has already accepted it. . Kwarteng and Zinnah (1984) affirmed this, stating that what may be an innovation to someone may have been adopted, and even discontinued by someone else.

Osuntogun, et al. (1985) stated that to increase agricultural production in the third world there must be changes in the technology of production. The major role pursued by extension services is to disseminate agricultural technical knowledge to farmers to enable them increase productivity. Increasing the farmers' technical knowledge base by persuading him to accept and practice new technologies is therefore the primary concern of the extension agent. Accepting and putting new ideas into continuous practice is termed Adoption. Rogers (1962) stated that the decision to continue full use of an innovation is adoption and this indicates the adopter is satisfied with the innovation.

3.2.1 Adoption as a Process

Wilkenning (1953) pointed out that an individual's decision to adopt an innovation is a process, composed of learning, deciding and acting over a period. He stated that the adoption of a specific practice is not the result of a single decision to act but a series of actions and thought decisions. Bohlen (1966) observed that the adoption of a new idea is not a single unit act, but a rather complex pattern of mental activities combined with 'actions' before the individual fully accepts or adopts the idea. Rogers (1962) earlier indicated that the adoption of an idea is a bundle of related events flowing through time. Adoption should therefore be seen as a process, a form of decision-making in which interrelated decisions must be made.

Literature is replete with the wide acceptance of the proposition that the individual goes through a minimum of five steps or stages in the process of adopting a new practice or idea. These are sequentially named as:

* Awareness: the individual first hears about the innovation,

* Interest: the individual seeks further information about the innovation he has heard of,
* Evaluation: the individual weighs up the advantages and disadvantages of using the innovation in his own circumstances,
* Trial: the individual tests the innovation on a small scale in his own situation, and
* Adoption: the individual applies the innovation on a large scale. (Bohlen, 1966; Lionberger, 1968; Maunder, 1972; Osuntogun, et al., 1985, Rogers, 1962; van den Ban and Hawkins, 1996).

Rogers (1995) later modified these steps to knowledge, persuasion (forming and changing attitudes), decision (adoption or rejection), implementation and confirmation. This modification, according to van den Ban and Hawkins (1996) is to provide for the fact that the new idea can possibly be rejected at any point of the adoption process. They further indicated that the idea that a change in information is followed by a change in behaviour is no longer accepted as a pattern. Thus the normative decision-making model is no longer considered to provide an adequate explanation of the way people make decisions. The idea that a change in information is followed by a change in attitude, and that this in turn is followed by a change in behaviour is no longer accepted as a usual pattern.

Lionberger (1968), Maunder (1972), and van den Ban and Hawkins (1996) all observed that though these steps or stages are clearly identified, they are not necessarily a rigid pattern being followed nor a set of exclusive categories with no overlap. The steps may be so blended that it is not possible to distinguish where one begins and where the one ends.

3.2.2. Determinants of Adoption Behaviour

When an individual gets to know about a new idea, a number of factors do influence him to the extent that he either accepts or rejects the idea. Barnett (1953) stated that the adoption of a new idea is not so fortuitous and unpredictable as it sometimes appears to be; the character of the idea is itself an important determinant. Wasson (1960) showed that the ease or difficulty of introducing ideas depends basically on the nature of the "new" in the new product.

Lionberger (1968) observed that the time span through which the adoption process occurs varies with the nature of the change involved, the individual himself, as well as the situation within which the individual finds himself when he learns about the change alternative.

Rogers (1962) also indicated that the characteristics of an innovation have a great influence on the rate of adoption. He stated that it is the characteristics of the new product, not as seen by the experts, but as perceived by the potential users that really matter. Effionayi (1975) observed that the adoption of new practices is influenced by social, psychological and economic factors. Swanson, et al. (1984) also supported these ideas, noting that besides the resource endowments of different groups of farmers, the specific characteristics of technologies continue to be an important factor affecting adoption behaviour. Hailu (1990) also indicated that the decision of the farmer to adopt or not to adopt (and also the intensity of use after adoption) is conditioned by a set of internal and external factors including the economic characteristics (profitability) and technical attributes of the innovation in question as well as a range of personal and socio-economic characteristics of potential adopters.

A: Technical Characteristics of the Innovation.

Abundant literature indicates that five conceptually distinct characteristics of an innovation are said to affect the rate of adoption of the new idea. These include:

(α) the relative advantage of the new idea,

(b) compatibility of the new idea to the individual and his environment,

(c) complexity of the new idea, (δ) trialability of the new idea, and

(d) communicability of the idea (Adams, 1982; Bohlen, 1966; Erasmus, 1961; Hailu, 1990, Lionberger, 1968; Rogers, 1962; and van den Ban and Hawkins, 1996).

i. Relative Advantage

According to Rogers (1962), relative advantage is expressed in economic profitability or otherwise; but it generally refers to the degree to which an innovation is superior to ideas or practices it supersedes. Swanson, et al. (1984) observed that small farmers will adopt a technology if it is economically and technically superior to their farming system. Johnson and Kellogg (1984) also stated that farmers will accept new practices or technologies when they perceive that the benefits are great enough to outweigh the costs. Osuntogun, et al (1985) indicated that new farm practices are of little value until they can be put to some practical use for the economic and social well-being of the people involved. Obviously therefore, a new idea that will enable a farmer fulfil his economic gain as well as social satisfaction will be accepted and practised more readily than the one that he doubts its contribution to his welfare. Lionberger (1968) also stated that changes that cost little will be adopted more quickly than those that require large expenditures from the adopter.

However, it has been proved that some crises situations and perceived needs can induce the adoption of new ideas. Bertrand (1951) found out that the crises of unionised labour and wartime labour shortages aided the adoption of farm mechanisation in Louisiana while Lionberger (1968) stated that recommended practices to control mould on tobacco went unheeded in North Carolina until farmers had experienced high losses from the disease.

Rogers (1962) emphasised that relative advantage of a new idea should be seen as the perception of the individual and his social system that affects the rate of adoption. Technology developers and transfer agents should assess the relative advantage in terms of need, profitability, and resource requirements of innovations from the point of view of the potential users before they can attempt to introduce them, otherwise the innovations are rejected. Mettrick (1993) observed that researchers must ensure that technologies produced are appropriate to the circumstances of their client groups and are actually capable of contributing to their development.

ii: Compatibility of the technology

This refers to the degree to which a new idea is consistent with the social norms and values as well as the past experiences of the individual and his social system. Practices that are compatible with existing practices and beliefs are most likely to be accepted quickly. Adams (1982) observed that there are many examples where many farmers have rejected new methods because they are incompatible with their values, for example high yielding rice and maize varieties are sometimes rejected because they do not taste like the traditional varieties. Introducing pig husbandry among Muslims, even if it is profitable, will be rather difficult.

Though adoption involves an individual decision-making process, his social system, with its norms, values and even standards set by groups to which he belongs do influence his decision-making and actions. An innovation whose adoption will result in one being rejected by his society will be rejected outright rather than being adopted. Leagans (1960) indicated that programmes cannot be successful when they are too much at odds with ideas the value system will sanction. Adams (1982) also observed that innovations that are incompatible with traditional management objectives will be rejected. He further indicated, as an example, that where labour rather than land is in short supply, farmers will be reluctant to adopt innovations which will produce more food but involve more work. Compatibility of the innovation with the adopter's resources as well as his social system does not only ensure greater security to the potential adopter, it makes the idea more meaningful to him.

iii: Complexity of the technology

Kivlin (1960), as cited by Rogers (1962) found that the complexity of farm innovations was more highly related, in a negative direction, to their rate of adoption. The more complex an innovation is and the more change it requires in the existing operations, the longer time it will take to understand, try, and finally adopt. Some innovations fail because they are not implemented correctly, while some require more complex knowledge and technical skill. Lionberger (1968) observed that traits and practices easily communicated by conventional methods used by farmers will be adopted more readily than those that are not.

iv: Trialability of the technology

This refers to the extent to which an innovation lends itself to be tried on limited basis (Kwarteng and Zinnah, 1994). Rogers (1962), and Bohlen (1966) referred to this as divisibility, by which they imply new ideas that can be tried on limited basis. These they indicated will generally be adopted more rapidly than those that are not divisible. If a farmer can try an innovation without committing much of his resources, he will adopt it more readily if its performance meets his objectives. He will however hesitate to commit many resources to an innovation whose performance he is in doubt, as a means of risk aversion.

v: Observability of the technology

Farmers learn much from observing and discussing their colleagues experiences, their observations often being a reason to start discussion (van den Ban and Hawkins, 1996). Some innovations have a short gestation period hence their results manifest early, the results of some are easily observable and can easily be communicated to other farmers while the results of others are rather difficult to observe and even describe to other people. The easier it is for a man to see the advantages of an innovation, the more likely he is to adopt it. Bohlen (1966) observed that people who have low ability to mentally handle abstract ideas tend to be more reluctant to adopt practices which do not produce visible outcomes when used. Erasmus (1961) indicated that the visibility of the results of an innovation is particularly important in affecting its rate of adoption in a less developed and preliterate society.

The general observation from the foregoing is that the adoption of one new practice is largely independent of other practices due to the inherent characteristics of each practice. Van den Ban and Hawkins (1996) observed that the rate of adoption of an innovation is influenced by the farmers' perception of the characteristics of the innovations, and the changes this innovation requires in farm management and the roles of the farm family. Thus it is possible some innovations are not adopted while others are. The universally relevant point is that the characteristics of the new idea not as seen by the experts but as perceived by the individual and his social system are critical with regards to the adoption of innovations.

B: The Individual and his Social Environment

The individual and his social environment, comprising his economic situation as well as his socio-cultural circumstances also do affect his adoption of innovations.

i: The Individual

The individual farmer is the target or focus of extension messages that are made up of technical innovations that he has to adopt to help him increase his productivity or improve upon his conditions of living. In communicating extension ideas, the individual farmer is the receiver of the extension message. His decision to adopt or reject the new ideas is dictated by his personal inherent variables, including his knowledge level, his attitudes and perception about the extension service, and even the extension agent himself, as well as his personal interests and these are forces to reckon with.

Lionberger (1968) noted that some people adopt new ideas and practices more quickly than others. This relates in part to the individual himself, where the individual or personal factors including age, years of schooling, physiological characteristics like mental flexibility, and orientation towards farming as a business. Rogers (1957), as cited by Lionberger (1968) observed that personality variables like mental rigidity, change orientation, and innovation proneness were found to be significantly related to farm practice adoption. Fliegel (1984) summed up these observations in his statement that each farmer, male or female, young or old, more or less educated, is ultimately a unique individual with a host of characteristics that may well affect how information is received, processed, and either used or not used in the production process.

Maunder (1972), in his analysis of the communication process, observed that knowledge, attitudes and interests differ from one individual to the other, and these differences tend to block communication. On knowledge levels, he indicated that differences in educational level means differences in the ability to understand concepts and technical language; hence can enhance or retard the adoption of technical messages.

Attitude has been defined as the more or less permanent feelings, thoughts and predisposition people have about certain aspects of their environment (van den Ban and Hawkins, 1996). Chitamber (1973) defined it as a feeling of like or dislike, attraction or repulsion, interest or apathy towards other persons, objects, situations or ideas. Attitude is therefore an attribute of the individual that predetermines the place of an innovation to the individual. The attitude of an individual, built or acquired over time and based on experiences and group standards may enhance the adoption or rejection of an innovation. A farmer who has had a bad experience with an extension agent will naturally reject anything that the agent introduces in his environment; on the other hand having established good relationship with this agent fosters the acceptance of messages that he brings.

ii: The Social Environment

Social environment refers to the social system to which one belongs. The social system is a population of individuals who are functionally differentiated and engaged in collective problem-solving behaviour (Rogers, 1962). Albrecht, et al. (1989) stated that the introduction of innovations in a social system is a complex process. This is because the action of the individual depends on the rest of the group; his behaviour is closely linked to that of the other members of his social system. The adoption of innovations by an individual results in the individual changing his ideas about his old system, his behaviour, or even his old practices. The individual learns new ways of doing things and has different perceptions about his environment. The individual has acquired or improved his ability to perform a behavioural pattern through the new experience or practice (van den Ban and Hawkins, 1996). His stimulus-environment comprises his social environment, including the norms, rules etc. of the society and these have a bearing on his decisions. Albrecht, et al. (1989) observed that the sum total of natural conditions, forms of awareness, economic interests and social conventions, influence the way the target group reacts to stimuli from inside and outside the group. This they call the 'innovation behaviour" of the social system. McCreary (1989), in his update on the teaching and learning of adults, indicated that the individual relates to the society like a single cell to the whole organism of which it is part. Therefore an attempt to change may find oneself either at odds with a society that does not lend itself to change; or he succeeds in his change effort in response to the changing society to which he belongs.

Largely, studies on the adoption of innovations by the individual tend to lay emphasis on the influence of both social structure, situation and contextual variables from the sociological point of view; on need and demand from economic analysis and compatibility of the innovation with the value system from anthropological perspective. The adoption of a new idea should therefore be seen as a variable with regards to the types of innovations or practices; and this is influenced by personal, social, economic and psychological factors (Nuhu, 1976).

In sum, the characteristics of the new idea, the personal factors of the individual and his entire social and economic environment are therefore critical in the choice of technical messages that need be introduced to effect a change in the individual in the short run and the society in the long run. Bunting (1983) indicated that technical methods have to be technically appropriate to the purposes, resources, and insecurities of the producers, and often socially acceptable and based at least in part on a clear knowledge of the local environmental resources and on what the producers know. Attempts at promoting technologies without due respect for human and local factors often produce unforeseen results (Wickramasinghe, 1981).

3.3: TECHNOLOGY TRANSFER

The ensuing sections examine technology transfer, extension and the communication process as observed by some authorities, and the need for feedback in the technology transfer process.

3.3.1: Technology Transfer

According to Mettrick (1993), the traditional view of the concept "Technology Transfer" is a one-way process. Scoones and Thompson (1993) observed that the pursuit of change in terms of development is derived exclusively from the research station and transmitted through the hierarchical, technology-oriented extension service. This, they indicated as the Transfer of Technology (TOT) model or approach. In this view, research evolves a technology, passes it on to extension services and they in turn pass it on to the farmer. Technology development and transfer was seen as a prerogative of research and extension services respectively. The farmer in this respect is considered as incompetent and should be a recipient of technology. Farmers are seen as "adopters" or "rejecters" of technologies not as originators of technical knowledge or improved practices (Scoones and Thompson, 1993).

In recent years, since the late 1970s, changes in view with regards to the concept of technology transfer have occurred. Merrill-Sands and Kaimowitz (1990) observed that technology transfer is not restricted to meaning the one-way flow of information and materials from those who develop and transfer technology to those who use it; rather it implies a two-way flow of technical information between these two groups. Eponou (1996) indicated "Technology Transfer" as referring to the process of: a) bringing research results in the form of new agricultural technologies and new information to farmers; and b) supplying research with information on farmers' needs, production constraints and feedback on technologies. This, he further stated, includes the activities of agricultural extension services, commodity boards, government and semi-private seed production units and commercial firms.

Whale (1989) also defined technology transfer as conveying information in such a way that it fulfills a particular need of the client and it can be effectively applied by the client to his or her own situation. The technology transfer agent should therefore not only be a communicator or disseminator of information to his client, but should also be an agent seeking to secure the adoption of new ideas by his client. Indeed, "Technology Transfer" has a broader coverage than extension; but it generally refers to the dissemination aspects of generating and transferring technologies. This position sees the starting point of change(development) as an active and equitable partnership between rural people and researchers and extensionists (Chambers, Pacey & Thrupp, 1989).

3.3.2: Extension and the Communication Process

Extension work is educational and the learning-teaching process is more like the communication process because it is an interaction between two or more people. Van den Ban and Hawkins (1996) defined communication as the process of sending and receiving messages through channels which establish common meanings between the source and the receiver. Coleman and Marsh (1958), Maunder (1972), and van den Ban (1996) analysed the communication process and indicated that its effectiveness is determined by:

* The communicator or source's variables: these include his or her social status, communication skills, attitudes and knowledge.
* The message variables: the purpose or objectives of the message, its content with regards to its relevance to the target group or receiver, as well as the structure into which the message has been organised to conform with expectations of the receiver.
* The channel variables: which include the methods by which the message is transmitted: the individual, group, or mass methods; and these may also involve the use of one or more of the natural senses of sight, taste, smell, touch, and sound.
* The receiver's variables: The receiver's communication skills, attitudes, knowledge level, and social background influence how he receives and interprets messages.
* Feedback: The response of the receiver is used by the source to evaluate the meaning the receiver has given to the message, and whether this meaning is the same as the source intended to arouse.

In relating the communication process to the adoption process, Fliegel (1984) indicated that extension communication is to provide knowledge on which action can be based; to persuade the farmer to make a decision to try new technology; to provide information necessary for actual implementation; and to provide information needed by the farmer to assess the results of that decision and hopefully confirm the decision. The technology transfer process involves the conscious use of communication of information to help people form sound opinions and make good decisions.

3.3.3: The Need for Feedback

One key element of effective communication, implied in the technology transfer process is the process of feedback. According to van den Ban and Hawkins (1996), feedback is the process in which knowledge of the surroundings or the consequences of actions of a system lead to adjustment of future actions seen in the light of achieving a certain goal. In the feedback process, the receiver of a message is given the opportunity to function as the sender with the sender or source acting as the recipient. This enables the source to assess the appropriateness of his message and the channel he has used. Feedback makes the technology transfer process a two-way rather than the one-way process.

Direct links between research and extension services with farmers is critical for the development and transfer of technologies (Merrill-Sands and Kaimowitz, 1990), since such linkages are not only relevant for the development of appropriate technologies but they ensure rapid feedback on the performance of the technologies that have been transferred to farmers. Fliegel (1984) observed that designers of specific scientific technologies must also be involved in the information feedback mechanism because some technologies are more effective than others; hence some must be redesigned to enhance their effectiveness. The feedback process must be sought to enable research and extension agents get information on any problems encountered by farmers in using improved technologies. It also gives information on the performance of relatively successful technologies so as to allow for the formulation of educational campaigns for eventual diffusion of these technologies.

However, the feedback mechanism is often lacking in the technology development and transfer process. Gilbert, et al. (1980) identified insufficient feedback from farmers to research programmes as one of the problems that face technology development, adaptation and transfer. Fliegel (1984) stated that all too often, the feedback process is simply allowed to happen and is rather treated as a passive aspect of the communication process. Johnson and Kellogg (1984) also observed the lack of communication and information feedback from farmers, and stated that extension personnel and researchers do not appreciate the need for eliciting information and evaluation from farmers on the performance of technologies in the farmers' situation. Eponou (1996) observed that almost all linkage mechanisms in place convey information from research to extension, then to farmers. He noted that an effective flow of information in the other direction is lacking; the feedback from extension and farmers, the key to the relevance of future technologies is weak. Eponou further indicated that the results of such poor feedback mechanism is that farmers reject a number of technologies produced by research because they are not responsive to farmers' needs.

The adoption of new ideas is the ultimate aim of the technology transfer process. Enhancing it requires the joint collaborative effort of the target group, the researchers and extension agents in the entire process. There should exist a collaborative relationship in the sharing of information between all stakeholders in order to reach a mutual understanding of the meaning of the information in the context of its use (Whale, 1989). Ampene (1979) observed that the purpose of learning is to bring about a change in the behaviour of the learner. Therefore all who engage in the learning activity are concerned that the learning should be as effective as possible so that the objective of the learning efforts may be achieved.

An overview of the extension teaching methods

According to Kang and Song (1984), a substantial number of proven educational methods or techniques exist from which the extension agent may choose to set up learning situations and maximise the transfer of information and skills to farmers. From a broad perspective, these methods are classified in terms of the target group into three main categories (Adams, 1982; Ampene, 1979; Kang and Song, 1984; Kwarteng and Zinnah, 1994; Maunder, 1972; van den Ban and Hawkins, 1996):

* *Individual Methods*: These include those techniques in which the individual farmer receives the undivided attention of the extension agent: farm and home visits, office calls or inquiries, informal contacts, and telephone calls are typical examples.
* *Group Methods*: These involve the face-to-face contact or interaction between the extension agent and his target group of farmers. They include demonstration-based methods, field days, farm tours, general meetings, field schools, lectures, seminars, symposia, etc.
* *Mass Methods*: These comprise the use of mass media such as the radio, newsprint, television, slide shows, etc., to reach a large number

of people. These methods often require no face-to-face contact between the extension agent and the audience.

Generally, each of these methods establishes a relationship between the learner or group of learners (farmers) and their tutor (the extension agent) (Ampene, 1979). Boone(1985) observed that delivery strategies for educational services take many forms, from one-to-one tutorial or advisement methods to a large scale formal classes and all sorts of educational settings in between. The tutor should therefore endeavour to create situations in which his target group will develop educationally.

To create a conducive atmosphere for effective extension delivery, a number of factors or issues need be considered in deciding the method to use (Kang and Song, 1984; Kwarteng and Zinnah, 1994). These include:

* A combination of methods may be required to bring about the desired learning in the target group. Studies have shown that the more different extension methods are used, the more people change their practice (Maunder, 1972; Kang and Song, 1984). Kelsey and Hearne (1963), earlier observed that the more ways through which people are exposed to extension information, the larger the acceptance of recommended practices. When an individual is exposed to a new practice in several ways, the more likely he would find his preferred method of learning (Maunder, 1972).

* A number of teaching methods can overlap in trying to attain an objective. In this regard, special attention must be given to the stage of the adoption process the target group is. Boone (1985), indicated that learning experiences or activities should be arranged into an overall strategy in which they are ordered and sequenced so that they reinforce one another. They should be organised to create awareness, stimulate interest, provide information and ultimately encourage behavioural change or adoption of new behaviour by the learner. It has been indicated that the mass methods, e.g. radio, are most effective at the awareness stage of the adoption process; while the individual and group methods may stimulate interest and play a major role in farmers' opinion and decision-making (Bohlen, 1966; Maunder, 1972; van den Ban and Hawkins, 1996).

* It has also been established that no extension method is better than the other. The extension agent should choose the technique best suited to the situation. Kwarteng and Zinnah (1994) stated that each method has its advantages and disadvantages, and these must be known to effectively guide the selection of an appropriate method in a given situation.

* A good knowledge and understanding of the audience, especially their differences and similarities with respect to their age, level of education, available resources and their entire social environment helps the

extension agent select the most suitable method or combination of methods to suit the target group.

* The characteristics of the message, the teaching and learning objectives, and what the participants are expected to be able to do with the content of the message should also be considered (Kwarteng and Zinnah, 1994). For example if the aim of the communication is to provide knowledge, the extension agent may use the lecture method; if the aim is to teach a skill, a demonstration method may be more appropriate.

Boone (1985) indicated that the choice of appropriate learning strategy is keyed to specified objectives, and should take into account historical antecedents service delivery, for example forms of instruction found to be acceptable to the target group in the past; social contexts and sponsorship (e.g. social action groups), and other factors that may affect both the participation in and effectiveness of whatever instruction is offered.

3.4: SUMMARY

This chapter reviewed literature on traditional methods of seed yam production and improved methods introduced with the view to providing options for the farmer to be self-sufficient in acquiring planting material to improve upon his productivity.

Factors that also determine the farmers' ability and/or preparedness to adopt a technology were also reviewed to broadly include the technical variables of the technology itself, internal and external factors; from the individual farmer's personal characteristics, to his socio-economic environment. Literature on effective and collaborative linkage between research, and extension and farmers as a critical input for the development and transfer of appropriate technology has also been made. The various extension teaching methods and communication of ideas were also found through literature to have great impact on the adoption of innovations.

CHAPTER FOUR:

METHODOLOGY

4.0: INTRODUCTION

This chapter outlines all the activities that were undertaken to achieve the objectives of the study. It indicates the choice of research design and how the data was collected, managed, processed and analysed to give the results. Difficulties encountered in the course of the study have also been briefly outlined.

4.1: RESEARCH DESIGN

The non-experimental descriptive survey research design was used. The methodological approach for this study therefore followed the principles of a survey research using quantitative measurements for collecting and analysing data. The study entailed the collection of quantitative data from a number of individual farmers in respect of a number of variables that were examined to discern any pattern of relationships.

Triangulation, defined as the combination of different methods of data collection when studying the same social issue (Atengdem, 1997) was employed. Triangulation:

* ensures that the same type of information is collected from different sources,
* ensures that different methods are used to collect the same type of information,
* allows comparison of findings from different sources, and
* enables reliability of data to be verified.

In this regards, structured questionnaire and interview guides, focused interviews, and documentary reviews as well as participant observation were largely employed. This helped lower costs and improve upon quality of the data collected.

4.1.1: Study Population

For the study, the target population comprised:

I. yam farmers who had received training on the yam minisett technology in the region.

II. extension agents who had knowledge of or have had training on the yam minisett technology and were in contact with farmers for the purpose of making available appropriate agricultural technologies to enable farmers increase their productivity and improve upon their standard of living in the region.

4.1.2: Sampling Technique and Sample Size

For convenience and time and resource constraints, and for the fact that lists of farmers trained in the yam minisett technology were not available, the purposive sampling technique was used to obtain four (4) agricultural districts; 120 farmers and 40 agricultural extension agents(AEAs):

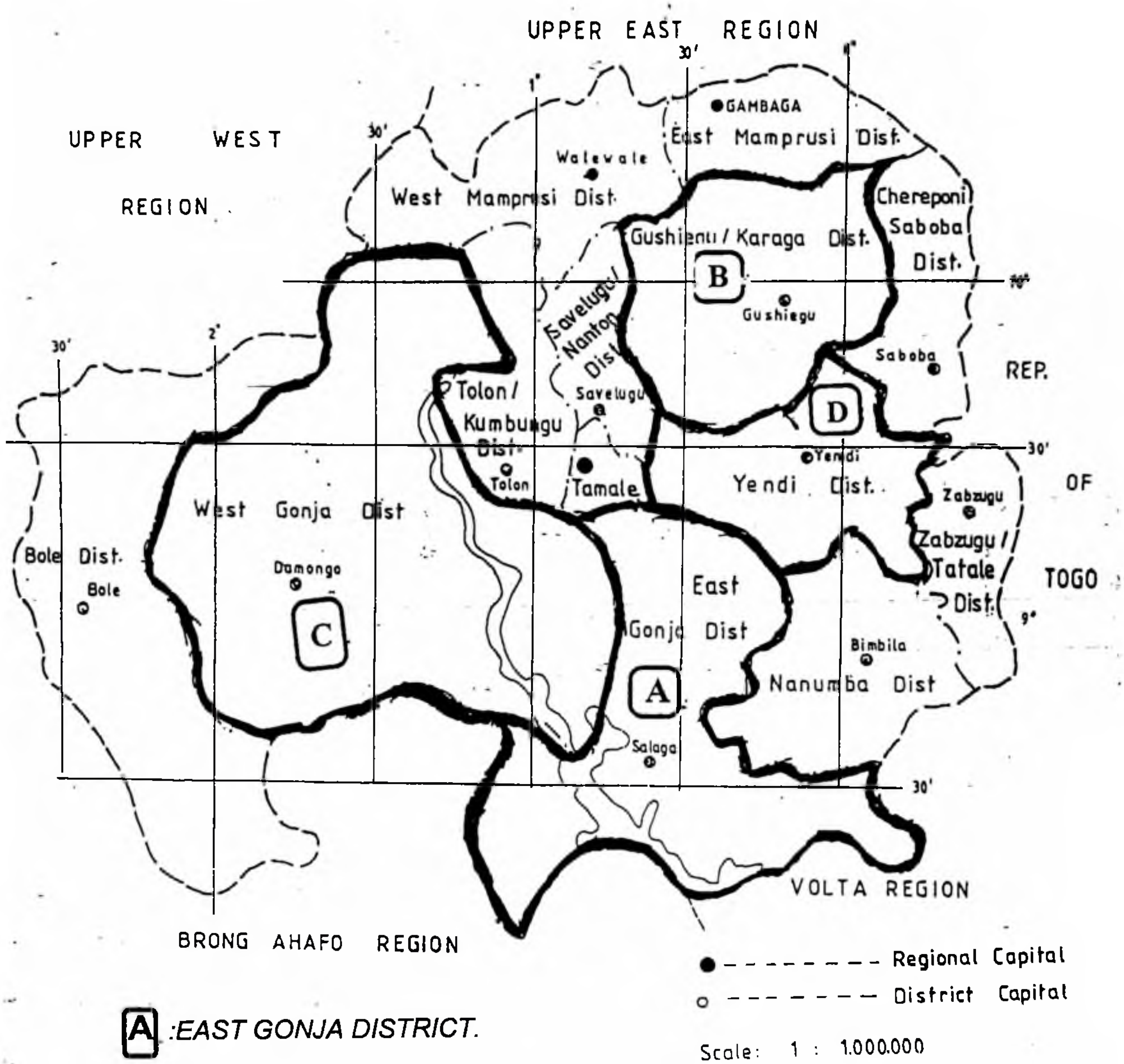
1) Four districts to represent the region: Agricultural districts in the region conform to the administrative districts or sub-divisions of the region. There are thirteen (13) agricultural districts in the region. As indicated in Chapter 2, the Northern Region has been subdivided into six (6) agricultural Subject Matter Specialists (SMS) centres; an SMS centre comprising one or more contiguous agricultural districts as follows:

* Tamale SMS Centre: Tamale, Savelugu/Nanton, and Tolon/Kumbungu Districts.
* Walewale SMS Centre: Walewale, East Mamprussi, and Gushiegu/Karaga Districts.
* Yendi SMS Centre: Yendi, Saboba/Chereponi and Zabzugu/Tatale Districts
* Salaga SMS Centre: East Gonja, and Nanumba Districts
* Damongo SMS Centre: West Gonja District
* Bole SMS Centre: Bole District.

A district was purposively selected from SMS Centres that recorded the top four production figures of yam in the region. The selected districts were: East Gonja, West Gonja, Yendi, and Gushiegu/Karaga (Map 2).

The basic assumption behind purposive sampling is that with good judgement and an appropriate strategy, one can hand-pick individuals or units to be included and thus develop a sample that is satisfactory in relation to one's needs (Kidder and Judd, 1986).

MAP 2: DISTRICT MAP OF THE NORTHERN REGION:



A :EAST GONJA DISTRICT.

B :GUSHIEGU/KARAGA DISTRICT.

C :WEST GONJA DISTRICT.

D: YENDI DISTRICT.

2) Selection of thirty farmers from each of the four districts: The farmers were also purposively sampled as there was no list of farmers trained in the yam minisett technology available in any of the districts sampled. Moreover, as indicated in 4.3.2, at the time this study was being carried out, the Ministry of Food and Agriculture was undergoing a restructuring exercise in conformity with the government's decentralisation programme. Thus a lot of personnel were being re-posted and in some instances fairly new personnel were in some operational areas with no updated handing-over notes.

3) Selection of ten agricultural extension agents (AEAs) from each of the sampled districts: AEAs in the districts who had knowledge of and training in the yam minisett technology and were in contact with farmers for the purpose of making available agricultural technologies to enable farmers increase their productivity and improve upon their standard of living were considered for the study.

The sample size therefore comprised 120 farmers and forty (40) agricultural extension agents.

4.2: INSTRUMENTATION AND PRE-TESTING

The ensuing sections discuss how the data collection instruments were developed, pre-tested, and the development of the final questionnaire and interview guide for the data collection.

4.2.1: Developing the Instruments

A data collection instrument is any type of device used to measure variables. The type of instrument to use depends on the data collection method and the type of data to be collected (Atengdem, 1997). The following need also be considered in the choice of a data-gathering instrument:

* ease of administration,
* ease with which response is elicited,
* precision and accuracy with which variable can be measured, and
* validity and reliability of the instrument.
* practical limitations (time and cost).

In view of the above and for the fact that this work is a quantitative survey research, the following instruments were used:

i. Questionnaire and interview Schedule (Appendix I & Appendix II),
ii. Focused interviews and discussions (Appendix IV),
iii. Literature and documentary reviews (AppendixV), and
iv. Participant observation

Questionnaire and Interview Schedule:

Both Questionnaire and interview schedule comprised two sections A and B. Section A was used to collect personal and social characteristics from respondents. This section obtained data on respondents with respect to location, sex, age, marital status and educational level as well as number of children. Besides affording the social description of the respondents, investigating the personal and social characteristics of respondents also helped in interpreting their influence on the adoption behaviour of the respondents. For the extension agents, information on their present position and rank helped in assessing their field experience and ability to deliver extension messages. Section B was used to obtain responses that assisted in the assessment of issues/areas of interest to the study (Table 4.1).

Table 4.1:Study Issues, Information required, Source and Method of Data collection.

ISSUE	INFORMATION REQUIRED	SOURCE	HOW DATA WAS GATHERED
EXTENSION CONTACT	• source of technical information • Awareness of AEA • forms & frequency of contact with AEA	Farmers & AEA	Questionnaire & Interview schedule
YAM MINISETT TECHNOLOGY	• Need for the technology • Source of technology • Knowledge level about the technology • Relative advantage of the technology • Trialability of the technology • Compatibility of technology to farming practices • Observability of the technology • Complexity of the technology.	Farmers & AEA	Questionnaire & Interview schedule
TECHNOLOGY TRANSFER	• Method of transfer employed • Who decides on choice of method • How is method used • Who provides resources or inputs • Where transfer occurs • Timeliness of message • Advantages and disadvantages of method used.	Farmers & AEA	Questionnaire Interview schedule & Secondary data
ADOPTION	• Level of adoption of technology or rejection • Reasons for adoption or rejection • Advantages and disadvantages of technology if adopted	Farmers & AEA	Questionnaire & Interview schedule
TRADITIONAL SEED YAM PRODUCTION	• Importance of yam • Level of production • How seed yam is produced • Availability and affordability of seed yam • criteria of quality seed yam • comparison between traditional method and minisett technology. • problems associated with seed yam production.	Farmers & AEA	Questionnaire & interview schedule
FEEDBACK	• When technology was introduced • Assessment of technology • Feedback received from farmers and whether referred and to where • Any follow-up.	Farmers & AEA	questionnaire Interview schedule & secondary data

i. **Extension Contact:** Data on this enabled the assessment of the degree of interaction between the AEA and farmers for educational purposes. For the farmer respondent, variables used included, primary source of technical information, awareness of extension agent's presence within the community, and forms and frequency of contact he often experienced with the extension agent. For the extension agent, his job description and performance, farmers' problem identification and planning of extension programmes, communication methods employed, his resources and general constraints to field work were investigated to assess his impact on extension delivery.

ii. **Traditional methods of yam production:** Data gathered here included the relative importance and scale of yam production by respondents, methods being used to produce seed yam, farmers' criteria of seed yam quality and problems associated with seed yam production and availability.

iii. **Technology transfer:** Variables here sought to know methods employed in technology delivery with respect to the yam minisett technology, where and how the technology was delivered, what and how inputs were provided for the delivery process, as well as the timeless of the message and ease of application of the technology.

iv. **The Yam minisett technology:** Data on the knowledge level of both extension agents and farmers about the yam minisett technology was collected, and a comparative assessment of the technology with the traditional seed yam production methods made with regards to relative advantage, complexity, trialability, and compatibility with traditional farming methods. Abundant literature reveals that these characteristics of innovations do influence their adoption rate by farmers (Section 3.2.2.).

v **Adoption of the technology:** Assessment was made on the rejection or possible levels of adoption of the yam minisett technology and what accounted for that.

vi. **Feedback:** Eponou (1996) observed that the feedback from extension agents and farmers is a key to the relevance of future technologies, but that this is often weak. Variables to assess feedback delved into follow-ups made by extension agents and/or researchers and subject matter specialists (SMS) to farmers after the technology had been introduced.

Researchers and/or subject matter specialists are often the main source of technical messages communicated at monthly training sessions to the agricultural extension agent for onward transfer to or training of farmers (Section 2.4.1). Type of information received or given during such follow-up visits helped assess the feedback mechanism between the users of the technology (farmers), on the one hand and the technology transfer agents (extension) and the technology developers (researchers) on the other.

Focused Interviews and Discussions

A focused interview checklist (Appendix IV) was also prepared to guide discussions with broad groups of stakeholders in the agricultural development sector, including, farmers, extension agents, researchers, agricultural supervisors, directors, and administrators as well as subject matter specialists.

Literature and Documentary Review:

A provisional list of departmental records/documents to consult to validate data to be collected was also prepared.

4.2.2: Pre-testing

According to Kidder and Judd (1986), pre-testing fulfils the following purposes:

* to clarify unforeseen problems with regards to question wording, respondent's comprehension of the question, question sequence, questionnaire administration; and in this particular circumstance, interviewer's translation of questions into the local dialect in view of the fact that there is high incidence of non-literacy in the study population,
* to decide the need for additional questions on some topics and elimination of others,
* to determine the length of administration of a questionnaire (and possibly the need to shorten it), and
* to enable the researcher phrase close-ended response alternatives from open-ended responses collected for the final questionnaire.

The questionnaire and interview schedule were pre-tested to ensure internal validity.

Both questionnaire and interview guide were pre-tested in the Tolon-Kumbungu District of the Tamale SMS centre in the Northern Region. Before the field pre-testing, consultations were held with the District Agricultural Development Officer (Extension), to identify AEAs who had been trained in the yam minisett technology and who were then at post, and if farmers in the district were also trained in the technology. All AEAs at post had been trained and they in turn indicated that most farmers in their extension contact groups had also been trained though no list of the farmers who had been trained could be provided.

A day's meeting was scheduled with all AEAs then at post to brief them on the purpose of the exercise and to guide them to fill the questionnaire and interview schedule. They were also guided on how to fill responses to the interview guide since each of them was to assist in the administration of the interview guides to farmers in their respective operational areas.

Selection of farmers for the pre-testing exercise was also purposive since no AEA had a concise list of farmers they had trained in the yam minisett technology. Both researcher and the AEAs administered the interview guides to farmers in five (5) operational areas in the district.

The pre-testing exercise lasted two (2) weeks, from 09/02/98-23/02/98, involving nine (9) AEAs and ten (10) farmers.

Notes taken during the pre-testing exercise covered the length of administering each questionnaire/interview schedule, clarity of responses to questions, ease of translation, and respondent's ease of understanding of the questions; as well as questions that appeared repetitive and thus redundant. The pre-tested questionnaires and interview guide were analysed to see if the questions posed were adequate in obtaining responses to meet the research objectives and answer the research questions.

4.2.3: Developing Final Questionnaire/Interview Schedule

Using results of the analysed questionnaire, as well as experiences during the pre-testing exercise as guide and discussions with the supervisor, modifications were made on the questionnaire and interview schedule. Redundant questions were deleted, questions were added to cater for specific areas earlier on not considered, and many more questions rephrased to avoid ambiguity and improve clarity. Some pre-coded questions were made open-ended to allow respondents to provide all possible answers. The interview schedule (Appendix I) and questionnaire (Appendix II) finally contained both close-ended and open-ended questions.

With the assistance of a historical calendar of some national and local events (Appendix III) from the supervisor the researcher was well equipped to assist farmers to approximately identify their birth dates. This was deemed necessary following problems encountered during pre-testing when farmers could not remember their birth dates but could link them up with popular national and local events.

4.3: DATA GATHERING

The ensuing section discusses the engagement of research assistants for data gathering, and how data were actually gathered using the various tools indicated.

4.3.1: Research Assistants

In view of the constraints within which the researcher had to work, four research assistants (one in each of the sampled districts) were trained for data gathering using the interview schedule. Besides personal involvement in the administration of the interview schedule, the researcher also provided supervisory and monitoring work. Choice of research assistants was dictated by the ability to speak the local language to facilitate interpretation of the questions to the understanding of the respondents.

Two main languages are spoken in the four study districts: Gonja in East and West Gonja Districts; and Dagbani in Gushiegu/Karaga and Yendi Districts. Selection of research assistants from among the Agricultural Extension Agents (AEAs.) was done in consultation with the District Directors of Agriculture in the respective districts.

4.3.2: Data Gathering

Data gathering was accomplished in two (2) months. For this period, all data gathering instruments earlier indicated were employed to obtain as much information as possible to enable answers to be derived for the research questions and meet the research objectives.

Appendix VI indicates the itinerary followed for the field data gathering exercise.

Administration of the Instruments

a: ***Administration of the Questionnaire***

Questionnaires were administered to the agricultural extension agents in each of the sampled districts. Following preliminary discussions with the District Directors of Agriculture for the sampled districts, scheduled staff meeting dates were obtained for each district. Fortunately these meeting dates never conflicted. Thus they helped in organising the itinerary indicated in Appendix VI. It was on the respective meeting dates that the agricultural extension agents were met in groups (after each meeting) and the questionnaire were completed after a thorough briefing on the purpose of the research.

This exercise did not only save time and cost of traveling to each operational area to meet the AEAs, it also allowed the researcher to clarify questions which were not understood. It also made it possible to ensure that all questions were duly answered.

b: ***Administration of interview schedule to farmers***

Both the researcher and research assistant administered the interview schedule in Yendi and Gushiegu/Karaga Districts. This was because the researcher could understand and speak quite fluently the language (Dagbani) of the people. To ensure effective supervision over the research assistant while administering the interview schedule, both researcher and the assistant visited the same village on a particular day. This allowed ease of contact between them for clarification of issues and questions during the exercise.

In East and West Gonja Districts where the researcher could barely understand the Gonja language but not speak it, he supervised the interview schedule being administered by the research assistant. Misunderstood and misinterpreted issues were instantly clarified.

In all cases, farmer respondents were interviewed individually to avoid influence from neighbours and family members.

c: *Focused Interviews*

Focused interviews and discussions were held with identified stakeholders in the agricultural sector in the region. These included researchers (of the Savannah Agricultural Research Institute-SARI), District Directors of Agriculture (DDAs), District Agricultural Development Officers (DDOs), Subject Matter Specialists (SMS--crops), and farmers. The focus of these interviews was on yam production, farmers' constraints to that effect, and efforts being made to develop and promote technologies that would enhance the production of the crop in the region. Notes made from these interviews were necessary to guide discussions on the findings of the research. Appendix IV indicates the check list used for the focused interviews

d: *Literature and Documentary Reviews*

Departmental monthly reports, and annual programmes of work for the selected districts were consulted to obtain relevant information on efforts being made to promote yam production, especially seed yam production, in view of the heavy losses made during the 1994 ethnic conflict. A document of special interest was the five-year District Development Plan (1996-2000) for the sampled districts.

Notes were made on plans to develop the agricultural sector since agriculture was the main source of livelihood for over 80% of their populations.

Reports from the Research-Extension Liaison Committee (RELC) and Bi-monthly Technical Review Meetings (BMTRM) for the previous years were also consulted to see plans set for 1998 in the selected districts to enhance technology transfer. Appendix V indicates the reports and project documents consulted in the course of data gathering.

e: Participant Observation

The researcher participated in the 1998 Research-Extension Liaison Committee (RELC) planning workshop from 7th to 8th May at Tamale. As a member of the group that discussed the programme on grain legumes and root and tuber crops, the researcher made notes from the workshop on the efforts that were being made to assist farmers improve upon production of these crops (especially yam).

4.4: DATA MANAGEMENT AND ANALYSIS

At the end of each day's schedule of administration of the interview guide, the researcher and his assistant cross-checked all interview guides to ensure that all questions were well answered. Discrepancies were clarified to obtain well filled interview guides. On rare occasions was it necessary to revisit a farmer respondent to clarify issues.

Questionnaire were self-administered by the AEAs in the presence of the researcher. Thus issues that were misunderstood were readily clarified to obtain well-completed questionnaires.

4.4.1: Post-Coding and Data Storage

As indicated in Section 4.3.2, both interview guide and questionnaire contained open-ended and closed-ended questions. `All open-ended questions were post-coded to ensure uniformity of responses to facilitate data analysis.

Data was then coded and stored using the Statistical Package for the Social Scientist (SPSS) software programme.

4.4.2: Data Analysis

The type of data analysis is determined by the objectives of the study and the research design. This research design being a non-experimental survey in which data were collected via the interview schedule and questionnaire, the non-parametric descriptive analysis of data was done using the Statistical Package for the Social Scientist (SPSS) software programme.

Siegel and Castellan (1988) stated that when data consist of frequencies in discrete categories, the chi-square test might be used to determine the significance of differences between two independent groups. They further stated that the focus of this test is on whether the differences in proportions exceed those expected as chance or random deviations from proportionality. Using frequencies of responses to specific variables from agricultural extension agent (AEAs) and farmer respondents, the chi-square test for independent samples was used to establish significant differences in perceptions, if any, between the two categories of respondents with respect to the specific variables.

To achieve this, the method described by Siegel and Castellan (1988), was used thus:

a: Data is arranged on a contingency table in which columns (***c***) represent groups; and row (***r***) represents a category of measured variable

b: Expected frequencies in each cell (E_{ij}) is computed by multiplying the two marginal totals common to a particular cell and the product divided by the total number of cases (***N***):

$$E_{ij} = \frac{R_i C_j}{N}$$

Where the observed frequencies (O_{ij}) are in close agreement with the expected frequencies ($O_{ij}-E_{ij}$ is small), the χ^2 value will be small. With a small χ^2 value, the hypothesis that the variables are independent of each other is rejected. However if many or some of the differences are large, then the χ^2 value will also be large. With a large χ^2 value, it is concluded that the two groups differ with respect to classification.

In conclusion, Siegel and Castellan (1988), noted that if an observed χ^2 value is equal to or greater than the value given in the "Critical value of the Chi-square Distribution" table for a particular level of significance, at a particular degree of freedom ***(df)***, then the hypothesis is rejected at that level of significance; where degree of freedom is computed by:

$$df = (r-1)(c-1)$$

where r = number of row classifications (rows)
and c = number of groups (column).

For this work, 0.05 level of significance is chosen using the following statistic:

$$\sum_{i=1}\sum_{j=1}\frac{(o_{ij}-e_{ij})^2}{e_{ij}}$$

where:

o_{ij} = observed number of cases categorised in the *ith* row of the *jth* column.

e_{ij}= number of cases expected in the ***ith*** row of the ***jth*** column and the double summation is over all rows and columns of the table.

The chi-square test of significance was used to establish significant differences between the AEAs and farmers with regards to their perception about the superiority of the yam minisett technology over the traditional methods of seed yam production, thereby assessing the research hypothesis that:

> Farmers judge that the yam minisett technology is not a better alternative to the traditional seed yam production methods in Northern Region.

The Sign Test (Siegel & Castellan, 1988), was used to match the Yam Minisett technology against the traditional seed yam production methods according to farmers' criteria of seed yam quality. Siegel and Castellan indicated that the Sign Test is based upon the direction of difference between two measures rather than quantitative measures as its data. According to them, the design is useful for research in which quantitative measurement is impossible or infeasible but it is possible to determine which is "greater". They indicated that the Sign Test is applicable to the case of two related samples when it is desired to establish that the two conditions are different. The Null hypothesis tested in this design is that:

$$P[X_T>X_Y]=P[X_T<X_Y]=1/2$$

Where X_T is judgement or score under one condition (or before treatment), and X_Y is the judgement under the other condition (or after the treatment). That is X_T and X_Y are the two "scores" for a matched pair. H_o can therefore be stated that the median difference between X and Y is zero. Thus for this research, H_o can be stated that: the median difference between the yam minisett technology and the traditional seed yam production methods is zero (i.e.: Farmers are equally distributed on their perceptions of the criteria of seed yam quality under the traditional methods of production and the yam minisett technology).

According to Siegel and Castellan, in applying the Sign Test, focus is on the direction of the difference between every X_i and Y_i, noting whether the ***sign*** of the difference is **positive** or **negative (+ or -)**. When H_o is true, the number of pairs which have $X_T > X_Y$ should be equal to the number of pairs which have $X_T < X_Y$; half of the differences should be **negative** and half **positive**. H_o is rejected if too few differences of one sign occur.

The Sign Test was found appropriate to test the hypothesis:

> H_o : Farmers are equally distributed on their perceptions of the criteria of seed yam quality under the traditional and yam minisett technologies.
>
> H_a: Farmers judge that the yam minisett technology is not a better alternative to the traditional seed yam production methods in Northern Region.

4.4.3: Presentation of Results and Findings

Equipped with data from focused interviews, literature and documentary reviews as well as notes from participant observation, results and findings of the research are fully discussed in **Part Two,** using frequency tables and bar charts where appropriate.

Part two comprises chapters five, six and seven. While chapter five discusses the technical characteristics of the yam minisett technology as they affect its adoption rate, chapter six dwells on extension delivery and its impact on the adoption rate of the yam minisett technology. Chapter seven elaborates the constraints to the adoption of the yam minisett technology in the Northern Region.

Part Three, which comprises chapter eight, gives the summary, conclusion and recommendations of the study.

4.5: CHALLENGES ENCOUNTERED DURING THE STUDY

This research work could not have been achieved without having to overcome some challenges and difficult situations. These include:

i) **Developing the questionnaire and interview schedule**: Whereas it was much easier to develop the questionnaire, developing the interview schedule was quite a difficult task since consideration was given to the fact that it was to be administered in a predominantly non-literate population. Questions had to be framed to facilitate translation into the various local dialects--Gonja and Dagbani. However, the researcher having worked in the study area for over fifteen years and could understand these dialects, this problem was somehow overcome with much assistance from the supervisor.

ii) Administering the data collecting instruments:

a: Travelling and transport: The study area, Northern Region, is quite vast; with a rather poor road network. The Regional Co-ordinating Planning Unit (RPCU, 1995) indicated the poor condition of the regional road network as one of the constraints to expanded agricultural development. The sampled districts were also far apart. Without an own means of transport, the researcher had to rely on public means of transport to shuttle from one district to the other. Intra-district movement was by motorbike over a rather rugged terrain.

b: Farmers' expectations: There was great misconception about the purpose of the research work. Most farmers anticipated that by the interview, information was required to launch a credit assistance project, hence it was commonly heard after an interview session when the credit facility would be disbursed. On a few occasions farmers turned down the invitation to be interviewed on the basis that similar audiences had been granted while assistance was never forthcoming. The researcher having worked in the study area for a long time and being able to speak the local dialect, was able to explain in-depth the purpose of the research to overcome this problem.

c: Lack of co-operation from field extension agents: On a few occasions, the attitude of some field extension agents fell below expectation. While some refused to fill the questionnaire, others demanded compensation in the form of per diem and fuel allowance for volunteering the information.

d: Institutional difficulties: Following the decentralisation exercise that the Ministry of Food and Agriculture (MoFA) was undergoing at the time of the field data collection exercise, it was difficult to have access to some departmental records as a result of re-posting of staff with inadequate handing over notes. Records of farmer training was hard to trace due to the replacement of the then District Agricultural Extension Officers (DAEO) with District Directors of Agriculture (DDA). Some Subject Matter Specialists (SMS) were rescheduled as District Directors of Agriculture or District Development Officers(DDO). Notwithstanding, the researcher being a former colleague of theirs, most field staff contacted volunteered all information that was required.

e: *Logistics*: A survey research with a sample size of 120 demands quite some amount of logistics in the form of stationery. While the assistance of Sasakawa Global 2000 and some individuals has been acknowledged, it must be indicated that it was quite inadequate and the researcher had to dwell on the scarce resources at his disposal to cope up.

4.6: CONCLUSION

By and large, the exercise afforded the researcher the opportunity to expand his working knowledge and experience of the study area. An in-depth knowledge about the study area has been of immense use to the researcher.

While the assistance of the supervisor has been formally recognised, it is worth indicating that his wide experience in participatory research and farmer training were of immense contribution to the development of the data gathering tools, data analysis and in fact the whole study. Lessons learnt to that effect richly equipped the researcher to overcome all difficulties encountered in the course of the study.

PART TWO:

FINDINGS, INTERPRETATIONS & PRESENTATIONS

CHAPTER FIVE:

"ADOPTION QUALITY" OF THE YAM MINISETT TECHNOLOGY

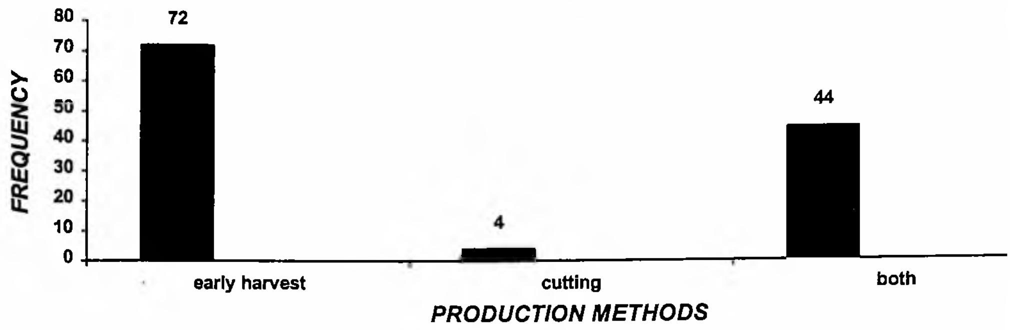
5.0: INTRODUCTION

This chapter discusses traditional seed yam production methods, farmers' criteria of seed yam quality, and the characteristics of the yam minisett technology from the farmers' perspective. It takes into consideration documentary expositions on technical characteristics of a technology that make it amenable to adoption. This amenability to adoption is referred to in this study as the "adoption quality" of the technology. Based on the farmers' criteria of good quality seed yam, a comparative analysis is made between the traditional seed yam production methods and the yam minisett technology.

5.1: TRADITIONAL METHODS OF SEED YAM PRODUCTION

The main traditional methods of seed yam production identified in the study included early harvest, sometimes referred to as "pricking" or "milking" or double harvesting and the cutting (Fig. 5.1) of tubers into cylindrical shapes weighing 200 grams and above but each retaining its outer skin or periderm.

Fig. 5.1: Bar chart of frequency distribution of farmer respondents on tradtional seed yam production methods



Whereas 72 farmer respondents indicated they employed only the early harvest as their main method of seed yam production, 4 of them used only the cutting method, and 44 applied both methods.

At the early harvest, developing yam tubers are harvested four to six months after planting, either for food or commercial purposes, while the plant is left to form new but smaller tubers. The second harvest from the early harvested plants constitutes planting material or seed yam for the subsequent season. Farmer respondents indicated that early harvest in the yam production cycle, which was variety dependent, played three major roles:

- the provision of food in the middle of the farming season when the family food grain supply falls short of requirement;
- to provide income to help finance other farm operations, and
- to provide seed yam for the subsequent season.

It was also indicated that some produce from the first harvest was used to celebrate a traditional yam festival, thanking the "gods" of the land for having witnessed another year.

Langyintuo (1996) observed that the double harvesting method was variety dependent. Only early maturing varieties of *Dioscorea rotundata* were pricked. He further noted that the savannah ecosystem being a less food secure zone, farmers considered the provision of early season food to bridge a hunger gap between June and August an important advantage of the double harvesting method. Other advantages of the double harvesting method Langyintuo (1996) identified included: the availability of more seed yam, early income (to enable the farmer meet other farm input and operational costs), and the availability of whole tubers for planting, in descending order.

In the cutting method, the cut pieces are cured by burial or shade drying and preserved to be used as planting material for the subsequent season. The study also noted that to a smaller extent, multiple tubering varieties were also used to obtain seed yam.

5.2: FARMERS' CRITERIA OF GOOD SEED YAM

Both AEA and farmer respondents indicated five main criteria which dictated farmers' choice of seed yam over the years (Table 5.1).

Table 5.1: Distribution of farmer and AEA respondents on criteria mentioned as portraying quality seed yam.

CRITERIA	FARMERS		AEAS	
	Freq.	%	Freq.	%
Variety	84	70	18	45
Germinability	72	60	21	53
Storability	82	68	39	98
Size of sett	99	83	25	63
Tuberisation	90	75	8	20
Multiplication rate	69	57	2	5

Source: Data of the study

Variety: It was indicated by 70% of the farmer respondents (Table 5.1) that emphasis is placed on early maturing varieties for three main reasons:

- early maturity allows early harvest of yam ("milking") to provide food for the household to bridge the hunger gap which often occurs between June and August;
- it allows farmers to fulfill their traditional commitment of celebrating a yam festival; and
- it allows an early harvest of yam for sale, the proceeds of which are used to finance the rest of the farm operations.

Germinability: Sixty percent (60%) of the farmer respondents (Table 5.1) indicated that the ability of a seed yam to germinate early, producing a vigorous seedling that is capable of early tuber production is also desired. This criterion, farmers described was characterised by "healthy", "rot-free" setts that are well lignified and possess well developed buds that are easily recognised.

Shelf life or Storability: . About 68% of farmer respondents indicated this as an important factor in the choice of seed yam. Storability is the ability of a seed yam to store for long and yet retain its viability. Farmer respondents indicated that since it was not always possible to plant all setts soon after harvest, depending on the readiness of mounds which in turn depended on weather conditions, varieties of seed yam that would store longer without rotting was preferable. Langyintuo (1989), and Acquah and Evange (1994) indicated that apart from pests and diseases rotting of seed yam was a problem in both savanna and forest zones of the yam production belt.

Size of sett: Up to 83% farmer respondents indicated that a sett size weighing about 500 grammes and above was the most desirable characteristic of seed yam since the sett size dictated its germinability, shelf-life, and potential tuber production. Gibe (1993) however, indicated the most economic sett size was found to be 125 grammes.

Potential tuber production: The ability to produce sizable ware yam (tubers) early in the season to allow “first harvest” (milking) was also indicated as a desirable variable of good seed yam. The need for early harvest of yam (first harvest) to provide food for the household and fulfill the traditional yam festival of farmers in the Northern Region which is celebrated annually, has already been elaborated under variety. The sale of produce from the first harvest to provide funds to finance other farm operations in the year has also been indicated.

Multiplication rate: This is the number of seed yam that can be obtained per plant (i.e. after the tuber has been removed or harvested for food or otherwise). All farmers contacted indicated this characteristic was variety specific and depended much on the earliness of “milking”(first harvest). They however conceded that the multiplication rate never exceeded 10 per plant no matter the time of “milking”.

Langyintuo (1996) observed that besides double harvesting, small tubers from multiple tubering varieties served as seed yam.

It was noted that all the characteristics so specified were interrelated and much linked to variety and size of sett planted. There was also a disparity in the ranking of these criteria of seed yam quality by AEAs and farmers. Whereas the AEAs (98%) considered storability as the most critical, farmers (83%) were of the view that "size" was most important.

In Northern Region, farmers' choice of seed yam is dictated by factors similarly identified by Tetteh and Saakwa (1994). According to them, factors which influence the choice of varieties that farmers grow include, consumers' taste and preference, early maturity, storability, yield, adaptability, and availability of planting material in decreasing order of importance. They further noted that as many as twenty-six varieties of *Dioscorea rotundata* are cultivated in most yam growing areas under different local names based on the specific attributes identified with the yam or based on the name of who introduced the yam into the area. In Northern Region, farmers' most desirable varieties include, *Laribako, Puna, Nimo, Chenchito, Moninyua, Seidu bila,* and a host of others in varied order of importance depending on location.

Considering farmers' criteria of good seed yam as the basis of comparison, the subsequent sections discuss the technical characteristics of the yam minisett technology with regards to its low adoption rate in Northern Region.

5.3: TECHNICAL CHARACTERISTICS OF A TECHNOLOGY THAT AFFECT ITS ADOPTION

Literature on adoption studies generally indicates that distinct technical characteristics of a technology can influence the acceptance or rejection of the technology at the farm level. These characteristics have been broadly categorised by many authorities including Adams, (1982); Bohlen, (1966); Hailu, (1990); Lionberger, (1968); Rogers, (1962); Rogers, (1995); and van den Ban and Hawkins, (1996) to comprise the relative advantage of the technology, its compatibility, complexity, trialability and observability.

Rogers(1962) indicated that it is these characteristics as seen by the potential users of the technology that really matter. These technical variables of the technology, acting simultaneously with the internal and external factors to the potential adopter, do influence him to the extent that he chooses to adopt or reject the technology in question.

In the ensuing sections, discussions will focus principally on the characteristic of the yam minisett technology (as assessed by the farmer) and how they influence its rate of adoption; the rate of adoption being the speed with which the technology is adopted by farmers in the Northern Region. This is measured by the number of individuals who have adopted the technology over time (Rogers, 1995).

5.3.1: The Relative Advantage of the Yam Minisett Technology

From economic analysis, the relative advantage of a technology reflects the profitability or otherwise of the technology. It implies that for the technology to be amenable to adoption it should prove economically superior to the practices or ideas already in place and used. Rogers (1962) indicated that technology developers and transfer agents should assess relative advantage of technology in terms of need, profitability and resource requirement from the point of view of potential users before attempting to introduce the technology, otherwise the innovation will be rejected.

Comparative Assessment of the Yam Minisett Technology and the Traditional Seed Yam Production Methods.

Using farmers' criteria of good seed yam, a comparative assessment was made between the yam minisett technology and the traditional methods of seed yam production (Table 5.2) to see the superiority or inferiority of one to the other.

Table 5.2: Distribution of farmer respondents on comparative quality of the Yam Minisett technology (YMT) and Traditional Methods of Seed Yam Production.

Comparative Quality	Traditional is better		YMT is better		Totals	
	Freq.	%	Freq.	%	Freq.	%
Germinability of sett	100	83	20	17	120	100
Shelf life of sett	102	85	18	15	120	100
Size of sett	108	90	12	10	120	100
Multiplication rate	43	36	77	64	120	100
Tuberisation	112	93	8	7	120	100

Source: Data of the study.

The data indicate that the traditional seed yam production methods were considered better than the yam minisett technology in producing seed that met the farmers' criteria of geminability, shelf life, size of sett and tuber production by sett (tuberisation). Farmers, however, conceded that the yam minisett technology performed better than their traditional methods with regards to multiplication rate.

Most farmers emphasised on **sett** size and **tuberisation** as very important criteria of seed yam quality. This is obvious since a bigger sett size produces a more vigorous seedling with the potential of producing a much bigger tuber early in the season to meet the farmers' objective of supplementing his household food requirement at the time that food grain is running out.

Multiplication rate as a relative advantage of the yam minisett technology.

Sixty-four percent (64%) of farmer respondents (Table 5.2) viewed the yam minisett technology as superior to the traditional seed yam production methods on the basis of multiplication rate.

This observation conforms to findings that the yam minisett technology has the potential of a higher seed multiplication rate than the indigenous double harvesting (milking) method hence the promotion of the technology. Seed yam multiplication ratio by the double harvesting method is low, between 1:4 and 1:8 (Alvarez and Hahn, 1994); while it is possible to obtain over 50 setts from one tuber by the yam minisett technique. Langyintuo (1996) observed that the high multiplication ratio of the yam minisett technique (4% of output against 33% in the traditional double harvest system) makes it economically superior to the traditional double harvesting method. The yam minisett technology was therefore assumed as a package for commercial production of seed yam.

However, the technology did not produce seed yam that has other critical characteristics often desired by farmers-including germinability, shelf life, size of sett and potential tuber production.

Using the Sign Test (Siegel & Castellan, 1988) the hypothesis that farmers are equally distributed on their perceptions of the criteria of seed yam quality under the traditional and Yam Minisett technologies was examined using the frequency distribution of farmers (Table 5.3).

able 5.3:Frequency distribution of farmer respondents on the criteria of seed yam quality under the Yam Minisett Technology and the traditional seed yam production methods.

Quality criteria	Traditional (X_T)	YMT (X_Y)	Direction of difference	Sign
Germinability	109	20	$X_T > X_Y$	+
Shelf life	102	18	$X_T > X_Y$	+
Sett size	108	12	$X_T > X_Y$	+
Multiplication rate	43	77	$X_T < X_Y$	-
Potential tuberisation	112	8	$X_T > X_Y$	+
$\alpha=0.5$	$X=1$	$N=5$	$p=0.188$	

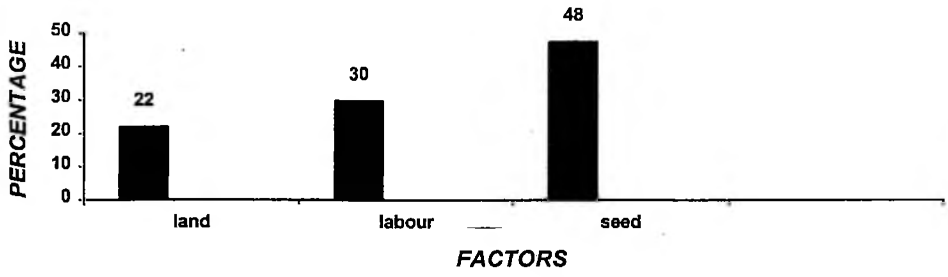
Siegel and Castellan indicated that the Sign Test is based upon the direction of difference between two measures rather than quantitative measures as its data. They stated that it is useful for research in which quantitative measurement is impossible or infeasible but it is possible to determine which is "greater" (Section 4.4.2).

From the Sign test in Table 5.3, 0.188 is in the region of rejection for $\alpha=0.5$, N being the number of matched pairs. The hypothesis that farmers are equally distributed on their perceptions of the criteria of seed yam quality under the traditional and yam minisett technologies is therefore rejected. There are fewer **negative signs (-)** than **positive (+).** Farmers perceived that the yam minisett technology is not a better alternative to the traditional seed yam production methods based on their criteria of seed yam quality in the Northern Region.

Commercial seed yam production as a relative advantage of the yam minisett technology

Farmer respondents (48%) indicated that seed yam was the most important factor in determining sizes of yam farms cultivated (Fig. 5.2).

Fig. 5.2: Bar chart of percent distribution of farmer respondents on determinants of sizes of yam farms cultivated



With the very high multiplication rate and the critical role seed yam played as a factor in determining farm sizes, the yam minisett technology could afford the farmer the option for commercial seed yam production. It was reported that trading in seed yam though popular in some parts of the yam growing areas in the Northern Region was limited by quality, quantity, and preference for particular varieties. Though about 80% of farmer respondents rated purchasing as their second means of obtaining seed yam other than self-production, 68% indicated they could never get their desired varieties when it was necessary.

While seed yam (48%), labour (30%) and land (22%) in descending order(Fig. 5.2) dictated the sizes of yam farms, data from the study also indicated that farmers scarcely experienced shortage of seed yam as in Table5.4.

Table: 5.4: Distribution of farmer and AEA respondents on frequency of seed yam shortage experienced by farmers.

Frequency	Farme		AEAs	
	Freq.	%	Freq.	%
Annually	25	21	11	28
Scarcely	95	79	29	72
Total	120	100	40	100
$\chi^2 = 0.76$	df = 1	p<0.05		NS

Source: Data of the study
NS: Not statistically significant

There is no significant statistical difference between AEAs' and farmers' observation about the frequency of seed yam shortage. Seed yam was thus not a major limiting factor to yam production in the study area. Buying seed yam was therefore a rare thing for most farmers; hence commercial seed yam production via the use of the yam minisett technology appeared limited. The foregoing implies that the promotion of the technology by the extension organisation was not based on farmers' perceived need; but on the premise that the technology was available and should therefore be "pushed".

While purchase of seed yam appeared to be an option where there was scarcity, farmers did so as last resort. Majority of farmer respondents (those who never bought seed yam-80%) were rather sceptical about the opportunities for commercial seed yam production through the use of the yam minisett technology since they were convinced that every serious yam farmer ensured he had adequate seed yam for his operations and would avoid "buying" a neighbour's "bad luck".

Yam production in Northern Region goes with some inexplicable myths that a farmer feels he may "buy" a neighbour's "bad" luck through seed yam purchase.

Tetteh and Saakwa (1994), similarly observed that farmers believe by selling or buying seed yams, one may "sell" his fortunes or "buy" the misfortunes of the other farmer. According to Langyintuo(1989), and Hahn et al. (1995), in the yam zone of Africa, yam plays vital roles in traditional culture, rituals, and religious life of the people. They further noted that trading in seed yam was found to be less popular in some communities due to the ethnocentricity farmers attach to yams.

This belief tends to limit further the extent to which seed yam production could be commercialised through the adoption of the yam minisett technology. Langyintuo (1996) therefore observed that inter-household transfer of seed yam was preferred to outright purchase.

Resource requirements of the yam minisett technology

Relative advantage of a technology should also be assessed on the resource requirements from the potential adopters' point of view. Farmer respondents (66% of) indicated that the yam minisett technology was tedious, labour-intensive, requiring chemical treatment and fertiliser. Others (57%) responded that the technology was a waste material (ware yam) and time. Farmer respondents indicated these as some of the contributory factors to the technology not being adopted.

By the yam minisett technology a tuber is cut into pieces of about 25-70 grams, treated with chemicals (fungicides), pre-germinated in nurseries before being transplanted in the fields (Section 3.1.2). This, farmers contended, was tedious, labour-intensive and required chemical treatment and fertilisers which they could not afford. Langyintuo (1996) observed that the extra labour required to manage the nurseries and fields was one of the obstacles to the practice of the yam minisett technology. It has also been indicated that the unavailability and cost of farm inputs was responsible for the non-adoption of the yam minisett technology (Madukwe, 1995; Okoli, Igbokwe, Ene & Nwokoye, 1982).

Farmer respondents also indicated that their most desired early maturing varieties, including *Laribako* and *puna,* did not lend themselves to the technology. They insisted that these two varieties, if cut into pieces as required by the yam minisett technology would rot when nursed no matter the chemical treatment. Thus whole tubers used for that would be a waste.

Johnson and Kellogg (1984) stated that farmers will accept new practices when they perceive that the benefits outweigh the costs. They further indicated that farmers will hesitate to commit resources to the innovation whose performance they are in doubt, as a means of risk aversion. Farmers indicated that committing their desired varieties of ware yam to the technology would just but be a waste. Consequently they would not risk practising the technology. Castillo (1966) observed that the anticipation of undesirable consequences as a result of the adoption of a practice contributes to the rejection of the practice.

It was verified that these varieties were never used for the demonstrations conducted to teach farmers about the applicability of the yam minisett technology. The AEAs contacted indicated that water yam (*Dioscorea alata)* and bush yam (*Olodor*) were the cultivars used for the demonstrations. The AEAs were equally convinced that farmers' desired varieties did not yield to the technology.

Okoli, Kissiedu & Otoo (1992) noted the difficult response of some varieties to the yam minisett technique and this they indicated was one of the reasons why farmers did not adopt it. According to Langyintuo (1996), in principle, the technique could be applied to commonly grown yams, but in practice, varieties of *Dioscorea alata* (water yam) were commonly used.

Immediacy of returns from the yam minisett technology

Maunder (1972) observed that new methods which can give the farmer a quick economic return are more likely to be accepted than those which he will have to wait for a long time to see the result. Farmers (41% of respondents) also indicated that for the technology to produce any good ware yam, it required a two-year gestation period. While the yam minisett technology will produce abundant seed yam, it will not yield tubers for consumption the year it is employed. They indicated this as a major factor militating against the adoption of the technology. Tuber production in yam, especially for the early-maturing varieties guarantees food security for the farmer in Northern Region. Since the primary objective of the farmer is to produce food for the household, having to wait for two years to obtain ware yam from his yam crop through the yam minisett technology cannot be justified. Thus, with regards to immediacy of results the yam minisett technology did not meet farmers' desire.

This conforms with observations made by Asadu and Akamigbo (1996) that using the yam minisett to produce ware yams has not been fully adopted by most yam producers because the technique requires chemical treatment, pre-germination and takes one full season to produce. They further noted that farmers facing land constraints may find it difficult to allocate land to the production of seed yam for a full season before using it to produce ware yam.

Rogers (1995) indicated that relative advantage is one of the best predictors of an innovations' rate of adoption. He further outlined sub-dimensions of relative advantage to include the degree of economic profitability, low initial costs, a decrease in discomfort, social prestige, a savings in time and effort and immediacy of rewards.

Contrarily, the study has observed that while the yam minisett technology had the superior advantage of higher multiplication rate for seed yam production, the quality of seed produced, the labour requirement for nursery work; the two year gestation period required to obtain ware yam, and non-susceptibility of farmers' desired varieties to the technology tend to negate the superiority of the technology over the local methods in this regards. In terms of need, the yam minisett did not address a felt need of the farmers since they never recognised seed yam as a limiting factor to yam production; despite its primary role in dictating the sizes of yam farms. They rarely lacked seed yam.

5.3.2: Compatibility of the Yam Minisett to Traditional Practices

Rogers (1995) noted that an innovation can be compatible or incompatible with (a): the socio-cultural believes, (b) previously introduced ideas, or (c) the client needs for the innovation. Adams (1982) observed that innovations that are incompatible with traditional management objectives will be rejected.

Incompatibility of the yam minisett technology with farmers' need

According to both farmers and AEAs, most farmers rarely lacked seed yam (Table 5.4) thus the technology was not addressing the farmers' need nor a priority problem. Though farmers' awareness of the yam minisett technology could have generated their need for the technology, the extension organisation through its field workers unilaterally diagnosed the technology as a panacea to farmers' seed yam problem which the farmers themselves did not recognise.

Incompatibility of the yam minisett technology with production objectives

The yam minisett technology by its nature takes a full season to produce seed yam. It will therefore require two full seasons for a farmer practising it to obtain ware yam either for food or sale. While the yam minisett technology will produce abundant seed yam, it will not yield tubers for consumption the year it is employed. Forty-one percent (41%) and three percent (3%) of farmer and AEA respondents (Fig. 7.1) respectively indicated the two-year gestation period of the yam minisett technology as one of the factors that hindered the acceptability and practice of the technology.

In the Northern Region yam constitutes one of the major starchy food crops farmers rely upon especially when the weather is unfavourable for cereal crop production. The prime objective of yam production therefore is to obtain ware yam for home consumption, and more particularly to bridge the hunger gap that exists around June and August with the first or early harvest from the yam crop. Produce from the first harvest is also needed to enable farmers fulfil their annual traditional yam festival. Hahn, et al. (1995) observed that in the yam zone of Africa, yam plays a vital role in traditional culture, rituals, and religious life. Since the use of the yam minisett technology requires that the farmer would have to wait for a full season to obtain ware yam, the technology is incompatible with the peoples' economic and cultural value of yam production. Innovations that are incompatible with the cultural values of the people can block their adoption rate.

Incompatibility with management objectives.

Adams (1982) indicated that farmers will be reluctant to adopt innovations which will produce more food but involve more work. Results from the study indicated that farmers contacted found the yam minisett technology tedious to practice and labour intensive involving nursery practices.

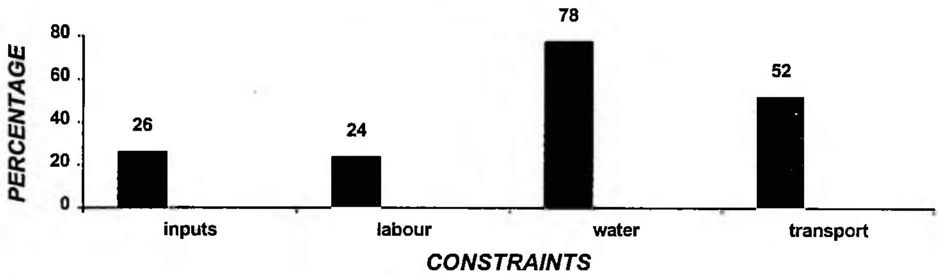
Only 43% of farmer respondents went beyond the awareness stage of the adoption process to try the technology on their own. Difficulties encountered by farmer respondents in the course of the trying the yam minisett technology were investigated to assess the extent of compatibility of the technology with farmers' traditional practices in the yam culture.

Enumerated difficulties of farmer respondents who had tried the yam minisett technology after having been trained included:

- Lack and cost of inputs (chemicals) (28% of farmer respondents who tried the technology);

- Labour requirement (24% of farmer respondents who tried the technology);
- Lack of water and watering problems (78% of farmer respondents who tried the technology) and
- Transportation difficulties (52% of farmer respondents who tried the technology) (Fig. 5.3):

Fig. 5.3. Bar chart of % distribution of farmer respondents on contraints encountered in trying the yam minisett technology



Lack and cost of inputs (chemicals): Farmers who tried the technology encountered difficulties in trying to procure fungicides that prevent rot of setts at the nursery. Fungicides were either not available or farmers could not afford the cost of these chemicals.

The availability, accessibility and affordability of inputs associated with a technology that has been introduced to farmers enhances the adoption of the technologies involved. Thus the absence of the necessary inputs did not permit the technology to be tried let alone to enhance its adoption. Okoli, et al. (1992) observed that the unavailability and high cost of fungicides and fertilisers was one of the factors responsible for the non-adoption of the yam minisett technology. According to Madukwe (1995), the factor of cost of the input that must be paid for if the technology is to be adopted made farmers consider the technology as costly to implement. Beneficiary assessment report of National Agricultural Extension Project (NAEP) also indicated among others that the lack and cost of farm inputs contributed to the low adoption of agricultural technologies promoted by agricultural extension (NAEP, 1997).

Labour: Farmer respondents indicated they had problems getting labour to establish and care for the yam minisett nurseries and fields. An innovation that produces more food but requires more labour than the farmer can afford will be rejected. Langyintuo(1996) noted that one of the constraints limiting the practice of the yam minisett technology was the extra labour it required to manage the fields.

Labour (30%) was ranked second (Fig. 5.2) as the factor that played a major role in determining farm sizes cultivated. Most farmer respondents (89%) relied mainly on family labour for all farm operations throughout the year. However, majority of respondents (69%) indicated they did not have adequate labour throughout the year for their farm operations. Most of the youth who constituted a significant proportion of the family labour migrated outside the region in search of jobs towards the end of a farming season, only to return at the onset of the rains.

Watering problems: The most severe constraint faced by farmers in trying out the technology was the lack of water, both for domestic use and the seed nurseries. Lack of water and even watering difficulties was encountered by about 78% of farmers (Fig. 5.3) who had tried the technology. Farmers indicated that for the technology to produce sizeable seed yam for a particular season, nursery work should take place just before or at the onset of the first rains. However, this is a period where water is really scarce in most communities in Northern Region especially when a fairly poor rainfall distribution has been experienced in the preceding year.

In the course of data collection, quite a number of deserted communities were noted and this was alleged to be due to lack of water for both domestic use and livestock. In this crisis situation, farmers indicated their attention to farm work was surely minimal. Thus it was difficult to manage seed yam nurseries.

Transportation difficulty: Where water was not available on the farm seed yam nurseries were set up in the homes. Fifty-three percent of the farmers who tried the technology had problems conveying sprouted setts to the farm for transplanting. The loss of sprouted setts due to shock in the course of transportation was indicated as common. The difficulty in handling small (25 grammes) setts resulting in losses due to "shock" has been indicated as one of the reasons why farmers do not adopt the yam minisett technology (Okoli, et al., 1992).

In sum, the yam minisett technology was not only incompatible with the current needs and production objectives of farmers, its comparatively labour-intensive nursery and chemical requirement made it incompatible with farmers' culture of yam production in the Northern Region.

5.3.3: Complexity of the Yam Minisett Technology:

Complexity is the degree to which an innovation is perceived by the potential adopter as relatively difficult to understand and/or use. The ease of understanding and practising a technology makes the technology readily adaptable at the farm level. Van den Ban and Hawkins (1996) indicated that some innovations fail because they are not implemented correctly (due to complexity and inadequate knowledge and skills).

Assessment of the farmers' level of understanding of the yam minisett technology and the possible need for further training indicated 71% of farmer respondents having full understanding of the technology. Despite this, 57% of all farmer respondents indicated they needed further training in the technology (Table 5.5).

Table 5.5:Distribution of Farmer respondents on their level of Understanding & Training Requirement on the Yam Minisett Technology.

Response	Full understanding		Training required	
	Freq.	%	Freq.	%
Yes	85	71	68	57
No	35	29	52	43
Total	120	100	120	100

Source: Data of the study.

Applicability of the yam minisett technology

Though majority of AEA respondents indicated it was easy for farmers to practice the technology, the farmers themselves indicated it was difficult for them to practice (Table 5.6).

Table 5.6: Distribution of farmer and AEA respondents on level of difficulty in applying the Yam Minisett Technology.

Level of difficulty in applying the technology	Farmers		AEAs	
	Freq.	%	Freq.	%
Simple	32	26	24	60
Difficult	88	74	16	40
Totals	120	100	40	100

$\chi^2 = 14.6$ df: 4 $p < 0.05$ S

Source: Data of the study.

S: Statistically significant

There is a statistically significant difference in conception about the ease of application of the yam minisett technology by farmers and AEAs. The difference arises from the many more AEA's perception that the yam minisett technology was relatively simple to practise which is the reverse of the distribution of farmers.

The yam minisett technology required that the farmer who is used to planting whole tubers of unknown weights to make a change to mini-yam-sett that has to conform to certain weights and treatment before planting. As observed by Rogers (1995), the complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption. The yam minisett technology, requiring relatively more steps and activities than the traditional methods was therefore perceived as difficult by the farmers.

Extension follow-up visits.

The study noted that only 44% of farmer respondents received follow-up visits from their trainers (AEAs) to find out how they were implementing the technology. According to Johnson and Kellogg (1984), farmer-managed trials are particularly important as they allow the farmers to participate in testing new technologies. The lack of concerted efforts by the extension agents to assist farmers to implement the technology on their own contributed to the low percentage (43%) of farmers who tried the technology on their own.

5.3.4: Trialability of the Yam Minisett Technology

The degree to which an innovation may be experimented with on a limited basis is denoted as trialability. Every farmer is cautious about economic losses in his daily operations, hence he would prefer to try a new technology on a small scale to assess its performance before adopting it on a larger scale. Van den Ban and Hawkins (1996) observed that farmers will be more inclined to adopt an innovation which they have tried first on a small scale on their own farm than an innovation they have to adopt immediately on a large scale. Technologies that are therefore divisible will generally be more rapidly adopted than those that are not divisible. An easily demonstrable practice is more easily adopted than one which cannot be demonstrated.

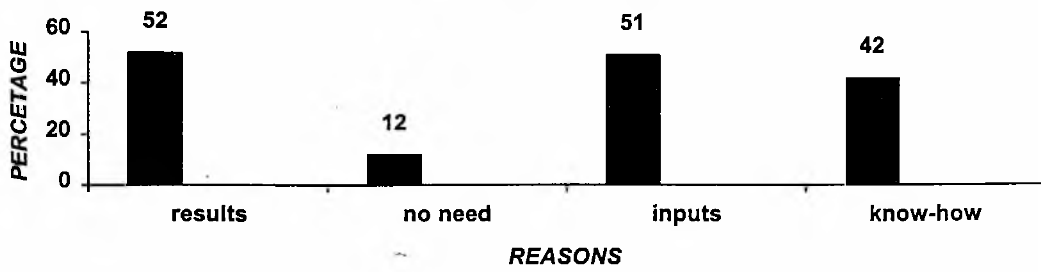
The yam minisett by its nature could be tried on a small scale. However, only 43% of all farmers interviewed went beyond the training sessions they attended to try the technology on their own (Section 5.3.2). On post-training evaluation of the technology to assess applicability of the technology, 57% of farmer respondents indicated they did not enter the trial stage of the adoption decision-making process.

Reasons enumerated by this group of farmers included:

- Unimpressive results of the demonstration (training) (52%)
- No inputs (chemicals) to try the technology (51%)

- Poor understanding of the technology (42%)
- No problem with seed yam production (12%).(Fig 5.4).

Fig. 5.4: Bar chart of % distribution of farmer respondents on reasons for not trying the yam minisett technology



Unimpressive Results of the Demonstration: More than half of the farmers who did not try the technology indicated the size of the seed yam produced from the demonstration and the general nursery work involved did not meet their expectation.

The outcome of field demonstrations does play a major role in stimulating farmers to try or even adopt the technology that has been demonstrated. Result demonstrations prove the practicability of technologies under the local conditions of the farmer. According to the farmer respondents, the yam minisett technology had nothing to offer with regards to seed yam production since its trial demonstration results were not impressive to them. Seed yam produced by the technology did not possess the desired characteristics of size, germinability, and potential tuber production ability (Table 5.1).

No Inputs to try: Over the years, most agricultural projects and government extension service supplied inputs for on-farm method and result demonstrations to encourage farmers to adopt the technologies so demonstrated. Following major economic reforms by government resulting in the privatisation of agricultural inputs within the last five years, the practice has been discontinued with emphasis being placed on farmer-supply of inputs or the use of locally available inputs for on-farm demonstrations. AEA respondents indicated that farmers were reluctant to provide inputs for demonstration purposes; and those who had successfully conducted demonstrations with inputs supplied by the extension organisation had reverted to their old practices with the discontinuance of input supply.

Like the farmers who tried the technology on their own, fifty-one percent of those who did not try it (51%) also indicated that they could not obtain the necessary chemical inputs required to treat their setts before nursing. Thus the absence of the necessary inputs did not permit the technology to be experimented. Okoli et al. (1992) and Langyintuo (1996) observed that one of the reasons for the non-adoption of the yam minisett technology was the unavailability and cost of fungicides and fertilisers.

Poor Understanding of the Technology: Inadequate understanding and skills was also noted as one of the obstacles to try the technology. As indicated in Section 5.3.3, 57% of all farmer respondents indicated they required further training to be skilful enough to practise the technology. This was attributed to the limited farmer involvement in the demonstration conducted to teach farmers. Effective farmer participation at method demonstration helps develop or improve the farmers' skills to practice the technology involved. Madukwe (1995) noted that the lack of sound technical knowledge including, cutting technique, spacing and use of chemical and fertilisers was an obstacle to the adoption of the yam minisett technology.

No Problem with Seed Yam Production: Farmers not faced with the problem of seed yam production did not bother themselves to try a technology that was meant to solve seed yam shortage problems. As in Table 5.4, most farmers indicated they scarcely lacked seed yam; some of those who did not try the technology (12%) therefore saw the yam minisett technology as that which was not addressing a felt need.

5.3.5: Observability of the Yam Minisett Technology

Data obtained from the study indicated that 80% of farmer respondents got introduced to the yam minisett technology through both method and result demonstrations while the other 20% got the message via group discussions. All farmer respondents (100%) subsequently had formal training on the technology through group farmer training involving both method and result demonstrations on one or more occasions. While 67% of farmer respondents observed these demonstrations carried out on farmers' own fields, only 32% of the farmer respondents had actually carried out the demonstrations themselves under the supervision of the AEA. All farmers indicated that they had attended more than two field days conducted by the AEAs to enable them assess the performance of the technology.

The need to conduct demonstrations on farmers' fields with their active participation is critical in enhancing the adoption of the technologies demonstrated. Johnson and Kellogg (1984) observed that farmer-managed demonstrations are critical in promoting the adoption of the technology involved because they allow the farmer to participate in testing the new technology under his own conditions. An analysis of the farmers' own assessment of the results of the demonstrations they had observed indicated 57% of them were satisfied with the outcome of the technology (Table 5.7).

Table 5.7:Distribution of Farmer respondents on their assessment of the results of the Yam Minisett demonstrations.

Response	FARMERS	
	Freq.	%
Satisfied	68	57
Not Satisfied	52	43
Total	120	100

Source: Data of the study.

Some farmers were satisfied on the basis that the technology could work in their own environment. Others were however not satisfied and attributed this to the output not meeting their criteria of seed yam quality. Farmers were thus able to make a comparative assessment of the yam minisett technology against their traditional seed yam production methods (Table 5.2) on the basis of their criteria of seed yam quality.

5.4: SUMMARY:

Castillo(1966) attributed the rejection of modern farming to:

* Incompatibility of the new method to existing conditions,
* The high cost of the adoption of the practice,

* The failure of the practice to prove superior or effective results of the adoption of the practice,
* Lack of resources and skills to carry out the practice and
* Difficulty in carrying out the practice in terms of skills, labour supply of inputs; among others.

Though the yam minisett technology by its nature lend itself to be tried on a small scale; and its results could readily be assessed, most farmer respondents indicated they required further training to understand and improve their skills to enable them practise it. The technology differed from the traditional yam production methods on the basis of nursery practices associated with the practice. Farmers' indicated their dissent for the labour-intensive and tedious nursery practices associated with the yam minisett technology by observing that it should be modified to allow straight planting thus conforming to traditional methods of planting yam.

The relative advantage of the technology in its multiplication rate was appreciated but the comparatively poor quality of seed yam produced and the two-year gestation period for the practice to yield tubers made the farmers reluctant to adopt it. Though some farmers did buy seed yam from their neighbours when in crises, commercialisation of seed yam production as envisaged by the promoters of the technology appeared not to have a potential in the region due to mythical reasons associated with seed yam purchase and yam production in general. Ezeh (1994), in his study on the economics of commercial seed yam production from the yam minisett technology in Nigeria, indicated that the venture had not been profitable.

In an overall assessment, both farmer and AEA respondents indicated the traditional method of seed yam production as being superior to the yam minisett technology (Table 5.8).

Table 5.8: Distribution of farmer and AEA respondents on the comparison of the superiority of the Yam Minisett Technology to Traditional Seed Yam Production Methods.

Superior technology	Farmers		AEAs	
	Freq.	%	Freq.	%
Yam Minisett Technology	22	18	17	43
Traditional methods	98	82	23	57
Totals	120	100	40	100
$\chi^2 = 9.5$	df: 1	$p<0.05$		S

Source: Data of the Study
S: Statistically significant

There is a statistically significant difference between the farmers' and AEAs perception about the relative inferiority of the Yam minisett technology and the traditional methods of seed yam production. Though majority of both farmer and AEA respondents indicated the traditional seed yam production methods were superior to the yam minisett technology the statistical difference is contributed mainly by the comparatively higher ratio of AEAs (43%) who in endorsing "modern" scientific agriculture assessed the yam minisett technology as being superior to the farmers' traditional methods.

Majority of both AEA and farmer respondents acknowledged that the traditional seed yam production methods were superior to the yam minisett technology. Farmers also indicated that the yam minisett technology did not produce seed yam that met their criteria of seed yam quality besides other disadvantages of the technology raised. Thus the research hypothesis that farmers judge that the yam minisett technology is not a better alternative to the traditional seed yam production methods in the Northern Region is retained.

The extension organisation, convinced it was promoting a technology that would enhance yam production failed to recognise that the technology was not meeting the farmers' production and management objectives hence the routine annual farmer training on the technology despite the low adoption rate noted by both researchers and extension personnel in the Northern Region (Langyintuo, et al., 1997). Moris (1991) noted that officials, insulated by their perception that they are endorsing "modern agriculture" in contrast to supposedly primitive and inefficient existing practices, continue to promote unpopular and inappropriate measures year after year. Consequently, the study realised that only 3% of the 120 farmer respondents were practising the technology for the second year running on a very limited scale.

5.5: CONCLUSION:

This chapter has discussed findings on the yam minisett technology based on its inherent technical characteristics as perceived by the farmers and the AEAs.

Since the yam minisett technology produced seed yam of inferior quality by farmers' standards; whilst the complex production process involving nursery work did not conform to indigenous farm practices and culture on yam production vis-à-vis perceived drudgery/difficulties involved as well as input cost requirements, the farmers' choice of their traditional methods of seed yam production appears justifiable.

CHAPTER SIX:

THE IMPACT OF EXTENSION ON THE ADOPTION OF THE YAM MINISETT TECHNOLOGY

6.0: INTRODUCTION

This chapter discusses the contributions and limitations of agricultural extension on the adoption of the yam minisett technology in the Northern Region. It focuses on the constraints, sources of extension messages, farmers' problem identification and methods of extension delivery.

6.1: EXTENSION DELIVERY AND ITS CONSTRAINTS

The ensuing sections discuss extension delivery in the Northern Region and constraints encountered by field extension staff in the process.

6.1.1: Extension Delivery in the Northern Region

According to Whale (1989), extension delivery is the conveyance of information about a technology to the target group such that it can be effectively applied by the target group in their own situation to fulfill a need.

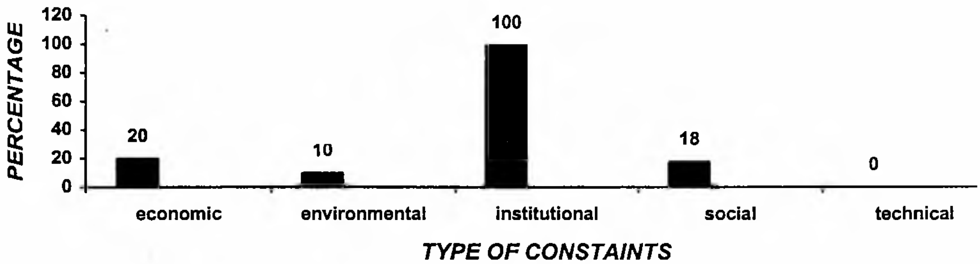
Reviewing the annual extension programmes and plans of work of the sampled districts, it was observed that extension services delivery in the Northern Region, like the rest of the country, was achieved principally by the group extension method whereby the AEA formed two farmer contact groups in each of eight contact villages in his operational area. A group normally consisted of about eight to twelve members. Through scheduled regular visits, the AEA met each contact group at least once a fortnight to deliver technical messages to enable farmers solve current farm-related problems; at the same time, pertinent problems were addressed, otherwise they were noted, and referred to the AEA's supervisor (SMS/DDO/DDA) for a solution to be found. At the end of every fortnight's schedule of visits, all AEAs in a district and their supervisors met to review the fortnight's programme performance, and plan for the ensuing fortnight. Scheduled monthly training sessions were held at the end of every two successive fortnightly visits. These training sessions were held to equip the AEAs with the necessary technical knowledge required to solve prevailing farm-related problems.

The operational structure, so set up for extension service delivery, was farmer-oriented, demanding frequent movement of the AEA to enable him get in touch with his target group. The study noted that the AEA was the main source of technical information on agriculture to all farmer respondents. All farmers contacted acknowledged the presence and role of the AEA in their communities with 87% of them describing his role as very useful. They further indicated that they themselves called on the AEA for technical advice when necessary apart from his normal visiting schedule. Despite the recognised significant role that the AEAs played in their respective operational areas, some factors were identified by the AEAs as major constraints to extension delivery and its impact on agricultural development. The ensuing section discusses these constraints.

6.1.2: Constraints to Extension Delivery

An assessment of obstacles to effective extension delivery and agricultural development in the region was made. Most AEAs enumerated issues which were catalogued into five broad categories, viz.: economic constraints (20% of AEA respondents), environmental factors (10% of AEA respondents), social factors (18% of AEA respondents), and institutional factors (100% of AEA respondents) (Fig. 6.1).

Fi. 6.1: Bar chart of % distribution of AEA respondents on contraints to extension delivery.



No technological constraints were identified. AEAs explained that due to the regular monthly training they received they were adequately equipped with current technical messages they required to help farmers address their problems. This was confirmed by the beneficiary assessment report of the National Agricultural Extension Project (NAEP) which indicated that the regular in-service training institutionalised in the form of monthly training for front-line staff had significantly improved the technical capabilities of the field staff; hence staff were confident of their knowledge and skills (NAEP, 1997).

Economic Constraints

Major economic constraints identified by AEA respondents were dominated by the unavailability and astronomical prices of farm inputs. The acceptance and practice of technological recommendations is based on the availability, accessibility and affordability of farm inputs associated with them. AEAs noted that it was often disheartening to be confronted by farmers on where to get inputs for some of the technologies they were recommending. They indicated that most recommended farm practices demanded the use of external farm inputs including improved seeds, chemical fertilisers and improved breeds of animals, the prices of which farmers complained they could hardly afford. They observed that this situation was worsened as a result of unavailability of credit facilities to enable them cope with cost of farm operations.

The beneficiary assessment report of the National Agricultural Extension Project (NAEP) identified some of the constraints to low adoption of agricultural technologies as the lack and high cost of labour and farm inputs as well as the lack of access to credit (NAEP, 1997). Thus most technical recommendations were practised below expectation.

b: Environmental Factors

These included mainly agro-climatic constraints to agricultural production. AEAs noted that unfavourable weather conditions, the unreliable rainfall pattern; its onset and distribution adversely affected effective application of some technical messages delivered. This was confirmed by the observation of the Ministry of Food and Agriculture (MoFA, 1997) that the erratic rainfall pattern was the major constraint to agricultural development in Northern Region, sometimes resulting in poor crop yields leading to food shortages.

Environmental degradation characterised by rapid deforestation due to pressure on the natural vegetation for fuelwood and farming purposes coupled with the severe annual bush fires was also noted by AEAs as a constraint on the impact of extension delivery and agricultural development in Northern Region. While some parts of the region have a fairly low population density, the densely populated urban and peri-urban central parts of the region is severely affected by this menace due to pressure on land. Efforts by extension on sustainable landuse programmes are yet to make an impact to redress the situation.

c. Social Constraints

Agricultural extension agents identified social constraints to extension delivery and its impact to include, customs and taboos, level of education and attitudes of the target group-the farmers.

Customs and Taboos: AEAs indicated that certain customs and taboos of the people tended to thwart efforts of extension in effecting changes in some farm practices. It was indicated that farmers believed that one may "buy" a neighbour's "bad" luck through the purchase of his seed yam. Maunder, (1972) similarly observed that rural people sometimes believe strongly that their way of doing things is the best, fearing the unknown and untried. Individuals who tend to be quite resolute in their customary beliefs and practices find it difficult to accept new ways of doing things.

The failure to take cognisance of local customs, beliefs and taboos of the social system within which innovations are being promoted often result in undesirable consequences. Rogers (1995) indicated that planners and officials in charge of development programmes fail to account for cultural values of the expected adoptors of an innovation, resulting in the failure or unexpected consequences of diffusion programmes.

ii: *Attitude*: The AEAs noted that most farmers sometimes looked upon some recommended practices with indifference. It was explained by both farmers and AEAs that since the withdrawal of subsidies on agricultural inputs, and subsequent privatization of the sale of these inputs in consonance with the economic restructuring programme of the government, agriculture was “no longer attractive”. This situation was worsened as inputs were no longer given to farmers for on-farm demonstration purposes. According to AEA respondents, farmers were reluctant to provide their own resources for on-farm demonstrations. Thus the age-long experience with the “supply-driven”, “top-down” extension delivery system appeared difficult to be replaced by the “demand-driven”, “bottom-up” “farmer-participatory” approach that is envisaged by the National Agricultural Extension Project (NAEP).

Chitamber (1973) defined attitude as the tendency to act in some way towards some object, person, situation or idea. It is a feeling of like, dislike, attraction, repulsion, interest or apathy toward other persons, objects situations or ideas. Attitude may be acquired over time based on experiences. A favourable attitude towards change might influence information utilization and increase adoption behaviours. Thus based on farmers’ attitude towards the extension organization and its personnel, technical messages of recent years did not entice farmers’ approval.

iii *Level of education of Farmers:* AEAs contended that the high illiteracy rate of farmers in the region inhibited farmers’ understanding and adoption of new ideas that were being promoted. Northern Region has the highest illiteracy rate in the country (RPCU, 1995). Of the 120 farmer respondents to this study, about 76% of them had no formal education (Table 6.1).

Table 6.1: Distribution of farmer respondents on educational level.

Educational Level	Farmers	
	Freq.	%
Basic Education (Primary)	19	16
SSS and beyond	10	8
No formal education	91	76
Total	120	100

Source: Data of the study

The AEAs' contention conforms with observations by some authorities that formal education changes the individual's outlook and greatly influences his attitude towards new ideas. Uwaka (1983) indicated that formal education is one of the most important factors that influence the acceptance of new ideas by farmers. Education provides individuals with tools to accept positive changes and serves as a means of increasing their knowledge about farm practices (Onu, 1991). Rogers (1995) also stated that with education the clients are more open to allow active interaction with the agent thereby enhancing effective extension delivery.

d: *Institutional Problems*: The commonest constraints to extension delivery in the Northern Region was organisation-related. All AEAs identified specific issues related to the extension organisation as major constraints to extension delivery in the region. They included:

Group Approach to Extension Delivery: In consonance with the demands of the T&V approach to extension and the working principles of the government extension organisation, the agricultural extension agent was requested to form extension contact groups of farmers with which he had to work in terms of technology delivery. By the operational definition, an extension contact group is a collection of farmers, usually between 8-12, whose fields are contiguous and are brought together by the AEA for the purpose of agricultural technology delivery. AEAs indicated they had difficulties forming workable and sustainable farmers' groups for extension delivery as demanded by the extension organization. These difficulties emanated from their inadequate skills for group formation. This was confirmed by the fact that "Working with contact groups" was noted as one of the training requirements of AEAs for that year.

The inability of AEAs to form groups that were homogenous in thought, ideas, and practices on a sustainable basis thwarted effective extension service delivery through the group approach. One of the specific areas of concern identified by the beneficiary assessment report (NAEP, 1997) as militating against the effectiveness of the extension services was the inadequate skills and strategies for group formation. The report indicated that this has slowed down the rate at which groups were formed and sustained.

iii *Inadequate Motivation of AEAs*: Most extension agents indicated they had lost much of the enthusiasm and commitment they ever had for extension work. They indicated that they were not happy with the lack of logistical support to work effectively.

They enumerated contributory factors to this situation as: the irregularity of field allowances, fuel supply and low monthly remuneration. It was also indicated that some staff had not been supplied with the required field logistics including field boots, field notebooks or other equipment to facilitate extension delivery. While all AEAs were equipped with motorbikes some complained the bikes were over aged, more than eight years, leading to frequent breakdowns and attendant increased cost of maintenance.

Consequently, visiting schedules were poorly followed with quite a number of AEAs conceding they engaged in other activities unrelated to their job schedules, all with the aim of supplementing their incomes. They observed that this reduced their frequency of contact with extension contact groups for technology delivery.

According to Benor and Baxter (1984), since the effectiveness of any extension system depends to a large extent on the contribution of the lower level staff, appropriate incentives are important; and that good work should be recognised and rewarded. Without adequate remuneration and incentives they noted that a vicious cycle would develop in which lack of success undermines the extension agents' self-confidence; making it less likely that they will have a significant impact.

iv. *Frequent Staff Movement*: Some AEAs indicated that they had been affected with frequent re-postings and thus extension delivery was adversely affected. Plans laid down for an intended period had to be discarded due to fairly poor or no handing-over notes from out-going to in-coming AEA to a particular operational area; hence continuity of extension programmes was sometimes disrupted.

Against these background constraints to effective extension service delivery in the Northern Region, subsequent sections of this chapter discuss contact between the AEA and farmers and how messages on the yam minisett technology were delivered and the impact of the delivery process on the adoption rate of the technology.

6.2: METHODS OF EXTENSION DELIVERY

This section focuses on farmer-AEA contact, methods of farmer problem identification and the sources of technical messages for the AEAs for transfer to farmers.

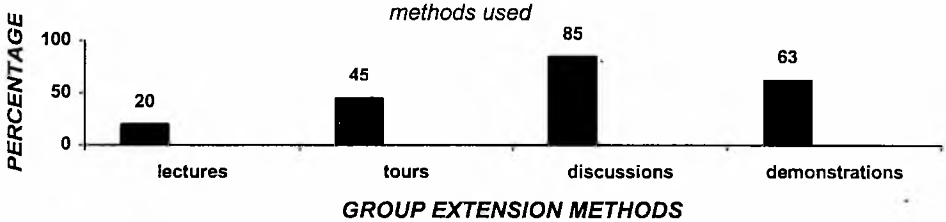
6.2.1: Farmer-Extension Contact

Extension teaching methods have been broadly categorised into individual, group and mass methods: based on the number of individuals that the extension agent comes into contact with at a time. The National Agricultural Extension Project (NAEP) stipulated the use of extension contact group methods for agricultural technology delivery. This was to enable a wider coverage since the AEA-farmer ratio was low, 1:1252 in the region. It was the expectation of the extension organisation that there would be a "trickle-down" effect of technical messages from members of the extension contact groups to non-members of the groups.

Besides the wider coverage permitted by the group extension method, Maunder (1972) indicated that group methods stimulate joint action and planning. Van den Ban and Hawkins (1996) observed that group extension methods allow the extension agent's information to be adapted more closely to farmers' needs and knowledge levels, help farmers decide if an innovation should be applied and group norms should be changed. Group methods have a significant effect on decision-making as well as transfer of information.

All the forty (40) agricultural extension agents interviewed used one or more group extension teaching methods for technology delivery. The methods used included method and result demonstrations, group discussions, farmer meetings, lectures and field trips. Prioritising the group extension methods used, AEA respondents indicated group meetings and discussions (85% of respondents) were mostly used, followed by demonstrations (63% of respondents), field trips and/or farm tours (45% of respondents), and lectures (20% of respondents) as indicated in Figure 6.2.

Fig. 6.2 Bar chart of % distribution of AEA respondents on group extension methods used



Studies have shown that the more different extension methods are used, the more people change their practices. Kelsey and Hearne (1963) observed that the more ways through which people are exposed to extension information, the larger the acceptance of recommended practices. Maunder (1972) also noted that when an individual is exposed to a new practice in several ways, the more likely he would find his preferred way of learning.

Method of AEA-Farmer contact

Averagely each front-line agent worked with 15 contact groups in his operational area; and each of these groups was visited once every fortnight. All AEA respondents indicated the individual contact was employed in special cases where an individual farmer required attention for a personal problem. A comparison of farmers' opinion on their preferred method of contact and the method of contact often held with the extension agent revealed that more farmers preferred being contacted individually than in groups as stipulated by the National Agricultural Extension Project (NAEP) (Table 6.2).

Table 6.2: Distribution of farmer respondents on method of AEA-farmer contact and Farmer's preferred method of contact.

Method	AEA-Farmer Contact		Farmers' preferred form of contact	
	Freq.	%	Freq.	%
Individual only	8	7	29	24
Group only	62	52	53	44
Both	50	41	38	32
Total	120	100	120	100

Source: Data of the study

Apparently more farmers preferred the individual contact with AEAs (24%) than the normal contacts they received (7%). This is obvious since at the village level there are many differences between farmers, for example, family size, age, power, social status, wealth, experience, etc. There is bound to be important differences in felt needs, perceptions and suitable strategies to help different types of farmers, learning being an individual process. This also confirms the AEAs' contention that for the "lack of trust" for one another, farmers did not wish to be contacted in groups, thereby making group approach to extension work rather difficult.

Frequency of AEA-Farmer contact

Rogers (1995) stated that the change agent's success in securing the adoption of innovations by clients is positively related to the extent of change agent's effort in contacting his clients. The more frequent the interaction between the AEA and farmers the more effective the impact in convincing farmers to use technical messages. This, by no means is a guarantee for success, other factors like the compatibility of the messages are equally important. However, the frequency of visits could be a priming factor to generate farmers' need for an innovation though they may not recognise that they have a need for that particular innovation.

Most AEAs contacted (83%) indicated strict compliance to the fortnightly visit schedules stipulated by the extension organisation. However, informal discussions with them and the farmers revealed that visits were never regular. As in Table 6.3, less than 50% of farmer respondents enjoyed the fortnightly visits.

Table 6.3: Distribution of farmer and AEA respondents on regularity of AEA-Farmer contact

Frequency of visits	Farmers		AEAs	
	Freq.	%	Freq.	%
Weekly	29	24	2	5
Fortnightly	58	48	33	83
Monthly	33	28	5	12
Totals	120	100	40	100
χ^2=14.69	df: 2		p<0.05	S

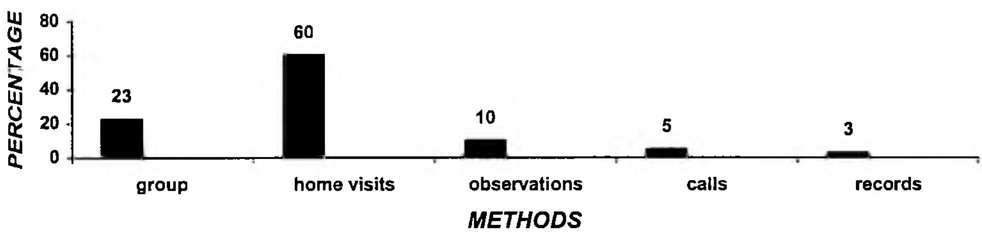
Source: Data of the study
S: Statistically Significant.

There is a statistically significant difference in the frequency of visits as indicated by the AEAs and that enjoyed by the farmers. This implied the likelihood of incorrect reporting of the actual contact and interaction between AEAs and farmers for extension delivery. Either farmers interviewed did not attend extension group meetings all times or the AEAs were not as regular as they reported. Following from earlier observation that the lack of logistics caused infrequent field visits (Section 6.1.2), the fortnightly visits reported by AEAs (83%) is disputed.

6.2.2: Farmers' Problem Identification

Though extension delivery was accomplished mainly by group methods, most AEAs (75%) indicated individual methods including home/farm visits, personal observation farmer calls and documentaries were used to identify farmers' problems as in Fig 6.3.

Fig. 6.3: Bar chart of % distribution of AEA respondents on methods of identifying farmers' problems.



The extension services emphasised the need for farmer-focused extension delivery in which AEAs should assist farmers to identify farm-related problems so that they may be solved with the farmers' active involvement. Rogers (1995) indicated that in diagnosing the clients' problems. the change agent should analyse them to determine why existing alternatives do not fit their needs. He asserted that the change agent must view the situation empathetically from the clients' perspective. Fisher (1993) observed that for economic development, to be meaningful at the local level, it must meet local perceptions of needs. He noted, however, that outsiders' assumption about insiders' needs are often inaccurate. Boone(1985), indicated that collaborative identification, assessment and analysis of the education needs of the target group will enhance commitment of both parties to the evolved educational programme.

On the identification of the yam minisett technology as the farmers' need it was observed that over 17% and 95% of farmer and AEA respondents respectively indicated it was a need (Table 6.4).

Table 6.4: Distribution of farmer and AEA respondents on identification of the Yam Minisett technology as a need.

Need for the Yam minisett technology	FARMERS		AEAs	
	Freq.	%	Freq.	%
It is a need	20	17	38	95
It is not a need	100	83	2	5
Totals	120	100	40	100

χ^2=79.6 df: 1 $p<0.05$ S

Source: Data of the study

S: Statistically Significant.

There is a statistically significant difference since many more AEAs than farmers felt the yam minisett was a need for farmers. However seed yam production apparently was not a problem confronting most farmers as evidenced by 79% and 73% of farmer and AEA respondents respectively acknowledging that farmers rarely faced inadequacy of seed yam (Table 5.4). The farmers themselves did not perceive the technology as a felt need since seed yam was not recognised as a limiting factor to yam production in their opinion. The extension organisation unilaterally determined that the yam minisett technology was a need for farmers, hence the AEAs had to promote it.

Leagans (1960) observed that decisions about programmes are usually best when made neither by the organisation's officials alone, nor by the people alone, but made jointly by the officials and the people. Moris (1991) indicated that outsiders can never solve problems of local farmers, the original problems will simply reappear at a later date (when the outsider is gone). Thus it was obvious that the adoption rate of the yam minisett technology was reported to be low. Farmers did not percieve the need for it.

Developing extension programmes and farmer involvement

It was further noted that though most AEAs (65%) indicated they involved farmers in the development of the local agricultural extension programmes, 35% of them evolved their programmes without farmer involvement.

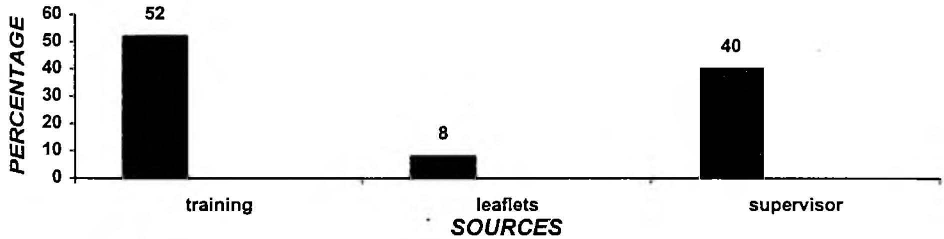
Despite the emphasis by the National Agricultural Extension Project (NAEP) to increase the involvement of farmers in defining agricultural extension programmes, a substantial proportion of AEAs contacted (35%) still retained the "top-down", "supply-driven" "hierarchical" and "technology-packaged" extension delivery system. Consequently, the farmers (97%) considered the yam minisett programme to be a programme for the extension organisation rather than being theirs, hence the low adoption rate (3%).

Frémy (1994), in his observation about sub-Saharan agricultural extension services noted that farmers were not considered as clients or partners, but people who had to be instructed, hence the 'top-down' extension practices were common to most public and parastatal extension systems in sub-Saharan Africa. Farmers' involvement in the process of developing relevant strategies to address farmers' difficulties improves the efficiency of the extension delivery process (FAO., 1994). Fisher (1993) stated that when plans override local interests, or where they are based on inaccurate assessment of these interests, the people are likely to ignore the rules and continue their normal activities. Albrecht et al. (1989) indicated that active participation of the target group in extension programmes is not only an immediate goal but a precondition for technical success.

6.2.3: AEAs' Sources of Technical Messages for Delivery

The study noted that regular monthly training sessions (52%) were the agricultural extension agents' major sources of technical messages for delivery to their contact groups. The AEAs field supervisors (40%), technical documentaries, leaflets, hand-outs and bulletins (8%) were supplementary sources of technical information as in Fig 6.4.

Fig 6.4: Bar chart of % distribution of AEA respondents on sources of technical messages received



Sources of message on the Yam Minisett Technology

The monthly training sessions by Subject Matter Specialists (SMS) were the commonest sources (75% of respondents) of message on the minisett technology for delivery. AEA supervisors comprising mainly the District Director of Agriculture (DDA) and the District Development Officers (DDOs) supplemented the monthly training sessions as sources of the message on the yam minisett technology to the AEAs (Table 6.5).

Table 6.5: Distribution of AEA respondents on source of message on yam minisett technology

Source of message	Freq.	%
Monthly training sessions	30	75
Supervisor	10	25
Total	40	100

Source: Data of the study

The modified T&V system of Ghana is organised to give the front-line agricultural extension agents every month intensive training on those agricultural practices and recommendations that relate directly to farm operations during the coming weeks, and to provide them with suitable technical and supervisory guidance to enable them teach these recommendations to farmers. Benor and Baxter (1984), the proponents of T&V extension system, indicated that to keep extension staff up-to-date on the latest know-how with regards to specific recommendations suited to changing farm conditions, there should be regular and frequent training of staff of all categories.

6.2.4. Knowledge level of AEAs on the Yam Minisett Technology

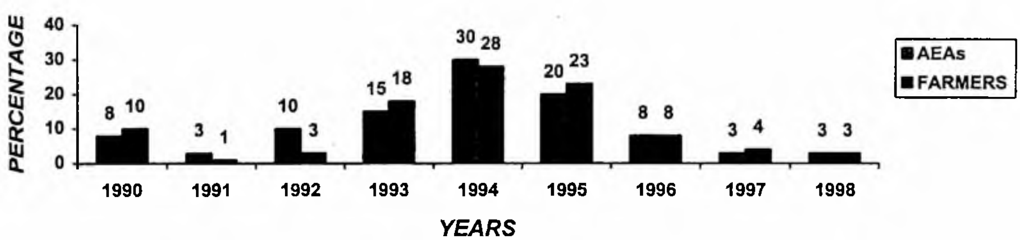
As indicated in Section 6.1.1. AEAs identified no technological constraint to extension delivery. Reasons assigned was that the regular monthly training sessions constantly updated their knowledge with time-bound messages required to solve current difficulties of farmers.

A self-assessment of AEAs on their knowledge level about the yam minisett technology indicated 32% of them had above average knowledge and 68% average. All of them had had more than one training on the yam minisett technology by subject matter specialists and/or their respective supervisors (Section 6.2.3). AEAs were therefore knowledgeable enough to transfer the yam minisett technology to farmers.

Introduction of the yam minisett technology in the study area:

From the study, yearly distribution of demonstrations on the technology in various operational areas in the region is given by Fig. 6.5.

Fig. 6.5: Bar chart of % distribution of AEA respondents who conducted demonstrations and farmer respondents who observed demonstations on the yam minisett technology in respective years.



Though the technology was introduced into the region as early as 1990, the highest number of demonstrations was conducted by the AEA respondents in 1994. This was found out to be a strategy employed by the extension organisation to equip farmers with the knowledge and skills to produce adequate seed yam to make up for losses they incurred as a result of the ethnic conflict that engulfed the entire region in that year. The 1994 ethnic conflict in the Northern Region resulted in heavy losses of farm produce especially yam. The researcher was then a field extension officer in the study area. Reacting to why they felt the yam minisett technology was necessary, about 60% of AEA respondents indicated it was because of the 1994 conflict that the technology was introduced, otherwise it was not a need to their farmers.

Though Bentrand (1951) and Lionberger (1968) observed that crises situations (and perceived needs) can induce the adoption of new ideas, the 1994 ethnic conflict which saw an increase in number of on-farm demonstrations on the yam minisett technology with the purpose of enhancing adoption of the technology did not change the adoption pattern of the technology by farmers. Data revealed that only 3% of the 120 farmer respondents started practising the technology in 1997, about seven years after its introduction and routine annual farmer-training sessions on the technology in the region.

Rogers (1995) observed that the change agent's success in securing the adoption of innovations by his clients is positively related to the degree to which the diffusion programme is compatible with the clients' needs.

While the extension organisation through its field agents would have been promoting improved farm practices to solve an "objective" fact of seed yam production problem, they failed to analyse the problem from the farmers' perspective. Peters (1989) indicated that it is not only the "objective" facts of a problem situation that matter, but how the situation is perceived by the target individual. He further indicated that the client will often act on the basis of how the situation appears to him, or on the basis of "subjective" facts even though the "objective" facts may be quite different from the individual's interpretation of them. Therefore in diagnosing a client's needs, a thorough understanding of how he defines his problem is necessary.

Though seed yam shortage could have been an apparent problem to farmers in 1994, they did not recognise that as their felt need at that time. Ignoring their felt need to promote the yam minisett technology that the extension organisation thought was a felt need resulted in the unexpectedly low adoption rate. Farmers at that time were much more concerned with other problems than the production-goal oriented programme that extension thought was most appropriate. Fisher (1993) stated that when plans are based on inaccurate assessment of the clients' interest, they are likely to ignore the rules and continue their normal activities.

6.3. THE YAM MINISETT TECHNOLOGY DELIVERY

a) Method of Delivery: Result and method demonstrations were identified as the main methods by which the yam minisett technology was delivered to farmers. On the role of demonstrations, van den Ban and Hawkins (1996) observed that they stimulate farmers to try out innovations themselves, or may even replace a test of the innovation by the farmer. Demonstrations are useful in convincing people who cannot think abstractly. Rogers (1995) stated that they could be an effective diffusion strategy especially for innovations that are easily observable and that are in the early stage of the diffusion process.

While 83% of AEA respondents used the group method, 17% applied the individual approach. Though the extension orgainsation stipulated contact group approach as the major form of AEA-farmer contact, individual contact and training was not discarded. The AEA respondents indicated that the individual contact was used mostly at the request of the farmers involved. Studies on information sources by stages in the adoption process indicate that the more complex the idea or practice, the greater the likelihood that agricultural agencies will be used as a source of information. While one-way impersonal communication plays its major role at the awareness and information stages, personal, two-way communication is more important for the stages of evaluation, trial and adoption (Bohlen, 1966).

As indicated earlier, most farmer respondents (74%) indicated the yam minisett technology was difficult for them to practice (Table 5.6); with a fairly high proportion of them (44%) requiring further training (Table 5.5) to be able to practise the technology. The study noted that as much as 24% of the farmer respondents indicated they preferred the individual form of contact to the group form as stipulated by the extension organisation (Table 6.2).

Personal influence of the extension worker is a vital force in securing co-operation and participation in extension activities as well as adoption of farm practices. The individual training therefore appeared to be the better option in improving farmers' skills to enable them practice the technology.

Training 'Environment': For teaching and/or training to be effective, the teaching/training environment should be conducive to the learner/trainee. A demonstration conducted within the farmers' own environment convinces him of the practicability and applicability of the technology being demonstrated in his environment. It was noted that AEAs (85%) carried out the demonstrations on the minisett technology in farmers' fields and 15% at the agricultural stations. Rogers (1995) indicated that potential adoptors of a new idea are aided to evaluate an innovation if they are able to observe it in use under conditions similar to their own.

Benor and Baxter (1984) indicated that though demonstrations are conducted on farmers fields, farmers are seldom involved since the planning of demonstrations, the necessary supply of inputs and provision of labour and the evaluation of the results are all done by the extension staff.

c. *Provision of inputs for demonstrations:* For the technology to be practised, inputs in the form of "mother seed yam", and fungicides were required. AEA and farmer respondents, 63% and 71% respectively, indicated that the extension agents provided all the inputs for the demonstrations. Less than 30% of farmer respondents actually provided inputs ("mother" seed yam) for the demonstrations to be carried out (Table 6.6).

Table 6.7: Distribution of AEA and Farmer respondents on their statements of who carried out the demonstrations

Who demonstrated	FARMERS		AEAs	
	Freq.	%	Freq.	%
Collaborating farmer	28	32	30	75
Extension agent	82	68	10	25
Totals	120	100	40	100

χ^2=23.1 df: 1 $p<0.05$ S
S: Statistically significant

There is significant statistical difference in farmer-involvement in demonstrations conducted to teach them as reported by farmers and AEAs. This is because most AEAs claimed the collaborating farmers carried out the demonstrations under their supervision while the farmers insisted the AEAs carried out the demonstrations while they observed. This contradiction is probably due to incorrect reporting by either the AEAs or the farmers. In any case farmers did indicate that they were not skillful enough to practise the yam minisett technology hence majority of them requiring further training in the technology (Tables 5.5 & 5.6). Some farmers did not try the technology due to the lack of knowledge and skills (Section 5.3.4). Raising the clients' technical competence does not only ensure self-reliance on the part of the client, it also guarantees sustainability of the practice without the agent.

Consequently, though most of AEA respondents (78%) indicated their farmers had average knowledge about the technology to enable them practise it, 55% of them did indicate that the training sessions had a negative over all impact reflected by a very low adoption rate of the technology by their farmers. The study contacted 120 farmer respondents, all being beneficiaries of the yam minisett training sessions, from which less than 50% had tried the technology after the training by themselves and only 3% practising the technology for the second year running but on a rather small scale alongside their traditional seed yam production methods. Tetteh and Saakwa (1994) similarly observed that though most farmers have heard about the yam minisett technique, very few of them have tried it, and none has adopted it.

6.4: FEEDBACK ON THE YAM MINISETT TECHNOLOGY DELIVERY PROCESS

According to van den Ban and Hawkins (1996), feedback denotes the process by which the consequences of action of a system lead to the adjustment of future actions seen in the light of achieving a certain goal. The need for a feedback process in a technology delivery system cannot be overemphasised. It enables technology developers (research) and technology transfer agents (extension) to get information on any problems encountered by farmers in using improved technologies that have been introduced. Fliegel (1984) noted that designers of scientific technologies must be involved in the information feedback since some of these technologies must be redesigned to enhance their effectiveness. Merrill-Sands and Kaimowitz (1990) observed that direct links between research and extension services with farmers is critical for the development and transfer of technologies since such linkages are not only relevant in the development of appropriate technologies but they ensure rapid feedback on the performance of the technologies that have been transferred to farmers.

The study investigated the extent of follow-up visits made by field extension agents to farmers they had trained in the yam minisett technology.

Of the 120 farmer respondents who all had training in the yam minisett technology, 44% of them had post-training follow-up visits by their trainers, mainly the AEAs, and to a very limited extent the Subject Matter Specialist, to assess the impact of the training as well as note farmers' problems in implementing the technology. Table 6.8 indicates the extent of post-training follow-up visits by extension agents to farmer respondents in the study.

Table 6.8: *A cross-match of distribution of categories of farmer respondents by extension follow-up visits.*

Farmer category	Follow-up		No follow-up		Total	
	Freq.	%	Freq.	%	Freq.	%
Tried technology	33	28	18	15	51	43
Not tried technology	20	16	49	41	69	57
Total	53	44	67	56	120	100

χ^2 =15.7 df :1 $p<0.05$ S
Source: Data of the study
S: Statistically significant

There is a statistically significant difference in the distribution of farmers who received follow-up visits and those who did not on the basis of trying out the yam minisett technology. The effect of follow-up visits by the AEAs seems to induce farmers to move from the awareness stage to the trial stage of the adoption process. A comparatively lower percentage (44%) of farmers received follow-up visits by the AEAs. These visits contributed immensely in encouraging farmers to try out the technology by themselves. The rather high non-follow-up visits is explained by the inadequate logistics that AEAs had to contend themselves with in the course of their field work (Section 6.1.2).

The study further noted that the inadequate follow-up visits did not only occur at the AEA-farmer level. It also occurred at the AEA-supervisor level. In the yam minisett technology delivery process, the AEAs were trained by the SMS, supplemented by their supervisors (6.2.2). Data from AEAs indicated that 30% of them were never followed up by their trainers and/or supervisors to ensure farmers were properly trained. Follow-up supervisory visits by SMS/DDA/DDO do not only serve to motivate the AEAs, they also ensure that the technical messages were delivered accurately.

6.5: SUMMARY

Most constraints to effective agricultural extension delivery were related to the extension organisation (Institutional Constraints). However, the extension organisation provided an elaborate system (Monthly Training Sessions) that frequently equipped field extension agents with current technical knowledge required to solve farmers' problems. In addition, social, economic, and environmental constraints also affected the impact of extension delivery and agricultural development in the region as whole.

Korang-Amoakoh, et al. (1994) indicated that the modified Training and Visit (T&V) extension system emphasised farmer-focused extension which would assist farmers to identify farm-related problems so that they could be solved with farmers' active involvement. On the contrary, the study observed that most AEAs, convinced they were endorsing "modern" agriculture, unilaterally diagnosed the yam minisett technology as a felt need for farmers to address seed yam problems. This implies that the extension organisation rather than adopting a problem-solving approach which would have permitted an accurate definition of the farmers' problem, used the transfer of technology (TOT) approach imposing on farmers a prescribed solution to a problem the farmers themselves did not recognise. Farmers did not recognise seed yam as a limiting factor to yam production yet extension agents felt the farmers needed it to address the problem. Though seed yam was identified as the primary determining factor of farm sizes, they scarcely lacked seed yam thus the technology was not addressing their felt need.

6.6: CONCLUSION

The poor involvement of farmers at the demonstration level coupled with the fairly low extension follow-up visits resulted in poor skill development of the farmers to enable them practise the technology. Only 3% of the 120 farmers studied were observed to be practising the technology but on a very limited scale. The study can therefore conclude that the technology was poorly patronised as a result of the poor involvement of farmers in the problem diagnosis and implementation concerning the yam minisett technology. Besides the fact that the technology did not prove itself a better alternative to the farmers' traditional methods based on farmers' criteria of quality seed yam (chapter, 5), the extension approach used to promote the technology can also be said to be inadequate.

CHAPTER SEVEN:

CONSTRAINTS TO THE ADOPTION OF THE YAM MINISETT TECHNOLOGY

7.0: INTRODUCTION

Adoption is the decision to make full use of an innovation as the best course of action available; while rejection is the decision not to adopt an innovation (i.e. non-adoption). This present work set out to identify and analyse possible factors, issues, and/or barriers that tend to hinder farmers of the Northern Region from deciding to use of the yam minisett technology to which they have been exposed through farmer training sessions and/or discussions. Based on farmers' socio-economic environment comprising availability of land, labour, and capital and the agro-climatic conditions within which farmers operated (chapter 2), farmers' perception of the yam minisett technology (chapter 5) vis-à-vis the way the technology was delivered to them (chapter, 6), this chapter discusses factors identified by farmers and agricultural extension agents (AEAs) as constraints to the adoption of the yam minisett technology in the Northern Region.

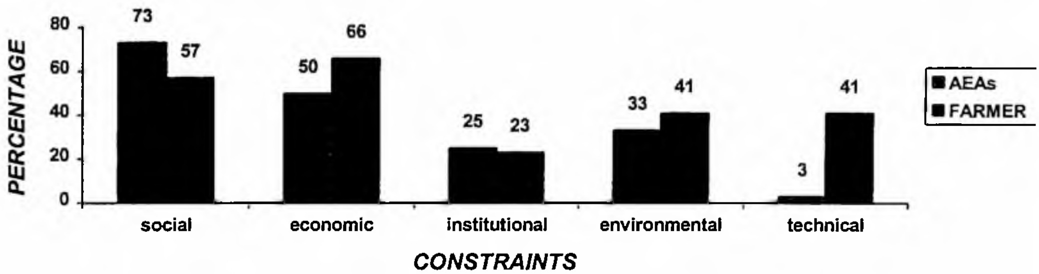
7.1: CATALOGUED CONSTRAINTS

Both farmer and AEA respondents indicated quite wide and varied reasons, factors and issues that they considered were responsible for the poor patronage of the yam minisett technology in the Northern Region. These factors were catalogued under five main categories:

- Social factors (73% and 57% of AEA and Farmer respondents respectively),

- Economic constraints (50% and 66% of AEA and Farmer respondents respectively),
- Institutional factors (25% and 23% of AEA and Farmer respondents respectively),
- Environmental issues (33% and 41% of AEA and Farmer respondents respectively), and
- Technological constraints (3% and 41% of AEA and Farmer respondents respectively), as indicated in Figure 7.1.

Fig. 7.1: Bar chart of % distribution of AEA and Farmer respondents on catalogued constraints to the adption of the yam minisett technology.



The categorisation was based on the theoretical framework which illustrates adoption (A_t) of a technology as a function of the technical characteristics of the technology itself *(C_t)*, external factors *(E_f)*, and internal factors *(I_f)* to the potential adopter himself. Equationally, this was expressed as:

$$A = f(C_t + E_f + I_f).$$

Whereas the technical characteristics of the technology itself ***(C_t)*** are reflected by technical or technological constraints, internal factors ***(I_f)*** are dominated by social constraints, and the external factors ***(E_f)*** embodying economic, environmental and institutional issues to the potential adopter. In the subsequent sections, detailed discussion of the catalogued factors is given.

7.1.1: Social Factors

This category includes,

- *No need for the technology,*
- *Undesirable characteristics of seed yam produced by the technology,*
- *Food security and cash income.*

No need for the technology

According to Rogers (1995), a need is a state of dissatisfaction or frustration that occurs when desires outweigh one's actualities, when "wants" outrun "gets". Van den Ban and Hawkins (1996) defined need as the condition in which a person experiences a lack of something and strives to overcome this lack.

Farmers (57% of respondents) and AEAs (73% of respondents) indicated that there was no need for the yam minisett technology since seed yam was not a limiting factor to yam production. As indicated in Table 5.4, 79% and 73% of farmer and AEA respondents respectively indicated farmers rarely lacked seed yam. Thus, it was the extension organisation that recognised the need for the technology for farmers hence AEAs had to promote it (Table 6.4). Thus farmers did not adopt the technology since it was not going to solve a problem they felt existed.

Agricultural technologies that address farmers' needs are more often readily accepted and implemented than those which do not. The ability of the AEAs to identify farmers' needs and promote technologies that are compatible to these needs enhances the adoption of the technologies so promoted. This calls for intensive, interactive, and collaborative approach to farmer problem identification. Boone (1985) observed that for an educational programme to succeed, there must be collaborative identification, assessment and analysis of the educational needs by both the target group and the "educator". This enhances commitment of both parties to the programme.

Undesirable characteristics of seed yam produced

According to the farmer-respondents, results from the demonstrations carried out to teach them how to practice the technology did not impress them. In their comparative assessment of the yam minisett technology against their traditional methods (Table 5.2) the seed yam produced from the technology did not possess characteristics that met farmers' criteria of size of sett, potential tuber production, shelf-life, and germinability. While farmers insisted on the use of setts weighing 500 grams and above, the setts obtained from the trial demonstrations and from their own trials weighed less. Some farmers refused to try the technology due to the unimpressive results of the demonstrations (Section 5.3.4). Farmers' choice of sett size is justifiable since, according to them, a bigger sett size produces a more vigorous seedling, that is capable of producing a bigger tuber early in the season to allow first harvest to supplement household food requirements; thereby guaranteeing food security.

Food Security and source of income

Yam production in the Northern Region, in the main is to provide food and income for the household (Table 7.1).

Table 7.1: Distribution of farmers on level of contribution of yam to household food and income.

Level of contribution	Household food		Income	
	Freq.	%	Freq.	%
Less than 50%	22	18	58	48
50%	32	27	48	40
More than 50%	66	55	14	12
Total	120	100	120	100

Source: Data of the study

Data from the study revealed (Table 7.1) that yam contributed 50% or more to farmers' household food (77% of farmer respondents) and income (52% of farmer respondents) At both first and second harvest, yam plays a crucial role in providing food and income for the household. Since yam can be harvested and consumed halfway through its production life, it is capable of supplying food over a long period during crop growth (Chandra, 1994). The sale of the early harvest of yam was also said to be a major source of income to finance other farm operations within the season, and meet other domestic cash requirements. About 57% of farmer respondents indicated that the use of the yam minisett technology did not guarantee food security at both the first and second harvest; since it produced only seed yam. Asadu, and Akamigbo (1996) similarly noted that the technology by its nature requires a full season to produce seed yam, then a second to produce ware yam. The yam minisett technology thus appeared incompatible with the production objectives of the farmer; hence its low adoption rate. Okoli, et al. (1992), Asadu, and Akamigbo (1996), and Langyintuo (1996) all indicated that the long time lag between seed yam generation and ware yam production is one of the reasons why farmers fail to adopt the yam minisett technology.

7.1.2: Economic Constraints

About 50% and 66% of AEA and farmer respondents respectively indicated economic constraints to the adoption of the yam minisett technology. These include:

- *the unavailability and high cost of farm inputs,*
- *labour problem,*
- *waste of ware yam, and.*
- *waste of time.*

The unavailability and cost of farm inputs.

The availability, accessibility, and affordability of inputs associated with a technology that has been introduced enhances the adoption of the technology involved. Successful application of the yam minisett technology requires the use of chemicals (fungicides) to minimise rotting of setts at the nursery stage, and fertiliser to provide nutrients to transplanted seedlings. For the demonstrations to train farmers on the technology these inputs and the "mother" seed yam itself were provided by the extension organisation. Without the supply of these inputs, 28% of farmers who had tried the technology by themselves had problems in procuring the required inputs (Section 5.3.2); while 51% of farmer respondents who never tried the technology indicated the unavailability and high costs of the inputs as the barrier (Section 5.3.4).

The unavailability and high cost of farm inputs, notably, fungicides and fertilisers, as constraints to the adoption of the yam minisett technology has also been observed by Okoli, et al. (1992) and Langyintuo (1996).

Following privatisation of the sale of farm inputs in consonance with government policies, AEAs were duly advised to rely on locally available materials that the farmers could provide for on-farm demonstrations, thereby encouraging "farmer-based" and "demand-driven" demonstrations. Subsequently, the use of wood ash as a substitute for the fungicide was introduced. Farmers, having been introduced to the technology through the use of the chemical *kocide* as the fungicide and the supply of the "mother" seed yam, were reluctant to make the necessary substitution. A rather low proportion of farmer respondents (29%) was noted to have provided only the "mother" seed yam for demonstrations on the technology (Table 6.5).

The labour factor

The practice of the yam minisett technology involves the establishment of nurseries prior to transplanting in the field. This practice, while not only being incompatible with yam production culture of farmers in the Northern Region, requires extra labour to care for the nurseries and fields. Assessment of the availability of labour for farm operations revealed that only 27% of all farmer respondents had adequate labour throughout the farming season; and 22% of them who depended mostly on hired labour could hardly afford the costs at critical periods of the yam production cycle, i.e. at the mounding and weeding stages. Langyintuo (1996) indicated that one of the constraints limiting the practice of the yam minisett technology by farmers was the extra labour required to manage the nurseries and fields.

Indicating their dissent for the nursery practices which they described as tedious, farmers suggested that the technology could be modified to allow direct planting. They further observed that this would avoid the destruction of nurseries in the field by stray animals and reduce the extra labour requirement for the nursery work.

Waste of ware yam

Most farmer respondents in relating the cash return or other opportunity cost of ware yam to the 25 gram pieces into which the ware yam is cut to be nursed considered the yam minisett technology as a waste of material. This situation was further compounded by farmers' observation that their most desired varieties (*Laribakor and Puna*) were not adaptable to the technology. Farmers therefore preferred consumption or sale of ware yam for cash returns to using it for the technology in quest for seed yam which they could conveniently obtain by the traditional methods.

Time factor

The yam minisett technology requires chemical treatment of 25-70 gram pieces of yam cut from a whole ware yam, pre-germination of these setts in nurseries before transplanting sprouted setts to the fields. It required the farmer who was used to planting whole tubers and setts of unknown weights to change to minisetts that has to conform to certain weights and chemical treatment before planting. Both farmers and AEAs indicated farmers' difficulty in trying to estimate the specified sett size as well as having to go through nursery practices which they observed as not typical of their traditional culture of yam farming. Farmers therefore looked upon the technology with indifference, believing that their traditional methods were the best. They therefore developed quite an unfavourable disposition towards the technology. This attitude made farmers feel very reluctant to practice the technology, indicating it was time-consuming.

7.1.3: Institutional Factors

Institutional factors which were indicated by AEAs (25% of respondents) and farmers (23% of respondents), were mainly issues emanating from the extension organisation and its agents. These factors bordered on inaccurate farmer problem diagnosis and analysis and the failure of the AEAs to equip farmers with adequate knowledge and skills to practise the technology.

Inaccurate farmer-problem diagnosis

Though the availability of seed yam was identified as the leading factor in determining sizes of yam fields cultivated (Fig. 5.2), both AEAs and farmers indicated that farmers rarely lacked seed yam (Table 5.4). The promotion of the yam minisett technology to enable farmers produce abundant seed yam therefore appeared to solve a problem that was never existing. This situation arose as a result of the non-involvement of the farmers in the diagnosis of the yam production problems in the region. The production-oriented objective of the extension organisation in the yam production sector did not meet farmers' prevailing need. The extension organisation failed to make farmers recognise the need for the technology. This is evident in the "supply-driven" nature in which the technology was "packaged and delivered". The recipients of the technology were barely involved with respect to problem diagnosis, and even contributing to the input supply for the implementation of the technology.

Rogers (1995) indicated that potential adopters may not recognise that they have a need for an innovation until they are aware of the new idea. He further noted that change agents may seek to generate needs among their clients but with care; otherwise the felt need upon which a diffusion campaign is based may be only a reflection of the change agent's need rather than those of the clients. Moris (1991) observed that (government) officials, insulated by their perception that they are endorsing modern agriculture in contrast to supposedly primitive and inefficient existing practices, continue to promote unpopular and inappropriate measures year after year.

Contrary to NAEP's objective of increased involvement of farmers in defining agricultural extension programmes, the extension organisation through their field agents, continued to deliver technologies that were not compatible with farmers' needs as in the case of the yam minisett technology. The beneficiary assessment report of the extension service indicated among others that the lack of institutional planning capacity at all levels to help develop productive strategies was constraining effective promotion of relevant technologies. Due to their poor involvement in the diagnosis, planning, and implementation of the yam minisett educational programme, farmers did not perceive the yam technology as a felt need.

Inaccurate analysis of the yam minisett technology

Though most AEAs indicated they had adequate knowledge about the yam minisett technology to enable them train farmers (Section 6.2.3), about 25% conceded they had indicated to farmers that the technology was intended for farmers who had inadequate seed yam for their fields. The use of the technology as a cheaper alternative of producing seed yam abundantly was not emphasised. In the light of this, and for the fact that farmers rarely lacked seed yam for their annual production, they did not see the need to try the technology. The inaccurate explanation of the message in the context of purpose or objective, relevance and potential of the yam minisett technology reflected the extension agent's inability to analyse the usefulness of the technology and to convince the farmers to adopt it.

Poor understanding and skills of the farmers

As discussed in Sections 5.3.3, and 6.3, most farmer respondent (74%) found the technology difficult to practise due to their poor understanding and inadequately developed skills resulting from their poor participation in the demonstrations conducted by AEAs to teach them. Madukwe (1995) similarly observed that the lack of sound technical knowledge with respect to cutting technique, spacing and use of chemical and fertiliser requirements are obstacles to the adoption of the yam minisett technology. There was also a fairly low post-training follow-up by AEAs and their supervisors to farmers to assist them implement the technology. This indicated a poor mechanism for feedback messages on the applicability of the technology to the extension organisation, hence the annual routine of farmer-training on the technology for well over seven years with a fairly low adoption rate. The "supply-driven" nature by which the technology was promoted, resulting in the poor farmer involvement in the input supply and the demonstrations themselves made farmers less enthusiastic and skilful to practise the technology.

7.1.4: Environmental Issues

Environmental and agro-climatic conditions like rainfall pattern and distribution, soil and its characteristics as well as the prevalence of pests and diseases do influence adoption rate of technologies. They do not only influence the performance of the technology, they dictate the type and productivity of farming systems in the locality.

About 33% and 41% of AEA and farmers respondent respectively (Fig 7.1) indicated environmental factors such as weather, stray animals inhibited the adoption of the yam minisett technology in the region.

Weather

As indicated in Section 2.1.2, the Northern Region lies entirely within the Savannah ecosystem, experiencing a unimodal rainfall pattern which lasts from May to September. The dry spell occurring between October and April is characterised by bush fires and dry north-easterly harmattan winds.

Farmers (41% of respondents) and AEA (33%) (Fig 7.1) indicated it was the long dry spell which adversely affected the practice of the yam technology. The farmers contended that for the yam minisett to perform well (produce sizeable setts) nursery practices should be started in March/April, so that by May/June field transplanting occurs. However, March/April is the period of absolute drought, with most water sources (mainly rivers and dug outs) depleted, sometimes resulting in farmers migrating out of their communities with their livestock in search of water. In this predicament, little attention is given to farm work, more so to establish a seed yam nursery that required watering. The researcher in the course of data collection for this study did notice deserted communities and this was alleged to be due to water crisis.

Farmers who tried the technology had to try it in baskets at home since water could hardly be got on the field. This resulted in yet a second problem of having to transport sprouted setts to the field for transplanting. Due to the unfavourable climatic conditions, watering (75% of farmer respondents) and transportation difficulties (52% of farmer respondents) were encountered by farmer respondents who tried the technology on their own (Section 5.3.2).

Stray Animals

To a limited extent, farmers indicated that the destruction of yam barns (storage sites) on the field by stray animals (cattle) discouraged them from establishing nurseries on the field where water was not a problem. In the Northern Region, domesticated animals (especially cattle) are herded but in the dry season due to scarcity of forage, herding is not strictly enforced. It is common for animals to stray into farmlands in search of forage thereby causing damage to yam barns and in severe cases stored ware and seed yam are destroyed. For fear of animal destruction, more of the farmer respondents who tried the technology carried out the trial in their homes resulting in loss of sprouted setts in the course of transporting them to the field for transplanting..

7.1.5: Technological Constraints

Technological constraints to the adoption of the yam minisett technology include factors related to the technical characteristics of the technology as perceived by farmers and AEAs. About 3% and 41% of AEA and farmer respondents respectively identified technological constraints to include:

- *Nursery practices,*
- *Two-year gestation period,*
- *Recommended sett size, and*
- *Poor adaptability of farmers' desired varieties to the technology.*

Nursery Practice

As described in Section 3.1.2, the yam minisett technology involves chemical treatment of setts of 25-70 grams cut from a healthy ware yam, pre-sprouting of these setts in a nursery and transplanting sprouted setts in to the field.

Besides, the labour and input requirements of the practice (Section 7.1.2), farmer and AEA respondents indicated the incompatibility of nursery work with the traditional culture of yam production. Farmers therefore saw the technology difficult to propagate, requiring them who are used to planting whole tubers and setts of unknown weights to change to mini-yam-setts that have to conform to certain weights and chemical and fertiliser treatment (Madukwe, 1995). Farmers observed that this was one of the major constraints to the adoption of yam minisett technology. To avoid the difficulties associated with nursery practices, both farmers and AEAs suggested the modification of the technology to permit straight planting, this being their main method of planting yam.

Two-year gestation Period

Yam production in the Northern Region is principally for food and cash income (Table 7.1), hence annual ware yam output from the farm is of primary concern to the average farmer though he endeavours to secure seed for the subsequent season.

By the use of the yam minisett technology, the farmer saw it as another way of growing a new crop in which he would lose a year of ware yam production to obtain seed yam. Ware yam is then produced in the second year round using the seed obtained in the preceding year. Farmers and AEA respondents indicated this two-year gestation period did not guarantee the farmer food security; hence farmers did not adopt the technology. The long time lag between seed yam generation and ware yam production was one of the reasons why farmers would not adopt the yam minisett technology.

One of the objectives of developing and introducing the yam minisett technology to farmers was to encourage commercial seed yam production. Since trading in seed yam was limited in most yam production communities by quality, quantity and preference for particular varieties alongside the myths shrouding seed yam purchase (Section 5.3.1) commercial seed yam production via the adoption of the yam minisett technology was not any better alternative to induce the farmer to adopt the technology. Besides, both AEAs and farmers acknowledged seed yam scarcity had never been a major constraint to farmers (Section 5.3.1) in their production system.

Recommended Sett-size

The yam minisett technology specifies sett-size of between 25-70 grams cut from ware yam into cylindrical shapes for pre-sprouting in nurseries. Both AEAs and farmers respondents indicated that not only was it difficult to estimate sett-size according to specifications, it was difficult to handle these setts, both at pre-sprouting and post-sprouting. This often resulted in loss of setts due to damage to the periderm (outer skin). Okoli et al. (1992) similarly observed that difficulties encountered by farmers in handling small (25 grams) setts contributed to the non-adoption of the yam minisett technology.

Beyond this difficulty of handling setts, seed yam produced by this technology did not meet farmers' criteria of quality seed yam, notably the size. Seed yam produced was of much smaller size than the farmer wished to have. Subsequently the tubers produced from these setts were also much smaller than the farmers choice (Section 5.2.1).

Poor adaptability of farmers desired varieties to the technology

Of the six species of yam cultivated in Ghana, *Dioscorea rotundata* is the principal commercial yam and constitutes 80% of total yam produced (Tetteh and Saakwa 1994). They further indicated that the choice of varieties farmers grow was dictated by factors including consumer taste and preference, early maturity, storability, yield, adaptability and availability of planting material in descending order of importance. The most popular varieties of *Dioscorea rotundata* grown in Northern Region include *Laribako, puna, lilia, Nimo, moninyua,* etc. under various local names.

Farmers and AEAs indicated that farmers' most popular varieties of *Laribako* and *puna* did not yield to the yam minisett technology. They observed that these varieties if cut into 25 grams size and nursed would rot no matter the anti-fungal chemical treatment. By far, farmers and AEAs indicated the only varieties adaptable to the yam minisett technology were the *Seidu bila* and *moninyua* They therefore considered the use of their popular varieties for the technology as a waste of ware yam

7.2: SUMMARY

This chapter has discussed factors identified by farmers and AEAs to be bottlenecks to the adoption of the yam minisett technology by farmers. In broad categorical terms, these factors have been discussed under social factors, economic constraints, environmental issues, institutional factors, and technological constraints.

These factors, emanating from the technical characteristics of the yam minisett technology itself, as well as internal and external factors to the farmer, prompt some conclusions to be drawn for the study. The ensuing section dwells on the summary, conclusions and recommendations of this work.

PART THREE:

CONCLUSION

CHAPTER EIGHT:

SUMMARY, CONCLUSION AND RECOMMENDATIONS

8.0: INTRODUCTION

This study, a non-experimental survey research, was undertaken with the main purpose of identifying and analysing the causes of the low adoption rate of the yam minisett technology. It set out to verify the main postulate that the low adoption rate is related to the farmers' perception of the quality of the technology in comparison with their traditional methods of seed yam production. In this regard, the resulting thesis was organised into three main parts. In **Part one,** the specific objectives of the study, the theoretical framework of the study, an overview of the socio-economic features of Northern Region, related literature to the study, and the methodology used to carry out the study have been presented in chapters one, two, three and four respectively. The characteristics of the yam minisett technology, the extension delivery and its impact on the adoption rate of the technology, and specific constraints to the adoption of the technology have been discussed as results of the study in chapters five, six, and seven respectively and presented in **Part two**.

This chapter which constitutes **Part three** of this research work, aims at summarising all activities and findings based on related literature and the implications of the results of the whole research exercise. Subsequent sections will therefore dwell on the summary, conclusions and recommendations to the study.

8.1: SUMMARY

In the maiden chapter to the study, the role of agriculture and the declining trend in agricultural productivity in sub-Saharan developing countries have been outlined. Special elaboration has been made on the Ghanaian situation where agriculture engages about 70% of the working population. For sustained growth and improved condition of living, Ghana's agriculture should be more productive and this is achievable with the intervention of appropriate agricultural technologies being developed and made available to farmers by research and extension respectively.

In the problem statement, the role of root and tuber crops, notably yam, in ensuring food security for the Ghanaian population is highlighted. Dapaah (1994) stated that the food deficit currently experienced in the country would have been drastically reduced if concerted efforts were made by all stakeholders in the agricultural sector to increase the productivity of root and tuber crops.

The main factors adversely affecting the yam industry were indicated, with the unavailability and cost of quality planting material being a primary concern. The development of the yam minisett technology by research and the effort by extension services in disseminating the technology to farmers is a significant breakthrough to address this problem. However, there is empirical evidence that the adoption of the technology was quite low in the Northern Region (Langyintuo et al., 1994). Why the technology was not adopted by farmers in Northern Region, the major yam producing region in the country is all that this research work was set out to examine.

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Consequently, three research questions were asked

a) Is the low adoption of the yam minisett technology due to the inferiority of seed yam produced by the technology to those produced by the traditional methods?

b) Is the low adoption of the yam minisett technology the result of the extension agents' inability to promote the technology among farmers? and

c) Is the low adoption of the yam minisett technology due to the socio-economic environment in which the farmer finds himself?

Following these research questions, the research hypothesised that the yam minisett technology was not a better alternative to traditional seed yam production methods.

The broad and specific objectives of the study have also been indicated in the maiden chapter, with specific terms related to the study defined. Towards the tail end of chapter one, a theoretical framework, indicating that the technical variables of a technology, the role of the extension organisation in inducing farmers to adopt technologies, and internal factors to the potential adoptor and how these factors simultaneously act to influence the adoption rate of the technology in a broad geo-physical, political, social and economic set up was developed.

In chapter two, an overview of the Northern Region was made. The geo-physical and agro-climatic characteristics as well as the socio-economic setting within which the yam farmer operated are elaborated. Yam production, its contribution to the socio-economic development of the region and factors that hinder accelerated agricultural development in the region were also discussed. Institutionalised agricultural efforts notably, extension and research, aimed at improving agriculture in the region in a collaborative manner have also been indicated.

Chapter three reviewed literature and documentary expositions on the traditional methods of seed yam production and improved methods available and/or introduced to farmers. Against the background of inadequate planting material in the yam production system, the development of the yam minisett technology is considered a significant break through in ameliorating the problem. In-depth documentary elaboration by various authorities of the determinants of technology adoption behaviour by farmers as outlined in the theoretical framework has been made. Further to this, various extension teaching methods and the role of the communication process in influencing adoption of agricultural technologies was also indicated.

With the theoretical background on the factors influencing technology adoption behaviour by farmers vis-à-vis the environmental context of the Northern Region where the study was being executed, the methodology of the study was developed and outlined in chapter four. Taking cognisance of the objectives of the study, which dwell mostly on farmers' opinions, values and perceptions about the yam minisett technology, the non-experimental descriptive survey research design was chosen as the most appropriate approach. To ensure both qualitative and quantitative data, different data collection methods including questionnaires, interview guide, focused interviews and review of relevant departmental and project reports and/or documents as well as participatory observation in extension programme planning activities were employed to gather the data.

In carrying out a social research where records were hardly available the purposive sampling method was used to obtain the sample for the study. In view of the vast nature of Northern Region with time and resources as major constraints, four districts, namely Gushiegu/Karaga, East Gonja, West Gonja and Yendi Agricultural Districts which recorded fairly high production figures for yam over the years were purposively sampled for the study. One hundred and twenty (120) farmers who were trained in the technology were purposively sampled from the extension contact groups. To further allow comparison of opinions of Agricultural Extension Agents (AEAs) who transferred the technology to farmers and the farmers on the technology and further validate the data so collected, all AEAs then at post in the sampled districts were included in the sample for the study. In all, the sample size comprised 120 farmers and 40 AEAs.

Prior to actual data gathering the questionnaire and interview guide were pre-tested for two weeks in Tolon/Kumbungu District of the Northern Region. Experiences from the pre-testing allowed modifications and refocusing of both interview guide and questionnaire to improve upon their relevance and appropriateness to the study. They finally contained both open-ended and close-ended questions.

Data was gathered over a two-month period with one research assistant per district using the interview guide. While the questionnaires were self-administered by the AEAs, the interview guides were administered to farmers individually by the researcher and trained research assistants. The researcher, using the focused interview checklist, had discussions with various representatives of stakeholders in the agricultural development sector in the region, notably, farmers groups/individuals, personnel of Ministry of Food and Agriculture (MoFA -

extensionists, Subject Matter Specialists, and Agricultural Directors) as well as researchers of the Savannah Agricultural Research Institute (SARI). Personal participation by the researcher at the Research-Extension Liaison Committee (RELC) workshop where planning of the 1998 agricultural research and extension programmes in the region was valuable in assessing farmers' role and/or involvement in this regards.

Data gathered were finally processed, stored in the Statistical Package for the Social Scientist (SPSS) software programme and analysed using the non-parametric descriptive analysis. The chi-square test of significance was used to test the research hypothesis.

Using the research questions as focus, results of the study have been discussed in three separate chapters (5, 6, and 7). In chapter 5, the farmers' criteria of quality seed yam were used as basis in comparing the yam minisett technology to the traditional methods of seed yam production taking into consideration the technical variables of the technology that influence its adoption rate, namely relative advantage, compatibility, complexity, trialability and observability of its performance.

Using the Sign Test (Siegel & Castellan, 1988) the hypothesis that farmers are equally distributed on their perceptions of the criteria of seed yam quality under the traditional and Yam Minisett technologies was examined based on the frequency distribution of farmer respondents.

The hypothesis that farmers are equally distributed on their perceptions of the criteria of seed yam quality under the traditional and Yam Minisett technologies is rejected. Majority of both AEA and farmer respondents indicated that the traditional methods of seed yam production were superior to the yam minisett technology. Thus the yam minisett technology was not a better alternative to traditional seed yam production methods. This therefore addressed the **research question 1: Is the low adoption of the yam minisett technology due to the inferiority of seed yam produced by the technology to those produced by the traditional methods?** Since the technology, while not meeting farmers' management and production objectives, produced seed yam that did not meet farmers' criteria it was poorly adopted.

In chapter 6, extension delivery and its impact on the adoption rate of the yam minisett technology was discussed. General constraints to extension delivery in the Northern Region, farmer problem identification methods, extent of farmer-extension contact and methods of delivery of the message on the yam minisett technology to farmers were also indicated. Both method and result demonstrations were found to be the main methods of delivery of the yam minisett technology. The study noted that there had been an annual routine farmer training sessions on the technology since 1990 when the technology was introduced to the region. Efforts in this direction reached a crescendo in 1994 to induce the adoption of the technology to enable farmers overcome the loss of farm produce including seed yam following an ethnic conflict in the region. Nevertheless, the study noted a rather low adoption rate of 3% of the 120 farmers respondents studied.

Data also revealed poor farmer involvement in farmer-problem identification and the entire technology delivery process. Though most demonstrations were conducted on farmers' fields to teach them, farmers themselves were seldom involved. The planning of the demonstrations, the necessary input supply, the provision of labour and even the evaluation of the results of the demonstrations were done by the AEAs. The technology was pre-packaged and delivered to farmers because it was available, the farmer being left with the option of accepting or rejecting it. It was also noted that due to the constraints of logistics, there were poor post-training follow-up visits to farmers by AEAs and their supervisors to get first hand feedback from farmers about the applicability of the technology. Apparently, the yam minisett technology was delivered in the "top-down," "supply-driven" fashion whereby the farmers had the options of either accepting or rejecting the technology. The "participatory" and "farmer-focused" approach outlined by the Training and Visit (T&V) management system of National Agricultural Extension Project (NAEP) which aimed at assisting farmers to identify their farm-related problems which would then be solved with farmers' active involvement was more preached than applied by the extension organisation.

The second **research question: Is the low adoption rate of the technology the result of the inappropriateness of the extension approach used to promote the technology?** is duly answered by fact that the methodology used by the agents made the farmers not to recognise the need for the technology hence the low adoption rate of the technology.

In answering **research question 3: is the low adoption of the yam minisett technology due to the socio-economic environment in which the farmer finds**

himself, in close relation to the other research questions, the research identified factors that militated against the adoption of the yam minisett by farmers in the region from a holistic perspective. Under the limitations of the prevailing geo-physical, political, social and economic context in which the technology was introduced, and in which the extension organisation and the farmer operated, the constraints to the adoption of the yam minisett technology were identified by both farmers (the beneficiaries of the technology) and AEAs (the technology transfer agents).

The identified constraints have been categorised into Social, Economic, Environmental, Institutional and Technological factors in chapter seven.

Social factors that reflect some internal variables to the adopters included:

a) Farmers' failure to recognise the need for the technology, being satisfied with their traditional methods.

b) The undesirable characteristics of setts produced by the technology based on farmers' criteria of good seed yam

c) Household food security and income: the technology by its nature was incompatible with the farmers' production objectives. It has a two-year gestation period to produce ware yam whereas the farmers prime objective is to produce ware yam annually either for consumption or cash income generation.

The economic constraints, comprised basically the unavailability and cost of farm inputs, mainly chemicals and labour for the effective application of the technology. Farmers also felt the technology was just but a waste of their time resource since they failed to recognise the need for the technology. They further indicated it was a waste of ware yam since their preferred varieties were not adaptable to the technology.

Environmental factors comprised mainly weather, stray animals that thwarted the applicability of the technology in the region.

Institutional constraints emanating from the extension organisation included the inaccurate diagnosis and analysis of the farmers' yam production problem by the extension organisation as well as the poor involvement of farmers in the entire technology delivery process. The "production-oriented", "top-down", “hierarchical" approach to the technology delivery process gave the farmer the option to either reject or accept the technology. Farmers being satisfied with their current production methods failed to recognise the need for the technology, hence the adoption of the yam minisett technology was far from encouraging.

Technological constraints to the adoption of the yam minisett technology involved mainly the technical characteristics of the technology itself. These included the nursery practices that were not identified with yam production system in the region, the two-year gestation period of the technology, poor quality of setts produced by the farmers' criteria and the non-adaptability of farmers desired varieties or cultivars to the technology.

8.2: CONCLUSION

The adoption rate of the yam minisett technology by farmers in the Northern Region was found to be very low. Whereas the technology was considered by farmers as no better alternative to their indigenous methods of seed yam production with respect to the farmers' production and management objectives, the extension organisation in adapting a production-technology oriented approach unilaterally diagnosed the technology as a panacea for the farmers' problem in the yam production industry. The farmers themselves did not perceive seed yam as a primary constraint to yam production. The extension organisation failed to convince the farmers to realise the need for the technology.

A different situation would have been observed if there had been increased involvement of the target group, the farmer, in the technology development and delivery processes. Active participation of the target group in this regards does not only secure commitment of the target group to the entire educational or change programme, it allows the pooling of technical know-how of all stakeholders, and ensures a rapid feedback from partners for the necessary adjustments to be made on the technology, thereby making it adaptable to the client's own circumstance.

The increased involvement of farmers in the development of technologies, and the need for farmer-focused extension aimed at assisting farmers to identify farm-related problems to be solved with the farmers' active involvement was rather more preached by the National Agricultural Extension Project (NAEP) than it was practised. The technology was promoted because it was available not because the farmers' needed it. The poor participation in the technology development and delivery processes made the farmers not to recognise the need and potential of the yam minisett technology, hence its low adoption rate despite the routine annual farmer-training programmes on the technology.

8.3: RECOMMENDATIONS

The need for client involvement in the development and delivery processes of agricultural technologies cannot be compromised with in an effort to evolve appropriate technologies the adoption of which will result in increased agricultural productivity. In this regard, the following recommendations are being offered:

FOR RESEARCH AND EXTENSION:

1. The new paradigm of "participatory", "demand-driven", and "bottom-up" technology development and transfer should be more applied than preached; thereby replacing the old paradigm of "take-it" or "leave-it", "supply-driven" "hierarchical" system. While production-oriented technology approaches to the current crises in the agricultural sector may be important, the farmer-problem solving approach appears more relevant and critical. The availability of a technology does not necessarily imply its applicability in all circumstances. It is therefore imperative that in evolving strategies to improve upon agricultural production, analysis of the situation need be made from the "grassroots" through more participatory approaches like the Rapid Rural Appraisal (RRA) or Participatory Rural Appraisal (PRA), rather than problems and solutions being perceived by the "top" and transmitted to the "grassroots". It is the definition of the problem that is the cardinal point for the planning and implementation of the extension programmes, not the definition of targets or decisions on the measures to be applied (Albrecht, et al. 1989).

2. While acknowledging this research work is not exhaustive on the constraints to the adoption of the yam minisett technology, it is also recommended that a more elaborate study be carried out on a wider scale on the topic to enable the necessary adjustments to be made on the technology thereby making it more adaptable to the farmers' situation.

3. It is the final wish of this researcher that routine field evaluation of adoption rates of technologies promoted should be institutionalised by both extension and research organisations to enable them obtain updated impacts of the technologies that they develop and promote. This would further enhance a rapid feedback mechanism, while fostering effective linkages between farmers, research, and extension.

FOR POLICY MAKERS:

4. Since adoption of agricultural technologies occurs within and is largely influenced by the economic and political environment, it is worth indicating that a conducive policy environment, which ensures the availability of production-enhancing inputs at affordable prices is absolutely necessary. The provision of some form of incentives for production can also go far in enhancing the adoption of technologies that are being promoted.

APPENDIX I: INTERVIEW SCHEDULE TO YAM FARMERS

CONSTRAINTS TO THE ADOPTION OF THE YAM MINSETT TECHNOLOGY.

QUESTIONNAIRE NO.------

SECTION A: PERSONAL RECORD.

1. NAME OF RESPONDENT--

2. VILLAGE:---

3. AGE: [ ]years

4. MARITAL STATUS: a. married [ ] b. single [ ] c. divorced [ ] d. widowed [ ]

5. NUMBER OF CHILDREN: [ ]

6. EDUCATIONAL LEVEL: a. no formal education [ ] b. Primary [ ]
c. MSLC/JSS [ ] d. SSS/GCE [ ] e. Tertiary education. [ ]

SECTION B: AGRICULTURAL ACTIVITIES

1.0. GENERAL INFORMATION ON FARMING.

7. How long have you been engaged in farming?
a. less than 10 years [ ] b. 10 - 20 years [ ] c. 20 - 30 years [ ]
d. 30 - 40 years [ ] e. more than 40 years [ ]

8. In the table below, indicate the crops you grow in order of **priority**, for food, and for market.

FOOD CROPS	CROPS FOR MARKET
a.	a.
b.	b.
c.	c.
d.	d.
e.	e.

9. What is the commonest source of labour for your farm operations? Tick one.
a. communal labour [ ] b. family labour [ ] c. hired labour [ ]

10. Do you often get adequate labour for your farm operations any time you want?
a. always [ ] b. sometimes [ ] c. never [ ]

11. If you depend on hired labour, can you always afford it?
a. always [ ] b. sometimes [ ] c. never [ ]

2.0. CONTACT WITH EXTENSION.

12. Which of the following is your **major** source of technical advice for your farming?
    a. the village chief [ ] b. contact farmer [ ] c. the school teacher [ ]
    d. the extension agent [ ] e. other(specify)--
13. Are you aware of an extension agent within your sub-district? Yes [ ] No [ ]
14. If yes, do you know his role in your village? Yes [ ] No [ ]
15. If yes, how often does he contact you? **TICK ONE**
    a. once a week [ ] b. once a fortnight [ ] c. once a month[ ] d. twice a year [ ]
16. What form of contact do you often have with him? **TICK ONE**
    a. alone[ ] b. in group [ ] c. both[ ]
17. Which of these do you prefer as the mode of contact that you wish to have with the extension agent? **TICK ONE** a. alone[ ] b. in group [ ] c.both [ ]
18. Do you ever call on the extension agent yourself? Yes [ ] No [ ]
19. If yes, what is often the purpose of your visit? **Tick one**
    a. social[ ] b. for technical advice [ ] c. both [ ]
20. How often do you call on the extension agent?
    a. daily [ ] b. weekly [ ] c fortnightly [ ] d. monthly [ ]
21. Does the extension agent often have useful technical information you need for your farm work? a. never [ ] b. sometimes[ ] c. always [ ]
22. Do you benefit from your contacts with the extension agent?
    a. I never benefit [ ] b. I sometimes benefit [ ]
    c I always benefit [ ] d I don't know [ ]
23. How useful do you find the services of the extension agent in this area?
    a. not useful. [ ] b. somewhat useful [ ] c. useful [ ] d. very useful [ ]

3.0 :TRADITIONAL YAM PRODUCTION

24. What has been the average size of your yam farm every year? [ ]ha.
25. What dictates the size of your yam farm annually? **Indicate in order of priority(1,2,& 3)** a. availability of good land [ ]. b. availability and cost of labour [ ] c. availability and cost of seed yam [ ]
26. Is the yam you produce annually enough to feed your family?
    a. always not enough.[ ] b. sometimes not enough [ ]
    c. always just enough.[ ] d. sometimes more than enough [ ]
    e. always more than enough .[ ]

27. What is the contribution of yam to your household food requirement?

a. less than half b. half c. more than half.

28. How much of the yam you produce do you sell?

a. all [ ] b. most [ ] c. about half [ ] d. few [ ] e. none [ ]

29. What is the contribution of yam to your annual farm income?

a. all [ ] b. most [ ] c. about half [ ] d. less than half [ ] e. none [ ]

30. What is the major source of seed yam for your farm? Indicate in order of **priority(1,2,3 etc.).** a. purchased [ ] b. self produced [ ] c.. Exchange [ ] d. borrowed [ ]

31. How do you produce your seed yam?--
----

32. What proportion of your annual yam harvest do you reserve as seed yam?

a. all [ ] b. most [ ] c. about half [ ] d. few[ ] e. none[ ]

33. Do you often produce enough seed yam to meet your annual need? Yes [ ]No [ ]

34. If no, how often do you experience seed yam shortages for your yam farm?

a. annually[ ] b. scarcely. [ ]

35. If shortages are experienced, how do you make up the difference? **Tick where applicable.** a. buy from the open market [ ] b. borrow from a neighbour [ ] c. cut down acreage [ ] d. exchange [ ]

36. What are the characteristics or qualities of good seed yam to you?

----

37. If you buy your seed yam, do you meet your desired quality?Yes [ ] No [ ]

38. Have you ever contacted the extension agent for advice on how to solve your seed yam problem? Yes [ ] No [ ]

39. What have you learnt from the extension agent that has helped you to solve your seed yam problem --

4.0. TECHNOLOGY TRANSFER

40. What technical messages have you received from the extension agent about yam production? a. improved varieties [ ] b. methods of staking [ ] c. planting methods [ ] d. seed yam production methods [ ] e. other(specify)------------------

41. Who identified your need for the technical messages you have identified?

a. the village chief[ ] b. contact farmer [ ] c. myself. [ ] d. village school teacher [ ] e. the extension agent. [ ] f. other(specify)----------------------------

42. In the table below, tick against those technical messages you have received and those you are practising now.

TYPE OF MESSAGE	RECEIVED OR HEARD OF.	PRACTISING
Improved varieties.		
Staking		
Methods of planting		
Seed yam production		

43. Have you ever heard about the yam minisett technology? Yes [ ] No [ ]

44. From whom did you hear it for the first time? **Tick one.**

a. the village chief[ ] b. contact farmer [ ]

c. village school teacher [ ] d. the extension agent. [ ]

45. When did you hear it for the first time? [ ] **Indicate the year.**

46. How was the message about yam minisett communicated to you for the first time? a. through group discussion[ ] b. through a lecture[ ] c. I read about it. [ ] d. through a demonstration[ ] e. other(specify)-------------------

47. How much do you know about the technology? Tick **ONE**

a. I have just heard about it [ ] b. I have tried it on my own [ ]

c. I have discussed it with my colleagues [ ] d. I have seen it demonstrated [ ]

48. How many times did you observe the technology being demonstrated?

a. once [ ] b. twice [ ] c. thrice [ ] d. more than three times[ ]

49. Who carried out the demonstration? **TICK ONE**

a. farmer supervised by extension agent [ ] b. extension agent [ ]

c. SMS [ ] d. other(specify)---

50. Where was the demonstration carried out?

a. in a classroom [ ] b. in a farmer's field [ ] c. at the agric station [ ]

d. at the research station [ ] e. other(specify)--------------------------

51. After the demonstration was laid, how many times did you visit the site?

a. once [ ] b. twice [ ] c. thrice [ ]

d. more than three times [ ] e. I never visited the site. [ ]

52. Who provided the inputs for the demonstration?

a. the farmer [ ] b. a research officer [ ]

c. the extension agent [ ] d. other(specify)-----------------------------------

53. If you did not provide the inputs for the demonstration, do you think you can afford them? Yes [ ] No [ ]

5.0. THE MINISETT TECHNOLOGY

54. How well did you understand the technology as demonstrated?

a. not well understood [ ] b. well understood [ ] c. very well understood [ ]

55. Do you require further training to fully understand the technology? Yes [ ] No [ ]

56. Was the timing of the demonstration early enough to produce good seed yam?

Yes [ ] No [ ]

57. If you understood and followed the demonstration to the end, how satisfied were you with the results? a. very satisfied [ ] b. satisfied [ ] c. not satisfied [ ]

58. Compare the traditional and minisett technologies of seed yam production on each of the following characteristics of seed yam. **Tick in the appropriate box** which method gives better quality of the respective characteristic.

CHARACTERISTICS OF SEED YAM	TRADITIONAL METHOD	MINISETT TECHNOLOGY
Good size of seed yam		
Number of seed yam produced		
Ability to germinate		
Longer storage life		
Good size of tuber produced from seed yam		

59. Does the technology produce seed yam that meet your desired qualities?

a. Yes [ ] b. No [ ]

60. How do you compare the minisett technology to your traditional method of seed yam production? a. The yam minisett technology is superior [ ]

b. The traditional method is superior [ ] c. I cannot compare them [ ]

61. How easy is it for you to use the yam minisett technology to produce seed yam?

a. very simple.[ ] b. simple.[ ] c. some what simple.[ ]

d. difficult.[ ] e. very difficult.[ ]

62. How useful do you find the yam minisett technology?

a. very useless.[ ] b. not useful.[ ] c. somewhat useful.[ ]

d. useful.[ ] e. very useful.[ ]

63. Can the technology help improve upon your seed yam situation?

Yes [ ] No [ ]

64. Do you think you require external inputs to practise the technology?Yes [ ] No [ ]

65. Compare the minisett technology to the traditional method of seed yam production under the following characteristics; **Tick** in the box which one is **better.**

	MINISETT TECHNOLOGY	TRADITIONAL METHOD
Number of seed yam produced.		
Size of seed yam produced		
Germinability of seed yam.		
Size of tuber produced from the seed yam		
Shelf life of seed yam.		

66. Do you really need the yam minisett technology? Yes[ ] No[ ]

6.0. ADOPTION OF THE TECHNOLOGY

67. Having been taught the yam minisett technology, did you ever try it out on your own? Yes[ ] No [ ]
68. What difficulties did you encounter when trying the technology? **Tick where applicable** a. cost of inputs was high [ ] b. no labour [ ] c. watering difficulties [ ] d. difficulty in transporting seedlings to the field [ ] e. other (specify):---------

69 If you did not try the technology, what reasons do you have? **Tick where applicable.** a. I did not understand it fully [ ] c. Its results did not impress me [ ] d. I did not have the inputs [ ]

70. List all the reasons why you are not practising the technology.-------------------------

7.0: FEEDBACK

71. After the technology was introduced to you, did anybody return to ask of your opinion? Yes [ ] No [ ]
72. If yes, who was it? a. a farmer [ ] b. research officer [ ] c. the extension agent [ ] d. other(specify)-----------------------------------
73. What information did he/she ask for?--
74. Did you on your own give your impressions about the technology to any other person? Yes [ ] No [ ]
75. If yes, to whom did you give this information? a. a colleague farmer [ ] b. the extension agent [ ] c. a researcher [ ] d. SMS [ ]
76. What information did you give?--
77. Besides your local extension agent, did any other officer interact with you about your seed yam problem? Yes [ ] No [ ]

78. If yes, what advice did you get from him?

a.---b--
c.---d--

79. What difficulties prevent you from practising the yam minisett technology?

GENDER ISSUES

80. Do women grow yam as one of their main crops? Yes [ ] No [ ]

81. If no, why is it so?---
----

82. Besides the work she does on her own farm, what major roles does she play in your yam production effort?---

83. Do you normally share agricultural technical messages you receive or learn with your wife? Yes [ ] No [ ]

84. If yes, what messages have you ever shared with her?

----

85. If no, why do you feel this is not necessary?--

APPENDIX II: QUESTIONNAIRE TO EXTENSION AGENTS

CONSTRAINTS TO THE ADOPTION OF THE YAM MINISETT TECHNOLOGY:

QUESTIONNAIRE NO------------------------

SECTION A: PERSONAL INFORMATION

1. Name of respondent**(optional)**---
2. Operational area:---
3. Sex: a. Male [ ] b. Female [ ]
4. Present rank: a. T.O. [ ] b. STO [ ] c. PO [ ] d. SPO [ ]
   e. AAO [ ] f. AO [ ] g. SAO [ ] h. AD [ ]
5. Present Position: a. Front-line staff [ ] b. Development officer [ ]
   c. SMS [ ] d. Director [ ]

SECTION B: AGRICULTURAL ACTIVITIES.

1.0 GENERAL EXTENSION ACTIVITIES or CONTACT WITH FARMERS.

6. How long have you been working as an extension agent? [ ]years.
7. How long have you been at your present position? [ ]years.
8. How far away do you stay from your operational area? [ ]km.
9. Briefly indicate your job description in this operational area.

----

10. Do you perform up to expectation as far as your job is concerned?
    a far above expectation [ ] b. above expectation [ ] c. as expected [ ]
    d. below expectation [ ] e. far below expectation [ ]
11. Give a few indicators that you have achieved some success as far as your duties are concerned. ---
    ----
12. Who plan(s) the extension programme for your operational area?

----

13. Which of these method(s) do you employ **most** in communicating ideas to your farmers? a. lecture [ ] b. group discussion[ ] c. field trips[ ]
    d. result/method demonstration [ ] e. theatre for development[ ]
    e. other (specify)--
14. Indicate the three most effective methods that you employ, according to ranking,(a. being the most effective; followed by b.; c.).

a---
b---
c---

15. Which of the following factors do you consider in selecting your extension methods? **Tick where appropriate.**

a. The type of technical message[ ] b. The educational level of my farmers [ ]

c. The farmers' resources [ ] d. My resources[ ]

16. Rank in order of **priority (1,2,3,4,&5)** how you identify farmers' problems.

a. Through field and home visits[ ] b. Group meetings and discussions [ ]

c. personal observation[ ] d. From records[ ] e .farmers report to me[

]17. Are farmers aware of your role in this operational area?

a. all farmers [ ] b. some farmers [ ] c. none of the farmers[ ]

18. How many farmers' groups do you work with in your operational area? [ ]

19. How often do you visit your farmers groups?--

20. List in order of **priority** your sources of technical messages to your farmers.

a. Technical leaflets/bulletins [ ] b. From my supervisor[ ]

c. SMS/monthly training sessions[ ] d. other(specify)--------------------------

21. List by rank order of influence, issues or factors which are obstacles to farmers' accepting technical messages promoted by extension.(a **-most important, b next, etc.).** a.---b.---

c---d.---

e---f.---

22. Indicate **major** constraints that you face in your field work.

2.0. TRADITIONAL YAM PRODUCTION

23. How many hectares of yam are cultivated in this operational area annually? [ ]

24. What is your opinion about the scale of yam production in this area?

a. subsistent crop [ ] b. Commercial crop [ ]

25. What proportion of yam produced in this area is sold? [ ]%

26. What is the contribution of yam to your farmers' annual farm income? [ ]%

27. Indicate in percentages your farmers' sources of seed yam(**N.B. the highest percentage being the primary source**). a. self produced [ ]% b. purchased [ ]%

c. borrowed [ ]% d. exchanged [ ]%

28. How do farmers produce seed yam?---

29. Do they produce enough to meet their annual requirements? Yes [ ] No [ ]

30. How frequent do your farmers experience shortage of seed yam?

a. They have never experienced any shortage. [ ] b. rarely [ ] c. annually[ ]

31. How do they make up the difference? tick as appropriate.

a. They buy [ ] b. they reduce their acreage [ ]

c. Other (specify)--

32. Indicate problems encountered with seed yam production in this operational area.

----

33. Briefly indicate the characteristics of good seed yam by your farmers' judgement.

3.0. THE MINISETT TECHNOLOGY

34. What technical messages on yam do you know?

a--b--

c--d--

35. Which of these have you taught your farmers to enable them improve upon their seed yam production?--

36. Have you ever trained your farmers on yam minisett technology? Yes [ ] No [ ]

37. If yes, who identified the need for this technology in your operational area? Tick where appropriate. a. Farmers [ ] b. extension agent [ ] c. researcher [ ] d. SMS [ ]

38. Who was the source of the message on the technology to you? Tick **one**.

a. A farmer [ ] b. The extension agent [ ] c. Researcher [ ]

d. SMS [ ] e. other(specify)---

39. What is your knowledge level about the yam minisett technology?

a. very high [ ] b. high [ ] c. average [ ] d low [ ] e. very low[ ]

40. What is your farmers' knowledge level about the technology?

a. very high[ ]b. high[ ] c. average[ ] d low[ ] e. very low[ ]

41. Does the minisett technology produce seed yam that have the characteristics of good seed yam by your farmers' assessment? Yes [ ] No [ ]

42. If no, what is the difference?---

43. How do you compare this technology to the traditional method of seed yam production? a. The yam minisett is superior [ ] b. There is no distinct difference between them [ ] c. The traditional method is superior. [ ] d. I cannot compare them [ ]

44. How simple is it for your farmers to use the minisett technology to produce seed yam? a. very simple [ ] b. simple [ ] c. somewhat simple [ ] d. difficult [ ] e. very difficult [ ]

45. How do your farmers compare the yam minisett technology to their traditional way of producing seed yam? a. The yam minisett is superior [ ] b. There is no distinct difference between them [ ] c. The traditional method is superior. [ ]
d. I do not know[ ]

4.0. TRANSFERRING THE TECHNOLOGY

46. Have you ever introduced the yam minisett technology to your farmers? Y[ ] N[ ]
47. If yes, what method did you use? a. Group [ ] b. individual [ ] c. mass [ ]
48. Who chose the method to be used?a. extension agent(EA.) [ ] b. Farmers [ ]
c. SMS [ ] d. researcher [ ]e. EA. & researcher [ ]f. EA. & farmers. [ ]
g. EA. & SMS [ ]
49. How did you use the method? a. individual farmer training [ ]
b. Group farmer training [ ] c. mass [ ]
50. Who provided the inputs for the training? a.extension agent [ ] b. farmer [ ]
c. SMS [ ] d. extension supervisor [ ] e. researcher[ ]
51. Where did the training take place?
a. in a classroom [ ] b. In a farmer's field [ ]
c. at the agricultural station [ ] d. at the research station [ ]
52. If it was a demonstration you laid, how many field days did you carry out with your farmers? a. none [ ] b. once [ ] c. 2 [ ] d. 3 [ ] e. more than 3 [ ]
53. What role did your farmers play in the conduct of the demonstration?
a. listening and observing [ ] b. carrying out the practical aspect [ ]
54. On what occasions did you carry out the field days?
a. nursery [ ] b. sprouting [ ] c. transplanting [ ] d. harvesting [ ]
55. How did your farmers see the results of the technology you demonstrated?
a. Poor [ ] b. impressive [ ] c. fair [ ]
56. How did you farmers see the results of the technology you demonstrated?
a. Poor [ ] b. impressive [ ] c. fair [ ]
57. Do you think your farmers can afford the inputs to this technology? a.Y [ ] N [ ]
58. How many farmers in all benefited from the training? a indicate the number [ ]
or tick b. I do not know [ ]
59. Did you ever teach the same group the same technology more than once?
Yes [ ] No [ ]
60. If yes, briefly indicate why this was necessary.--

61. What difficulties did you encounter in the use of the method you chose to teach your farmers? --
----

62. How effective do you see the method you employed in teaching farmers the minisett technology? a very effective[ ] b. effective[ ] c somehow effective[ ] d not effective [ ] e. very ineffective [ ].

63. Do you think there is a better alternative method by which you could have trained the farmers in the minisett technology? Yes [ ] No [ ]

64. If yes, why did you not use it?--

5.0. ADOPTION OF THE TECHNOLOGY

65. What has been the impact of the training on your farmers' ability to improve upon their seed yam production.?--

66. Do your farmers have adequate knowledge to practise the technology?

Yes [ ] No [ ]

67. What percentage of the farmers you taught are now practising the technology? [ ]

68. List in order of priority factors that you think make farmers not to practice the yam minisett technology. a.---

b.--

c.--

d.--

6.0. FEEDBACK

69. When did you introduce the technology in your operational area? Indicate the year[ ]

70. Was there a reintroduction of the technology after the first occasion to the same communities? Yes[ ] No[ ]

71. If yes, what prompted this?---

72. When did the reintroduction take place? Indicate the year [ ]

73. Are there fresh requests for the technology to be introduced in communities you did not earlier on introduce? Yes [ ] No [ ]

74. After the technology was introduced, were there reports of seed yam shortages in those same communities where it was introduced? Yes [ ] No [ ]

75. Give reasons for your answer.---

76. Who was the originator of the technology for you to introduce? Tick one.

a Extension agent/supervisor [ ] b. Researcher [ ]

c. SMS [ ] d. Other(specify)---

77. Did the originator follow up to see the performance of the technology in your operational area? Yes[ ] No[ ]

78. If yes, what information did he request for? Tick where appropriate.

   a. number of farmers adopting the technology[ ] b. supply of inputs [ ]

   c. Problems farmers face in adopting the technology [ ]

79. What information did he also give with respect to the technology?

----

80. Did you yourself assess the performance of the technology in the field? Yes [ ] No [ ]

81. Without you following up, did the farmers themselves report back to you on their experiences with the technology? Yes [ ] No [ ]

82. If yes, where did you send these reports? tick where appropriate.

   a. My supervisor [ ] b. SMS [ ] c. researcher [ ]

83. Briefly indicate any other issues you wish to give with regards to the minisett technology, its introduction, adoption, and feedback messages on it.-----------------
----

GENDER ISSUES

84. Do women in your operational area cultivate yam? Yes [ ] No [ ]

85. If yes what is the average acreage cultivated by women in this area? [ ]

86. If no to 84, what are their roles in yam cultivation? Indicate the major ones

----

----

87. Do you involve women farmers in extension training activities? Yes [ ] No [ ]

88. How many women farmers participated in the yam minisett training you carried out for your farmers? [ ]

89. What is often the adoption rate of technologies you introduce by women as compared to the men? a. Higher than men [ ] b. equal to men [ ]

   c. lower than men. [ ] d. I cannot compare them. [ ]

90. How many women have adopted the minisett technology? [ ]

APPENDIX III: CALENDAR OF NATIONAL AND LOCAL EVENTS/ACTIVITIES/MEMORABLE OCCASIONS USED TO ESTIMATE THE AGES OF RESPONDENTS WHO DID NOT KNOW THEIR ACTUAL AGES

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DATE/PERIOD	EVENT/ACTIVITY/MEMORABLE OCCASION
6/3/57	Ghana's Independence Day
Oct. 1919	Sir Gordon Guggisberg arrives in Ghana as Government of The Gold Coast
1/7/60	Ghana's Republic Day
24/2/66	First coupe détat in Ghana
17/4/66	Counter coupe (Kotoka killed).
1/10/69	Second Republic; Dr. K. A. Busia becomes Prime Minister of Ghana (Progress Party)
13/1/72	Second coupe détat (Dr. Busia overthrown).
July, 1958	Preventive Detention Act (PDA)
1964	National Referendum on one-party state
1962	First attempt at assassinating Dr. Kwame Nkrumah (Kulungugu Bomb)
1964	Second attempt at assassinating Dr. Kwame Nkrumah (Flagstaff House)
24/4/72	Dr. Kwame Nkrumah dies in exile
1967	Sir Gordon Guggisberg builds a memorial at Wa.
12/6/49	First political party launched in Ghana (UGCC)
9/1/50	CPP/Nkrumah calls for sit down strike of workers(Positive Action)
28/2/48	Police officer shoots and kills Sgt. Adgetey et al. (Accra)
1954	Northern Peoples' Party takes part in National elections
July, 1956	Pre-independence general elections
1912	Government School in Gambaga
1925	Government Boarding School at Lawra, Salaga and Wa
1935	Native Administration Schools opened at Yendi, Lawra and Bawku
1918	Chief Kanton I installed (Tumu)
1951	Chief Kanton I dies
1952	Baptist Mission established in Tumu
1945	Tumu Primary Boarding

1914	Outbreak of World War 1
1918	World War 1 ends
1939	Outbreak of World War 2
1945	World War 2 ends
1943	Government Training College, Tamale
1951	Government Secondary School, Tamale
1906	Government Station, District Commissioner's House, Tumu
1920	Government Station in Tumu closed
1946	Government Station, Tumu, re-opened
1960	Ghana Population census
1936	"Lampo" (Direct taxation introduced)
1911	First government school in Tamale
1900-1917	Ya Na Alhassan (Paramount Chief of Dagbon, Yendi)
1920-1938	Ya Na Abdulai II
1938-1948	Ya Na Mahama II
1948-1953	Ya Na Mahama III
1953-1957	Ya Na Abdulai III
1968-1969	Ya Na Andani III
1969-1974	Ya Na Mohamadu Abdulai IV
23/4/06	White Fathers arrive in Navrongo (Frs. Morin, Chollet, and Bro. Eugene)
1910	First school in Navrongo by White Fathers
1920	New chapel built in Navrongo
1934	Chapel upgraded to Cathedral
1937	Teacher training College (Bosco's) Navrongo
1960	Navrongo Secondary School opened
1983	Upper Region sub-divided into Upper-East and Upper-West Regions
Dec., 1935	Sir Frank Stockdale visits Navrongo and Zuarungu
1935	Agricultural survey in Wiaga, Navrongo, Chaina, Kologo etc. by Lynn
16/5/40	Durbar in honour of Sir Arnold Hudson (Governor, The Gold Coast)
1907	Whittall as District and Provincial Commissioner, Northern Province.
1916	Cardinall as D.P.O., Yendi
1920	Gilbert as D. C., Yendi.

APPENDIX IV: FOCUSED INTERVIEW CHECKLIST

A. FARMING SYSTEMS AND PRACTICES

i. Main farming systems being practised
- land ownership
- tenancy
- availability and suitability for cropping

ii. Major crops grown in the sub-district.
- Acreage (N.B. YAM)
- existing varieties
- Preferred varieties AND their availability.
- estimated yields

iii. Production practices
- Practices with their respective calendars.
- Inputs and outputs associated with a practice.
- farm credit: source, availability and accessibility;

B. ESTIMATED YIELDS AND RETURNS
- for major crops.
- market availability
- prospects for yam

D. LABOUR
- types, availability and affordability for yam production.
- seasonality

E. GENERAL ATTITUDE TOWARDS AGRICULTURAL EXTENSION

•farmers' participation/involvement in developing sub-district agricultural extension programmes

•farmers' social groups and extension contact groups;

•their receptivity to extension messages.

•Adoption pattern of agricultural recommendations

F. CONSTRAINTS TO AGRICULTURAL PRODUCTION

- How do these affect seed yam production
- How do they relate to adoption of agricultural technologies.
- Culture-related issues.

G. COMMUNICATION

- formal and informal channels of information diffusion within the community.
- Prevailing extension teaching methods
- barriers to effective communication.

H. MISCELLANEOUS

- General community development issues
- factors that can enhance agricultural development.

APPENDIX V: REPORTS AND PROJECT DOCUMENTS CONSULTED

1. Annual Programme of Work (1994 to 1998): Gushiegu/ Karaga District
2. Annual Programme of Work (1994 to 1998): East Gonja District
3. Annual Programme of Work (1994 to 1998): West Gonja District
4. Annual Programme of Work (1994 to 1998): Yendi District
5. Monthly, Quarterly, and Situation Reports: Gushiegu/Karaga, East Gonja, West Gonja, and Yendi Districts
6. Research-Extension Liaison Committee (RELC) Planning Workshop Report. Zone II (1997,1998).Tamale
7. Bimonthly Technical Review Meetings (BMTRM) reports (1997), Tamale
8. District Development Plans (1996-2000): Gushiegu/Karaga, East Gonja, West Gonja, and Yendi Districts
9. Bi-Annual Progress Reports Smallholder Rehabilitation and Development Programme (SRDP); PCU Reports (1990-1995), Tamale
10. A Growth Strategy for the Northern Region (1995) Regional Planning Co-ordinating Unit (RPCU).Tamale
11. Socio-economic Development of Northern Region: The role of the Ministry of Food and Agriculture (1997). Tamale
12. Ghana National Agricultural Extension Project. Joint IDA/GOG Implementation Assistance Mission. Aide Memoir and Annexe 1-3. October, 6-10 and 27-31, 1997. Accra.
13. Staff Appraisal Report. National Agricultural Extension Project. World Bank Report (1992). Accra
14. Ghana - Vision 2020 (The First Step: 1996-2000). Presidential Report on Co-ordinated Programme of Economic and Social Development Policies (1995). Accra.

APPENDIX VI: ITINERARY FOR DATA COLLECTION

PERIOD	ACTIVITY	LOCATION	ACTION BY
23/03/98-25/03/98	Multiplication of questionnaire and interview guide	Tamale	Researcher
26/03/98-27/03/98	Attend workshop on decentralisation of MoFA	Tamale	Researcher
30/03/98-31/03/98	Consult District Directors of Yendi, East Gonja, West Gonja and Gushiegu/Karaga Districts	Tamale	Researcher
02/04/98-03/04/98	Selection and training of research assistant	Gushiegu	Researcher & DDA
06/04/98-17/04/98	Field data collection	Gushiegu/Karaga District	Researcher & Research Asst.
20/04/98-21/04/98	Selection and training of research assistant	Salaga	Researcher & DDA
22/04/98-29/04/98	Field data collection	East Gonja District	Researcher & Research Asst.
01/05/98-02/05/98	Selection and training of research assistant	Yendi	Research & DDA
02/05/98-06/05/98	Field data collection	Yendi District	Researcher & Research Asst.
07/05/98-08/05/98	Attend RELC workshop	Tamale	Researcher
11/05/98-12/05/98	Selection and training of research assistant	Damongo	Researcher
13/05/98-21/05/98	Field Data collection	West Gonja District	Researcher & Research Asst.

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