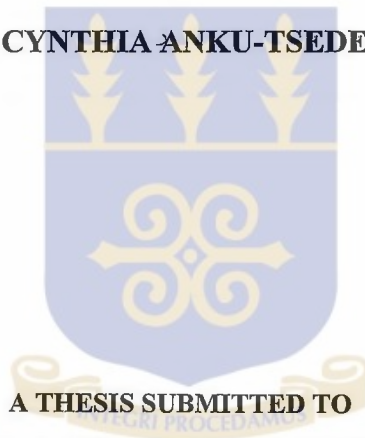


**ADOPTION OF  
IMPROVED COWPEA PRESERVATION TECHNOLOGIES  
IN THE  
AKATSI DISTRICT OF THE VOLTA REGION, GHANA**

**BY**

**CYNTHIA ANKU-TSEDE**



**A THESIS SUBMITTED TO**

**THE DEPARTMENT OF AGRICULTURAL EXTENSION, UNIVERSITY OF  
GHANA, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE  
AWARD OF THE MASTERS OF PHILOSOPHY (M.PHIL) DEGREE IN  
AGRICULTURAL EXTENSION**

**FEBRUARY, 2000**



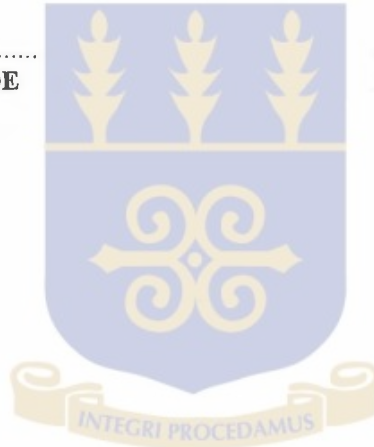
## DECLARATION

I, do hereby declare that with the exception of literature cited, which I have duly acknowledged, this thesis is entirely my original work. I further declare that no part of this thesis has been presented for a degree anywhere.



A handwritten signature in black ink, appearing to read 'Cynthia Anku-Tsede', written over a horizontal dotted line.

**CYNTHIA ANKU - TSEDE  
(STUDENT)**



A handwritten signature in black ink, appearing to read 'Dr. O. Sakyi-Dawson', written over a horizontal dotted line.

**DR. O. SAKYI - DAWSON  
(SUPERVISOR)**

## DEDICATION

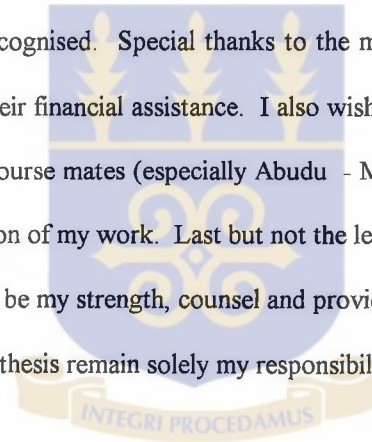
This thesis is dedicated to  
Vincent, my Parents and Siblings,  
Who shared this phase of my life  
With me.



## ACKNOWLEDGEMENT

This thesis would not have been accomplished without certain amount of support and guidance from others. It is on this note that I wish to express my sincerest gratitude to my supervisor, Dr. O. Sakyi - Dawson of the Department of Agricultural Extension, University of Ghana, Legon. He made constructive criticisms and offered useful suggestions that inspired me to work harder, and led to the completion of this work.

Credit is also given to all lecturers of the Department of Agricultural Extension, University of Ghana, Legon, for their assistance and useful suggestions. Your contribution to the completion of this thesis cannot go unrecognised. Special thanks to the management and staff of Social Security Bank (S.S.B.) for their financial assistance. I also wish to thank Vincent, George, my siblings, Theodosia and my course mates (especially Abudu - Mumuni Insah) for their diverse contributions to the completion of my work. Last but not the least, I give all the glory to God, who has been and continues to be my strength, counsel and provider. I however wish to remark that any shortcomings of this thesis remain solely my responsibility.



## ABSTRACT

Enhancing the adoption of Improved Cowpea Preservation Technologies (ICPTs) can contribute greatly to food security in low-income countries such as Ghana. However, although such improved technologies have been the focus of technology development and extension effort for sometime now in Ghana, there is a dearth of studies on the extent of adoption of ICPTs and its determinants. Among others, current adoption of technology literature suggests that target or potential user's perceptions of technologies are likely to influence adoption. However, this paradigm has not been studied in Ghana for ICPTs. This thesis therefore examined the relationship between cowpea farmers' and traders perceptions and the adoption of ICPTs in the Akatsi district of the Volta Region, Ghana. Specifically, it attempts to answer the question - how does their perceptions of characteristics of four ICPTs (namely the use Actellic liquid, Actellic dust, Phostoxin and edible oil in preserving cowpea), mode and effort of extension delivery, determine the pattern of utilization of ICPTs.

Data was collected using questionnaires from sixty cowpea producers, twenty-five cowpea traders and fifteen Agricultural extension Agents (AEAs) of the Ministry of Food and Agriculture (MoFA). In addition, the Rapid Rural Appraisal (RRA) methods for focus group discussions, was used to collect contextual information. Data analysis included frequency distribution, chi-square tests and the Spearman's rank order correlation co-efficient.

The results show that apart from respondents gender and the quantity of cowpea stored, there was statistically no significant difference between the characteristics of cowpea producers and traders. Cowpea producers were mainly males and the traders were solely females. Traders also stored more cowpea than producers did and they stored it for a longer period of time.

Extension agents delivery efforts on the selected ICPTs was mainly by a combination of interpersonal (individual and group) methods and contact tended to be more frequent (thrice or more within a month). However, cowpea traders were contacted less frequently than producers. Traders are however more important with regards to preservation of cowpea than producers yet, they have little access to ICPT messages. It is therefore suggested that extension agents need to direct more cowpea preservation messages to traders.

There was substantial knowledge of cowpea pests and their control in the study area. Comparatively, the level of awareness of traditional cowpea preservation technologies was higher than that of ICPTs. Level of awareness of ICPTs in descending order is similar - Actellic dust, Actellic liquid, Edible oil and Phostoxin (Producers - 52%, 37%, 35%, 21% and Traders - 48%, 32%, 24%, 16% respectively). The study established that Phostoxin had a higher range of positively perceived attributes by producers and traders and edible oil had the least.

Analysis of the relationship between adopter characteristics and perception of attributes revealed that with the exception of Actellic liquid, these variables did not make a difference in perception of ICPTs. The extension method used did not bring about a difference in perception of overall attributes of ICPTs but made a difference in perception of general attributes (Relative Advantage and Complexity) of Actellic liquid. With the exception of Actellic liquid, the frequency of contact of AEAs with the respondents did not bring about any significant difference in perception of ICPTs. An increase in the frequency of contact of AEAs with the respondents resulted in more positive perception of attributes of Actellic liquid but not the other ICPTs.

There was a positive relationship between respondents positive perceptions of selected ICPTs and adoption levels. Producers' perceptions of specific attributes gave the closest prediction of adoption levels whereas traders overall perceptions of attributes gave the closest prediction of adoption level. It shows that to an extent, perceptions of attributes reflect their adoption levels.

It is suggested that AEAs need to re-examine and refine ICPTs, taking the negative perceptions of attributes of ICPTs and their inverse relationship with adoption levels into consideration. In order to enhance adoption of ICPTs, AEAs should deliver detailed technical knowledge, emphasising positive attributes. This can be done through regular contact (thrice or more within a month) and the use of interpersonal channels of extension delivery (use of a combination of the group and individual methods of extension delivery) for increased adoption of cowpea preservation technologies.

## TABLE OF CONTENT

<b>DECLARATION</b> .....	<b>i</b>
<b>DEDICATION</b> .....	<b>ii</b>
<b>ACKNOWLEDGMENT</b> .....	<b>iii</b>
<b>ABSTRACT</b> .....	<b>iv</b>
<b>TABLE OF CONTENT</b> .....	<b>vii</b>
<b>LIST OF ABBREVIATIONS</b> .....	<b>xii</b>
<b>LIST OF TABLES</b> .....	<b>xiii</b>
<b>LIST OF FIGURES</b> .....	<b>xvi</b>
<b>LIST OF MAPS</b> .....	<b>xvii</b>
<b>LIST OF APPENDICES</b> .....	<b>xviii</b>

## PART ONE: BACKGROUND

### CHAPTER ONE: INTRODUCTION

<b>1.0.</b>	<b>Background Information</b> .....	<b>1</b>
<b>1.1.</b>	<b>Statement of the Problem</b> .....	<b>5</b>
<b>1.2.</b>	<b>Research Question</b> .....	<b>7</b>
<b>1.3.</b>	<b>Objectives</b> .....	<b>7</b>
1.3.1.	Main Objectives .....	7
1.3.2.	Specific Objectives .....	7
<b>1.4.</b>	<b>Significance of the Study</b> .....	<b>8</b>

**CHAPTER TWO: LITERATURE REVIEW**

<b>2.0</b>	<b>Introduction</b> .....	<b>10</b>
<b>2.1</b>	<b>Adoption of Innovations</b> .....	<b>11</b>
2.1.1	How Adoption takes Place .....	12
2.1.2	Benefits of Adoption .....	14
<b>2.2.</b>	<b>Perceptions and Adoption</b> .....	<b>15</b>
2.2.1	Perceptions of Characteristics of Innovations .....	15
2.2.2.	How Perceptions are Established .....	22
<b>2.3.</b>	<b>Extension Delivery</b> .....	<b>24</b>
2.3.1.	Extension Delivery and Adoption .....	24
2.3.2.	Extension Delivery and Perceptions of Innovations .....	26
<b>2.4.</b>	<b>Personal / Individual Characteristics and Adoption</b> .....	<b>27</b>
2.4.1.	Personal Characteristics and perception of Characteristics of Innovations .	32
<b>2.5.</b>	<b>A Conceptual Model of Determinants of Adoption of Innovations</b> .....	<b>32</b>
<b>2.6</b>	<b>Definition of Terms</b> .....	<b>35</b>
<b>2.7.</b>	<b>Conclusion</b> .....	<b>36</b>

**CHAPTER THREE : METHODOLOGY**

<b>3.0.</b>	<b>Introduction</b> .....	<b>38</b>
<b>3.1.</b>	<b>Research Design</b> .....	<b>38</b>
3.1.1.	Study Area .....	39

3.1.2.	Study Population .....	39
3.1.3.	Sample Size & Sampling Technique .....	39
3.2.	<b>Data Gathering Technique .....</b>	<b>44</b>
3.2.1.	Development of Data Gathering Instruments .....	45
3.3.	<b>Pre - Testing .....</b>	<b>49</b>
3.4.	<b>Data Gathering .....</b>	<b>49</b>
3.5.	<b>Data Analysis .....</b>	<b>49</b>
3.6.	<b>Problems Encountered During Field Work .....</b>	<b>52</b>

## **PART TWO: RESULTS & DISCUSSION**

### **CHAPTER FOUR: CHARACTERISTICS OF COWPEA PRODUCERS, COWPEA TRADERS & AEAs**

4.0.	<b>Introduction .....</b>	<b>53</b>
4.1.	<b>Personal Characteristics of Cowpea Producers &amp; Cowpea Traders ...</b>	<b>53</b>
4.2.	<b>Enterprise Characteristics of Cowpea Producers &amp; Traders .....</b>	<b>60</b>
4.3.	<b>Personal &amp; Professional Characteristics of AEAs .....</b>	<b>62</b>
4.4.	<b>Conclusion .....</b>	<b>65</b>

### **CHAPTER FIVE : EXTENSION DELIVERY EFFORTS:**

5.0.	<b>Introduction .....</b>	<b>67</b>
5.1.	<b>Prevention of Pest Infestation in Cowpea. ....</b>	<b>67</b>
5.2.	<b>Cowpea Preservation Technologies Extended by AEAs. ....</b>	<b>.80</b>

5.3.	Sources of Cowpea Preservation Messages .....	82
5.4.	Extension Delivery Efforts .....	84
5.5.	Constraints to Delivery of Cowpea Preservation Messages .....	92
5.6.	Re - Introduction of Cowpea Preservation Technologies .....	96
5.7.	Conclusion .....	97

## CHAPTER SIX: PERCEPTION OF ATTRIBUTES OF SELECTED IMPROVED COWPEA PRESERVATION TECHNOLOGIES

6.0	Introduction .....	100
6.1	Level of Awareness of Cowpea Preservation Technologies .....	100
6.2.	Perceptions of Specific Attributes of Selected Improved Cowpea Preservation Technologies .....	101
6.3	Perceptions of General Attributes of Selected Improved Cowpea Preservation Technologies .....	102
6.4	Perceptions of Overall Attributes of Selected Improved Cowpea Preservation Technologies .....	104
6.5	Characteristics and Perceptions of Attributes of Selected ICPTs .....	104
6.5.1	Personal Characteristics of Respondents & Perceptions of General Attributes of ICPTs .....	106
6.5.2	Enterprise Characteristics of Respondents & Perceptions of General Attributes of ICPTs .....	107
6.6	Extension Delivery and Perceptions of Attributes of Selected Improved Cowpea Preservation Technologies .....	110
6.6.1	Extension Methods and Perception of Overall Attributes of Improved Cowpea Preservation Technologies .....	110

6.6.2	Extension Method and Perception of General Attributes of Improved Cowpea Preservation Technologies .....	110
6.6.3	Frequency of Contact & Perception of Overall Attributes of Improved Cowpea Preservation Technologies .....	111
6.6.4	Frequency of Contact & Perception of General Attributes of Improved Cowpea Preservation Technologies .....	112
6.7	<b>Conclusion .....</b>	<b>113</b>

## **CHAPTER SEVEN: ADOPTION OF IMPROVED COWPEA PRESERVATION TECHNOLOGIES**

7.0.	<b>Introduction .....</b>	<b>115</b>
7.1.	<b>Awareness - Adoption Gap .....</b>	<b>115</b>
7.2.	<b>Adopter Characteristics and Adoption .....</b>	<b>116</b>
7.3.	<b>Extension Delivery and Adoption .....</b>	<b>127</b>
7.3.1.	Method of Extension Delivery and Adoption .....	127
7.3.2.	Frequency of Contact and Adoption .....	129
7.4.	<b>Perceptions and Adoption Levels .....</b>	<b>130</b>
7.5.	<b>Summary &amp; Conclusion .....</b>	<b>133</b>

## **PART THREE: CONCLUSION**

### **CHAPTER EIGHT: SUMMARY, CONCLUSION & RECOMMENDATIONS**

8.1.	<b>Summary &amp; Conclusion .....</b>	<b>135</b>
8.2.	<b>Recommendations .....</b>	<b>141</b>
8.3.	<b>Suggestions for Further Research .....</b>	<b>143</b>
	<b>BIBLIOGRAPHY .....</b>	<b>145</b>
	<b>APPENDICES .....</b>	<b>161</b>

## **LIST OF ABBREVIATIONS**

<b>ADB</b>	-	<b>Agricultural Development Bank</b>
<b>AEAs</b>	-	<b>Agricultural Extension Agents</b>
<b>FAO</b>	-	<b>Food &amp; Agricultural Organization</b>
<b>FLS</b>	-	<b>Frontline Staff</b>
<b>ICPTs</b>	-	<b>Improved Cowpea Preservation Technologies</b>
<b>ISSER</b>	-	<b>Institute for Statistical &amp; Social Science &amp; Economic Research</b>
<b>MoFA</b>	-	<b>Ministry of Food and Agriculture</b>
<b>NAEP</b>	-	<b>National Agricultural Extension Project</b>
<b>NAES</b>	-	<b>National Agricultural Experimental Station</b>
<b>PHDU</b>	-	<b>Post Harvest Development Unit</b>
<b>T&amp;T</b>	-	<b>Travel &amp; Transport Allowance</b>

**LIST OF TABLES**

Table 3.1	Information Collected, Source (s) & Techniques used in Data collection . .	45
Table 4.1	Working Experience of Cowpea Producers & Traders . . . . .	57
Table 4.2	Quantity of Cowpea stored by Producers and Traders . . . . .	62
Table 4.3	Position & Educational Qualification of AEA's in the Study Area . . . . .	64
Table 4.4	Language of Communication of AEA's . . . . .	65
Table 5.1	Disadvantage with Use of Group Extension Method by AEA's in Dissemination of Cowpea Preservation Message . . . . .	90
Table 5.2	Disadvantage of Use of Individual Extension Method by AEA's in Dissemination of Cowpea Preservation Message . . . . .	92
Table 6.1	Level of Awareness of Cowpea Preservation Technologies . . . . .	100
Table 6.2	Perceptions of Specific Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	102
Table 6.3	Perceptions of General Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	103
Table 6.4	Perception of Overall Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	103
Table 6.5	Characteristics & Overall Perception of Attributes of Improved Cowpea preservation Technologies . . . . .	105
Table 6.6	Personal Characteristics of Respondents and their Perceptions of General Attributes of ICPTs & of Producers . . . . .	107
Table 6.7	Enterprise Characteristics & Perceptions of General Attributes of ICPTs. . . . .	109
Table 6.8	Extension Method Used and Perceptions of Overall Attributes of Improved Cowpea Preservation Technologies . . . . .	110

Table 6.9	Extension Method Used and Perceptions of General Attributes of Improved Cowpea Preservation Technologies . . . . .	111
Table 6.10	Frequency of Contact and Perceptions of Overall Attributes of Improved Cowpea Preservation Technologies . . . . .	112
Table 6.11	Frequency of Contact and Perceptions of General Attributes of Improved Cowpea Preservation Technologies . . . . .	112
Table 7.1	Gender and Adoption Levels . . . . .	117
Table 7.2.	Age and Adoption . . . . .	118
Table 7.3.	Education Level and Adoption . . . . .	120
Table 7.4.	Working Experience and adoption . . . . .	121
Table 7.5.	Producers Farm Size and Adoption . . . . .	122
Table 7.6.	Variety of Cowpea Grown or Sold and Adoption . . . . .	124
Table 7.7.	Producers Crop Yield and Adoption . . . . .	125
Table 7.8	Quantity of Cowpea Stored and Adoption . . . . .	126
Table 7.9	Method of Delivery and Adoption . . . . .	128
Table 7.10	Frequency of Contact and Adoption . . . . .	129
Table 7.11	Degree of Relationship Between Producers Overall Perception of Attributes of Selected Improved Cowpea Preservation Technologies and Adoption. . . . .	130
Table 7.12	Degree of Relationship Between Traders Overall Perception of Attributes of Selected Improved Cowpea Preservation Technologies and Adoption. . . . .	130
Table 7.13	Summary of Ranking of Key Aspects of Perceived Attributes and Adoption . . . . .	131
Table 7.14	Ratings of Key Aspects Perceived Attributes Using Spearmans Rank Order Correlation Co - Efficient and Adoption . . . . .	132

**LIST OF FIGURES**

Fig. 2.1	A Conceptual Model of Determinants of Adoption of Innovations . . . . .	33
Fig. 4.1	Percentage Distribution of Respondents by Gender . . . . .	54
Fig. 4.2	Percentage Distribution of Respondents by Age . . . . .	55
Fig. 4.3	Educational Level of Cowpea Producers & Traders . . . . .	56
Fig. 4.4	Distribution of Farmers by Farm Size . . . . .	58
Fig. 4.5	Distribution of Cowpea Producers by Crop Yield . . . . .	59
Fig. 4.6	Variety of Cowpea Grown & Sold by Respondents . . . . .	61
Fig. 4.7	Distribution of AEAs by Gender . . . . .	63
Fig. 4.8	AEAs Working Experience in Current Location . . . . .	64
Fig 5. 1	A Local Sieve ( 'Abgadza' ) . . . . .	71
Fig 5. 2	A Local Keg ( 'Adjafi' ) . . . . .	79
Fig. 5.3	ICPTs Extended by AEAs in the Study Area . . . . .	81
Fig. 5.4	Traditional Cowpea Preservation Technologies Recommended by Certain AEAs in the Study Area . . . . .	82
Fig. 5.5	AEAs Source of Cowpea Preservation Messages . . . . .	83
Fig. 5.6	Methods of Extension Delivery Used by AEAs & Frequency of Contact with Clientele . . . . .	84
Fig. 5.7	Method of Extension Delivery Producers Indicated AEAs Used & their Frequency of Contact . . . . .	86
Fig. 5.8	Method of Extension Delivery Traders Indicated AEAs Used & their Frequency of Contact . . . . .	87
Fig. 5.9	AEAs Constraints to Delivery of Cowpea Preservation Messages . . . . .	92

Fig. 5.10	Reasons for Re-Introduction of Improved Cowpea Preservation Technologies . . . . .	97
Fig. 7.1	Awareness - Adoption Gap of Producers . . . . .	116
Fig. 7.2	Awareness - Adoption Gap of Traders . . . . .	116

**LIST OF MAPS**

**Map 1:** A Map of Ghana Showing the Study Area ..... 40

**Map 2:** Akatsi District Map Showing Some Villages in the Study Area ..... 41

**APPENDICES**

APPENDIX 1:	Structured Interview Schedule for Cowpea Producers . . . . .	161
APPENDIX 2:	Structured Interview Schedule for Cowpea Traders . . . . .	167
APPENDIX 3:	Agricultural Extension Agents Questionnaire . . . . .	173
APPENDIX 4:	Focus Group Discussion . . . . .	177
APPENDIX 5:	Perceptions of Specific Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	179
APPENDIX 6	Perceptions of General Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	180
APPENDIX 7	Overall Perception of Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	180
APPENDIX 8:	Personal Characteristics & Overall Perception of Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	181
APPENDIX 9	Personal Characteristics & Perceptions of General Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	182
APPENDIX 10	Enterprise Characteristics & Perceptions of General Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	184
APPENDIX 11	Extension Method Used & Perceptions of Overall Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	186
APPENDIX 12	Extension Method Used & Perceptions of General Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	187
APPENDIX 13	Frequency of Contact & Perceptions of Overall Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	188
APPENDIX 14	Frequency of Contact & Perceptions of General Attributes of Selected Improved Cowpea Preservation Technologies . . . . .	189

APPENDIX 15A	Relationship between Producers Perception of Overall Attributes of Improved Cowpea Preservation Technologies and Adoption . . . . .	190
APPENDIX 15B	Relationship between Traders Perception of Overall Attributes of Improved Cowpea preservation Technologies and Adoption . . . . .	191

# **PART ONE: BACKGROUND**

## CHAPTER ONE

### INTRODUCTION

#### 1.0. Background Information

The current food crisis in Sub-Saharan Africa, which is a major cause of concern worldwide, is the result of the inability of most countries in the region to produce or purchase and stock enough food to satisfy demand owing to rapid population growth, urbanization, and rising incomes among some segments of the population (Okigbo, 1986).

The need to increase productivity in sub-Saharan Africa is urgent since basic population growth in this region is out-stripping increases in food production (Pickering 1989; Dapaah, 1994). While the rate of growth in food production is increasing by 1-2% per annum, the average rate of growth of the population is 2.5% per annum (FAO World Report, 1984). In Ghana, growth in agricultural productivity is 2.1% per annum while population growth rate is 2.6 - 3.2% per annum since 1985 (Korang - Amoako, Donkor, & Amoah, 1994).

The State of the Ghanaian Economy Report for 1996 indicated a prevailing underlying deficiency in food production and supply from year to year (ISSER, 1997). This indicates inadequate production of food and the need for measures to have adequate food for the population. New technologies are increasingly being viewed as the vehicle for increasing agricultural production (Sackey, 1975). Food production is therefore expected to increase as a result of the introduction and adoption of these new technologies.

Whilst food production is inadequate, food security is worsened by food losses and deterioration which occur during storage, utilization and distribution of the albeit inadequate food. Most shortfalls in food supply to majority of people in developing countries have been attributed to post-harvest losses due to inappropriate drying and storage facilities. Post-harvest food loss in developing countries is estimated to be between 10-15% (Muhlbauer, 1991). Post harvest losses of farm produce are known to be substantial in Ghana. Conservative estimates in Ghana have been put between 10-20% (Nicol, Darko, & Ofose, 1997). This (post harvest loss) is a great problem in developing countries in spite of availability of modern technology.

An area of major concern to both farmers and extensionists therefore is the fairly high post harvest losses of grain legumes, notably Cowpea (*Vigna unguiculata*). The situation is even more crucial considering the importance particularly of grain legumes. Post harvest loss of cowpea is a specially serious loss because cowpea:

- i. is important to the livelihood of millions of relatively poor people in less developed countries of the tropics. It is a relatively cheap source of protein especially for those who cannot afford meat regularly. In fact, it is a key staple food for the poorest sector of many developing countries (Rachie & Singh, 1985).
- ii. provides variety in the diet of people when eaten in various forms and combinations with other foods (especially when used in the fortification of dishes).
- iii. increases the nutritional status of the population - an increase in its production will help reduce the incidence of protein malnutrition.
- iv. processing of cowpea also offers employment opportunities for people.
- v. makes a significant contribution to the agricultural economy - that is, it serves as fodder for animals, replenishes soil fertility and provides ground cover to prevent soil erosion (Rachie *et. al.*, 1985; Hossain, 1990; Quinn, 1997).

Cowpea is therefore an important crop for now and for the future thus making studies on it vital. Because of the importance of cowpea, making it more available will be beneficial especially to the poorest sector of developing countries. Availability of it will also help achieve greater food security.

Cowpea constitutes about 2% of the total world output of grain legumes (Kay, 1979). It is also one of the major food crops widely cultivated in Ghana (Hossain, 1990). It is grown in all parts of the country. Ghana produces over 57,000 tons of cowpea annually, but due to the very high level of pest damage and poor storage practices amongst others, only a small fraction of what is produced becomes available for human consumption (Rachie *et. al.*, 1985). The financial and nutritional losses of cowpea to storage pests in sub - Saharan Africa is not well documented but is clearly high (Collinson, 1993; Amegatse, 1995). The nature and extent of this post harvest loss problem therefore requires careful examination.

It is necessary not only to arrest the progress of infestation in cowpea immediately after harvest, but to provide a means of protecting it up to the point of consumption (Rawnsley, 1969). Post-harvest loss prevention is however a major but often neglected step towards offering greater volume of food on the African continent (Proctor, Goodliffe, & Coursey, 1979). Post-harvest loss prevention is advantageous in that it:

- i. acts as an incentive to increase crop production.
- ii. results in production of better quality food for the family (better nutrition).
- iii. leads to less waste and reduction in food losses.
- iv. results in more reliable food supply throughout the year.
- v. brings about increased income from the sale of increased quantity and better quality crops.

vi. is also an important step for developing rural areas.

The need for efficient, effective, safe, and economical methods of reducing post harvest losses (especially in Ghana) has therefore become very imperative considering the population growth rate of 2.6% per annum (Appiah, 1997). There are several ways of addressing this post harvest loss problem. Some measures include, increasing production, processing and preservation of food, without changes in primary production levels. The adoption of improved preservation technologies will go a long way to address this problem.

Preservation of farm produce can be effected at various levels: household level, farm level, and commercial level (including preservation by sellers). What happens at one level, however affects all other levels. In a country where a large proportion of the population is rural (that is about 75% of the population in Ghana), it is essential that prevention of post harvest losses be effected at farm level and eventually at the commercial level (Rawnsley, 1969). Improved farm storage is important because a large portion of food production is consumed locally in the producing communities. It also enhances income of producers through adequate prices and ensures household food availability during the lean season. The prevention of waste at this level would make more good quality food available for sale than would otherwise be the case.

Many governments of developing countries have identified the food supply of their people as a major problem area and consequently are allocating considerable resources to the Agricultural sector. The greater part of their resources has been concentrated on increasing agricultural production and decreasing food losses to make more food available (Bani, 1991). There is little question therefore that changes must be made in production and methods of decreasing food losses (including preservation methods) in Ghana to make more food available.

Ghana's Ministry of Food and Agriculture (MoFA) recognized the magnitude of the post harvest loss and its adverse effect on the country's economy as well as on the standard of living of the people especially small -scale farmers. Thus the Post-Harvest Development Unit (PHDU) was instituted within the Department of Crop Service of the Ministry of food and Agriculture (MoFA) in 1986. Its mandate is to help reduce post-harvest losses through development and dissemination of information on improved methods of storage and preservation. This it is hoped, would augment the available food supply and enable a more even distribution of food supplies over time, space and social groups.

### 1.1. Statement of the Problem

In Ghana, an important cowpea growing area is the Akatsi District of the Volta Region. Anecdotal evidence in the district indicates that cowpea producers have problems with cowpea during storage. Most of the cowpea sold in the Akatsi market have bruchid emergence holes. In most cases such holes are due to infestation of cowpea by the cowpea beetle, *Callosobruchus maculatus walp* (known erroneously as the 'cowpea weevil'). These have an effect on food quality and nutrient availability in cowpea.

It is also observed that farmers often sell their cowpea at harvest when prices are lowest in the year, partly because they anticipate storage losses. This way farmers income from cowpea production is reduced. Being aware of the storage problem, it is expected that cowpea producers and distributors would be interested in better techniques for preserving their grain after harvest.

MoFA in Ghana has identified and disseminated improved cowpea preservation technologies (ICPTs) involving the use of chemicals, to farmers and other households in cowpea producing

areas such as the Akatsi District, to reduce post harvest losses. They include: the use of Actellic dust (1.6% Pirimiphos - methyl; 0.3% Permethrin), Actellic 25EC liquid (25% Pirimorphos - methyl), Edible oil and Phostoxin (56% Aluminium phosphide). Numerous traditional preservation technologies are also available including the use of neem products, wood ash, pepper, quicklime and sea sand.

With the availability of these preservation technologies, it should be expected that post harvest loss of cowpea would be brought under control if these technologies are used by cowpea producers and traders. Monthly reports of extension agents in the District however indicated that there are problems mainly with weevil infestation of stored cowpea in the district. It was also indicated in their reports that the chemical control of insect pests is not being widely practiced. Cowpea farmers may have recognized the usefulness of these technologies but certain factors may account for their non-utilization and this is a matter that needs to be investigated. Currently, there is a dearth of studies on the level of adoption of improved cowpea preservation technologies and its determinants.

Further, little is known in terms of factors that influence the adoption of ICPT's and thus incorporation of these cowpea preservation technologies into the farming system in the Akatsi District. This suggests a need to determine the exact levels of adoption, and factors responsible for adoption and non-adoption of the ICPTs.

An examination of literature on causes of low adoption of innovations suggests that personal characteristics of respondents, target clientele's perceptions of such technologies and the extension agents effort in dissemination of these technologies, are important factors likely to affect adoption

of ICPTs (Swanson *et al.*, 1984; Faye, 1991; Perse & Courtright, 1993; Rogers, 1995; Agarwal & Prasad, 1995; Reagan, Pinkleton, Chen, & Aaronson, 1995). This study therefore examined, the extent to which these factors are important determinants of adoption patterns of cowpea producers and traders in the Akatsi District, Ghana.

## **1.2. Research Question**

The main research question addressed by the study is:

How do cowpea farmers and traders personal characteristics and perceptions of characteristics of ICPTs, determine the pattern of utilization of these technologies and to what extent does the mode and efforts of extension delivery influence these perceptions?

## **1.3 Objectives**

### **1.3.1. Main Objective**

The main objective is to determine the extent to which the rate of adoption of ICPTs in the Akatsi District of the Volta Region is related to cowpea farmers and traders perceptions of the characteristics of the technologies and the mode and effort of their dissemination to cowpea farmers and traders (by Agricultural Extension Agents).

### **1.3.2. Specific Objectives**

The specific objective of the study are to:

- i. identify various cowpea preservation technologies in the study area.
- ii describe and analyse the extension delivery efforts in disseminating ICPT messages in the Akatsi District by the public Agricultural Extension Agents.
- iii. describe and analyse some important personal characteristics of cowpea producers and traders and Agricultural Extension Agents (AEAs).

- iv determine cowpea producers and traders perceptions of characteristics of selected ICPTs.
- v. find out the adoption levels of ICPTs in the district.
- vii. determine the relationship between perceptions of characteristics of ICPTs, mode and effort of dissemination of ICPT messages, personal and enterprise characteristics and the adoption levels of ICPTs.

#### 1.4. Significance of the Study

The study would provide insights into factors that inhibit the adoption of innovations (including ICPTs). This would contribute to increasing knowledge on how to enhance the adoption of recommended ICPTs. This would be achieved by incorporating considerations of perceptions in the technology development and dissemination stages of development of the cowpea commodity sector. Insights into the effect perceptions have on adoption decisions could assist those responsible for implementing new information technology.

Examination of extension delivery efforts would also alert extension agents to the possibilities that some categories of stakeholders in the cowpea sector may require more intensive extension efforts. An understanding of the relative importance of alternate communication channels in influencing perceptions would help extension agents make better informed and more effective resource allocation decisions with regards to their choice of extension methods.

The rest of the thesis is structured in the following way. A review of literature on adoption of innovations as well as its determinants are discussed in Chapter Two. Chapter Three describes the methodology of the study. These have been presented as Part One of the thesis. Data

analysis, results and discussions are presented in Chapters Four, Five, Six, and Seven respectively. These have been presented as Part Two of the thesis. The summary, conclusion and recommendations are presented in Chapter Eight and this is Part Three of the thesis.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.0. Introduction:

Several theoretical and empirical approaches to characterize factors influencing adoption exist in literature (Feder, Just, & Zilberman, 1985; Feder & Umali, 1993). Most of these studies focus on socioeconomic characteristics as key determinants of technology adoption decisions (Voh, 1982; Lee & Stewart, 1983; Osuntogun, Adeyemo & Anyanwu, 1986; Norris & Batie, 1987; Polson & Spencer, 1991; Baidu - Forson, 1999). Other studies indicate the influence of personal characteristics and communication on adoption behavior ( Fliegel, 1984; Faye, 1991; Perse & Courtright, 1993; Reagan, Pinkleton, Chen, & Aaronson, 1995;). Certain studies also indicate the effect of extension delivery on adoption ( Rahm & Huffman, 1984; Swanson *et. al.*, 1984, Rogers, 1995; Agarwal & Prasad, 1995)

While such factors are important, the majority of studies ignored subjective assessments of characteristics or attributes specific to the technology themselves and their effect on adoption behavior (Adesinah & Zinnah, 1993). Adesinah & Zinnah (1993) showed that farmers perceptions of characteristics of agricultural technologies strongly influence farmers adoption behavior. This “adopter perception” paradigm or model suggest perceived attributes of innovations condition adoption behavior (Kivlin & Fliegel, 1966b; Adesinah & Zinnah, 1993 ; Adesinah & Baidu - Forson, 1995).

The limited number of empirical studies on the subject (using the ‘adopter - perception paradigm’) as it concerns agricultural technology adoption justifies further investigation to assess its general

applicability for adoption studies especially in developing countries agricultural settings. Thus necessitating a further study into how perceptions influence the adoption of ICPTs in the study area. This chapter gives a review of literature on the determinants of adoption of innovative technologies. The determinants include: perceptions of characteristics of technologies, extension delivery efforts and the personal characteristics of respondents.

### **2.1. Adoption of Innovations**

“Innovation” is a term defined in several ways. It is a new idea, method, practice or technique, perceived as new by an individual which provides the means of achieving sustained increases in farm productivity and income (Adams, 1982). The idea may not be a new one altogether but if it has not been accepted by an individual, to that person, it is an innovation (Adams, 1982; Rogers, 1995; Melkote, 1997). It is therefore the newness of the idea to the individual that determines his reaction to it.

Adoption on the other hand is a decision to make full use of an innovation as the best course of action available (Lionberger, 1968; Rogers & Burdge, 1972, Rogers, 1995). It is also defined as the process through which the individual arrives at a decision to adopt or reject an innovation from the time they become aware of it (Melkote, 1997). It is not a simple unit act, but rather a complex pattern of mental activities combined with actions taken before an individual fully accepts or adopts a new idea (Bohlen, 1966). After an innovation has been introduced, the individual does not accept it immediately but needs time to think things over before making a decision. This mental process an individual hypothetically passes through from first hearing about an innovation to forming an attitude towards the innovation, is referred to as the “adoption process” or the “innovative - decision process” (Rogers, 1995). The individual either decides to reject or adopt an innovation or confirm his adoption decision.

### 2.1.1. How Adoption Takes Place

There are several views about what the process of adoption entails. Now there is a relatively wide acceptance of the proposition that people go through a minimum of five stages while adopting innovations (Wilkening, 1952; Bohlen, 1966; Maunders, 1972; Van den Ban & Hawkins, 1985; Kwon & Zmud, 1987; Rogers, 1995; Melkote, 1997). The stages of the adoption process are:

- i. Awareness - This is the stage at which the individual recipient is exposed to the idea but lacks complete information about it (Melkote, 1997). Awareness of the innovation compels potential adopters to seek further information.
- ii. Information -- This is the stage at which the individual seeks further general information regarding the innovation, apparently because there is more interest regarding the innovation (Kwon & Zmud, 1987; Melkote, 1997). Information is sought on why and how the innovation works, how much it costs, how it compares with other ideas purported to perform the same way among others.
- iii. Evaluation - The individual mentally weighs the advantages and disadvantages of using the innovation in his own circumstances or in the light of the existing conditions into which the practice would have to fit. He considers his resources and management ability and decides whether he has the necessary resources to adopt the idea. If he feels it will maximize his goals and objectives, he makes the decision to give the idea a try (Wilkening, 1952; Melkote, 1997).
- iv. Trial - At this stage, the innovator tests the innovation on a small scale in his own situation (Lionberger, 1968; Melkote, 1997).

- v. Adoption - This is the stage at which the individual decides the new idea, product or practice is good enough for continued use on a full scale basis in his operation.

It has been observed that though these steps or stages are clearly defined, they are not necessarily a rigid pattern or exclusive category with no overlap, but there may be overlaps thus one cannot identify the beginning of one stage from the other (Maunder, 1972; Van den Ban & Hawkins, 1985). In other words, they do not represent discrete or distinctly separate stages in the individual adoption process. What the stages do is however a useful way of describing a relatively continuous sequence of action, events and influences that intervene between initial knowledge about an idea, product, or practice and the actual adoption of it (Lionberger, 1968). The results of the adoption process is as follows:

- i. Adoption This can be classified into two: full adoption and partial adoption.
- a. Full Adoption This is the full use of an innovation as the best course of action available (Rogers, 1995) or 100% utilization of an innovation by an individual.
  - b. Partial Adoption This is the use of certain aspects of an innovation or less than 100% utilization of an innovation by an individual.
- ii. Rejection This is a decision not to adopt an innovation (Rogers, 1995). This may occur at any stage in the adoption process.
- a. Discontinuance This is a decision to stop using an innovation after previously adopting it. It can occur only after the adoption process is completed. It may also occur when an individual becomes dissatisfied with an innovation or because the innovation is replaced with an improved idea. (For instance replacing traditional cowpea preservation technologies with improved cowpea preservation technologies).

- b. Continued Adoption      This is a decision to adopt an innovation after previous rejection.

It is noteworthy that rejection or adoption of an idea may be temporary. An innovation could be adopted after previous rejection or rejected after previous adoption (Rogers, 1995).

### 2.1.2. Benefits of Adoption

People adopt innovations for various reasons. These include psychological, sociological, and economic reasons. Psychologically, adoption of an innovation results in the individual gaining new experience, recognition, better life for their children and greater efficiency. It also enables individuals meet emergency needs (Maunder, 1972). Sociologically, adoption results in higher social status, greater prestige, sociability and role expectancy. Economically, adoption results in higher incomes for farmers, lower real prices of agricultural products for consumers and greater economic efficiency (Akinwumi, Adesinah, & Baidu - Forson, 1995). This increase in income would enable individuals educate their children, have more consumer goods (that is more comfort and prestige). Economically, it results in better homes, higher levels of living, more earning power, better occupational efficiency (Maunder, 1972).

Adoption of innovations also results in the satisfaction of learning. A set of skills when learned, would help motivate adults to tackle more difficult skills (Maunder, 1972). Adoption of innovations is also one of the most important means of accelerating material development in economies with large agricultural sectors. This is why the adoption of technological innovations in agriculture has attracted considerable attention among development scholars and practitioners. The benefits indicated are likely to motivate individuals to adopt innovations including ICPTs.

## 2.2. Perceptions and Adoption

Perception as defined by Berelson & Steiner (1964), is what must be added to and subtracted from input to produce our picture of an output or the more complex process by which people select, organize and interpret sensory stimulation into a meaningful and coherent picture of the world.

Crider, Goethals, Kavanaugh & Scott (1989) also defined perceptions as a closely related process by which the brain selects, organizes and interprets information about the environment, brought by the senses. Perceptions could also be said to be a process of creating meaningful patterns from raw sensory information (Morris, 1985). Wortman, Loftus & Marshall (1988), however defined perceptions as the process whereby the brain gives order and meaning to the sensation it receives. It was simply defined by Yussen & Santrock (1983), as the interpretation of what is sensed through taste, touch, sight, hearing, smell and the message it brings. The primary function of perceptions is to help individuals make sense of information received. It also allows us impose a logic and order on the chaos of the millions of stimuli that bombard our senses (Crider, 1989).

Perceptions influence farmers adoption behavior and need to be taken into account in adoption studies (Adesinah & Zinnah , 1993). Since there are varying definitions of perceptions, for the purpose of this study, the operational definition of perceptions of characteristics of ICPTs is a complex process by which individuals or people select, organize and interpret what is sensed in the environment into a meaningful and coherent picture about the characteristics of ICPTs.

### 2.2.1. Perception of Characteristics of Innovations

Extensive work in innovation - adoption has highlighted the key role of perceptions in adoption of innovations (Swanson *et. al.*, 1984; Rogers, 1995; Agarwal & Prasad, 1998). Rogers (1995),

indicated that the characteristics of an innovation, has a great influence on the adoption of innovations. He indicated that it is the characteristics of the innovation not as seen by experts but as perceived by the potential users, that really matters and these specific characteristics of the technology continue to be an important factor affecting adoption behavior. A decision to adopt is predicated upon the technical characteristics of the innovation: Relative Advantage, Compatibility, Complexity, Trialability, and Observability. These five characteristics are somewhat interrelated but are conceptually distinct (Rogers, 1995). The crucial role played by such perceived characteristics in driving the adoption decision has been recognized in a variety of research (Davis, 1989; Moore & Benbasat, 1991; Saga & Zmud, 1994; Rogers, 1995; Melkote, 1997; Agarwal & Prasad, 1998) including the study of the adoption of cowpea preservation technologies in the Akatsi district.

#### Relative Advantage

Relative advantage captures the extent to which the potential adopter views the innovation as offering an advantage over previous ways of performing the same task (Akinwumi, Adesina & Seidi 1995; Agarwal & Prasad, 1998). It is the degree to which an innovation is perceived as better than the idea it supersedes (Rogers 1995; Melkote, 1997). The individual critically assess the characteristics of the technology against those of existing local technologies and only adopt the former if they are judged superior to the latter for some critical attributes. Relative advantage is expressed in terms of its cheapness, it being time, labor and money saving or the financial advantage of applying an innovation. It should provide income and there should be no marketing problems.

Recent empirical studies in the information technology domain support the importance of relative advantage in predicting adoption behavior (Davis 1989; Davis, Bagozzi & Warshaw, 1989; Moore

& Benbasat, 1991; Adams, Nelson & Todd, 1992; Keil, Beranek & Konsynski, 1995) It is often expressed in terms of its economic profitability. A number of studies have been made to measure the importance of profitability of a practice as it affects the rate at which the practice is adopted. (Fliegel, Frederick & Kivlin, 1962; Grilliches, 1957, Havens & Rogers, 1961). Those practices that are perceived to have a high marginal return, tend to be adopted more rapidly than practices which have low marginal returns. It is worth mentioning however that the nature of the innovation may determine what specific type of relative advantage (eg. economic, or social) is important to adopters (Wilkening & Johnson, 1961). For instance the major advantage of two 4 - D weed sprays over previous methods of farm weed control was a reduction in unpleasant labor requirements rather than a direct financial gain from higher crop yields (Rogers, 1962). Sutherland (1959) also showed that a cotton spinning innovation was adopted more quickly by English firms because of the labor shortage in World War II. Bertrand (1951) found that the crisis of unionized farm laborers and war time labor shortages aided the rate of adoption of farm mechanization in Louisiana.

It is worth mentioning however that, it matters little if the innovation has a great degree of advantage over the idea it is replacing. What matters is whether the individual perceives the relative advantage of the innovation at all.

### Compatibility

Compatibility was proposed as a characteristic of an innovation and a good predictor of adoption (Moore & Benbasat, 1991; Rogers, 1995; Melkote, 1997). It is the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters (Rogers, 1995; Melkote, 1997). The taste, texture and color of the final products must

be in line with existing ones. The innovation should not disrupt prevailing social, cultural and religious life but blend with it. The more compatible a practice is with the existing farming operations, the more likely it will be to be adopted quickly (Lionberger, 1968). The more change required however in the existing operation, the more slowly it will be adopted (Lionberger, 1968).

Several investigations show compatibility affects the rate of adoption. Santopolo (1961) for instance reported the difficulty encountered by Kentucky County Agents in convincing farmers to switch from tobacco - growing to pickle - raising. Even though the latter crop was more profitable, it was not adopted because cucumbers were perceived by farmers as a feminine type of enterprise. On the other hand, raising tobacco, which was less profitable, was prestigious so more people adopted that innovation. Parish (1954) also found that Australian farmers adopted mechanical innovations more rapidly than non - mechanical innovations because the former was more compatible with their needs. Prundeanu & Zwerman (1958) and Lionberger (1960) found that soil conservation practices that were mainly production increasing and required a minimum of maintenance (eg. tilling) were adopted more quickly by New York farmers than such conservation practices as terracing and contouring. Farmers values tend to be more compatible with mechanical innovations and with those that increase production.

### Complexity

Complexity, recurs in several studies as a significant determinant of adoption behavior (Davis, Bagozzi & Warshaw, 1989). Complexity is similar in definition to Agarwal & Prasads' (1998) notion of 'ease of use' and encapsulates the degree to which a potential adopter views usage of the target technology to be relatively free of effort (Davis, Bagozzi & Warshaw, 1989). Simply it is defined as the degree to which an innovation is understood and can be used by farmers.

Melkote (1997) defines it as the degree to which an innovation was relatively difficult to understand and use. Innovations that are perceived to be easier to use, simpler to understand and less complex have a higher likelihood of being accepted and used by potential users than innovations that require adopters to develop new skills and understanding (Lionberger, 1968; Rogers, 1995; Agarwal & Prasad, 1998).

Studies by Kivlin (1960), suggests that the complexity of farm innovations was highly related (in a negative direction) to their rate of adoption than any other characteristics of an innovation except its relative advantage. Graham (1956) sought to determine why Canasta and television diffused at different rates in the upper and lower classes. He concluded that one reason was the difference in complexity of the two ideas. Canasta had to be learned through detailed personal explanation from other card players. Its procedures were complex and difficult to master. Television however appeared to be a relatively simple idea that required only the ability to turn a knob.

### Trialability

Technologies must lend themselves to be tried on a limited basis. Trialability is the degree to which an innovation could be tried on a limited basis (Rogers, 1995; Melkote, 1997). This factor is apparently most important for the majority of farmers who wish to try practices on a small-scale basis in their own situation, before adopting it on a large scale (Bohlen, 1966). If farmers try out without committing too much money, they may adopt the innovation quickly (Adams, 1982). Traits or practices that are readily communicated by conventional methods are more likely to be adopted than those that are not (Lionberger, 1968). Costly and complex practices that can be taken a little at a time, are also likely to be adopted more quickly than in situations where this is not possible.

Ryan & Gross (1943) found that every one of their Iowa farmer respondents adopted hybrid seed corn by first trying it on a partial basis. If the new seed could not be sampled experimentally, its rate of adoption was much slower. Another evidence suggests that the killing effect of a new insecticide could be easily understood and convincingly demonstrated (Rogers, 1962) thus resulting in its adoption. An example is also an Ohio farmer who tried a new feed on his entire dairy herd for one week. He then compared milk production with that of previous weeks and after realizing the benefits, adopted the technology (Rogers, 1962). Nevertheless some innovations are more difficult than others to divide or try and their trialability is likely to influence the adoption of ICPTs.

### Observability

This is the degree to which the results of an innovation are visible to others. The easier it is to see the advantages of an innovation, the more likely he is to adopt it (Melkote, 1997). One illustration of this generalization is the case of pre - emergent weed killers that are sprayed on a field before the weeds emerge from the soil. The rate of adoption of this idea has been slow by Midwestern farmers, in spite of its relative advantage because there are no dead weeds the farmer can show his neighbor (Rogers, 1962).

Hruschka (1961) rated farm innovations into four categories of observability in an investigation of the role of demonstration farmers in diffusing new ideas in German villages. The ideas which were rated as more communicable for instance haymaking techniques, diffused more readily from the demonstration farmers to surrounding villagers than less communicable techniques like keeping of farm records. Erasmus (1961) also showed the visibility of innovations is particularly important in affecting its rate of adoption in less developed preliterate society. In 1951 for

example the point four program in Bolivia introduced Cuban Yellow Corn in one town and within two years the local demand for the seed far exceeded the supply. The farmers were mostly literate but were convinced to adopt by spectacular results of the new seed which often tripled corn yield. The results were so highly visible and widely discussed that more scientific comparison of the new idea was not necessary to convince the local villagers to adopt (Rogers, 1962).

The results of the use of a practice (observability) affect its adoption in varying degrees. Those people who have a low ability to mentally handle abstract ideas for instance tend to be more reluctant to adopt practices that do not produce highly visible outcomes when used while those with high ability to mentally handle abstract ideas tend to adopt practices once the outcome is highly visible (Bohlen 1966).

All five perceptions are relative concepts and not innate attributes of the innovation, and can be perceived differently by different individuals. People's perceptions may affect their adoption far more than the technical characteristics of innovations. Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability and less complexity will be adopted more rapidly than other innovations (Rogers, 1995). Past research indicates these five qualities are the most important characteristics of innovation in explaining the rate of adoption (Rogers, 1995). Perceptions are influenced by our personal characteristics, extension delivery, values, beliefs, attitudes, and objective assessment of the characteristics of innovations (Adams, 1982). They play a different role in adoption for different individuals (Agarwal & Prasad, 1998). Although several perceptions have been proposed and to a limited extent shown to be predictors of adoption behavior, only three have consistently emerged salient (Agarwal & Prasad, 1998). These are the perceptions of the relative advantage, compatibility and complexity of the innovations.

### 2.2.2. How Perceptions are Established

Numerous factors lead individuals to organize perceptions in an orderly manner. Perceptions are established through exposure, experience and learning. The empiricist view holds that the perceptual process is largely a matter of learning. Learning is the demonstration of a relatively permanent change in behavior that occurs as a result of practice or experience (Gerow, 1995). An example of the empiricist view is the claim that babies enter the world with little or no ability to perceive things in the environment and gradually, they learn to infer adult like perceptions on the basis of the cues the environment provides. Learning is therefore an explanation of the reason why people perceive things as they do. Others are of the view that it is partly a result of what we are exposed to and our experiences (Wortman *et. al.*, 1988).

Klapper (1960), suggested people exposed themselves to messages selectively. There was a tendency for individuals to expose themselves relatively more to those items of communication that were consonant with their beliefs, ideas, values among others (Melkote, 1997). The exposure in effect helped them in the establishment of their perceptions of things in the environment. The early experience of individuals also affects the way one perceives the world (Crider, 1989).

In agricultural extension, learning experiences are made available to clientele by AEAs. They expose their clientele to information on innovations through the use of extension teaching methods and frequent contact with clientele. These learning experiences and contact help influence the way farmers and traders perceive the attributes of innovations they are exposed to.

### *Perceptions and Adoption*

The importance of attribute perceptions has long been of interest to social scientists investigating agricultural technology adoption decisions (Akinwumi *et. al.*, 1995). As indicated earlier, the decision to adopt is predicated upon five key perceptions of the characteristics of innovations: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1995). Indeed various authors have argued using qualitative methods, that farmers' subjective assessment of agricultural technologies influence adoption behavior (Kivlin & Fliegel, 1966; Nowak, 1992)

Economist investigating consumer demand have accumulated considerable evidence showing that consumers generally have subjective preferences for characteristics of products and that their demand for products is significantly affected by their perceptions of the products' attributes (Jones, 1989; Lin & Milon, 1993). For example, using a double - hurdle model, Lin & Milon (1993) found that commodity attributes and consumers' safety perceptions were significant in explaining decisions to consume and the frequency of consumption of shellfish in the USA. Similarly, Jones (1989) found using Cragg's double - hurdle framework, that consumers' subjective perceptions influenced cigarette smoking decisions. In their recent study, Adesina & Zinnah (1993a) found that farmers perceptions of the characteristics of modern rice varieties significantly affected adoption decisions in Sierra - Leone.

Although extensive reviews of adoption studies show a relationship between perceptions and adoption, the paucity of empirical studies on this issue as it concerns agricultural technology adoption, justifies further investigation especially in developing countries agricultural settings (Adesinah & Zinnah, 1993). Thus necessitating a further study on the extent to which the rate of adoption of ICPTs is related to the perception of the characteristics of ICPTs in the Akatsi District.

### **2.3. Extension Delivery**

The adoption of an innovation is an activity entailing extensive communication and requires the use of extension channels (Zmud, 1983). These extension methods are required to awaken a desire for change and to give the clientele self confidence to embark on what they may see as a dangerous or relevant undertaking (Adams, 1982). Individuals are posited to use these channels for uncertainty reduction and information gathering, which are critical to facilitating innovation - adoption (Rogers, 1983). AEA's use these channels to create learning experiences through which their clientele develop perceptions which ultimately lead to adoption or non - adoption of innovations.

#### **2.3.1. Extension Delivery and Adoption**

Educational techniques or methods exist from which extension agents choose to set up learning conditions so as to influence the target groups to acquire skills and to transfer information. These methods are classified into three main categories and these are the individual, group and mass methods (Maunder, 1972; Adams 1982; Van den Ban & Hawkins 1985; Kwarteng & Zinnah 1995; Rogers, 1995 ). Rogers (1995), who explicitly addresses the role of communication channels in innovation adoption, distinguishes between two broad channel types. These are the mass media channel and the interpersonal channel. These communication channels are responsible for dissemination of two kinds of information about an innovation: general knowledge about the innovation (mass media channel), as well as specific knowledge that is personalized for individuals (interpersonal channel). The mass media channels enable large amounts of information to reach a wide audience (for example, the mass extension method). It is also relatively effective in creating awareness about the overall worth of the innovation in general and fostering pro - innovation attitudes (Rogers, 1995). Awareness does not connote simply acknowledging the

existence of an innovation but reflects a generally favorable attitude toward the innovation. The mass media channel is however too general to provide the specific kinds of reinforcement that an individual needs to confirm his or her beliefs about the innovation.

The individual and group methods are examples of interpersonal channels. It involves customized communication and is focused on the expected personal outcomes of adopting the innovation. Interpersonal channels help provide specific reinforcement that individuals need to confirm their belief about an innovation. and consequently, can be more valuable in developing individual perceptions about innovations ( Rogers, 1995; Agarwal & Prasad, 1998).

Several studies have shown the significant effect of extension delivery on adoption (Jamison & Lau, 1982; Feder & Slade, 1984; Jamison & Moock, 1984; Rahm & Huffman, 1984). Farmers are known to gain from access to improved information provided through extension (Birkhaeuser *et. al.*, 1991). Extension delivery makes a substantial contribution to motivating adoption or intensity of use of technologies (Akinwumi *et. al.*, 1995). It is visualized as the important link through which exogenous ideas enter the local communities (Melkote, 1997). It also accomplishes many things including creating a necessary condition for bringing about most desired changes in individuals; and providing information, motivating and persuading clientele of the need for, and usefulness of a technology (Fliegel 1984; Adhikanya *et al.* 1987).

Comparative analysis of studies ( Adesina & Zinnah, 1993a; Rogers, 1995) show some important patterns in the role of extension and farmer contact variables in influencing farmers adoption decisions. It was realized that extension had very little to do with technology diffusion: this occurred mainly through farmers self - experimentation, evaluation, exchange and transfer. In the

case of sorghum in Burkina Faso (Adesina, Baidu - Forson, 1995), extensive on - farm testing of varieties in a number of test - villages appears to have affected adoption decisions. This suggests that extension workers do not influence technology transfer in all cases. Farmers are also important as sources of technology information and agents of technology transfer. When farmers assess the characteristics of new technologies and find them to match their preferences, they often give the technologies to other farmers to test and evaluate thereby setting into motion an endogenous process of technology diffusion (Adesina & Baidu - Forson, 1995).

As is evident from substantial quantity of work in this area, persuading individuals to adopt technological innovations is a matter of considerable importance for organizations (Agarwal & Prasad, 1998) including MoFA. Individuals are persuaded by AEAs to try out new practices or innovations. They create learning experiences using different extension methods or communication channels and frequent contact. Extension delivery therefore plays a central role in adoption of innovations. Effective extension delivery programs must thus be used to disseminate relevant information including information on the use of ICPTs, to the selected target audience and to convince them of the benefits of adopting. Initiating the chain of events leading to adoption of improved practices is therefore a principal challenge for extension agencies. Thus justifying further investigation into its effect on adoption of ICPTs.

### 2.3.2. Extension Delivery and Perception of Characteristics of Innovations

Although the role of communication channels in innovation adoption has been recognized by prior research (Zmud, 1983; Nilakanta & Scamell, 1990), there is a dearth of knowledge on the effect of communication channels on perceptions (Agarwal & Prasad, 1998). Zmud (1983) examined the effects of many different varieties of external information channels in facilitating the adoption of modern software practices among systems professionals, however, his study did not look at the

effects of these channels on the development of perceptions. The study by Nilakanta and Scamell (1990) of database development practices was similar in that it did not include a consideration of perceptions. Although these two studies did examine the effects of both communication sources as well as channels on adoption decisions, the distinction they drew between channels and sources was not clear and it did not study the effect of perceptions on adoption behavior (Agarwal & Prasad, 1998).

Since perceptions are established through learning (Gerow, 1995), the communication channel or method of extension delivery used in exposing individuals to learning experiences determines how people perceive the attributes of the innovation and subsequently their adoption of these innovations. In addition to this, the frequency of contact with their clientele would also influence adoption of innovations. It is reasonable therefore to assume that any messages or information transmitted about an innovation would be focused on emphasizing such positive value; and hence, depending on the channel, would serve to heighten and sharpen either positive awareness or positive perceptions about innovations.

In addition to examining the effect of communication channels on adoption decisions therefore, the study hopes to examine the effect of these channels on the perceptions of attributes of ICPTs (something extensive studies on communication channels and perceptions has not investigated).

#### **2.4. Personal / Individual Characteristics & Adoption**

The major actor in the agricultural production drama is of course, the individual farmer. Male or female, young, or old, more or less educated, each farmer is ultimately a unique individual with a host of characteristics that may affect how information is received, processed and either used or not used in the production process (Fliegel, 1984). Adoption is not necessarily the same across

all users, but may vary based on the characteristics of the users (Perse & Courtright 1993; Reagan, Pinkleton, Chen & Aaronson 1995). In communication adoption studies, it is usual to investigate personal characteristics of respondents in order to understand its relative influence on adoption behavior (Faye, 1991). This helps explain why some people adopt new ideas and practices more quickly than others. The following personal characteristics were examined: Age, Education, Sex, Working experience because they would help us to an extent to understand the adoption behavior of respondents.

#### Age:

The age of farmers has been found to have indeterminate effects in various adoption studies (Feder & Slade, 1985). Younger farmers have been reported as having greater likelihood of adopting new technologies due to their longer planning horizon ( Bultena & Hoiberg, 1983; Feder & Slade, 1985) than older farmers. However, it may also be that with age, farmers accumulate more personal capital and, thus show a greater likelihood of investing in innovations. With younger farmers on the other hand, they may desire to make changes in farming but are not always in a position to do so because of capital restrictions or because final decisions may rest with money lenders or with the person who owns the farm (Lionberger 1968).

Older farmers may be elders in the village and may have preferential access to new information or technologies through extension services or development projects that work in the villages. Onu, (1991), however found out that farm information sources use decrease with increased age of farmers. This implies young farmers are more alert to attaining information from sources that discuss more ways of improving their vocation than older farmers.

Older farmers may have more skills in assessing innovations (Akinwumi, Adesina & Seidi 1995) but are somehow less inclined to adopt new farm practices than younger ones because they are less receptive to change (Copp, Sill, & Brown, 1958; Lionberger, 1968). Although evidence indicates older farmers are less receptive to change than younger ones, failure to adopt new practices does not necessarily mean that they are not receptive to change but issues like health, declining energies and pending retirement may dictate their actions not being in accord with maximization of income and profit (Lionberger, 1949).

The foregoing shows evidence of the inconsistent relationship between age and innovativeness. Among several studies reviewed: half show no relationship between age and innovativeness; 19% support the hypothesis of younger people favoring adoption and 33% support hypothesis of older people favoring adoption of innovations (Rogers, 1983). Baidu - Forson's (1999) study for instance revealed that age had no significant effect on the adoption of 'tassa' and earthen mounds shaped in the form of half crescent which have been improved with the concentration of biological and chemical inputs. The result was indicated to be contrary to the observed negative influence of age on adoption of biological and chemical inputs because of the conservative outlook of older farmers (Cotlear, 1986). This contrary observation confirms the inconsistency of evidence about the relationship between age and innovativeness thus necessitating further studies into this relationship.

#### Education:

Illiteracy amongst the target group can be a severe setback to the delivery and adoption of technologies in developing countries (Merrill - Sands, 1989). Generally people share the basic belief that education can cure most ills of society. It has been valued as a means of increasing knowledge about new farm technology. The assumption is that schooling facilitates learning,

which in turn is pressured to instill a favorable mental atmosphere for the acceptance of new practices (Lionberger, 1968). Education imparts new knowledge that might otherwise not be acquired from social experience. The level of education will therefore enhance his understanding and the likelihood of utilization of a technology.

The proper application of information on agricultural technologies such as agro-chemicals, inorganic fertilizers as well as new varieties require users to process complex procedural information. Prior knowledge enables inferences to be made. Eiseimon (1990) reporting on his work in Kenya, noted that compression of procedures for applying agro-chemicals, for instance, communicated orally or through printed texts, is influenced by schooling. Lack of education therefore would be a drawback in the processing and extension of information.

Research suggests that adoption is moderately and/or strongly related to the educational level (Lin & Jeffres, 1998). Research work indicates adoption was moderately and/or strongly related to the educational level of respondents (Evenson, 1974; Mehra, 1994; Abdelmagid Hassan, 1996 ; Lin & Jeffres, 1998) Individuals with some level of education normally accept innovations more than the uneducated ones. Education is therefore an important factor that influences the acceptance of new ideas by farmers (Onu, 1991). It was suggested that farmers with better education are earlier adopters of modern technologies and apply modern inputs more efficiently throughout the adoption process than the late adopters who are mostly the older and less educated farmers (Abdelmagid & Hassan, 1996). Some indirect inferences to support this assertion can be made from studies by Lockheed , Jamison & Lau (1980) This study found significant relationship between education indicators and farm productivity . Thus since adoption of innovations increases productivity, the effect of education on adoption can be implied. Education acts as an essential

triggering input for other activities to occur effectively. The educational level of individuals therefore enhances his understanding and acceptance of an innovation. It enables the learner to feel competent and confident. These qualities are important for the success of the extension program (Blackburn, 1989). This is because measures carried out without the understanding of the recipient meet with lack of interest, mistrust or rejection (Albrecht *et al.*, 1989).

### Sex

Sex has an influence on the acceptance and utilization of extension messages. In sub-Saharan Africa including Ghana, there is a gender division of labor (Mehra, 1994). Certain agricultural tasks are allocated to men and women. Men may help initially in serious stage of clearing the bush, cutting trees among others but the remaining agricultural work which includes hoeing, weeding, tilling soil, harvesting and preservation are womens responsibilities (Benor D. *et al.*, 1985).

Wolfson *et al.*, (1990), reported important gender differences with respects to cowpea storage practices. They found women were much more likely to take active measures to preserve their cowpeas than men farmers. They also found a strong association between the gender of the person storing cowpeas and the method used ( eg. women use proportionally more methods than men do). Where the message is not directed to the appropriate sex therefore, it is likely to fail (Mehra 1994) Sex therefore is likely to influence the adoption of innovations including ICPTs.

### Working Experience

A store of knowledge is obtained through experience over the years. As farmers' accumulate experience it can be expected that this would positively influence their decision - making skills. Any new knowledge that extension agents are willing to impart must fit into the adults experience

which may result in a conflict emanating from change (Bohlen, 1966). This may contribute to the reluctance of older adults to accept and utilize information as it is in the late majority and laggards categories of the adoption curve (Bohlen, 1966). Basu (1969) however revealed that there was no correlation between professional experience and adoption.

#### *2.4.1. Personal Characteristics and Perception of Characteristics of Innovations*

A review of literature suggests that there is a dearth of studies showing the relationship between personal characteristics of individuals and the perception of attributes of innovations. This calls for further studies in this area. Research in social psychology has shown that personal characteristics can moderate the development of behavioral intentions (Liska, 1984). It is implied from this that the relationship between perceptions and the adoption decision for individuals can potentially be moderated by personality factors (Agarwal & Prasad, 1998).

### **2.5. A Conceptual Model of Determinants of Adoption of Innovations**

Numerous authors (Lionberger, 1968; Swanson, Rolings & Jiggins, 1984; Osuntogun, Adeyemo & Anyanwu, 1985; Rogers, 1995), have identified factors that influence the adoption behavior of farmers. In the study, the following modified model adopted from Osuntogun *et. al.*, (1985), was formulated to explain determinants of adoption. Adoption of ICPT's can be viewed as a variable which is a function of:

a = Personal & Enterprise Characteristics of Respondents

b = Extension Delivery Efforts

c = Perceptions of Characteristics of ICPTs

U = Error or disturbance term

Thus:  $Y_1 = f(a, b, c, U)$

It is postulated that the extent to which the use of improved cowpea preservation technologies is adopted, can be determined by personal and enterprise characteristics, mode and effort of extension delivery (that is the frequency of contact and extension methods used), and potential adopters perception of characteristics of improved cowpea preservation technologies. Personal characteristics of respondents and extension delivery efforts (that is the frequency of contact and extension methods used), determine respondents perceptions of characteristics of ICPTs. The research model underlying this study is shown in Figure 2.1.

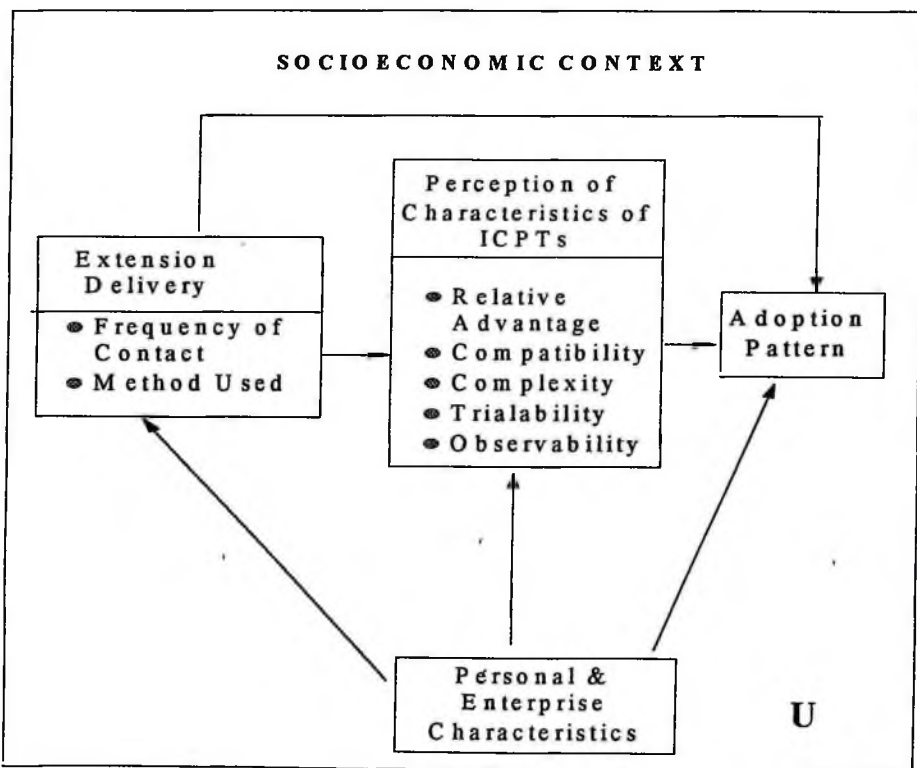


Figure 2.1. Conceptual Model of Determinants of Adoption of Innovations

### *Description of Variables*

The dependent variable ( $Y_1$ ), the adoption index for each respondent, was ICPTs adopted for preservation of cowpea. These include adoption of Actellic liquid, Actellic dust, Phostoxin, and Edible oil.

The personal and enterprise characteristics of respondents (a) is indexed by  $x_1 - x_8$  which is Gender ( $x_1$ ), Age (in years -  $x_2$ ), Educational level ( $x_3$ ), Working Experience ( $x_4$ ), Farm size ( $x_5$ ), Crop Yield ( $x_6$ ) Variety of Cowpea Grown/Sold ( $x_7$ ), Quantity of Cowpea Stored ( $x_8$ ).  $a = f(x_1 - x_8)$ . It is hypothesized that the effect of personal and enterprise characteristics on adoption, can either be positive or negative for a particular respondent.

Extension delivery (b) is measured in terms of  $x_9, x_{10}$ , which is the Extension Method Used ( $x_9$ ) and the Frequency of Contact of AEAs with Clientele within a Month ( $x_{10}$ ).  $b = f(x_9, x_{10})$ . It is postulated that the relationship between extension delivery and adoption of improved cowpea preservation technologies, will be positive if respondents are contacted with multiple methods of extension delivery and are in very frequent contact with AEAs within a month. This is because the more ways people are exposed to extension information, the larger the acceptance of recommended practices (Mauders, 1972). With frequent contact also, AEAs are likely to enlighten respondents on improved cowpea preservation messages thus they would be more aware of the benefits of adopting the technologies.

Potential adopters perception of characteristics of improved cowpea preservation technologies (c) is measured in terms of the following variables  $c = f(x_{11} - x_{15})$  which are, Relative Advantage, Compatibility, Complexity, Trialability, and Observability.

*General Attributes*1. Relative Advantage ( $x_{11}$ )2. Compatibility ( $x_{12}$ )3. Complexity ( $x_{13}$ )4. Trialability ( $x_{14}$ )5. Observability ( $x_{15}$ )*Specific Attributes*

- Income yielding
- Length of storage ( Shelf-life)
- Work-involved in use of the technology
- Time involved in use of technology
- Effectiveness of technology
- Marketing problems
- Similarity to existing practices
- Difference in taste after preserving ( Taste )
- Smell of chemical ( Smell )
- Ease in understanding technology
- Ease of use
- Piloting cost
- Generation of curiosity
- Visibility of advantage of using ICPTs

**2.6. Definition of Terms:**

## i. Adoption

This is a decision at an individual cowpea preservation technology users level to make use of an ICPT as the best course of action available as indicated by utilization or non - utilization of a particular selected ICPT.

## ii. Extension Delivery

This is the method used in conscious communication of agricultural information and the frequency of contact of extension officers with farmers and traders who use ICPTs.

## iii. Perception

This is the selection, organization and interpretation of what is sensed in the environment, into a meaningful and coherent picture. This enables the individual to give meaning to information received.

iv. Perception of Characteristics of ICPTs

This is the selection, organization and interpretation of what is sensed about the characteristics of ICPTs. The characteristics include: relative advantage, compatibility, complexity, trialability, and observability of ICPTs. This enables the individual to give meaning to information received about ICPTs.

v. Improved Cowpea Preservation Technologies

These are cowpea preservation technologies, recommended by staff of the public extension agency, to keep seed in a good condition for a long time.

## 2.7. Conclusion

A review of determinants of adoption behavior revealed that perceptions, extension delivery efforts and the personal characteristics of individuals influence the adoption of innovations. The role of different types of communication channels in facilitating information - technology adoption has also been investigated by others but these studies have typically examined the effects of communication channels on adoption decisions without taking perceptions into account. Consequently, little literature was obtained on the role of perception in adoption of innovations and this highlights the need for further studies.

The review revealed that other variables affect perceptions of attributes of innovations and these are likely to influence the adoption of innovations. This includes awareness of innovations, which was realized to be a crucial prerequisite to the development of specific positive perceptions which in turn lead to innovation adoption. There was however a dearth of knowledge on the effect of extension delivery and personal characteristics on the perception of characteristics of innovations. If these are ignored in adoption studies, the results of the study may be biased. This explains why

the study included these factors. This limited number of empirical studies on the subject using this adopter - perception model especially as it concerns agricultural technologies (including improved cowpea preservation technologies) justifies further investigation to assess the general applicability of the framework for adoption studies in the Akatsi District of Ghana.

## CHAPTER THREE

### METHODOLOGY

#### **3.0. Introduction:**

This chapter outlines activities undertaken to achieve the objectives of the study. It indicates how data was collected, analysed and interpreted to deduce a conclusion. The study sought to identify how cowpea farmers and traders perceptions of characteristics of ICPTs determine the pattern of utilisation of these technologies and to what extent the mode and efforts of extension delivery influence these perceptions.

#### **3.1. Research Design:**

A research design is a plan that guides the investigator while collecting, analysing and interpreting observations (Yin, 1988). It is the logic that links the empirical data to be collected, and the initial question of study to its conclusion (Yin, 1988). The study design is a case study. The case study involves an intensive study of one or more cases considered typical or representative in the area of investigation of a larger number of cases - in this instance, the case is the adoption of improved cowpea preservation technologies in the Akatsi district of Ghana ( Chitamber, 1983).

The primary purpose of a case study is to determine the factors, and relationships among the factors that have resulted in the current behaviour pattern of the subject of study (Chitamber, 1983). Since the objectives of the study were similar to the primary purpose of case studies, this design is suitable for carrying out the research. The design was again chosen because the type of research question and the focus of the work was on contemporary events in which behaviour cannot be manipulated as opposed to historical phenomena (Yin 1981a, 1981b). In the case study design, more than one strategy was used within the study.

### 3.1.1. Study Area:

The study was carried out in the Akatsi district of the Volta Region. The district is located in the south - eastern part of the Volta Region. It lies between latitude  $6^{\circ}\text{S} - 7^{\circ}\text{N}$  and Longitude  $0^{\circ}\text{W} - 1^{\circ}\text{E}$ . (Refer to Maps 1 and 2). This district was chosen because it is one of the major cowpea growing areas in the Volta Region. The researcher also speaks the same language as the people. The only barrier to communication was a difference in dialects.

### 3.1.2 Study Population

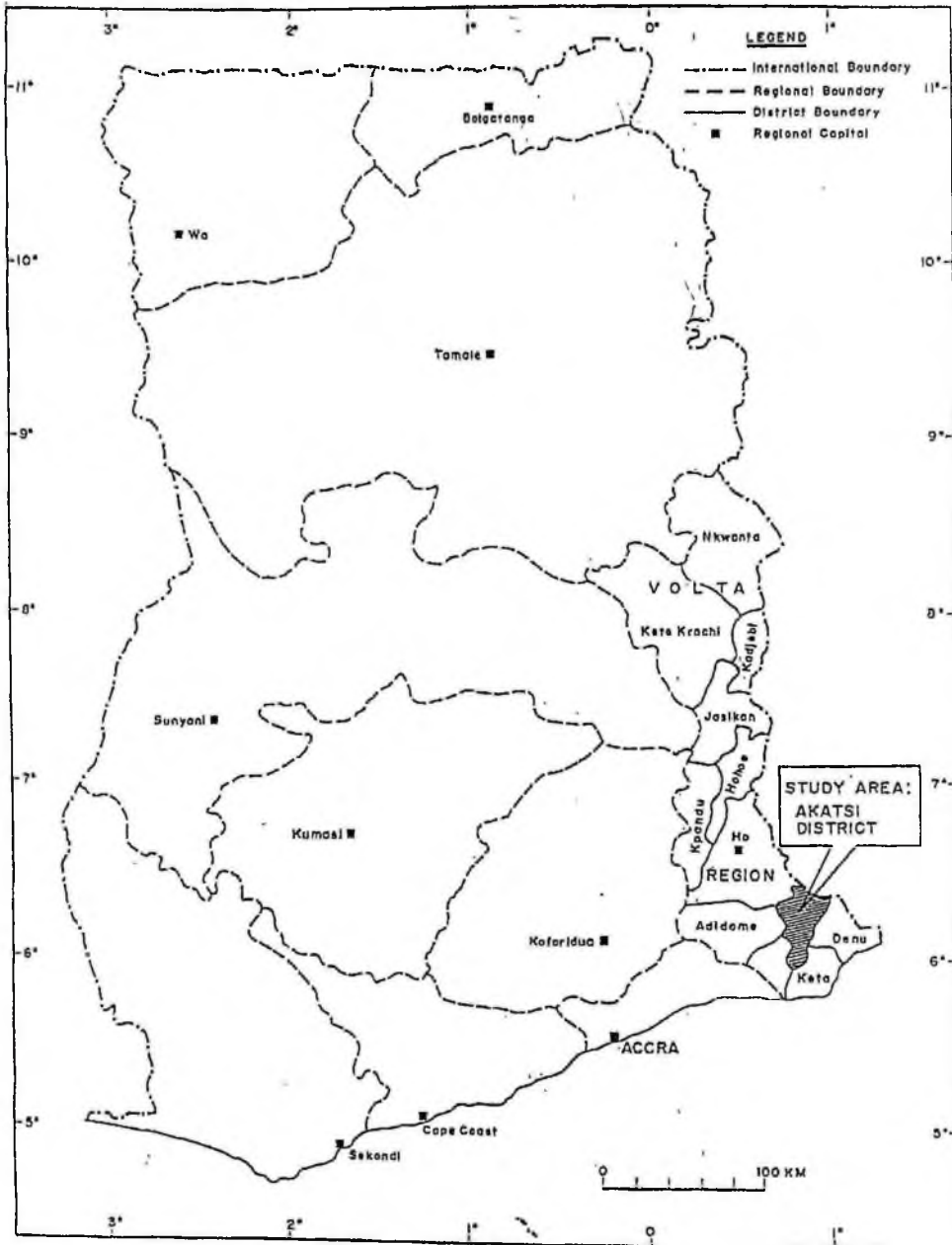
The target population for the study comprised all:

- Cowpea producers living and farming in the southern and middle part of the district.  
Ministry of Food and Agriculture (MoFA) extension agents working with farmers within the district.
- Cowpea traders in and outside the district, who sell cowpea at the Akatsi market.

### 3.1.3. Sample Size & Sampling Technique:

Cost, time, transportation and representativeness were the over riding factors determining the sample size in this study. Thus a sample that represented the target population with least cost, time and transportation constraints was used.

Map 1: A MAP OF GHANA SHOWING THE STUDY AREA: AKATSI DISTRICT





*Cowpea Producers:*

Sixty (60) cowpea producers were selected from four operational areas for the research. Cowpea producers were selected using the Two-stage-random-sampling method which is a combination of the cluster random sampling and the individual random sampling method ( Frankel & Wallen 1993). The district has been divided into fifteen (15) operational areas or clusters (as determined by MoFA in the district). Out of the fifteen, four (4) operational areas were randomly selected. Each operational area consists of eight sub -operational areas or villages. Three villages in these operational areas were again randomly selected. The sub-operational areas chosen include:

- Operational Area 1                   - Kpedzramor,, Agorweme, Dagbamate
- Operational Area 5                   - Logakope, Hlihave, Herlogo Ahiagokope
- Operational Area 9                   - Bredokope, Atidzivie, Nukpokofe
- Operational Area 12                 - Sushikope, Adrakpo, Kpoikope

These villages have high levels of cowpea farming and are aware of the cowpea storage problem. The sub-operational areas were also selected to increase the chances of getting many varied patterns of adoption. Thus in all, community level respondents were selected from twelve villages.

Since no list of cowpea farmers was available, the farmers interviewed were selected using convenience sampling. Convenience sampling method was used because it was difficult getting farmers to attend meetings so the first five-cowpea farmers, who turned up for the meeting in each sub-operational area, were interviewed.

*Cowpea Traders:*

A total of twenty-five (25) traders were selected from the Akatsi market on a market day (that falls every fifth day). The interview was conducted on a market day when a large representation of traders from different parts of the district and beyond were present. The researcher chose the Akatsi market because it is the principal market in the district and an easily accessible one. Systematic random sampling was used in the selection of the cowpea traders. It involved the selection of the first cowpea trader at the cowpea section of the market and subsequently, every alternate cowpea trader according to their sitting position in the cowpea section of the market.

*Extension Agents:*

Out of all MoFA agricultural extension agents (excluding the district director, his deputy and extension agents from veterinary services), fifteen (15) extension agents were selected using the simple random sampling technique. The underlying principle of the simple random sampling technique is that there must be a homogeneous population. Since the population used is all extension agents in the Akatsi district, they may be said to have homogeneous characteristics thus the simple random sampling method was appropriate in their selection.

*The Community:*

Information on the community was collected using the Rapid Rural Appraisal (R.R.A.) technique. Targets for this information was a group of traders; a group of extension agents; and a group of cowpea farmers. They were selected using purposive sampling. This was based on the assumption that with good judgement and an appropriate strategy, the researcher can pick individuals or units to be included thus develop a sample that is satisfactory in relation to ones

needs. The sample for the group of farmers consisted of a contact farmer and two non-contact farmers. These were selected using purposive sampling. In an attempt to cross check information given by the group of farmers, three separate groups of farmers were interviewed from three different villages (namely Dagbamate, Hlihave and Atidzivie). These groups were again chosen using purposive sampling. The group of cowpea traders also comprised a cowpea wholesaler and three cowpea retailers who were selected using purposive sampling. The group of extension agents comprised a supervisor and three technical officers (T.Os) who were also selected using purposive sampling.

#### *Cowpea Preservation Technologies:*

The selection of cowpea preservation technologies was made on the basis that they were those recommended to producers and traders by extension staff of the Ministry of Food and Agriculture (MoFA), and those technologies that are being used by cowpea farmers and traders in the sampled communities. The technologies are Actellic liquid, Actellic dust, Phostoxin and Edible oil.

### **3.2. Data Gathering Technique:**

A data gathering instrument is any device used to measure variables (Yin, 1988). The type of instrument used depends on the type of data to be collected. The type and nature of information collected for each concept, source of information and data collection technique is contained in Table 3.1. These were designed to obtain information that will help achieve the objectives of the study. A review and analysis of secondary data and information on the preservation of cowpea was also done.

### 3.2.1 Development of Data Gathering Instrument:

Relevant data was collected through the use of the following instruments: a questionnaire; personal interview of respondents; focused group discussion (rapid rural appraisal method - RRA); literature and documentary reviews.

**Table 3.1.: Information Collected, Source(s), & Techniques used in Data Collection:**

VARIABLE	INFORMATION REQUIRED	SOURCE	DATA COLLECTION TECHNIQUE
Extension Delivery	<ul style="list-style-type: none"> <li>- Extension Methods</li> <li>- Frequency of Contact</li> </ul>	<ul style="list-style-type: none"> <li>- Cowpea Producers</li> <li>- Cowpea Traders</li> <li>- Extension Agents</li> <li>- Secondary Source</li> </ul>	<ul style="list-style-type: none"> <li>- Questionnaire</li> <li>- Interview</li> <li>- Secondary Data</li> <li>- focused group discussion (rapid rural appraisal method - RRA)</li> </ul>
Characteristics of Respondents	<ul style="list-style-type: none"> <li>- Age</li> <li>- Sex</li> <li>- Working Experience</li> <li>- Educational Level</li> <li>- Farm Size</li> <li>- Crop Yield</li> <li>- Variety of Cowpea Grown/Sold</li> <li>- Quantity of Cowpea Stored</li> </ul>	<ul style="list-style-type: none"> <li>- Cowpea Producers</li> <li>- Cowpea Traders</li> <li>- Extension Agents</li> </ul>	<ul style="list-style-type: none"> <li>- Questionnaire</li> <li>- Interview</li> </ul>
Perception of Attributes of Selected ICPTs	<ul style="list-style-type: none"> <li>- Specific Attributes of ICPTs</li> <li>- General Attributes</li> <li>- Overall Attributes</li> </ul>	<ul style="list-style-type: none"> <li>- Cowpea Producers</li> <li>- Cowpea Traders</li> </ul>	<ul style="list-style-type: none"> <li>- Questionnaire</li> <li>- Interview</li> </ul>
Adoption	<ul style="list-style-type: none"> <li>- Level of Awareness of ICPTs.</li> <li>- Adoption / Non-Adoption of ICPTs</li> </ul>	<ul style="list-style-type: none"> <li>- Cowpea Producers</li> <li>- Cowpea Traders</li> <li>- Extension Agents</li> </ul>	<ul style="list-style-type: none"> <li>- Questionnaire</li> <li>- Interview</li> <li>- focused group discussion (rapid rural appraisal method - RRA)</li> </ul>

*Questionnaire:*

Questionnaires are used where respondents are sufficiently educated to read and respond accurately to the question asked in the questionnaire (Chitamber, 1983). The questionnaire was used for collection of data on extension agents in the district, who were literate thus could read and answer items in the questionnaire. A questionnaire was used also because it allows the collection of data within a limited time.

The questionnaire developed was broken into three sections that contained questions or statements covering the variables measured (Ref. Appendix 3). Section 'A' consisted of both open and closed - ended questions to solicit information on extension agents' personal and professional characteristics. Section 'B' on the other hand consisted of statements to solicit information on extension delivery. In section 'C', the field staff was asked to indicate problems encountered with the delivery of cowpea preservation messages and what they think could be done to improve extension delivery.

The questionnaire was hand delivered by the researcher at a monthly training session. The completed questionnaires were then collected at the end of the training session for editing and analysis. Out of the twenty questionnaires distributed, fifteen (75%) were accepted while five (25%) were rejected. Due to the unified extension system, extension agents in the district comprising three officers from Veterinary Services and two from Plant Protection have joined the Agricultural Extension Agents (AEAs) of MoFA. These respondents questionnaires were rejected since they were not filled properly thus reduce the total sample size of extension agents of twenty to fifteen.

*Personal Interview of Respondents:*

The interview schedule which is essentially the oral, in-person administration of a written guide to each member of a sample (Gay, 1987), was used in the collection of data on cowpea producers and traders. A written guide that indicated questions to be asked and in what order, was used when interviewing the respondents. The interview method was most suitable because of the educational level of the respondents. It was also used since the researcher could explain and clarify items to respondents individually in their local dialect.

Moser and Kalton (1972) distinguished three broad ideas as necessary conditions for a successful interview namely: the accessibility of the required information to the respondents; the cognition or understanding by the respondents of what is required of him; the motivation by the respondent to answer the questions accurately. These three conditions were considered and used by the researcher since it was found that the population sampled could have and give information sought for, understand the usefulness in participating in such an interview and to co-operate in giving genuine and frank answers to the questions put to them.

The interview schedule of cowpea farmers was broken down into four sections. Section 'A' consisted of information on cowpea producers personal and enterprise characteristics. Section 'B' consisted of questions asked to solicit information on cowpea production and preservation. Section 'C' contained open - ended and closed - ended items that helped deduce information on farmers' utilization of improved cowpea preservation methods. It was also aimed at getting respondents to indicate their source of cowpea preservation technology information. Questions in section 'D' were designed to derive information on cowpea producers' contact with extension activities.

The interview schedule of the cowpea traders also consisted of four sections. Section 'A' like that of the cowpea producers consisted of personal and enterprise characteristics. Section 'B' had items that sought to obtain information on the storage and preservation of cowpea. Section 'C' included questions to solicit information on traders' utilization of improved cowpea preservation methods. Questions designed in section 'D' were aimed at soliciting information on their contact with extension or extension activities.

*Rapid Rural Appraisal (R.R.A.) Method:*

A Rapid Rural Appraisal (R.R.A.) method, the checklist was also used as an instrument of data collection. The checklist was used to collect general information about the community. The result of the checklist was used as a guide in the discussion and investigation of the research results.

The checklist consisted of two main sections. Section 'A' aimed at getting information on the biophysical and demographic characteristics of the study area. Section 'A' was administered to a group of farmers and extension agents. Section 'B' aimed at soliciting information on the economic characteristics of the population. This was administered to groups of cowpea producers, traders, and extension agents.

*Literature & Documentary Review:*

Findings from this source helped give an account of circumstances under which technologies evolved and were introduced. It also helped in the discussion of the research work. A review was done of monthly reports and of the Five (5) Year Development Plan (1996-2000) of the Akatsi district. Besides this other sources of literature were used.

### **3.3. Pre-Testing:**

Pre-testing of the questionnaire, checklist, interview schedule used for the study was done in the Suhum -Kroaboa -Coaltar district of the Eastern Region using ten (10) farmers and five (5) extension agents as the sample size. They were selected using purposive sampling. The aim of pre - testing was to reveal inadequacies if any in the initial design and to help reduce errors and biases in the study. It helped refine data collection plans with respect to both the contents of the data and the procedure to be followed. The need to inculcate cowpea traders in the target population was also realized after pre - testing. The cowpea traders questionnaire was pre-tested later at the Makola market on ten (10) cowpea traders who were also selected using purposive sampling.

### **3.4. Data Gathering:**

In view of the time constraint within which the researcher worked, two research assistants were trained for data gathering using the interview schedule. The choice of the research assistants was based on their ability to speak the local language. This was to help facilitate the interpretation of the questions in the questionnaire to the understanding of the respondents. Data gathering was done within a month. Within this period, the data gathering instruments indicated were employed to obtain as much information as possible.

### **3.5. Data Analysis:**

The researcher did editing of the responses of the interview guide and questionnaire. The responses were examined for consistency, accuracy, and appropriateness. Discrepancies were clarified to obtain well-filled items. Analysis was done following the nature of items in the

questionnaire, interview schedule, and checklist. A coding scheme was prepared to direct the process of coding. To facilitate easy identification, questionnaires returned by respondents were given serial numbers. Tabular methods of presenting data (like the use of frequency and percentage distribution tables and graphs) were used to summarize salient features. In order to ascertain the influence of variables measured, chi - square tests were applied where appropriate to determine the existence or non- existence of significant relationships between variables, and differences between categories of respondents. The relationship or differences is considered significant if  $p < .05$ .

A 1-4 scale for a continuum of positive and negative perceptions of the specific attributes for rating each of the selected ICPT compared with traditional cowpea preservation technologies was prepared. The scale for the cost attribute for example was 1= High; 2= Moderate; 3= Low; 4= Very Low (Ref. Appendix 1 & 2). To arrive at the perception of specific attributes of each of the ICPT, (based on the standardized list of components of perceived innovations developed by Rogers, 1983), respondents who indicated awareness were asked to compare traditional cowpea preservation technologies with the improved ones, using the ranking provided. Each improved cowpea preservation technology was ranked separately with no comparison between them. The responses were re-grouped so that 1 & 2 = Negative perception; and 3 & 4 = Positive perceptions while those that were not applicable were represented by an asterix (\*). The frequencies are found in Appendix (5 - 14). To arrive at whether a sample has a negative or positive perception about a specific attribute, the total frequency distribution for the specific attribute was compared. The highest percentage frequency was taken to be the perceived attribute of that sample.

To determine the perception of the general attributes, the ranking indicated for the specific attribute was added up for each of the general attributes to derive a total. This was again grouped based on the following critical values (which are the mid-point of the totals of the specific attributes in a scale of continuum).

GENERAL ATTRIBUTES	SCALE OF CONTINUUM	CRITICAL VALUES
Relative Advantage	7 – 28	17.5
Compatibility	3 – 12	7.5
Complexity	2 – 8	5.0
Trialability	2 – 8	5.0
Observability	1 – 4	2.5

Respondents with total scores equal to or higher than these critical value were considered to have positive perceptions with regards to the general attribute and vice-versa. Once again frequencies of positive and negative perceptions for the general attributes were compared and the one with the highest frequency was taken as the perception for the sample (Ref. Appendix 8). Similarly, adding up the general attributes to arrive at an overall total for each individual resulted in the over-all perception of the attributes of each ICPT. These were classified as positive and negative. Respondents with overall total scores equal to or higher than a critical value of 37.5 (which was the mid - point of the 15 - 62 scale of continuum), were considered to have positive perception and vice versa. The frequency distribution for positive and negative over-all perceived characteristics was used in a similar way to determine the samples' perceived over-all attribute (Ref. Appendix 9).

To deduce the norm or total perception in each instance, the perceptions for all ICPTs (that is the negatives and positives were added up and an average found (Ref. Appendix 5 - 14). The highest total perception was used as the norm for discussing the qualitative differences between perceptions. The Spearman rank correlation coefficient was also used to determine the degree of relationship between respondents' perceptions of attributes of ICPTs and adoption.

### **3.6. Problems Encountered During Field Work:**

Several constraints were encountered during the study. Initially the researcher moved from farm to farm interviewing cowpea producers. This was time and energy consuming besides increasing the cost of research. To reduce the period for data collection and the cost of research therefore, taboo days were used for interviewing producers. These were days that producers did not go to the farm and could be found at home.

There was a problem with farmers responding to the items in the interview guide. Farmers wanted to know the benefits they would derive from the interview (if there were any package to be sent later) before answering questions. This may affect the responses given (especially when they realized there was no package while they needed financial assistance).

Respondents were also unwilling to provide answers relating to extension agents activities. They felt they were in a way reporting or betraying extension agents if they gave responses to these items. In such cases, the researcher had to assure the respondents the responses given would not affect the extension agent in any way but rather help him improve his work (that is make him deliver messages more effectively).

# **PART TWO:**

# **RESULTS & DISCUSSIONS**

## CHAPTER FOUR

### CHARACTERISTICS OF RESPONDENTS

#### 4.0. Introduction

While people in general are rather similar, they differ in thousands of ways. Their individual characteristics, influence their behaviour pattern. In adoption studies, it is usual to investigate the personal and enterprise characteristics of respondents in order to understand their influence on adoption behaviour ( Onu, 1991). These individual differences help explain why adoption of practices is variable within a community (Effionayi, 1975). They may well affect how information is received, processed, and either used or not used in the production process (Fliegel, 1984). Investigating personal characteristics of respondents therefore enables one to understand their heterogeneity. This chapter gives an overview of personal and enterprise characteristics of respondents in the study area. The personal characteristics examined are: gender, age, educational level, professional experience, whereas the professional characteristics are: farm size, crop yield, variety of cowpea grown or sold and the quantity of cowpea stored.

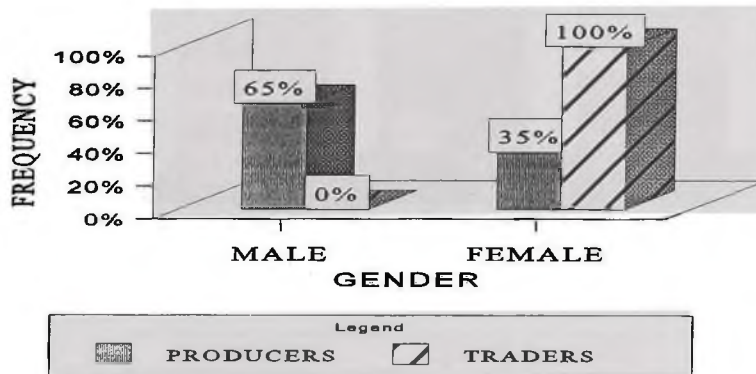
#### 4.1. Personal Characteristics of Cowpea Producers & Traders

##### *Gender of Traders & Producers*

An analysis of Fig 4.1 shows cowpea production is done mainly by men (65%), while its sale is done solely by women (100%). Statistically there is no significant difference between the gender of cowpea producers and traders ( $\chi^2 = 30$ ,  $df = 1$ ,  $p < .01$  ).

Sexual division of labour in food production is task and crop specific. It is widely recognized that women play an important role in post harvest processing, storage, and marketing of agricultural products while men perform tasks that are considered tedious like land clearing, cutting trees among others ( Date - Bah & Stevens, 1984; Swanson, Roling & Jiggins, 1984; Benor, *et. al.*, 1985).

Literature reveals the sex of respondents has an influence on the acceptance and utilization of extension messages. Where the message is not directed to the appropriate sex, it is likely to fail (Swanson, Roling & Jiggins, 1984; Mehra, 1994). This sexual division of labour, calls for the appropriate delivery of extension messages to them based on their roles. Cowpea traders as well as women farmers, must be targeted by extension agents in the study area for preservation messages while more males are targeted for production messages. If this is not done, there is likely to be a low adoption of preservation technologies. There is therefore likely to be a difference in adoption pattern of producers and traders with regards to this variable.



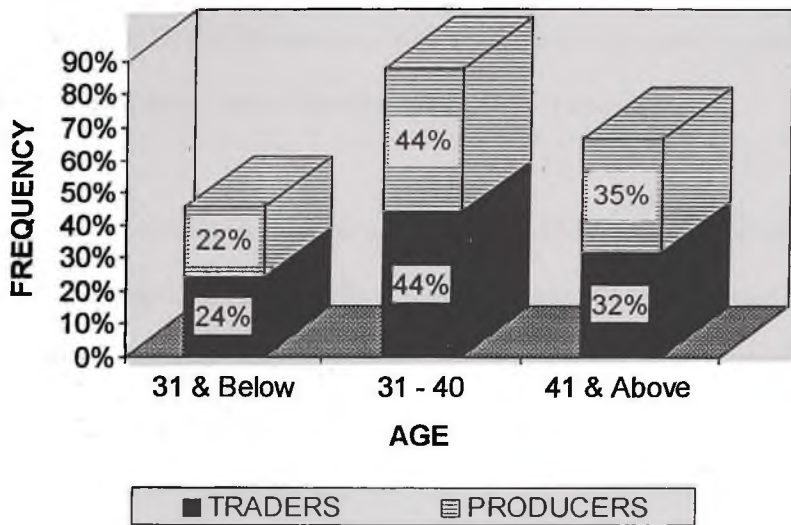
Source: The Study (1998)

Fig. 4.1. : Percentage Distribution of Respondents by Gender

#### *Age Distribution*

Most of the respondents were relatively young (66% of producers and 68% of traders were 40 years or less), with an average age of 30 and 32 years respectively for producers and traders. There is no statistically significant difference between cowpea producers and traders with regards to their age ( $\chi^2 = 0.01$ ,  $df = 2$ ,  $.9 < p < 1.0$ ). Age is therefore not a determinant of whether a person is a cowpea producer or trader.

Studies suggest high adoption is at middle age (Wilson, & Gallup, 1955). Since majority of the respondents fall within this category (that is between 31 - 40 yrs.), the adoption pattern of cowpea preservation technologies is likely to be high. If this is not the case, then variables other than age may be responsible for adoption. It is noteworthy that the effect of age on adoption could be either positive or negative for a particular farmer or respondent (Jacques, 1991).



Source: The Study (1998).

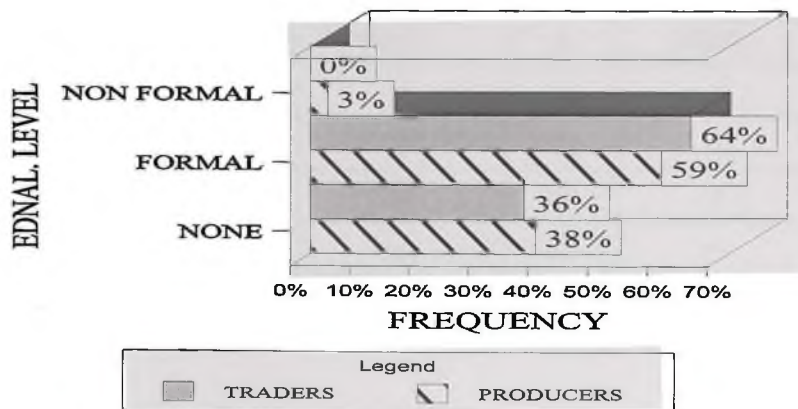
Fig. 4.2. : Percentage Distribution of Respondents by Age

#### *Educational Level*

Majority of the respondents are literate (that is 62% of cowpea producers and 64% of cowpea traders have some form of formal or non- formal education). There is no statistically significant difference between cowpea producers and traders with regards to this variable ( $\chi^2 = 1$ ,  $df = 2$ ,  $.5 < p < .6$ ). The educational level thus does not determine whether one is a cowpea trader or producer (Ref. Fig. 4.3).

The predominantly literate population is desirable since education provides individuals with a tool to accept positive changes and serves as a means of facilitating farmers use of written information sources and increasing their knowledge about new farm practices (Onu, 1991). The basic idea is that higher levels of education are conducive for technological progress (Mundlak, Larson, & Butzer, 1997). Education imparts new knowledge that might otherwise not be acquired from social experiences and enhances the understanding and likelihood of utilization of technologies (Lionberger, 1968). Education is likely to influence the adoption pattern of respondents in the study area since most of them have some form of education.

Difference in educational level would mean there are different abilities to understand difficult concepts and technical language (Maunder, 1972). Extension agents in the district need to use different extension techniques to meet each individuals difference in ability of understanding, if high adoption levels of cowpea preservation messages are expected.



Source: The Study (1998).

Fig. 4.3 : Educational Level of Cowpea Producers & Traders

***Working Experience:***

Majority of respondents (Producers, 72%; Traders, 84%), had 5 years or more working experience. The modal working experience of cowpea producers was 5 years, while that of cowpea traders was 10 years. There is no statistically significant difference between the professional experience of cowpea producers and traders (Table 4.1).

A store of knowledge is acquired through experience over the years. Experience is both a helpful resource and a potential hindrance to new learning (Zinnah & Kwarteng, 1995). More experienced people are able to appreciate the benefits of improved technology (including preservation technologies) and are likely to adopt new practices. On the other hand, they may be conservative thus reluctant to accept and utilize change (Onu, 1991). Working experience is therefore likely to influence the adoption pattern of respondents.

**Table 4.1 : Working Experience of Cowpea Producers & Traders**

WORKING EXPERIENCE	COWPEA PRODUCERS		COWPEA TRADERS	
	FREQ.	%	FREQ.	%
Less than 5 years.	17	28	4	16
5 years.	13	22	4	16
More than 5 years.	30	50	17	68
TOTAL	60	100	25	100

$\chi^2 = 2.4$        $df = 2$        $.2 < p < .3$  (Not Significant)

Source: The Study (1998).

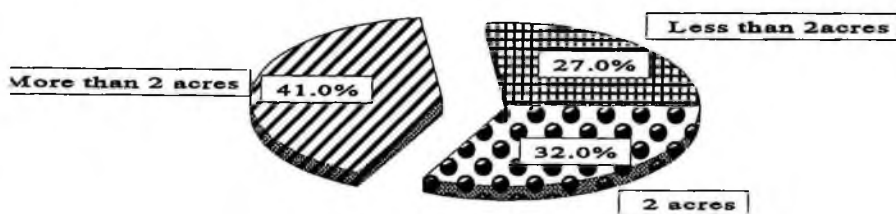
#### 4.2. Enterprise Characteristics of Cowpea Producers & Traders

##### *Farm Size*

Most farmers (59%) have relatively small farm sizes being 2 acres or less, they are less likely to adopt new farm practices including preservation technologies recommended by AEAs. Preservation technologies ( including traditional preservation technologies) suitable for preserving small quantities of cowpea are likely to be preferred.

Contrary to the findings of Bond, 1974; Staudt, 1975; Fortmann, 1981; that large farmers are primary beneficiaries of extension efforts whilst small farms receive less attention than their overall contribution merits, certain small farmers in the study area indicated they received attention from AEAs.

Majority of the farmers in the study area have relatively small farm sizes. Since the greatest differences in farm practice adoption levels occur between relatively small farms (Matthews Jenkins & Sletto, 1942, Lionberger & Coughenor, 1957; ),the likelihood is that differences in farm practice adoption (including adoption of ICPTs) is likely to be high.

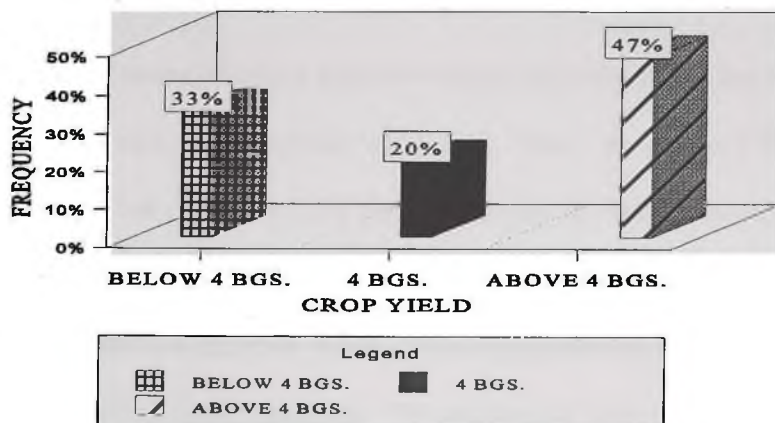


Source: The Study (1998).

Fig. 4.4. : Distribution of Farmers by Farm Size

### *Crop Yield*

Figure 4.5 gives the percentage distribution of cowpea producers by their crop yield. Results of the study revealed cowpea yields in the study area were generally low (53% had a yield of 4 bags and below within a farming season). Relatively small farm sizes in the study area, result in low crop yield. The crop yield of farmers determines whether they would preserve cowpea or sell all immediately after harvest. The crop yield affects the farmers income level, which determines his purchasing power, which ultimately determines if he can afford purchasing chemical inputs for preservation or not. Farmers in the study area indicated that they dispose of their cowpea immediately after harvesting so as to avoid incurring the extra cost of preserving. If they would preserve at all, they may not utilize preservation technologies suitable for large scale production, (like ICPT's) but prefer those suitable for preserving small quantities of cowpea ( which include traditional preservation technologies as is the case in the study area).



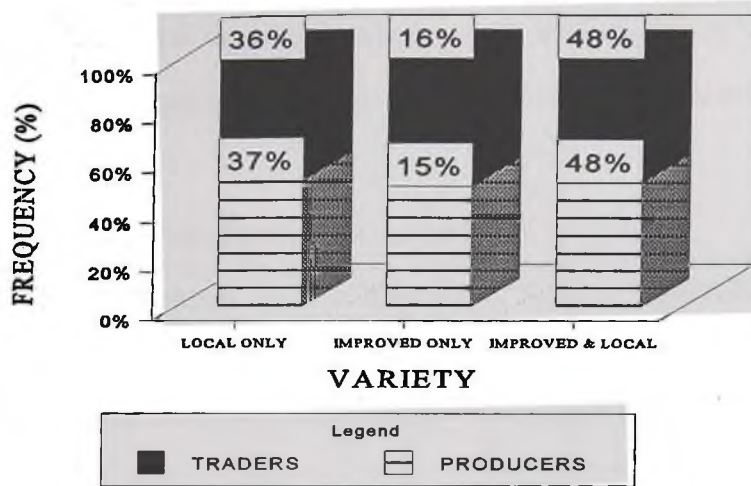
Source: The Study (1998).

Fig. 4.5 : Distribution of Cowpea Producers by their Crop Yield

*Variety of Cowpea Grown / Sold in the Study Area*

An analysis of Fig. 4.6 shows 85% of cowpea producers grow the local variety while 63% grow the improved variety. Local varieties of cowpea grown in the area include Local red (Wakli), Local white (Tsenabawu, Dabango, Ayiyimosue) while the improved varieties are black-eye beans (Agric. White) and Valenga (Agric red). Cowpea producers indicated that although the improved variety is higher yielding, spoilage with this variety occurs faster and it gets easily infested. The local variety on the other hand, is lower yielding but stores better and is more resistant to pests. Despite the fact that the improved varieties are higher yielding, producers prefer growing the local variety and the traders prefer selling that too. More of the local variety is produced so as to avoid the extra cost incurred in purchasing preservatives for preserving cowpeas. This naturally is likely to result in low crop yield and low utilization of preservation technologies. Preservation technologies suitable for preserving small quantities of cowpea are likely to be adopted.

It is obvious traders' source of stock is from the locals or within the district thus resulting in the similarity between what is produced and what is sold. Thirty - six percent (36%) of cowpea traders buy from local producers, 32% from wholesalers in Akatsi district, 28% grow it themselves, while only 24% buy from outside Akatsi district. The local variety happens to be more marketable than the improved variety. Consumer preference for the local variety has influenced the growth of it in the study area. This accounts for why traders prefer selling more of the local variety than the improved one.



Source: The Study (1998).

Figure 4.6. : Variety of Cowpea Grown / Sold by Respondents

#### *Quantity of Cowpea Stored*

Table 4.2 reveals that 96% of traders store more than 2 mini bags of cowpea while only 40% of producers store more than 2 mini bags of cowpea. This shows traders store more cowpea than producers. The modal number of bags stored by cowpea producers was two (2) mini bags while that of the traders was five (5) mini bags. This is obviously because traders store for commercial purposes. There is also a statistically significant difference between the quantity of cowpea stored by producers and traders ( $\chi^2 = 22.6$   $df = 2$   $p < 0.00001$ ).

Since traders store more cowpea than producers, they are likely to perceive the need for preservation technologies more than producers. The traders therefore may utilize preservation technologies more than the producers. Information on preservation technologies thus needs to

be extended more to traders than producers. Cowpea producers on the other hand, may not perceive the need for preservation technologies because of the small quantity of cowpea preserved. To encourage producers preserve, there is a need to extend information to help increase their production.

Table 4.2. : Quantity of Cowpea Stored by Producers and Traders

QUANTITY OF COWPEA STORED	COWPEA PRODUCERS		COWPEA TRADERS	
	FREQ.	%	FREQ.	%
Below 2 mini bags.	18	30	0	0
2 mini bags.	18	30	1	4
Above 2 mini bags.	24	40	24	96
TOTAL	60	100	25	100

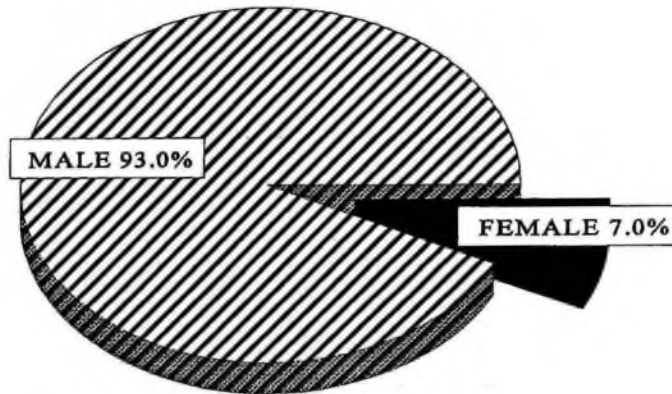
$$\chi^2 = 22.6 \quad df = 2 \quad p < 0.00001 \text{ (Significant)}$$

Source: The Study (1998).

### 4.3. Personal and Professional Characteristics of AEA's

#### *Gender*

Only one AEA (7%) is a female thus indicating that women are negligibly represented within the extension service in the Akatsi District (Ref. Fig. 4.7). A survey of extension services worldwide revealed that in no African country did women represent more than 9% of the staff (Swanson & Rassi, 1990). They are mostly given Home Economics assignments, even though their training is in general agriculture (Swanson, Roling & Jiggins, 1984).



Source: The Study (1998).

Fig.4.7. : Distribution of AEs by Gender

#### *Position and Educational Qualification of Agents in MoFA*

Fifty - three (53%) of AEs interviewed attended agricultural colleges, 34% had diploma's in agriculture while 13% had 'O' level qualification (Ref. Table 4.3). This formal education in agriculture, is designed purposefully to help AEs in agricultural extension work in rural communities.

The local extension worker is the most important single element in achieving the aims and objectives of the extension organization. The qualification and function of personnel in MoFA depend to a great extent on the organizational structure of extension in each country. In the districts, Frontline Staff (F.L.S.) are in constant contact with their clientele while supervisors are in contact with people they supervise, giving advise, guidance, and encouragement.

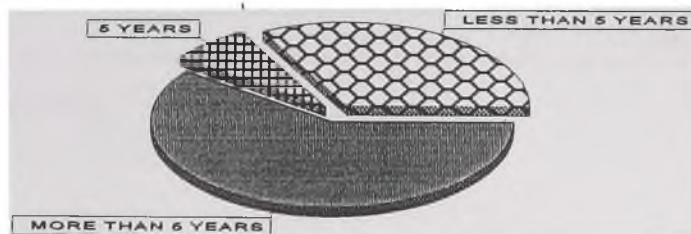
Table 4.3. : Position &amp; Educational Qualification of AEAs in the Study Area.

VARIABLE	CATEGORY	FREQ.	%
POSITION OF AGENT IN MoFA	Supervisor	2	20
	Frontline Staff (F.L.S.)	13	80
	TOTAL	15	100
EDUCATIONAL LEVEL	Diploma in Agriculture	5	34
	Certificate In Agriculture	8	53
	Ordinary Level Education	2	13
	TOTAL	15	100

Source: The Study (1998).

#### *Working Experience in Current Location*

Majority of AEAs (67%) have long working experience of 5 years or more in the current location (Ref. Fig 4.8). This long working experience with farmers or clientele for a period of time enables AEAs have knowledge about the people and their farming practices, problems encountered by them or their needs so they can help them meet their needs. Living in the same area, enables them get into contact with farm people and develop proper working conditions so they would be able to disseminate information effectively to them to help them meet their needs.



Source: The Study (1998).

Fig. 4.8 : AEAs Working Experience in Current Location

*Language of Communication:*

When AEAs were asked to indicate their language of communication with their clientele, the following responses were given. All respondents (100%) speak the local language (Ewe) and communicated with their clientele in this native language. The possibility therefore that their clientele would understand the message is very high (Ref. Table 4.4).

Communication is one of the variables that influence change. Change agents spend considerable amount of time giving out and sending information to rural people about new ideas, practice, or technology ( Zinnah & Kwarteng, 1995). There is a need for the receiver to make sense out of the message. If the same language of communication is used (as is the case in the study area), the receiver is likely to make sense out of the message. This similarity in language spoken would lead to shared meaning, healthy communication climate, positive relationship and a clear information contact ( Zinnah & Kwarteng, 1995). This condition is likely to facilitate a healthy climate for effective communication and dissemination of cowpea preservation technologies.

Table 4.4 : Language of Communication of AEAs

LANGUAGE	FREQUENCY	Percentage (%)
Ewe	11	73
Ewe & English	4	27
TOTAL	15	100

Source: The Study (1998)

#### 4.4. Conclusion

Personal and enterprise characteristics of cowpea producers, traders and AEAs in the Akatsi District were examined to ascertain whether these differed and therefore which of these were likely to influence their adoption of improved cowpea preservation technologies. Apart from

gender and the quantity of cowpea stored, there were no significant differences between the characteristics of cowpea producers and traders. This implies gender and quantity of cowpea stored may be important source of difference in their adoption behaviour (and this would be further investigated).

Cowpea farmers were mainly males while cowpea traders were all females. Majority of cowpea farmers and traders were between the ages of 31 - 40 years, had some form of formal education and they had more than five years working experience. The average farm size of cowpea producers was 2 acres, and their average crop yield was 4 bags of cowpea. Cowpea producers mainly grew a combination of the local and improved varieties of cowpea while cowpea traders mainly sold a combination of the local and improved varieties of cowpea. Whereas most cowpea producers stored less than 2 mini bags of cowpea (60%), most traders stored more than 2 bags (96%).

Majority of AEAs in the study area were males and the language mostly used for communication was “Ewe.” Most of them had more than five years working experience in the Akatsi district. The educational qualification of majority of AEAs was a Certificate in Agriculture. These characteristics of AEAs in the Akatsi District shows that they have the capacity to deliver messages on selected ICPTs effectively.

## **CHAPTER FIVE**

### **EXTENSION DELIVERY EFFORTS**

#### **5.0. Introduction**

One factor in the change agents' success in securing the adoption of innovations by clients is the amount of effort spent in communication activities with clients (Maunder, 1972; Rogers, 1995). The indicators used for measuring extension delivery in the study were the types of extension methods used in delivery of cowpea preservation messages and frequency of contact with clientele.

#### **5.1 Prevention of Pest Infestation in Cowpea**

Throughout history, man has employed a variety of preservative and curative measures against food pests, designed either to prevent infestation or to inhibit pests in their development by repelling or destroying them. Cowpea producers and traders have developed storage techniques that could be studied by extension for further improvement. Extension agents also recommend certain cowpea preservation technologies to their clientele in the study area. A brief discussion will be made of these precautionary measures.

To ensure that there are quality seeds available for preservation, special methods of cultivation are used. These are as follows: crop rotation; choice of harvest time; selection of suitable varieties that store well; selection of produce for storage; and maintaining good storage conditions.

## 1. Special Methods of Cultivation:

### a. Crop Rotation:

This is practised to prevent the accumulation of certain diseases and pests in a particular field. This system is gradually being replaced by the mixed farming system (mainly because of inadequacy of farm land). With this system also, pests (including stored food pests) are less numerous than in single - crop farming perhaps because of the better biological balance that mixed farming creates (Zehrer 1980).

### b. Choice of harvest time

Crops are infested with pests if they are not harvested at the right time. Harvesting crops at the right time is therefore one way of improving its storage prospects. Mature cowpea pods are picked by hand on the farms. The harvested pods are then transported to the drying site and spread on a clean floor, mat or raised platform for further drying. They are stirred periodically to help in uniform drying. The pods need to be covered to avoid dew or rain making them moist. When fully dried, they are threshed and then dried further (Nicol *et al.* 1997). After ensuring that grains are well dried, (to about 14% moisture level or less), they are winnowed to remove all foreign matter (broken pods, stones etc.,) immature and discoloured grains from the threshed grains.

### c. Selection of suitable varieties that store well

Choosing the right variety of cowpea seed to cultivate is an important factor in the subsequent storage life of the produce. Local varieties are well adapted to environmental conditions both in the field and in the granary. Farmers use seed that has survived in good condition from the previous harvest. There is therefore a constant process of natural selection producing seed

varieties that are resistant to pests. These seeds tend to have the qualities of good storage life and guaranteed yield (Zehrer, 1980). Certain farmers select these varieties and keep it for the next farming season thus ensuring that pest resistant varieties are produced in the next farming season.

#### d. Selection of produce for storage

The farmer normally sorts his harvested grain before placing it in storage. Long - term storage losses can be drastically reduced by selecting only healthy undamaged seeds for storage. There is a higher probability that such seeds will be free from infestation at the time of storage ( Zehrer, 1980).

The threshed grain which is sorted by certain farmers, is then treated to prevent insect infestation. Grains are then put into suitable containers and stored (with periodic inspection). Whereas certain cowpea producers sell their cowpea fresh without further drying after harvesting, majority of cowpea producers interviewed stored part of their cowpea for sometime before selling it. Some also stored it in the pod without adding preservatives while others stored it shelled, with or without a preservative.

#### e. Storage conditions

The type of storage condition may determine how long the seed will last or the amount of infestation. Seeds must not be stored in hot, moist places but are best stored in cool dry places. Under such conditions, they prevent infestation of seeds by insects. Besides the preventive measures described, some of which are adopted consciously by the farmers while some are practised unconsciously (which are often the result of many generations of experience), a number of active pest control measures have evolved. These are designed to destroy or repel the pests,

or to hinder their propagation. These include the use of: mechanical methods for preservation; solar and other thermal disinfestation techniques; admixtures or mineral substances of plant origin; and sealed container storage.

## 2. Mechanical Methods of Pest Control:

### a. Picking out pests by hand

Pests can be picked by hand and then destroyed before grain is sold. These normally occur in small rural markets in various parts of Africa (Zehrer, 1980). In countries of West Africa, including Ghana, women who sell cereals and legumes in the market (or their children and assistants), sort out the pests by hand to make their wares more presentable to customers. This method is also used mainly by cowpea traders in the Akatsi district.

### b. Sifting out insect pests

Special sieves for sifting out pests (that is smaller than the stored grains) have been developed in different cultures including Ghana. In the study area, it is locally called "*Agbadza*." Fig 5.1. shows a picture of a local sieve (an "*Agbadza*"). These are used for sifting small quantities of grain. Pests removed this way must later be destroyed to prevent re - infestation of stock. There is however a need to sift grains at regular weekly intervals. If this is done, pest infestation is reduced quite considerably. This is a preservation technique used by majority of cowpea traders in the district. Cowpea traders in the district indicated that since farmers have already preserved cowpea, they do not need to preserve with any chemical preservative but just sift it. This accounts for the reason why it is mostly used in the Akatsi District.



Fig. 5.1. A local Sieve (*Agbadza*)

### c. Winnowing

Depending on their specific weight, this is a common method for cleaning of cereals in developing countries (Zehrer, 1980). It is done by using the power of the wind to separate the unwanted lighter parts (including damaged grains, insect pests, dust, bits of stalk, etc.) From the heavier cereal/legume grains. It could be done with the use of a winnowing machine or shovels which toss grain in the air. It could be done manually by pouring the grain out of a container from a height so that the wind blows out the lighter parts. This is practised in the study area.

### 3. Solar & Other Heat/Thermal Disinfestation Techniques:

Thermal techniques are based on the assumption that stored food pests cannot tolerate high temperatures. Insects die when exposed to high temperature because of their limited physiological capacity to thermogulate (Murdock & Shade, 1991). If grain is exposed to full heat, (e.g. from the sun) its temperature rises to the point that adult insect pests are no longer able to survive. As the temperature rises, pests are driven away or killed by the heat. Cowpea bruchid eggs, larvae and pupae do not thermogulate and, being immobile, are unable to escape from a hot environment. Therefore, high temperatures destroy bruchid living within grain.

#### a. Use of corrugated galvanised tin or aluminium sheeting:

This is widely available at fairly low cost in many areas in Africa and it is also used to prevent the infestation of cowpea by pests. Cowpea is dried on these galvanised sheets and placed in the sun. The heat emanating from the sheets helps in the destruction of cowpea pests thus serving as a preservation method. Certain farmers and traders use this method for preservation of cowpea in the study area.

#### b. Intermittent drying of cowpea in the sun:

This is a method mostly used by majority of the farmers in the study area for the preservation of threshed or unthreshed cowpea. It is used since no extra cost is incurred with the use of this method.

#### 4. Use of Admixtures or Mineral Substances:

##### a. Use of abiotic materials

##### i. Wood ash:

The addition of ash to various kinds of cereals and legumes is extremely effective for prolonging the storage life of grain crops and legumes (Golob and Webley, 1980; Ofuya, 1986). The method consists of sifting wood ash from kitchen fires and mixing it with cowpea grain. The mixture is placed in a mud pot granary, jar, jute sacks, or any other vessel, and sometimes pressed down to compress it. Its results, varies with variations in the mode of application, and to the proportion of ash to cowpea grain used. The method works extremely well depending on the ash: grain ratio. The method recommended is to mix sieved ash from cooking fires with cowpea grain in equal volumes, then put this mixture in a closed vessel, press it down firmly, and cover with a 3-cm layer of loose ash (Kitch & Ntoukam, 1991a)

Ash storage does not provide complete protection against the building up of cowpea bruchids unless the ratio of ash to grain is three or more parts as to four parts grain. If immature *C. Maculatus* is already present in grain at the time the grain is mixed with ash, they will complete their development within the seed and may even emerge from the seed even if covered with ash. Consequently, farmers sometimes put infested grain - but apparently undamaged into ash and discover when they remove it later that it now has emergence holes, evoking doubts about its usefulness. When properly used, ash storage arrests cowpea bruchid population development in storage, but it does not kill the generation already within the seeds (Kitch & Ntoukam, 1991a). Therefore, it is important to mix the grain well with ash soon after threshing. This procedure of using ash for storage has the advantage of being universally available as the natural by-product of cooking (especially if firewood is used). Its use does not involve any risk to health. At the

same time, it is said to promote further drying of the stored product (Zehrer, 1980). Since it is a cheap preservation technique, it is used by cowpea producers in the Akatsi district.

ii. Sand:

Sand, for example sea sand is added to seeds provided the cowpea grains are larger than the grains of sand. The use of this method is dependent on the availability of sand close to the place of storage and is thus limited to areas where sand occurs naturally, as is the case in the study area (Zehrer, 1980). For a given quantity of grain measured by volume, the farmer adds a similar or slightly larger volume of sand and mixes them thoroughly.

The addition of sand to beans in the specified quantity, soon results in the destruction of insect pests. This may be due to several different reasons including : poor ventilation that makes it difficult for insects to breathe; their movement being hampered by the dense compacted mixture and the weight of the sand. This effectively prevents them from reproducing thus causing their population to die out. The insects also injure themselves when they try to move through the hard grains of sand, resulting in loss of body fluid and dehydration. This preservation technology, is used just by a few people in the study area.

iii. Use of chemicals:

The use of chemicals to protect cowpea grain in storage seems to be the most readily available technology for the suppression of cowpea pests. There are numerous chemicals which are useful in grain storage work. These include contact chemicals and fumigants. Contact chemicals are chemicals that insects must actually get on their body. Contact chemicals include dust formulations like Actellic dust, and emulsion concentrates like Actellic liquid. The second major

category of insecticides are the fumigants for example Phostoxin. These are gases which enter all cracks. They can get between highly packed grains in storage and do not leave marks on grains. It is noteworthy however that fumigants are extremely dangerous to man. Protective clothing need to be worn when using it (Lindblad & Vita, 1976).

**Actellic Dust (1.6% Pirimiphos - methyl; 0.3% Permethrin) :**

This is a dust formulation which contains low concentrations of insecticide (1.6% Pirimiphos - methyl; 0.3% Permethrin ) mixed with powder. The combination of powder and insecticide makes it safer to handle by the user. Dust mixed with grain causes damage to the body surface and limb joints of insects. Their effectiveness depends on the size of particles. Dust achieves its effect mainly by interfering with the delicate water balance of storage pests ( Zehrer, 1980 ). The dust is mixed with the shelled cowpea and stored in bags. Five teaspoons Actellic dust, is thoroughly mixed with one bag (100 kg) of shelled cowpea. A bag of Actellic 2% dust currently being sold will treat 10 bags of cowpea.

**Actellic 25EC Liquid (25% Pirimorphos - methyl):**

This contains high amount of insecticide mixed with other ingredients. It is more difficult for individuals to use as compared to the use of Actellic dust and they require the use of special equipments for its application (Lindblad & Vita, 1976). One bottle of Actellic 25EC or Actellic liquid is used for mixing a maxi bag of cowpea. Five millilitres of actellic liquid is equivalent to one teaspoonful or one half of the metal cap from the actellic can. This Five millitres (ml) of Actellic liquid is diluted with 190 ml. of water in a hand pump sprayer (the type used to spray mosquitoes). The mixture is sufficient to spray one bag (100kg.) of shelled cowpea grain.

#### Phostoxin (56% Aluminium phosphide):

This is a solid fumigant which can either be found in a tablet, packet or pellet form. The active chemical in this fumigant is Aluminium phosphide. The tablet releases phosphine gas when it gets into contact with moisture. Fortunately, the tablet takes about three hours to release enough poison to kill a person. It is advisable therefore to use in airtight containers. The fumigation must continue for at least 72 hours. The poison kills the insects present in the grain but does not protect the grain from further attack (Lindblad & Vita, 1976).

A minimum of 2 tablets of Phostoxin, are put into a maxi-bag of dried and shelled cowpea. Since certain producers and traders in the study area store cowpea in their living rooms (sitting room, bedroom, and kitchen), they feel it is not healthy to use this preservation technology, especially because it is poisonous. Their storage practice is therefore likely to affect the adoption of this technology.

#### 5. Substances of Plant Origin or Botanicals:

The plant kingdom is very large and offers a wealth of resources. The use of plant materials for the preservation of cowpea is common on low resource farms in sub-Saharan Africa. This is often as whole plants or leaves of various mints, aromatic or pungent plant materials, or oils are mixed with the stored cowpea grain. These include many substances that are effective against insects.

##### a. Use of Edible Oil:

An effective way to protect dry beans such as cowpea from bruchids is to mix the grain thoroughly with small amounts of edible oil (Schoonhoven, 1978; Singh, Luse, Leuchner, & Nangju, 1979). A variety of oil seeds can be used, including oil from palm kernel, cottonseed, groundnut, neem, soybean, citrus peels, sheabutter (Percira, 1983).

Groundnut oil is used to preserve small quantities of cowpea from damage by storage insects. Only small amounts of oil that is 5 - 10 millilitres of oil per kilogram of the threshed grain is needed to preserve the grain for months (Singh *et. al.*, 1979 ). Another measure is 1-2 teaspoonful of oil per full margarine tin of grain). One and one-half beer bottle of cooking oil is needed to treat one maxi -bag of cowpea.

Though effective, oil treatment has some negative attributes. Treating much grain ( for instance above 10 kgs) thoroughly is tedious. Oil also becomes rancid with time, or have inherently negative properties ( neem oil, for example, stains the hands and has an unpleasant 'garlic' odour). Oil treatment is often messy and it is easy to pick up dust and debris while applying it. Thus, while oil treatment is effective, its degree of acceptance is limited by these negative attributes. In the study area, although extension agents recommend the use of groundnut oil, respondents who used the method indicated they used more of palm-kernel oil which is locally produced for preservation instead of groundnut oil. They also indicated they preferred using the oil (which is scarce to come by) for cooking instead of preserving cowpea.

It is noteworthy that the use of Actellic dust, Actellic liquid, Phostoxin, and Edible oil are preservation technologies extended by Agricultural extension agents in the district. These technologies were introduced in the study area during the cowpea season in August/September, 1993.

#### b. Neem tree products

The Neem tree (*Azaterachta indica.*) probably found throughout tropical Africa, contains certain insecticidal properties. Various substances derived from the neem tree, have traditionally been

used for the control of pests in storage. Some cowpea producers in the Akatsi district are also aware of the use of this technology for preservation of cowpea. The seeds and leaves are dried, crushed and either mixed in powder form with the dried cowpea or diluted with water and mixed with cowpea before drying.

### c. Pepper / Paprika

Ofuya (1986), noted that onion scales and dried chili pepper fruits confer some degree of protection against *C. maculatus*. Thus they are mixed with cowpea to prevent weevil infestation. This practice is not too well known in the study area.

### 6. Sealed Container Storage:

Experiments suggest that oxygen elimination contribute to the preservation of grains (James, 1993). A consequence of oxygen removal from a grain store is the suppression of insect infestation that could develop in the grain. In modern times, it has been proven that air tight storage suppresses insect infestations in stored grain. Sealed containers may include: underground silos, metal drums, clay pots, local kegs ('Adjafi'), among others. The procedure involves drying the threshed cowpea grain in the sun, then filling the storage containers and sealing them off.

It is vital that the storage containers have no openings such as cracked seams that might admit oxygen and that the cap be tightly sealed. Even a brief opening can admit enough oxygen to allow insects to resume activity and further damage grains (Singh *et. al.*, 1987). To ensure that it is air - tight, the cap should be greased before tightening. Filled containers should be kept in the shade or storehouses so that the cowpea grain does not get too hot due to absorption of solar radiation by the drum.

In the Akatsi District of the Volta Region, the container in which cowpea is preserved after drying is a local keg known as “Adjafi”. This method is used for small scale preservation of cowpea in the district. Figure 5.2 is a picture of a local keg commonly called “Adjafi” which is used as a sealed container for preservation of cowpea.



Fig. 5.2. A local Keg (Adjafi)

b. **Bagging:**

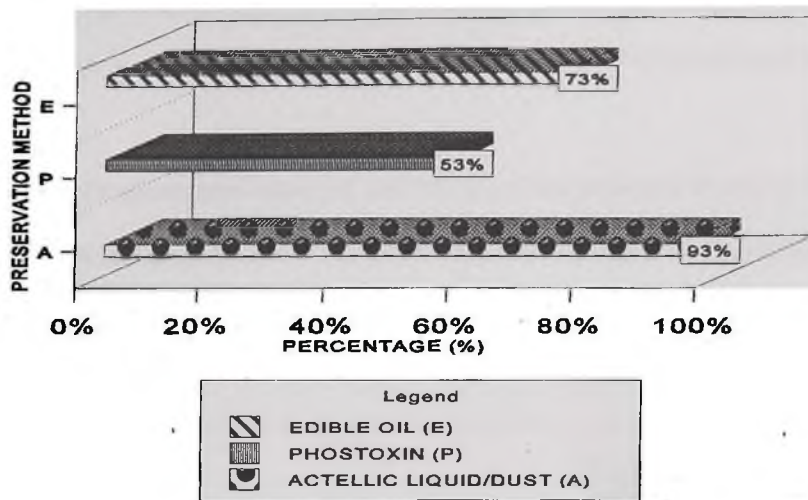
In the Bean /Cowpea - CRSP cowpea storage project in Cameroon, researchers devised a simple and inexpensive bagging technique for long - term storage of cowpea. The test involved adding fumigants to cowpea stored in plastic bags. These bags were sealed and stored for months. Because the bags are transparent it was easy to visually monitor grain storage. A disadvantage with this technology however is that the bags are fragile and could burst any time especially with rough handling. In the study area instead of the plastic bagging, jute sacks are used for the preservation of cowpea.

Generally the findings suggest there is a substantial amount of indigenous knowledge about cowpea pests and their control in the study area. Those introduced by extension are cowpea preservation technologies that either involve the use of chemicals or substances of vegetable origin.

Each technology described above for post harvest storage of cowpea has limitations and merits. Cowpea producers and traders with grain to store, have to choose among the methods (Murdock, *et al.*, 1997). The range available make it more likely that they will find a technology that meets their individual needs. However, the limitations of the purely physical means, and the use of botanicals imply that whatever method is used should be accompanied by insecticides to achieve good control of the pests (Singh *et al.*, 1997)

## **5.2. Cowpea Preservation Technologies Extended by AEA's**

Figure 5.3 gives the percentage distribution of improved cowpea preservation technologies extended by AEA's in the study area. Improved cowpea preservation technologies mainly extended by AEA's in ranked order are Actellic, Edible oil, and Phostoxin.



Source: The Study (1998).

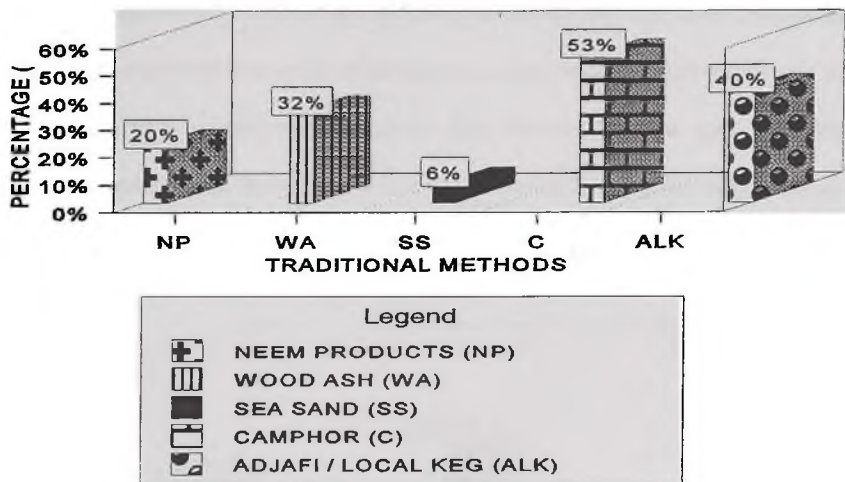
Fig. 5.3. Improved Cowpea Preservation Technologies Extended by AEAs in the Study Area.

Due to certain reasons, 47% of AEAs extend more information on non - chemical based and traditional technologies instead of information on ICPTs. These reasons include: the fear of residual effect of chemical preservatives on human health; the need for farmers to have cheaper methods of preservation. Other reasons are because AEAs personally do not believe in the use of chemical preservatives and also the fact that chemicals pollute the environment.

Figure 5.4 gives an indication of traditional cowpea preservation technologies extended by certain AEAs. The traditional cowpea preservation technologies extended in ranked order are: the use of naphthalene balls or camphor (53%) for storage of cowpea in a sealed container, the use of the local keg - 'Adjafi' (40%), wood ash (32%), neem products (20%) and the use of sea sand (6%). Since such AEAs would rather give information on the non - chemical based or traditional

cowpea preservation technologies instead of information on ICPTs, their clientele would be deprived of the opportunity to have knowledge about these ICPTs, for them to decide whether they would adopt or not. This situation is likely to affect the level of adoption of ICPTs.

A combination of traditional and improved methods of cowpea preservation appear to have been extended by AEAs in the study area. These are to help cowpea producers and traders reduce post harvest losses and increase the shelf - life of their produce.



Source: The Study (1998).

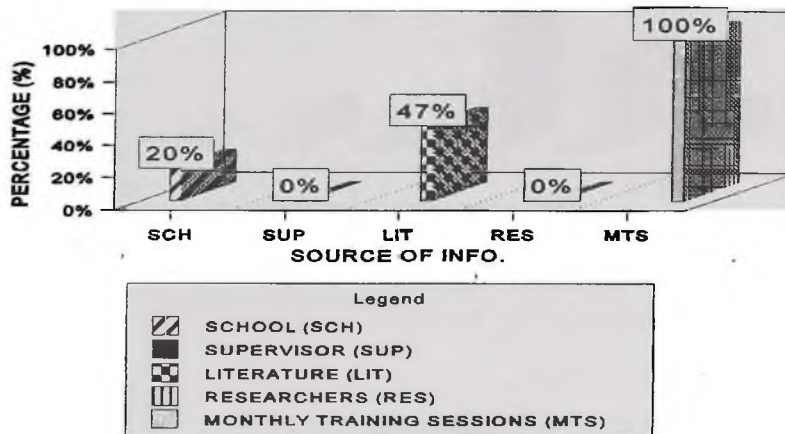
Figure 5.4: Traditional Cowpea Preservation Technologies Recommended by Certain AEAs in the Study Area.

### 5.3. Sources of Cowpea Preservation Messages

Technological information is the main commodity the extension worker has. To determine their information source(s), extension agents were asked to indicate those sources through which they received cowpea preservation messages. Figure 5.5. shows that the main source of information

for AEAs was monthly training sessions (100%) followed by Literature (47%), information acquired in school (20%), and no information was derived from their supervisors (0%) and researchers (0%).

Extension agents expedite the flow of appropriate information from selected sources to selected audiences ( Lancaster & Sattar, 1984). Since the volume of technology is increasing at an accelerated rate, field extension workers must have a readily available source of technical information to keep abreast with the accelerated rate of technology. This would enable them help their clientele solve current problems of agricultural production and rural living (Maunder, 1972). It follows therefore that the effectiveness of extension services must depend heavily on the quality, reliability, and efficiency of information sources they themselves draw upon. If adequate and current information on cowpea preservation is made available at these monthly training sessions, AEAs would have information to disseminate to their clientele to help solve their problems.



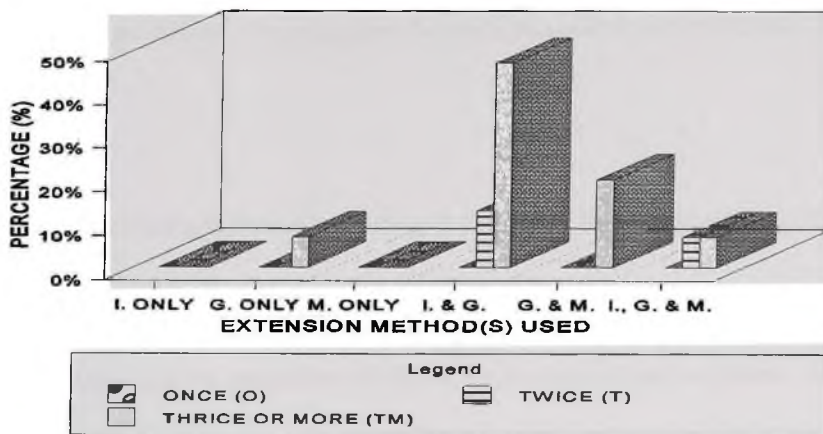
Source: The Study (1998).

Fig.5.5 : AEAs Source Of Cowpea Preservation Messages

#### 5.4. Extension Delivery Efforts

##### *Methods of Extension Delivery Used By AEA's and the Frequency of Contact with Clientele.*

An attempt was made in this study to find out the different educational techniques employed by AEA's in educating their target group and the frequency of contact with them. The combination is showed in Figure 5.6. Combining the method used and the frequency of contact as indicated by extension workers gives a picture of extension delivery from the AEA's point of view. It shows that not only are combinations of interpersonal channels of extension delivery used (group and individual methods) in dissemination of cowpea preservation messages, but in addition, they tend to be used more frequently to contact clientele. Majority (87%) of AEA's indicated that they contacted their clientele thrice or more within a month especially in the cowpea farming season.



I = Individual Method

G = Group Method

M = Mass method

Source: The Study (1998)

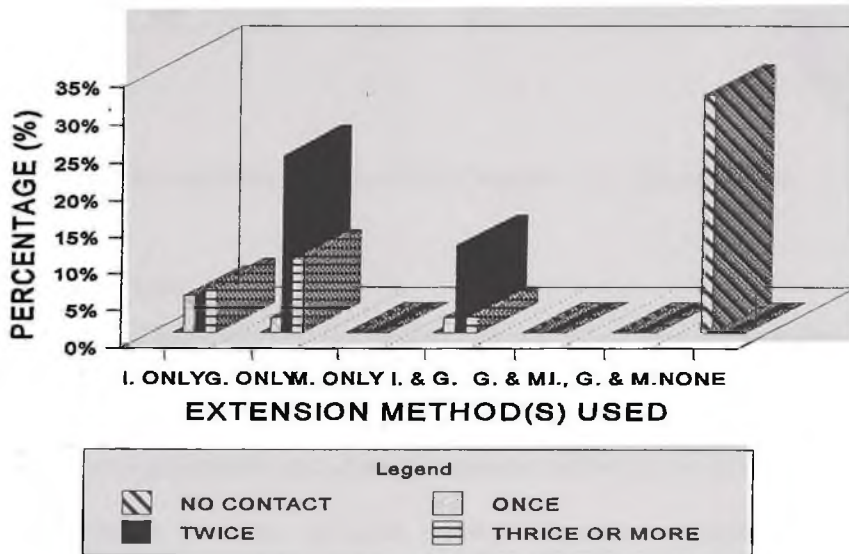
Fig. 5.6. : Methods of Extension Delivery Used By AEA's and the Frequency of Contact with Clientele.

The use of multiple methods re-enforces each other since the more the number of ways new information is presented, the faster the individual learns (Swanson, 1984). The more ways people are exposed to extension information, the larger the likelihood of acceptance of recommended practices. So when a new practice is exposed in several ways to an individual, the more likely he would find his preferred method of learning (Maunder, 1972) which would aid in the adoption of practices. The multiple methods used in extending information thus would enhance the awareness and adoption of improved cowpea preservation technologies (Van den Ban & Hawkins, 1985). In addition to this, those frequently contacted are likely to have higher adoption levels. Basu (1969), in his report on the Western State of Nigeria, found that those who had extension contact, more readily adopted new practices. The number of contacts that individuals have with new ideas is positively related to early adoption of innovations (Effionayi, 1975). Adoption of cowpea preservation technologies in the study area is likely to be related to frequency of extension contact.

*Methods of Extension Delivery Producers & Traders Indicated AEAs used and their Frequency of Contact.*

Whilst Fig. 5.6. gives the nature and intensity indicated by the AEAs as their contact with their clientele, it is important that the assessment of input is based on the clients contacted. The extent to which producers and traders have received improved cowpea preservation messages through various extension methods and their frequency of contact with AEAs, is shown in Figures 5.7 & 5.8. A comparison of these figures shows the difference in extension methods producers and traders were contacted with. Twenty-four percent of traders (24%) indicated they were reached with multiple methods (mainly a combination of group and individual methods) than producers (16%). Thirty-six percent of producers (36%) indicated they were contacted mainly with the group - only method. There is also a difference between the frequency of contact indicated by

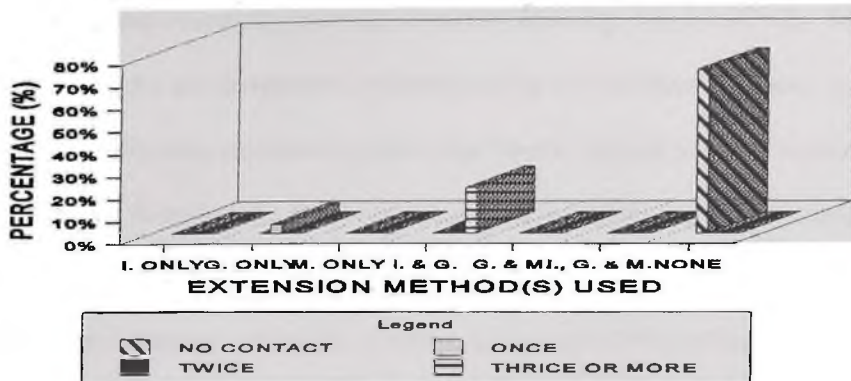
producers and traders and what was indicated by AEAs. Traders are contacted less frequently by AEA's than producers. Seventy - two percent (72%) of traders as compared to 30% of producers had no contact at all with AEAs. In fact, most producers (61%) indicated they were contacted twice or more within a month whereas majority of traders (72%) had no contact at all. It shows that there is vast inequality in access to extension messages on ICPTs between producers and traders, in favour of producers.



I = Individual Method    G = Group Method    M = Mass method

Source: The Study (1998)

Fig. 5.7. : Methods of Extension Delivery Producers Indicated AEAs used and their Frequency of Contact.



I = Individual Method    G = Group Method    M = Mass method

Source: The Study (1998)

Fig. 5.8. : Methods of Extension Delivery Traders Indicated AEAs used and their Frequency of Contact.

Together, the emerging picture is that, although extension workers try to contact their clientele at least twice a month, the contact per client is lower since not every member or clientele is contacted that frequently. Although fewer traders are contacted (those who are also farmers), the nature and intensity, is better and more intensive than that of producers.

The sheer amount of client contact is by no means the sole explanation of a change agents success in dissemination of information. On the other hand, extension agents may have presented a false report but actually do not use those methods of extension delivery and do not contact them as frequently as they indicated. To verify this, the extension methods clientele indicated they were contacted with and their frequency of contact was compared with that from AEAs point of view.

A comparison of the method of extension delivery and frequency of contact from the clientele and AEAs point of view reveals the following disparities (Ref. Fig. 5.6, 5.7, & 5.8). Whereas AEAs indicated they did not disseminate information using the individual extension teaching method only, 17% of cowpea producers indicated they were contacted with that method only. The traders confirmed AEAs report. They were not contacted with the individual method only. The producers and traders confirmed that AEAs contacted them with the group only method but indicated a difference in frequency of contact. Twenty - five percent (25%) of cowpea producers indicated they were contacted twice within a month and 4% of cowpea traders indicated they were contacted once. Whereas AEAs report showed no producer nor trader was contacted less than thrice or more with this group only method. There is therefore a disparity in their account. The producers and traders however confirmed the mass only method was not used by AEAs in contacting them.

Producers and traders further confirmed AEAs use of the combination of the individual and group only methods but there was a difference in the report of the frequency of contact. Whereas 60% of AEAs indicated they used that combination in extending information with thrice or more contact, 2% producers indicated they were contacted just once with this combination of extension teaching methods.

No trader nor producer indicated they were contacted with a combination of the group and mass teaching method nor a combination of the individual, group and mass teaching methods although AEAs indicated they used these combinations. The disparity may either be because genuinely AEAs made just those contacts clientele indicated they made but gave wrong information to create an impression that they were effectively working. If this is the situation, certain constraints

to extension delivery may help make this situation understandable. These are examined in the study.

It was deduced from the study that the most used extension teaching method by AEAs (94%) was the group method (Ref. Fig. 5.6). This confirms findings of Kang & Song (1984), that group teaching methods are more frequently used in extension work than the individual teaching method. This is not surprising because by utilizing group techniques, an extension worker can reach more people than possible by following the individual method alone. It is also an important factor when time and staff are limited as is the case in the Akatsi district. It is also an effective method in trying to persuade extension clientele to try new ideas or practices ( Swanson, 1984).

Examples of the group teaching methods used in the study area were the traditional demonstration - based methods that have been in many ways the corner - stone of extension work. These are the method and result demonstrations. Twenty percent (20%) of AEAs used method demonstration only, about 7% used result demonstration only while 73% indicated they used both result and method demonstration. Ideally, each individual attending the demonstration, should have an opportunity to practice the new skill during the session but time and logistics however does not permit more than a few to participate in the demonstration in the study area. When this results and there is inadequate follow-up by the extension agent, there is likely to be the problem of misapplication of preservation technologies and subsequently, if farmers do not achieve the result they expect, there is likely to be low adoption of the innovation.

The least used method was the mass media channel. A reason for the low utilization of the mass method was because they did not have the facilities for extending information using that method.

Since cowpea preservation information is not just needed to keep up to date on farming issues but to help meet the farmers need of reducing post - harvest losses and acquire more income, the mass method may not be reliable in dissemination of information, thus resulting in its low utilization by extension agents.

The individual method mostly used was home visits of individual farmers or farm families. A reason for the moderately high use of the individual method although it is time consuming, and wastes money is that, it is through working individually with clientele that the extension worker gets to know what their needs are and how they carry on their work. It is through this method that the credibility and integrity of the extension worker can be nurtured ( Kang & Song, 1984) so that in future he would be able to convince clientele to adopt innovations.

*Disadvantages with Use of Extension Method by AEA's in Dissemination of Cowpea Preservation Messages*

Perceptions of disadvantages of the extension teaching methods employed in dissemination of cowpea messages were indicated by the AEAs. These they indicated made the methods of delivery ineffective for dissemination of cowpea preservation messages (See Table 5.1. Below).

Table 5.1 : Disadvantages with Use of Group Extension Method by AEA's in Dissemination of Cowpea Preservation Messages

DISADVANTAGE	FREQ. (n=14)	%
- Negative attitude of farmers to attendance of meetings	7	50
- Not all individuals in the group will understand the tech.	6	43
- If monitoring of the tech is not well done, misapplication of technology occurs.	4	29
- Rate of concentration of group member is low	2	14
- Not Applicable	1	7

In addition to this, group methods often reach one select part of the target group because only those interested in extension or those who are members of farmers groups come to the meetings. The implication is that cowpea preservation messages may not get to all end - users of the technology but only to those interested in extension activities if the group extension method is used in dissemination of information. This confirms findings by Van den Ban & Hawkins (1985) that dissemination of information using the group method, often reaches only a selected part of the target group who are interested in extension or those who are members of certain organisations since they are the ones who come for meetings. Those in the group could however help in diffusion of the message.

It is noteworthy that group methods may successfully promote a general awareness of new ideas. However, they are woefully inadequate as a source of specific information that meets a particular farmers needs ( Whale, 1989). This was however the method mostly used by AEAs in the study area. The clientele may agree at a meeting or demonstration that a certain method is good because he wishes to conform with other members in the group in the acceptance of a new idea. He may be reluctant or embarrassed to admit that he does not understand. For effective delivery, there is a need for AEAs to follow up demonstrations with individual visits to discuss new ideas in relation to his own farm and the problem he sees in trying to apply this new method ( Maunders, 1972). This suggests a need for an overlap in the use of extension methods (as was the case in the study area).

Van den Ban & Hawkins ( 1985), indicated that costs in terms of staff time and travel is high with the use of the individual method and this also applies in the study area since these were the main reasons given by AEAs in the study area as disadvantages of using the individual method in dissemination of cowpea preservation messages.

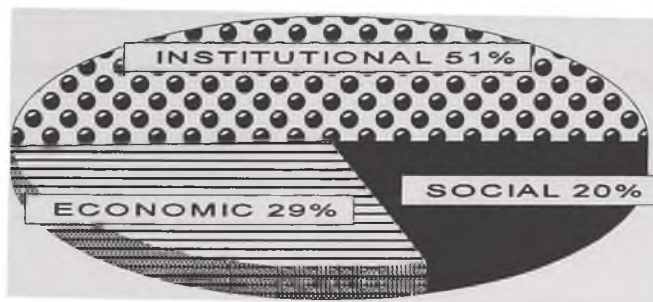
Table 5.2 : Disadvantages of Use of Individual Extension Method by AEA's in Dissemination of Cowpea Preservation Messages

DISADVANTAGE	FREQUENCY (n=11)	PERCENTAGE(%)
-It is a waste of money only	1	9
-It is a waste of time only	7	64
-It is a waste of time and money	3	27
-Not applicable	4	36

### 5.5.- Constraints to the Delivery of Cowpea Preservation Messages

Reducing post-harvest loss so as to gain more income and make more food available, are priorities of farmers. Agricultural extension organizations have the potential to address these priorities of farmers. To do so however, some serious problems constraining the extension agents ability to facilitate effective dissemination of cowpea preservation messages need to be addressed and if possible resolved.

An attempt was made to find out from AEAs, constraints to effective delivery of cowpea preservation messages. These have been grouped into categories namely, the social constraint, economic constraint and institutional constraints, as summarized in Figure 5.9. below.



Source: The Study (1998).

Fig.5.9. : AEAs Constraints To Delivery Of Cowpea Messages.

*Institutional Constraints:*

The main constraint to delivery of cowpea messages was the institutional constraint. Institutional constraints indicated by AEAs were poor pay and service conditions (100%), mobility problems (47%) and inadequate supply of input for demonstration (40%). Extension service is primarily about people. Their attitude and behaviour determine the effectiveness of the organisation. It is important to have enough personnel to organise and conduct programmes reaching members of the rural community. But this is not possible for services in early stages of development or where funds are limited (Maunder, 1972) as is the case in the study area. In the study area, technical trained personnel are simply insufficient. They therefore have to work with a large number of clientele within large operational areas. To compound the problem, extension agents in the district indicated they lacked zeal for performing extension work due to lack of adequate incentives. They are not remunerated adequately, there is irregularity in fuel supply and payment of travel and transport (T& T) allowances and other field allowances.

Since the effectiveness of extension education depends so much on the energy and initiative of the staff, high morale is especially important. Underpaid and ill - equipped personnel are unlikely to display much enthusiasm in their work ( Maunder, 1972). Reduced salaries, and absence of fringe benefits, lower the morale of staff and this results in inefficient extension education occurring.

Adequate transportation is the prerequisite for effective extension work and presents special problems for extension organisations including Extension Officers in the study area. The field level personnel in the study area, lack adequate transportation to reach farmers effectively.

Although majority of the AEsAs have motorcycles, a few do not have this. Even those who had it complained about mechanical problems due to the age of the motorbikes. As a result of this, AEsAs found it difficult visiting farmers within their operational areas especially when dispersed settlement patterns were prevalent in the study area. To compound this problem, there is only one Nissan pick - up that is used by the district director and his deputy for supervisory trips thus AEsAs without motorbikes do not have access to this. Visiting schedules (individual visits and group meetings) consequently were inadequately followed. AEsAs rather used the time engaging in activities unrelated to their job schedules in a bid to get income to supplement their meagre salary.

It does appear that lack of mobility is perceived to be a serious problem not only in Ghana, but also worldwide (Sigman & Swanson, 1984) and this affects the efficiency of extension delivery. All categories of extension staff, must be able to travel throughout their respective service areas if the organisation is to fulfill its mission (Claar & Bentz, 1984). Without transportation, contacts may be limited to those who come to see them and a few who live within walking distance (Maunder 1972).

Demonstrations and teaching equipments are the tools of the extension agents profession. Supplies of input for demonstrations are important, always bearing in mind that equipments used in demonstrations should also be available to farmers who are expected to follow recommended practices ( Maunder, 1972). This seems so obvious for effective extension delivery but extension workers in nearly every country (including those in the Akatsi District) are handicapped by the lack of inputs necessary for effective work (Maunder, 1972). Extension agents in the study area

rely on farmers for the provision of inputs for demonstrations. As indicated by Claar & Bentz (1984), extension agents can naturally not be successful in demonstration work without access to adequate supplies and equipments.

#### *Economic Constraints:*

Economic constraints identified by AEAs include: lack of capital to buy inputs for demonstration (47%), high cost of inputs (40%) and unavailability of inputs (33%). Twenty-seven percent (27%) also indicated a need to subsidize the cost of chemicals. Adequate funds with which to operate an extension service is the most commonly expressed need of extension administrators. Extension requires funds for the large number of personnel required, as well as for transport, input supplies and equipments (Maunder, 1972).

The recommended cowpea preservation practices, require the use of chemical preservatives, the prices of which farmers could hardly afford. The problem was magnified as a result of the unavailability of credit facilities for farm operations. A report by National Agricultural Extension Project (N.A.E.P., 1997) realized the problem with using available storage technologies was the cost, of the technology. A constraints to low adoption of agricultural technologies was therefore the lack of inputs and astronomical prices of farm inputs (as is the case in the study area). As a result of this, there is likely to be a low adoption of recommended preservation practices.

#### *Social Constraints:*

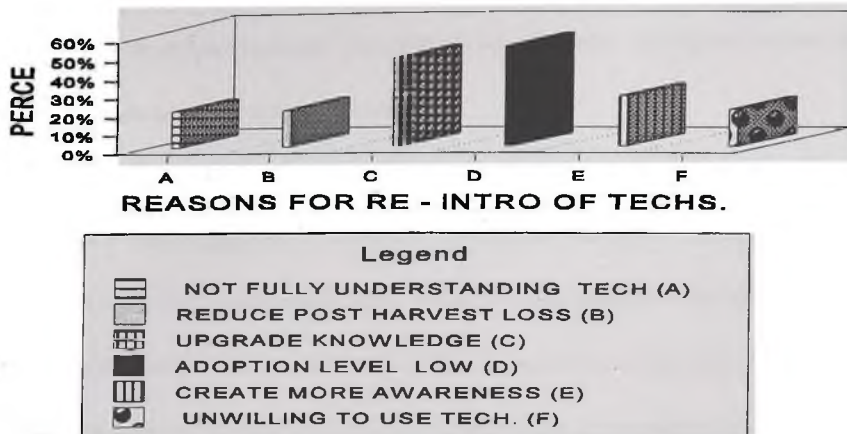
Farmers attitude towards extension activities was a constraint to extension delivery. Extension agents explained that ever since the withdrawal of subsidy on agricultural inputs, farmers have lost interest especially in practices that involved the use of inputs. Since the recommended cowpea

preservation practices require the use of inputs which most farmers cannot afford, they do not see why they should attend meetings that are not beneficial to them. Twenty-seven percent (27%) of the AEAs indicated farmers portrayed a lukewarm attitude to extension activities, 40% indicated farmers were unwilling to attend meetings, while 13% indicated they were unwilling to preserve cowpea altogether. The attitude of farmers dampens AEAs enthusiasm or zeal in performing extension activities.

These constraints if not addressed would lead not only to ineffective dissemination of improved cowpea preservation messages but to the general dissemination of information in the study area. When addressed however, it would help in the reduction of post harvest loss of food and help increase food security in the study area and subsequently in Ghana as a whole.

#### **5.6. Re - Introduction of Cowpea Preservation Technologies**

It is noteworthy that despite the fact that cowpea preservation technologies have been introduced in the study area, 93% of the AEAs interviewed felt there was a need for the re - introduction of these preservation technologies. Reasons given for the need for re-introduction are indicated in Figure 5.10. The most important reason for the need for re - introduction of cowpea preservation messages was the low level of adoption of the technologies recommended by AEAs.



Source: The Study (1998).

Fig.5.10. : Reasons for Re - Introduction of the Technology:

## 5.7. Summary and Conclusion

This chapter discussed the nature and intensity of extension delivery efforts with regards to cowpea preservation technologies. It was realised that messages on traditional as well as improved cowpea preservation technologies were disseminated by AEAs in the study area. ICPTs mainly extended by AEAs in ranked order are: Actellic, Edible oil, and Phostoxin. In addition, information is extended on traditional cowpea preservation technologies. These are in ranked order: the use of naphthalene balls or camphor for storage of cowpea in a sealed container, the use of the local keg, wood ash, neem products and the use of sea sand.

Extension workers have acquired information on cowpea preservation mainly through monthly training sessions and to a limited extent, from literature and pre - service training. Methods indicated to be used by the AEAs in extension delivery are a combination of the individual and

group methods to contact farmers thrice or more within a month. The general impression is that extension delivery efforts have involved contacting cowpea farmers and traders mainly with group methods about twice or more within a month.

There was also a vast inequality in access to extension messages on cowpea preservation technologies between producers and traders, in favour of producers. The infrequent contact is detrimental to achievement of the objectives of reducing post-harvest losses through the use of improved cowpea preservation methods since cowpea traders store more cowpea and for longer periods of time than the producers. Extension agents need to widen their target net and make preservation messages more accessible to cowpea traders.

Constraints to the delivery of cowpea preservation messages, were categorised into three namely: institutional, economic and social in descending order. These need to be addressed for effective dissemination of information to occur. As a result of the low adoption of cowpea preservation technologies, extension agents in the study area felt the need for re - introduction of cowpea preservation technologies to their clientele. This further supports the need for this study to contribute knowledge to improving adoption of ICPTs.

## CHAPTER SIX

### PERCEPTIONS OF ATTRIBUTES OF ICPTs

#### 6.0. Introduction

The chapter describes the level of awareness of these technologies, before going on to describe the perceptions of characteristics that cowpea producers and traders have on the different ICPTs that have been introduced by the MoFA, Ghana's extension staff in the Akatsi District of the Volta Region. These attributes are grouped into the relative advantage, compatibility, complexity, trialability and observability of the technologies. The use of such classification of attributes enables different innovations to be studied and compared in general terms.

#### 6.1. Level of Awareness of Cowpea Preservation Technologies

Awareness is a favourable attitude towards adoption of an innovation (Agarwal & Prasad, 1998). Although it is not a direct predictor of adoption behaviour, it compels potential adopters to seek further information about the innovation. Awareness is thus a crucial prerequisite to the development of specific positive perceptions which in turn lead to innovation adoption (Ajzen & Fishbein, 1980; Agarwal & Prasad, 1998).

Table 6.1. Level of Awareness of Cowpea Preservation Technologies

METHOD	SPECIFIC TECHNOLOGY	LEVELS OF AWARENESS			
		Producers		Traders	
		Freq. (n=60)	%	Freq. (n=25)	%
i. Mechanical method	- Handpicking	9	15	7	28
	- Sifting	60	100	19	76
	- Sun drying	60	100	8	32
	- Winnowing	50	83	15	60
ii. Use of admixtures/ mineral substances	- Sand	1	2	0	0
	- Wood ash	17	28	5	20
iii. Use of chemicals	- Actellic liquid***	22	37	8	32
	- Actellic dust***	31	52	12	48
	- Phostoxin***	15	25	4	16
	- Naphthalene balls (Camphor)	40	67	12	48
iv. Substances of Plant Origin	- Edible oil***	21	35	6	24
	- Neem Products	6	10	0	0
	- Pepper	1	2	0	0
v. Sealed Container Storage	- Use of Local Keg (Adjafi)	15	25	5	20
*** Preservation Technologies recommended by Agricultural Extension Agents (AEAs)					

Table 6.1. shows that both producers and traders are aware of some of the five groups of methods of cowpea preservation technologies. The level of awareness of preservation technologies by cowpea producers and traders was highest with the use of mechanical methods. Intermittent drying of cowpea (100%) and sifting of cowpea (100%) were mechanical methods producers were mostly aware of. Cowpea traders on the other hand were mostly aware of the use of the sifting method (76%). For producers and traders, the highest level of awareness of ICPTs was in the use of Actellic dust (52% and 48% respectively) followed by Actellic liquid (37% and 32% respectively), Edible oil (35% and 24% respectively) and Phostoxin (25% and 16% respectively) in descending order.

Generally, producers had higher awareness levels of ICPTs than traders. Cowpea traders who had knowledge of ICPTs were those who grew cowpea themselves. Comparatively, the level of awareness of traditional cowpea preservation technologies (especially the mechanical methods) was higher than that of extension recommended cowpea preservation technologies. Improved cowpea preservation technologies are used by a minority of respondents who can afford the cost of storage. The use of improved methods of preservation including ICPTs, would however augment the available food supply and enable a more even distribution of these supplies over time and space. Intensive education on the use of improved cowpea preservation technologies, which would help increase awareness and subsequently adoption of cowpea preservation technologies, is therefore necessary to foster production increases needed to sustain current population growth.

## **6.2 Perceptions of Specific Attributes of Selected ICPTs**

Perceptions of attributes of technologies can be examined at three levels: specific, general and overall levels. The components of the general and specific attributes are shown in Table 6.2 and Appendix 5). Perceptions of specific attributes of the ICPTs are such that Phostoxin is perceived to have the highest range of positive attributes (13), followed in descending order by Actellic dust (10), Actellic liquid (8), and Edible oil (6).

Apart from the quantitative differences, there are qualitative differences. The presence of positive perceptions for some and not for others enables us identify seven main attributes on which ICPTs are perceived to differ qualitatively. With the exception of Phostoxin, the use of all ICPTs were perceived to involve the use of more time and work. The use of Phostoxin was perceived to involve less work and time as compared to the use of traditional cowpea preservation technologies. With the exception of Phostoxin, as compared to the use of traditional cowpea

problems if cowpea was preserved using ICPTs. Actellic liquid and Edible oil were considered dissimilar to traditional cowpea preservation technologies. With regards to complexity of use of ICPTs, Edible oil was perceived as not being easy to use while the others were perceived as being easier to use than traditional cowpea preservation technologies. The use of Phostoxin and Actellic dust were perceived as not being expensive to try out on a limited basis (piloting cost). The advantage of using Edible oil was perceived to be less visible.

**Table 6.2.: Perceptions of Specific Attributes of Selected ICPTs**

General Attributes	Specific Attributes	Selected ICPTs				Norm
		Actellic Liquid	Actellic Dust	Phostoxin	Edible Oils	
Relative Advantage	Cost		-			
	Income Yielding	+	+	+	+	+
	Shelf - Life	+	+	+	+	+
	Work Involved	-	-	+		
	Time Involved			+		
	Effectiveness	+	+	+	+	+
	Marketing Problems		-	+	-	
Compatibility	Similarity	-	+	+		+
	Taste	+	+	+	+	+
	Smell	+	+	+	+	+
Complexity	Ease of use	+	+	+		+
	Ease in understanding	+	+	+	+	+
Triability	Piloting cost		+	+		
	Generation of Curiosity			-	-	-
Observability	Visibility of advantage	+	+	+		+

### 6.3. Perception of General Attributes of Selected ICPTs

An analysis was made of respondents' general perceptions of attributes of ICPTs. The results of the analysis are found in Table 6.3. and Appendix 6. Quantitatively, Actellic liquid (AL), Actellic dust (AD), and Phostoxin (P) were each perceived to have four (4) positive attributes, whilst Edible oil (EO) was perceived to have only one (1) positive attribute.

A qualitative analysis of Table 6.3. showed that all ICPTs with the exception of Edible oil were perceived to offer an advantage over the use of traditional cowpea preservation technologies (relative advantage). With the exception of Edible oil, all ICPTs were perceived to be easy to understand and use (complexity); and it was easy to see the result of use of these technologies (observability). However, it was perceived that too much money was committed when trying out all ICPTs (trialability).

Table 6.3.: Perception of General Attributes of Selected ICPTs

General Attributes	Selected Improved Cowpea Preservation Technologies				
	AL	AD	P	EO	Norm
Relative Advantage.	+	+	+	-	+
Compatibility	+	+	+	+	+
Complexity	+	+	+	-	+
Trialability	-	-	-	-	-
Observability	+	+	+	-	+

AL = Actellic liquid AD = Actellic dust P = Phostoxin EO = Edible oil

#### 6.4. Perceptions of Overall Attributes of Selected ICPTs

Table 6.4. (Ref. Appendix 7) shows the overall perceptions of ICPTs. Actellic dust and Phostoxin were perceived positively whereas Actellic liquid and Edible oil were perceived negatively.

Table 6.4.: Perceptions of Overall Attributes of Selected ICPTs

Improved Cowpea Preservation Technologies	Overall Perception of Attributes
Actellic liquid	-
Actellic dust	+
Phostoxin	+
Edible oils	-

The negative perceptions of attributes are likely to have an effect on the level of adoption of the preservation technologies. Extension workers therefore need to increase their extension delivery efforts so as to increase the awareness of the use of ICPTs. This awareness would compel potential adopters to seek further information about the usefulness of ICPTs. Awareness through increased extension delivery would not only help change negative perceptions about ICPTs, but

help in the development of more positive perceptions (Date-Bah and Stevens, 1985; Ajzen & Fishbein, 1980; Agarwal & Prasad, 1998), which would lead to innovation adoption .

The qualitative difference in attributes as perceived by producers and traders may be attributed to the difference in adopter characteristics, extension methods used, and frequency of extension contact ( Moore & Benbasat, 1991; Rogers, 1995). To understand why respondents may perceive the attributes of a technology in a particular way, a relationship between these variables and perceptions would be analysed.

### **6.5. Characteristics and Perceptions of Attributes of ICPTs**

Table 6.5 shows the relationship between the characteristics of respondents and their overall perceptions of attributes of ICPTs. An analysis of the relationship between personal characteristics and overall perception of the attributes of ICPTs, in Table 6.5. (Appendix 8) shows that, quantitatively, personal characteristics influenced the perception of attributes of Actellic liquid (AL) but not Phostoxin (P), Actellic dust (AD) and Edible oil (EO).

Qualitatively, there was a difference in perception of Actellic liquid and Edible oil. Although personal characteristics did not make a difference in the perception of the attributes of Edible oil, it differed most from the norm. Personal characteristics however influenced the perception of attributes of Actellic liquid. Whilst males had positive perceptions about Actellic liquid, females had negative perception about it. The young (40 years or less) perceived the attributes of Actellic liquid positively while the old perceived it negatively. The educational level was another characteristic that brought about a difference in the perception of attributes of Actellic liquid. Those with no form of education had positive perceptions about Actellic liquid, whereas those with some form of education (formal or non - formal) had negative perception about Actellic liquid.

While those with little working experience had positive perception about Actellic liquid, those with more working experience had negative perceptions about it. Those with small farm sizes perceived the use of Actellic liquid negatively while those with large farm size perceived it positively. Those with small crop yield and those with large crop yield perceived the use of Actellic liquid positively.

Respondents who grew or sold the local variety of cowpea perceived the attributes of Actellic liquid negatively while those who grew or sold the improved variety only or a combination of the improved and local varieties perceived Actellic liquid positively. Those with small quantities of cowpea to store had negative perceptions about Actellic liquid whereas those with large quantities of cowpea to store had positive perceptions.

Table 6.5.: Characteristics and Overall Perceptions of Attributes of ICPTs

Characteristics	Category	Selected Improved Cowpea Preservation Technologies				
		AL	AD	P	EO	NORM
Gender	Male	+	+	+	-	+
	Female	-	+	+	-	+
Age	40 years or less (Young)	+	+	+		+
	41 years & above (Old)		+	+	-	+
Educational Level	None	+	+	+		+
	Formal & Non - Formal		+	+		+
Working Experience	5 years or less (Little)	+	+	+		+
	More than 5 years (More)		+	+		+
Farm Size	2 acres or less (Small)		+	+		+
	More than 2 acres (Large)	+	+	+	-	+
Crop Yield	4 bags or less (Low)	+	+	+		+
	More than 4 bags (High)	-	+	+		+
Variety Grown	Local only		+	+		+
	Improved only	+	+	+		+
	Local & Improved	+	+	+	-	+
Quantity Stored	2 bags or less (Small)		+	+		+
	More than 2 bags (Large)	+	+	+		0

AL = Actellic liquid AD = Actellic dust P = Phostoxin EO = Edible oil

### *6.5.1. Personal Characteristics of Respondents & Perceptions of General Attributes of ICPTs*

An analysis of the relationship between the personal characteristics of cowpea producers and their general perception of the attributes of ICPTs in Table 6.6. & Appendix 9 shows that with the exception of Actellic liquid, personal characteristics did not influence the perception of general attributes of ICPTs. Age of respondents and working experience made a difference in the perception of attributes of Actellic liquid but not gender and the educational level.

The old (more than 40 years) perceived the use of Actellic liquid as not offering an advantage over the use of traditional cowpea preservation technologies (relative advantage) while the young (40 years or less) perceived it as offering an advantage over the use of traditional cowpea preservation practices. The old also felt it was not easy to understand and use Actellic liquid as compared to traditional cowpea preservation technologies (complexity) while the young felt it was easy to understand and use. Contrary to the perception of respondents with little working experience (5 years or less), those with more working experience (more than 5 years) felt the use of Actellic liquid did not offer an advantage over the use of traditional cowpea preservation technologies.

Table 6.6.: Personal Characteristics of Respondents and their Perceptions of General Attributes of ICPTs

ICPTS	General Attributes	Gender			Age			Educational Level			Working Experience		
		M.	Fe	A	<41	>40	A	N.	F &NF.	A	<6	>5	A
Actellic liquid	Relative Adv.	+	+	+	+	-	+	+	+	+	+	-	+
	Compatibility	+	+	+	+	+	+	+	+	+	+	+	+
	Complexity	+	+	+	+		+	+	+	+	+	+	+
	Trialability	-			-						-	-	-
	Observability	+	+	+	+	+	+	+	+	+	+		+
Actellic dust	Relative Adv.	+	+	+	+	+	+	+	+	+	+	+	+
	Compatibility	+	+	+	+	+	+	+	+	+	+	+	+
	Complexity	+	+	+	+	+	+	+	+	+	+	+	+
	Trialability			-							-		-
	Observability	+	+	+	+	+	+	+	+	+	+	+	+
Phos.	Relative Adv.	+	+	+	+	+	+	+	+	+	+	+	+
	Compatibility	+	+	+	+	+	+	+	+	+	+	+	+
	Complexity	+	+	+	+	+	+	+	+	+	+	+	+
	Trialability												
	Observability	+	+	+	+	+	+	+	+	+	+	+	+
Edible oil	Relative Adv.												
	Compatibility	+	+	+	+	+	+	+	+	+	+	+	+
	Complexity												
	Trialability				-		-						
	Observability	-	-	-	-	-		-	-	-			-

Phos. = Phostoxin

M = Male

Fe = Female

A = Norm

N = No Education

F = Formal Education

N-F = Non- formal education

## 6.5.2. : Enterprise Characteristics of Respondents &amp; Perceptions of General Attributes of ICPTs.

An analysis of Table 6.7 and Appendix 10 shows that the farm size, crop yield, variety of cowpea grown or sold and the quantity of cowpea stored made no difference in the perception of the general attributes of Actellic dust, Phostoxin, Edible oil but made a difference in the perception

of the attributes of Actellic liquid. Cowpea producers with small farm size ( 2 acres or less) perceived its use as not being better than the use of traditional cowpea preservation technologies (relative advantage) while those with large farm size ( more than 2 acres) perceived it as being better than the use of traditional preservation practices.

Cowpea producers with low crop yield ( 4 bags or less) perceived the use of Actellic liquid as offering an advantage over the use of traditional cowpea preservation technologies (relative advantage) whereas those with higher crop yield ( more than 4 bags) perceived it otherwise. While respondents who grew or sold improved cowpea varieties only or a combination of improved and local only varieties perceived the use of Actellic liquid as offering an advantage over the use of traditional methods (relative advantage), those who grew or sold the local variety only perceived it as not offering an advantage over the use of traditional preservation technologies. Respondents who store small quantities of cowpea ( 2 bags or less) felt it was not easy to understand and use Actellic liquid for preserving cowpea (complexity) while those who stored large quantities of cowpea (more than 2 bags) felt it was easy to understand and use the technology in preserving cowpea.

Table 6.7. Enterprise Characteristics &amp; Perceptions of General Attributes of ICPTs

ICPTs	G.A	Farm Size			Crop Yield			Variety Grown / Sold				Quantity Stored		
		<3	>2	A	<5	>4	A	L	I.	L & I	A	<3	>2	A
AL	RA	-	+	+	+	-	+	-	+	+	+	-	+	
	C.	+	+	+	+	+	+	+	+	+	+	+	+	+
	Co.	+	+	+	+	+	+	-	+	+	+	-	+	+
	Tria	-	-	-	-	-	-	-	-			-	-	
	Ob	+	+	+	+	+	+	+	+	+	+	+	+	+
AD	RA.	+	+	+	+	+	+	+	+	+	+	+	+	+
	C.	+	+	+	+	+	+	+	+	+	+	+	+	+
	Co	+	+	+	+	+	+	+	+	+	+	+	+	+
	Tria	-	-	-	-	-		-	-			-	-	-
	Ob	+	+	+	+	+	+	+	+	+	+	+	+	+
P	R.A	+	+	+	+	+	+	+	+	+	+	+	+	+
	C	+	+	+	+	+	+	+	+	+	+	+	+	+
	Co.	+	+	+	+	+	+	+	+	+	+	+	+	+
	Tria	-	-	-	-		-					-	-	-
	Ob.	+	+	+	+	+	+	+	+	+	+	+	+	+
EO	R.A		-	-	-	-	-	-	-			-	-	-
	C	+	+	+	+	+	+	+	+	+	+	+	+	+
	Co		-	-	-	-		-				-	-	-
	Tria	-	-	-	-		-					-	-	-
	Obs	-	-	-	-	-		-	-			-	-	-

AL = Actellic liquid

AD = Actellic dust

P = Phostoxin

EO = Edible oil

GA = General Attributes

RA = Relative Advantage

C. = Compatibility

Co. = Complexity

Tria. = Trialability

Obs. = Observability

A. = Norm

L. = Local variety

I. = Improved variety

Adopter characteristics did not influence the perception of general attributes of Actellic dust, Phostoxin and Edible oil but made a difference in perceptions of attributes of Actellic liquid. Age, and working experience did influence the perception attributes of Actellic Liquid. All enterprise characteristics also influenced the perception of attributes of Actellic liquid. The general attributes influenced most by these adopter characteristics were the relative advantage and complexity of the technology.

## 6.6. Extension Delivery and Perception of Attributes of ICPTs

To further understand why respondents may perceive attributes of a technology in a particular way, analysis was made of the relationship between extension delivery and perceptions.

### 6.6.1. Extension Methods Used & Overall Perceptions of Attributes of ICPTs

An analysis of the relationship between methods of extension delivery used and the overall attributes of improved cowpea preservation technologies in Table 6.8. and Appendix 11 the extension method used did not influence the perceptions of attributes of ICPTs. Irrespective of the extension method used, ICPTs were perceived similarly. The overall perception of the attributes of Edible oil however differed from the norm. Edible oil was perceived negatively whereas the other ICPTs were perceived positively.

Table 6.8.: Extension Method Used and Perceptions of Overall Attributes of ICPTs:

ICPTs	METHOD USED			
	Individual	Group	Individual & Group	Norm
Actellic Liquid	+	+	+	+
Actellic Dust	+	+	+	+
Phostoxin	+	+	+	+
Edible Oils		-	-	-
Norm	+	+	+	

### 6.6.2. Extension Method and General Perception of Attributes of ICPTs

An analysis of the relationship between the extension method and perceptions of general attributes may help explain the influence of the method on perceptions. The method used as shown in Table 6.9 and Appendix 12 did not bring about a difference in the perceptions of general attributes of Actellic dust, Phostoxin and Edible oil but made a difference in perception of the attributes of Actellic liquid. The use of the individual method only resulted in respondents perceiving the use

of Actellic liquid as not offering an advantage over the use of traditional cowpea preservation technologies (relative advantage). The use of Actellic liquid was also perceived as not being easy to understand and use (complexity) when the individual method of extension delivery was used. Methods that lead to positive perception of attributes (eg. the group method and a combination of the group and individual method ), should be noted and used more often to achieve the educational objective of extending information to reduce post - harvest loss.

Table 6.9.: Extension Method Used and Perceptions of General Attributes of ICPTs

General Perceived Attributes	Improved Cowpea Preservation Technologies															
	Actellic liquid				Actellic dust				Phostoxin				Edible Oil			
	I	G	I&G	A	I	G	I&G	A	I	G	I&G	A	I	G	I&G	A
Relative Advantage	-	+	+	+	+	+	+	+	+	+	+	+	-			-
Compatibility	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Complexity	-	+	+	+	+	+	+	+	+	+	+	+	-	-		-
Trialability	-	-	-	-	-	-	-	-					-	-		-
Observability	+	+	+	+	+	+	+	+	+	+	+	+	-	-		-

I = Individual method      G = Group method      A = Norm

### 6.6.3. Frequency of Contact and Perceptions of Overall Attributes of ICPTs

An analysis of the relationship of the frequency of contact and the perception of overall attributes of ICPTs in Table 6.10. and Appendix 13 shows that the frequency of contact did not influence the perception of overall attributes of Actellic dust, Phostoxin and Edible oil but made a difference in the perceptions of attributes of Actellic liquid. Those with no contact and those with one contact within a month had negative perceptions about the use of Actellic liquid while those with contact twice or more within a month had positive perceptions. This implies that an increased frequency of contact results in more positive perceptions of attributes of Actellic liquid.

Table 6.10.: Frequency of Contact and Perceptions of Overall Attributes of ICPTs

ICPTs	Frequency of Contact			
	No Contact	Once	Twice	Thrice or More
Actellic Liquid	-	-	+	+
Actellic Dust	+	+	+	+
Phostoxin	+	+	+	+
Edible oils	-	-	-	-
Norm	-	+	+	+

#### 6.6.4. Frequency of Contact and General Perception of Attributes of ICPTs

An analysis of Table 6.11. and Appendix 14, shows that the frequency of contact did not make any difference in the perceptions of general attributes of Actellic dust, Phostoxin and Edible oil but made a difference in the perception of the relative advantage and complexity of Actellic liquid. Those with no extension contact or one contact within a month perceived the use of Actellic liquid as not offering an advantage over the use of traditional cowpea preservation technologies (relative advantage) while those with twice or more contact perceived this attribute positively. It is suggested therefore that there should be more extension contact with clientele to ensure their perceptions be more positive since this would encourage clientele to adopt the technologies.

Table 6.11.: Frequency of Contact of AEAs and Perceptions of General Attributes of ICPTs

General Attributes	Selected Improved Cowpea Preservation Technologies																			
	Actellic Liquid					Actellic Dust					Phostoxin				Edible Oils					
	N	O	T	M	A	N	O	T	M	A	N	O	T	M	A	N	O	T	M	A
Rel. Adv.			+	+	+	+	+	+	+	+	+	+	+	+	+					-
Co.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Com	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					-
Tria.											-									
Obs.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					-

Rel Adv. = Relative Advantage

Tria = Trialability

O = Once

A = Norm

Co. = Compatibility

Obs. = Observability

T. = Twice

Com. = Complexity

N = No contact

M = More than thrice

### 6.7. Conclusion:

The study revealed that both producers and traders were aware of five ranges of methods of cowpea preservation technologies and the highest level of awareness was in the use of mechanical method. Generally producers had higher knowledge levels of ICPTs than traders. Comparatively, the level of awareness of traditional cowpea preservation technologies was higher than awareness of ICPTs. The levels of awareness of ICPTs for both producers and traders were highest for Actellic dust, Actellic liquid, Edible oil and Phostoxin, in descending order. Intensive education which would increase awareness and subsequently, adoption of ICPTs is therefore necessary to foster production increases needed to sustain current population growth.

Phostoxin was perceived as having the highest range of positive specific attributes, whilst Edible oil had the least. Qualitatively, the seven main attributes on which perception of the attributes of improved cowpea preservation technologies differed were perception of work and time involved in the use of the technology, extent of marketing problems, extent of similarity of technology to traditional practices, ease in use of technology, piloting cost, visibility of advantage of use of ICPTs.

With the exception of Edible oil, the perceptions of general attributes of ICPTs revealed that the use of ICPTs offered an advantage over the use of traditional cowpea preservation technologies (relative advantage), and the results of use of these technologies was visible (observability). All ICPTs were also perceived to be easy to understand and use (complexity) whereas their trial on a limited basis was perceived to involve too much money (trialability).

The perception of overall attributes of ICPTs revealed that Actellic dust and Phostoxin were perceived positively whiles Actellic liquid and Edible oil were perceived negatively. Extension

workers need to increase extension delivery efforts so as to create more awareness, which would not only help change negative perceptions but help in the development of more positive perceptions which subsequently would lead to high innovation adoption.

An analysis of the relationship between adopter characteristics, extension delivery method, frequency of contact and perceptions of attributes revealed that with the exception of Actellic liquid ICPTs were not influenced by these variables. With the exception of the quantity of cowpea stored, all adopter characteristics brought about a difference in the perception of overall attributes of Actellic liquid. Adopter characteristics that brought about a difference in the perception of general attributes were age, working experience and variety of cowpea grown or sold, and quantity of cowpea stored.

It would be advantageous if AEAs took note of extension methods that result in more positive perceptions of attributes (the group method only and a combination of the group and individual method). and used more of it since this would help more producers and traders have positive perceptions of ICPTs which ultimately would help the adoption of ICPTs. An increase in AEAs frequency of contact resulted in producers and traders having more positive perceptions of Actellic liquid. It is suggested therefore that AEAs should increase extension contact so as to ensure their clientele develop more positive perceptions of the attributes of ICPTs.

Although five attributes have been proposed and to a limited extent shown to be predictors of adoption behaviour (Rogers, 1995; Agarwal & Prasad, 1998), only two have consistently emerged as salient in this study, as being influenced by adopter characteristics, extension delivery methods and frequency of contact. They are the relative advantage and complexity. These attributes influenced mostly the perception of Actellic liquid but not the other technologies. Technology developers need to re - examine this technology and refine items that the target group had negative perceptions about so as to make the technology more acceptable.

## **CHAPTER SEVEN**

### **ADOPTION OF IMPROVED COWPEA PRESERVATION TECHNOLOGIES**

#### **7.0. Introduction**

Adoption level is traditionally indicated by the percentage of target beneficiaries of extension activities who are using the innovations disseminated for a given period of time. However, in comparing adoption levels of innovations which have been introduced at different times, one more relevant measure is the awareness - adoption gap. This chapter considers adoption and how these are related to personal characteristics, extension delivery and perceptions of attributes of ICPTs.

#### **7.1. Awareness - Adoption Gap:**

A better indicator of the extent of adoption of various technologies is the gap between the level of awareness and the level of adoption. Figures 7.1 & 7.2 show this gap between awareness and adoption for the selected ICPTs. The values for producers and traders awareness-adoption gap is least for Phostoxin (2% - 0%), followed by Actellic dust (7% - 12%), Actellic liquid (14% - 16%), and Edible oil (23% - 16%) in ascending order for cowpea producers and traders respectively. In other words, adoption level is highest for Phostoxin and least for Edible oil. With the exception of Phostoxin, producers generally had lower adoption levels of ICPTs than traders (based on the awareness - adoption gap ).

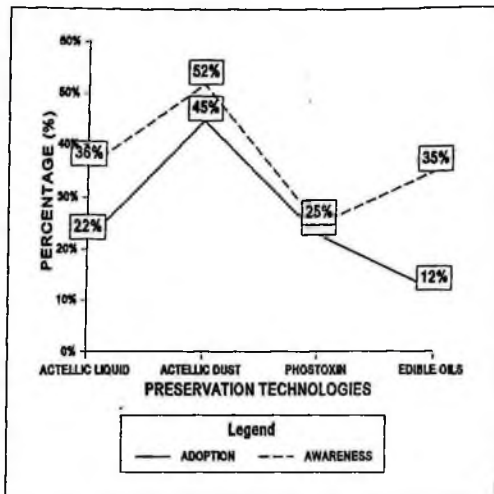


Fig. 7.1: Awareness - Adoption Gap of Producers

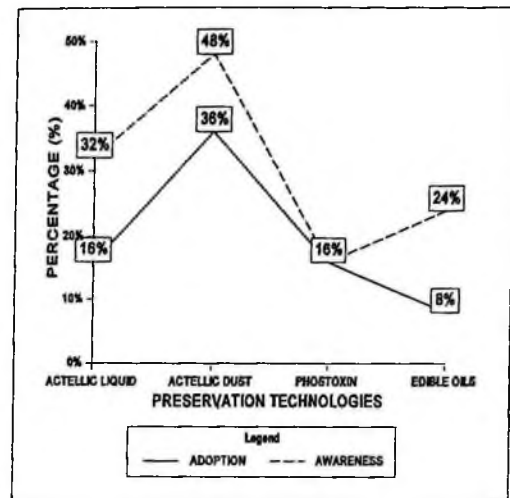


Fig. 7.2: Awareness - Adoption Gap of Traders

## 7.2. Adopter Characteristics and Adoption of ICPTs

To get an idea of factors influencing adoption of ICPTs, the relationship between respondents characteristics and adoption was studied. The characteristics studied were gender, age, educational level, working experience, farm size, crop yield, variety of cowpea grown or sold and the quantity of cowpea stored. An analysis of adopter characteristics of respondents in Chapter 5 revealed cowpea producers and traders only differed significantly with regards to their gender and quantity of cowpea stored. These are therefore the only two adopter characteristics that would be disaggregated and studied as two populations (cowpea producers and traders).

### *Gender & Adoption:*

Table 7.1. shows that there is statistically no significant relationship between males and females with regards to adoption of Actellic liquid, Phostoxin and Edible oil but statistically the adoption of Actellic dust is significantly related to gender ( $\chi^2 = 6.97$   $df = 2$   $< p = 0.03$ ). Contrary to studies (Benor *et al.*, 1985; Wolfson *et al.*, 1990) that women were likely to take more active measures

to preserve cowpea than men, significantly higher proportions of men tended to adopt Actellic dust and Phostoxin than females. More women tended not to be aware of the use of ICPTs as compared to men. This implies cowpea preservation messages are not being directed to the appropriate clientele (women), although they tended to preserve more cowpea. To ensure that there is an increase in adoption of ICPTs, AEA's need to redirect their extension information especially to women since preservation is mainly a woman's task (Benor *et. al.*, 1985).

Table 7.1. Gender and Adoption Level

ACTELIC LIQUID	PRODUCERS						TRADERS					
	Male		Female		Total		Male		Female		Total	
	F	%	F	%	F	%	F	%	F	%	F	%
Awareness - Adoption	6	15	7	33	13	22	0	0	4	16	4	16
Awareness- Non-adoption	7	18	3	14	10	16	0	0	5	20	5	20
Non-awareness	26	67	11	53	37	62	0	0	16	64	16	64
TOTAL	39	100	21	100	60	100	0	0	25	100	25	100
	$\chi^2 = 2.59$		df = 2		.2 < p < .3 (NS)							
ACTELIC DUST												
Awareness - Adoption	22	26	5	24	27	45	0	0	9	36	9	36
Awareness- Non-adoption	3	4	1	5	4	7	0	0	3	12	3	12
Non-awareness	14	16	15	71	29	48	0	0	13	52	13	52
TOTAL	39	100	21	100	60	100	0	0	25	100	25	100
	$\chi^2 = 6.97$		df = 2		< p = 0.03 (S)							
PHOSTOXIN												
Awareness - Adoption	11	13	3	14	14	23	0	0	4	16	4	16
Awareness- Non-adoption	0	0	1	5	1	2	0	0	2	8	2	8
Non-awareness	28	33	17	81	45	75	0	0	19	76	19	76
TOTAL	39	100	21	100	60	100	0	0	25	100	25	100
	$\chi^2 = 3.63$		df = 2		.1 < p < .2 (NS)							
EDIBLE OIL												
Awareness - Adoption	3	4	4	19	7	12	0	0	2	8	2	8
Awareness- Non-adoption	10	12	4	19	14	23	0	0	5	20	5	20
Non-awareness	26	30	13	62	39	65	0	0	18	72	18	72
TOTAL	39	100	21	100	60	100	0	0	25	100	25	100
	$\chi^2 = 1.81$		df = 2		.3 < p < .4 (NS)							

Source: The Study (1998)

*Age & Adoption:*

Table 7.2. Age and Adoption:

ICPTs	AGE							
	Less than 31 years F %		31 - 40 F %		Above 41 years F %		TOTAL F %	
Actellic liquid	5	16	9	24	3	10	17	20
Awareness - Adoption	5	16	9	24	3	10	17	20
Awareness - Non Adoption	3	11	6	16	6	21	15	18
Non-Awareness	11	39	22	60	20	69	53	62
TOTAL	19	100	37	100	29	100	85	100
	$\chi^2=0.61$ df=2 .6 <p<.7 (NS)		$\chi^2=0.78$ df=2 .6 <p<.7 (NS)		$\chi^2=2.59$ df=2 .2 <p<.3 (NS)			
Actellic dust								
Awareness - Adoption	4	21	19	51	13	45	36	43
Awareness - Non Adoption	5	26	1	3	1	3	7	8
Non-Awareness	10	53	17	46	15	52	42	49
TOTAL	19	100	37	100	29	100	85	100
	$\chi^2=12.39$ df=2 p = 0.002 (S)		$\chi^2=3.85$ df=2 .1 <p<.2 (NS)		$\chi^2=1.34$ df=2 .4 <p<.5 (NS)			
Phostoxin								
Awareness - Adoption	1	5	8	22	9	31	18	21
Awareness - Non Adoption	0	0	2	5	1	3	3	4
Non-Awareness	18	95	27	73	19	66	64	75
TOTAL	19	100	37	100	29	100	85	100
	$\chi^2=5.02$ df=2 .07 <p<.1 (NS)		$\chi^2=1.07$ df=2 .6 <p<.7 (NS)		$\chi^2=2.58$ df=2 .2 <p<.3 (NS)			
Edible Oil								
Awareness - Adoption	4	21	3	8	2	7	9	11
Awareness - Non Adoption	1	5	10	27	8	27	19	22
Non-Awareness	14	74	24	65	19	66	57	67
TOTAL	19	100	37	100	29	100	85	100
	$\chi^2=5.89$ df=2 .5 <p<.6 (NS)		$\chi^2=1.07$ df=2 .5 <p<.6 (NS)		$\chi^2=0.46$ df=2 .7 <p<.8 (NS)			

Source: The Study (1998)

An analysis of Table 7.2. shows that with the exception of Actellic dust, there was no significant relationship between the age of respondents and the adoption of ICPTs (-31 years and below -  $\chi^2=12.39$  df=2 p = 0.002). Comparatively, higher proportions of the young tended not to be aware of ICPTs than the old. A comparison of this result and previous studies on the effect

of age on adoption (Feder & Slade, 1985; Rogers, 1983; Adesina & Seidi, 1995; Baidu - Forson, 1999) shows the inconsistent relationship between age and adoption. Whereas certain studies indicate it has an effect on adoption (Rogers, 1983; Feder & Slade, 1985; Akinwumi, Adesina & Seidi, 1995 ), others indicate that it does not have an effect on adoption ( Baidu - Forson, 1999) This study is also a case in point. It could be concluded that age does have an indeterminate effect on adoption.

#### *Education & Adoption:*

Table 7.3. shows that there is no significant relationship between the educational level of respondents and adoption of ICPTs. This is contrary to research findings that suggests adoption is moderately and or strongly related to educational levels (Mehra, 1994; Abdelmagid Hassan, 1996; Lin & Jeffres, 1998). Higher proportions of those with formal education tended not to be aware of the use of ICPTs. Since education is an important factor that influences the acceptance of ideas (Onu, 1991), AEAs need to intensify their education to this group so as to increase the adoption of ICPTs.

Table 7.3. Educational Level &amp; Adoption:

ICPTs	EDUCATIONAL LEVEL							
	None		Formal		Non-Formal Edn.		TOTAL	
	F	%	F	%	F	%	F	%
<b>Actellic liquid</b>								
Awareness - Adoption	10	31	7	14	0	0	17	20
Awareness - Non Adoption	4	13	11	22	0	0	15	18
Non-Awareness	18	56	33	64	2	100	53	62
<b>TOTAL</b>	<b>32</b>	<b>100</b>	<b>51</b>	<b>100</b>	<b>2</b>	<b>100</b>	<b>85</b>	<b>100</b>
	$\chi^2=4.32$ df=2 .1 < p < .2 (NS)		$\chi^2=3.73$ df=2 .1 < p < .2 (NS)		$\chi^2=1.24$ df=2 .4 < p < .5 (NS)			
<b>Actellic dust</b>								
Awareness - Adoption	12	38	24	47	0	0	36	43
Awareness - Non Adoption	2	6	5	10	0	0	7	8
Non-Awareness	18	56	22	43	2	100	42	49
<b>TOTAL</b>	<b>32</b>	<b>100</b>	<b>51</b>	<b>100</b>	<b>2</b>	<b>100</b>	<b>85</b>	<b>100</b>
	$\chi^2=1.02$ df=2 .5 < p < .6 (NS)		$\chi^2=2.06$ df=2 .2 < p < .3 (NS)		$\chi^2=2.10$ df=2 .3 < p < .4 (NS)			
<b>Phostoxin</b>								
Awareness - Adoption	3	9	14	27	1	50	18	21
Awareness - Non Adoption	1	3	2	4	0	0	3	4
Non-Awareness	28	88	35	69	1	50	64	75
<b>TOTAL</b>	<b>32</b>	<b>100</b>	<b>51</b>	<b>100</b>	<b>2</b>	<b>100</b>	<b>85</b>	<b>100</b>
	$\chi^2=4.41$ df=2 .1 < p < .2 (NS)		$\chi^2=3.18$ df=2 .1 < p < .2 (NS)		$\chi^2=1.05$ df=2 .4 < p < .5 (NS)			
<b>Edible Oil</b>								
Awareness - Adoption	4	13	5	10	0	0	9	11
Awareness - Non Adoption	7	22	12	23	0	0	19	22
Non-Awareness	21	65	34	67	2	100	57	67
<b>TOTAL</b>	<b>32</b>	<b>100</b>	<b>57</b>	<b>100</b>	<b>2</b>	<b>100</b>	<b>85</b>	<b>100</b>
	$\chi^2=0.20$ df=2 .8 < p < .9 (NS)		$\chi^2=0.16$ df=2 .8 < p < .9 (NS)		$\chi^2=1.01$ df=2 .5 < p < .6 (NS)			

Source: The Study (1998)

*Working Experience & Adoption:*

Table 7.4. Working Experience &amp; Adoption:

ICPTs	WORKING EXPERIENCE						
	Little (5 years or less)		Average(5 years)		Long (More than 5 years)		TOTAL
	F	%	F	%	F	%	
<b>Actellic liquid</b>							
Awareness - Adoption	5	24	3	18	9	19	17
Awareness - Non Adoption	4	19	4	23	7	15	15
Non-Awareness	12	57	10	59	31	66	53
TOTAL	21	100	17	100	47	100	85
	$\chi^2=0.15$ df=2 .8<p<.9 (NS)		$\chi^2=0.81$ df=2 .5 <p<.6 (NS)		$\chi^2=0.15$ df=2 .8 <p<.9 (NS)		
<b>Actellic dust</b>							
Awareness - Adoption	8	38	7	41	21	45	36
Awareness - Non Adoption	2	10	1	6	4	8	4
Non-Awareness	11	52	9	53	22	47	42
TOTAL	21	100	17	100	47	100	85
	$\chi^2=0.23$ df=2 .8<p<.9 (NS)		$\chi^2=0.20$ df=2 .8 <p<.9 (NS)		$\chi^2=0.29$ df=2 .8 <p<.9 (NS)		
<b>Phostoxin</b>							
Awareness - Adoption	4	19	2	12	12	25	18
Awareness - Non Adoption	1	5	1	6	1	2	3
Non-Awareness	16	76	14	82	34	72	64
TOTAL	21	100	17	100	47	100	85
	$\chi^2=0.18$ df=2 .8<p<.9 (NS)		$\chi^2=1.36$ df=2 .4 <p<.5 (NS)		$\chi^2=1.65$ df=2 .4 <p<.5 (NS)		
<b>Edible Oil</b>							
Awareness - Adoption	2	9	0	0	7	15	9
Awareness - Non Adoption	6	29	2	12	11	23	19
Non-Awareness	13	62	15	88	29	62	57
TOTAL	21	100	17	100	47	100	85
	$\chi^2=0.62$ df=2 .6<p<.7 (NS)		$\chi^2=4.74$ df=2 .09 <p<.1 (NS)		$\chi^2=2.34$ df=2 .2 <p<.3 (NS)		

An analysis of Table 7.4. shows there was statistically no significant relationship between the working experience of respondents and the adoption of ICPTs. This result confirms studies by Basu (1969) that there was no correlation between working experience and adoption. A higher proportion of respondents with more than 5 years working experience tended not to be aware of the use of ICPTs. Since accumulated experience positively influences decision making (Bohlen,

1966), farmers with more working experience need to be targeted for extension of messages on ICPTs

*Farm Size & Adoption:*

Table 7.5. Producers Farm Size & Adoption:

ICPTs	FARM SIZE						
	Small (2 acres or less) F %		Medium (2 acres) F %		Large (More than 2 acres) F %		TOTAL F %
<b>Actellic liquid</b>							
Awareness - Adoption	3	19	3	16	7	28	13 22
Awareness - Non Adoption	2	12	4	21	4	16	10 16
Non-Awareness	11	69	12	63	14	56	37 48
TOTAL	16	100	19	100	25	100	60 100
	$\chi^2=0.49$ df = 2 .7 < p < .8 (NS)		$\chi^2=0.77$ df = 2 .6 < p < .7 (NS)		$\chi^2=1.03$ df = 2 .5 < p < .6 (NS)		
<b>Actellic dust</b>							
Awareness - Adoption	4	25	9	47	14	56	27 45
Awareness - Non Adoption	3	19	0	0	1	4	4 7
Non-Awareness	9	56	10	53	10	40	29 48
TOTAL	16	100	19	100	100		60 100
	$\chi^2=7.0$ df = 2 p = 0.03 (S)		$\chi^2=1.99$ df = 2 .3 < p < .4 (NS)		$\chi^2=2.23$ df = 2 .3 < p < .4 (NS)		
<b>Phostoxin</b>							
Awareness - Adoption	2	13	4	21	8	32	14 23
Awareness - Non Adoption	1	6	0	0	0	0	1 2
Non-Awareness	13	81	15	19	17	68	45 75
TOTAL	16	100	19	100	25	100	60 100
	$\chi^2=3.96$ df = 2 .1 < p < .2 (NS)		$\chi^2=0.58$ df = 2 .6 < p < .7 (NS)		$\chi^2=2.37$ df = 2 .3 < p < .4 (NS)		
<b>Edible Oil</b>							
Awareness - Adoption	1	6	4	21	2	8	7 12
Awareness - Non Adoption	4	25	3	16	7	28	14 23
Non-Awareness	11	69	12	63	16	64	39 65
TOTAL	16	100	19	100	25	100	60 100
	$\chi^2=0.62$ df = 2 .6 < p < .7 (NS)		$\chi^2=2.79$ df = 2 .2 < p < .3 (NS)		$\chi^2=0.9$ df = 2 .6 < p < .7 (NS)		

Source: The Study (1998)

In this study (Ref. Table 7.5. ), there was no statistically significant relationship between Actellic liquid, Phostoxin and Edible oil but statistically, there was a relationship between farm size and the adoption of Actellic dust (Small farm size -  $\chi^2 = 7.0$  df = 2 p = 0.03).

Farm size has been one of the controversial factors on which empirical studies have focussed (Abdelmagid & Hassan, 1996). Its effect on adoption is unclear ( Adesina & Seidi, 1995).

Farm size could have different effects on the rate of adoption depending on the technological characteristics and the institutional setting.

#### *Variety Grown / Sold & Adoption:*

An analysis of Table 7.6. shows there was statistically no significant relationship between the variety of cowpea grown or sold and the adoption of Actellic dust, Phostoxin and Edible oil but the adoption of Actellic liquid is statistically significantly related to the variety of cowpea grown or sold. A higher proportion of those who grew or sold only the improved variety of cowpea tended to adopt the use of Actellic liquid more than those who sold or grew the local variety only and those who sold or grew a combination of the local and improved varieties. Cowpea producers indicated that although the improved variety is higher yielding, spoilage occurs faster with them than with the local variety. Farmers growing the improved variety therefore need to preserve their cowpea to avoid spoilage. This accounts for why those who grew the improved variety adopted the use of ICPTs.

Table 7.6. Variety of Cowpea Grown or Sold &amp; Adoption:

ICPTs	VARIETY OF COWPEA GROWN/ SOLD							
	LOCAL %		IMPROVED %		LOCAL & IMPROVED %		TOTAL %	
Actellic liquid	F	%	F	%	F	%	F	%
Awareness - Adoption	6	7	6	7	5	6	17	20
Awareness - Non Adoption	5	6	1	1	9	11	15	18
Non-Awareness	20	23	6	7	27	32	53	62
TOTAL	31	36	13	15	41	48	85	100
	$\chi^2 = 0.11$ df = 2 .9 < p < .10 (NS)		$\chi^2 = 6.76$ df = 2 p < .034 (S)		$\chi^2 = 3.4$ df = 2 .1 < p < .2 (NS)			
Actellic dust								
Awareness - Adoption	10	12	6	7	20	23	36	42
Awareness - Non Adoption	2	2	1	1	5	6	7	8
Non-Awareness	20	23	6	7	16	19	42	50
TOTAL	31	36	13	15	41	48	85	100
	$\chi^2 = 4.91$ df = 2 .08 < p < .09 (NS)		$\chi^2 = 0.09$ df = 2 .9 < p < .10 (NS)		$\chi^2 = 4.01$ df = 2 .1 < p < .2 (NS)			
Phostoxin								
Awareness - Adoption	5	6	4	5	9	11	18	21
Awareness - Non Adoption	2	2	1	1	0	0	3	4
Non-Awareness	24	28	8	9	32	37	64	75
TOTAL	31	36	13	15	41	48	85	100
	$\chi^2 = 1.8$ df = 2 .4 < p < .5 (NS)		$\chi^2 = 1.81$ df = 2 .4 < p < .5 (NS)		$\chi^2 = 2.9$ df = 2 .2 < p < .3 (NS)			
Edible Oil								
Awareness - Adoption	3	4	2	2	4	5	9	11
Awareness - Non Adoption	7	8	4	5	8	9	19	22
Non-Awareness	21	24	7	8	29	34	57	67
TOTAL	31	36	13	15	41	48	85	100
	$\chi^2 = 0.04$ df = 2 .9 < p < .10 (NS)		$\chi^2 = 1.22$ df = 2 .5 < p < .6 (NS)		$\chi^2 = 0.50$ df = 2 .7 < p < .8 (NS)			

Source: The Study (1998)

*Crop Yield:*

Table 7.7. shows that there was no statistically significant relationship between Actellic liquid, Phostoxin, Edible oil and the adoption of ICPT's but statistically, there was a significant relationship between the crop yield and the adoption of Actellic dust (Above average crop yield -  $\chi^2 = 7.27$  df = 2 p = 0.03 ). Producers who had high crop yield (more than 4 bags), tended to

adopt the use of Actellic dust more than those with lower crop yield. Since producers with high crop yield need to increase the shelf - life of their harvest so as to prevent post harvest loss, they tended to adopt the preservation technologies more than the others.

**Table 7.7. Producers Crop Yield & Adoption**

ADOPTION	CROP YIELD							
	Below Average(> 4 bags)		Average (4 bags)		Above Average (<4 bgs)		Total	
Actellic liquid	F	%	F	%	F	%	F	%
Awareness - Adoption	4	20	1	8	8	29	13	21
Awareness - Non Adoption	1	5	3	25	6	21	10	17
Non-Awareness	15	75	8	67	14	50	37	62
TOTAL	20	100	12	100	28	100	60	100
	$\chi^2 = 3.35$ df = 2 .09 < p < .1 (NS)		$\chi^2 = 1.92$ df = 2 .3 < p < .4 (NS)		$\chi^2 = 6.22$ df = 2 .3 < p < .4 (NS)			
Actellic dust								
Awareness - Adoption	5	25	5	42	17	61	27	45
Awareness - Non Adoption	2	10	2	16	0	0	4	7
Non-Awareness	13	65	5	42	11	39	29	48
TOTAL	20	100	12	100	28	100	60	100
	$\chi^2 = 4.89$ df = 2 .08 < p < .09 (NS)		$\chi^2 = 2.42$ df = 2 .2 < p < .3 (NS)		$\chi^2 = 7.27$ df = 2 p = 0.026 (S)			
Phostoxin								
Awareness - Adoption	3	15	2	42	9	32	14	23
Awareness - Non Adoption	1	5	0	16	0	0	1	17
Non-Awareness	16	80	10	42	19	68	45	75
TOTAL	20	100	12	100	28	100	60	100
	$\chi^2 = 2.99$ df = 2 .2 < p < .3 (NS)		$\chi^2 = 0.64$ df = 2 .7 < p < .8 (NS)		$\chi^2 = 2.98$ df = 2 .2 < p < .3 (NS)			
Edible Oil								
Awareness - Adoption	1	5	1	8	5	18	7	12
Awareness - Non Adoption	4	20	4	33	6	21	14	23
Non-Awareness	15	75	7	59	17	61	39	65
TOTAL	20	100	12	100	28	100	60	100
	$\chi^2 = 1.75$ df = 2 .4 < p < .5 (NS)		$\chi^2 = 0.89$ df = 2 .6 < p < .7 (NS)		$\chi^2 = 1.95$ df = 2 .3 < p < .4 (NS)			

Source: The Study (1998)

## Quantity Stored &amp; Adoption:

Table 7.8. Quantity of Cowpea Stored &amp; Adoption

ICPTs	PRODUCERS				TRADERS											
	Below Average		Average		Above average		Total									
	F	%	F	%	F	%	F	%								
<b>Actellic Liquid</b>																
Awareness - Adoption	1	6	3	17	9	38	13	21	0	0	0	0	4	16	4	16
Awareness - Non Adop.	2	11	3	17	5	21	10	17	0	0	0	0	5	21	5	21
Non-Awareness	15	83	12	66	10	41	37	62	0	0	1	100	15	63	16	64
TOTAL	18	100	18	100	24	100	60	100	0	0	1	100	24	100	25	100
	$\chi^2=5.51$ df = 2 .5 < p < .6 (NS)		$\chi^2=0.40$ df = 2 .7 < p < .8 (NS)		$\chi^2=7.64$ df = 2 p = 0.02 (S)						$\chi^2=2.99$ df = 2 .2 < p < .3 (NS)		$\chi^2=0.64$ df = 2 .7 < p < .8 (NS)			
<b>Actellic dust</b>																
Awareness - Adoption	5	27	10	56	12	50	27	45	0	0	0	0	9	37	9	37
Awareness - Non Adop.	3	17	1	6	0	0	4	7	0	0	0	0	3	13	3	13
Non-Awareness	10	56	7	38	12	50	29	48	0	0	1	100	12	50	13	52
TOTAL	18	100	18	100	24	100	60	100	0	0	1	100	24	100	25	100
	$\chi^2=5.83$ df = 2 .05 < p < .06 (NS)		$\chi^2=1.16$ df = 2 .5 < p < .6 (NS)		$\chi^2=2.91$ df = 2 .2 < p < .3 (NS)						$\chi^2=0.96$ df = 2 .6 < p < .7 (NS)		$\chi^2=0.96$ df = 2 .6 < p < .7 (NS)			
<b>Phostoxin</b>																
Awareness - Adoption	4	22	2	11	8	33	14	23	0	0	0	0	4	17	4	17
Awareness - Non Adop.	0	0	1	6	1	42	1	2	0	0	0	0	2	8	2	8
Non-Awareness	14	78	15	83	6	25	45	75	0	0	1	100	18	75	19	76
TOTAL	18	100	18	100	24	100	60	100	0	0	1	100	24	100	25	100
	$\chi^2=1.71$ df = 2 .4 < p < .5 (NS)		$\chi^2=3.77$ df = 2 .1 < p < .2 (NS)		$\chi^2=8.13$ df = 2 p = .01 (S)						$\chi^2=0.33$ df = 2 .7 < p < .8 (NS)		$\chi^2=0.33$ df = 2 .7 < p < .8 (NS)			
<b>Edible Oil</b>																
Awareness - Adoption	0	0	1	6	6	25	7	12	0	0	0	0	2	8	2	8
Awareness - Non Adop.	5	28	4	22	5	21	14	23	0	0	0	0	5	21	5	21
Non-Awareness	13	72	13	72	13	54	39	65	0	0	1	100	17	71	18	72
TOTAL	18	100	18	100	24	100	60	100	0	0	1	100	24	100	25	100
	$\chi^2=3.42$ df = 2 .1 < p < .2 (NS)		$\chi^2=0.52$ df = 2 .4 < p < .5 (NS)		$\chi^2=2.98$ df = 2 p = .03 (S)						$\chi^2=0.41$ df = 2 .8 < p < .9 (NS)		$\chi^2=0.41$ df = 2 .8 < p < .9 (NS)			

Source: The Study (1998)

There was no statistically significant relationship between the quantity of cowpea stored by traders and their adoption of ICPTs (Ref. Table 7.8). With producers however, there was a significant relationship between the quantity stored and the adoption of Actellic liquid, Phostoxin and Edible oil but not Actellic dust.

### **7.3. Extension Delivery and Adoption**

Communication channels are critical to facilitating innovation adoption. The study examined the effect of two variables: method of extension delivery and frequency of contact on adoption behaviour of respondents.

#### **7.3.1. Method of Delivery & Adoption:**

Table 7.9. shows that there was statistically no significant relationship between the method of extension delivery used and the adoption of Actellic liquid and Edible oil but there was a relationship between extension delivery methods and the adoption of Actellic dust and Phostoxin. Higher proportion of respondents adopted Actellic dust and Phostoxin when contacted with a combination of the individual and group methods of extension delivery than with the use of the other methods.

Table 7.9. Method of Delivery &amp; Adoption:

ICPTs	METHOD OF EXTENSION DELIVERY								
	Individual. F %		Group F %		Individual & Group F %		No Contact F %		TOTAL F %
Actellic liquid									
Awareness - Adoption	2	2	7	8	5	6	3	4	17 20
Awareness - Non Adoption	3	4	1	1	3	4	8	9	15 18
Non-Awareness	5	6	14	16	9	11	25	29	53 62
TOTAL	10	12	22	25	17	21	36	42	85 100
	$\chi^2 = 1.26$ df = 2 .5 < p < .6 (NS)		$\chi^2 = 5.10$ df = 2 .07 < p < .08 (NS)		$\chi^2 = 1.24$ df = 2 .5 < p < .6 (NS)		$\chi^2 = 5.49$ df = 2 .6 < p < .7 (NS)		
Actellic dust									
Awareness - Adoption	7	8	11	13	15	18	3	4	36 42
Awareness - Non Adoption	1	1	2	2	1	1	3	4	7 8
Non-Awareness	2	2	9	11	1	1	30	35	42 50
TOTAL	10	12	22	25	17	21	36	42	85 100
	$\chi^2 = 4.43$ df = 2 .1 < p < .2 (NS)		$\chi^2 = 1.14$ df = 2 .5 < p < .6 (NS)		$\chi^2 = 19.97$ df = 2 p < .00005 (S)		$\chi^2 = 29.6$ df = 2 p < .0000004 (S)		
Phostoxin									
Awareness - Adoption	4	5	4	5	8	9	2	3	18 21
Awareness - Non Adoption	0	0	0	0	2	2	1	1	3 4
Non-Awareness	6	7	18	21	7	8	33	38	64 75
TOTAL	10	12	22	25	17	21	36	42	85 100
	$\chi^2 = 2.65$ df = 2 .2 < p < .3 (NS)		$\chi^2 = 1.16$ df = 2 .5 < p < .6 (NS)		$\chi^2 = 14.09$ df = 2 p < .0009 (S)		$\chi^2 = 9.52$ df = 2 p < .009 (S)		
Edible Oil									
Awareness - Adoption	0	0	2	2	3	4	4	5	9 11
Awareness - Non Adoption	3	4	5	6	4	5	7	8	19 22
Non-Awareness	7	8	15	18	10	12	25	29	57 67
TOTAL	10	12	22	25	17	21	36	42	85 100
	$\chi^2 = 1.51$ df = 2 .4 < p < .5 (NS)		$\chi^2 = 0.06$ df = 2 .9 < p < .10 (NS)		$\chi^2 = 1.23$ df = 2 .5 < p < .6 (NS)		$\chi^2 = 0.31$ df = 2 .8 < p < .9 (NS)		

Source: The Study (1998)

## 7.3.2. Frequency of Contact &amp; Adoption:

Table 7.10. revealed that there was statistically no significant relationship between frequency of contact and adoption of Actellic liquid and Edible oil but there was a relationship between the frequency of contact and the adoption of Actellic dust and Phostoxin. Higher proportions of respondents tended to adopt Actellic dust and Phostoxin with an increase in the frequency of contact. It implies therefore that the number of contact one has with new ideas is positively related to adoption of certain innovations (Effionayi, 1975).

Table 7.10. : Frequency of Contact &amp; Adoption:

ICPTs	FREQUENCY OF CONTACT								
	No Contact %		F Once %		F Twice %		Thrice or More %		TOTAL %
Actellic liquid									
Awareness - Adoption	4	5	4	5	8	9	1	1	17. 20
Awareness - Non Adoption	7	8	1	12	4	5	3	4	15 18
Non-Awareness	26	30	5	6	14	16	8	9	53 62
TOTAL	37	43	10	12	26	31	12	14	85 100
	$\chi^2 = 3.5, df=2$ $p < .2$ (NS)		$\chi^2 = 2.9, df=2$ $p < .3$ (NS)		$\chi^2 = 2.72, df=2$ $p < .3$ (NS)		$\chi^2 = 1.42, df=2$ $p < .5$ (NS)		
Actellic dust									
Awareness - Adoption	5	6	10	12	16	19	5	6	36 42
Awareness - Non Adoption	4	5	0	0	1	1	2	2	7 8
Non-Awareness	28	32	0	0	9	11	5	6	42 50
TOTAL	37	43	10	12	26	31	12	14	85 100
	$\chi^2 = 22.5, df=2$ $p < .00013$ (S)		$\chi^2 = 15.4, df=2$ $p < .00044$ (S)		$\chi^2 = 5.79, df=2$ $p < .055$ (S)		$\chi^2 = 1.38, df=2$ $p < .6$ (NS)		
Phostoxin									
Awareness - Adoption	2	2	6	7	5	6	5	6	18 21
Awareness - Non Adoption	1	1	0	0	2	2	0	0	3 4
Non-Awareness	34	40	4	5	19	22	7	8	64 75
TOTAL	37	43	10	12	26	31	12	14	85 100
	$\chi^2 = 10.22, df=2$ $p < .006$ (S)		$\chi^2 = 10.3, df=2$ $p < .0056$ (S)		$\chi^2 = 1.93, df=2$ $p < .4$ (NS)		$\chi^2 = 3.8, df=2$ $p < .2$ (NS)		
Edible Oil									
Awareness - Adoption	4	5	1	1	4	5	0	0	9 11
Awareness - Non Adoption	8	9	1	1	6	7	4	5	19 22
Non-Awareness	25	29	8	9	16	19	8	9	57 67
TOTAL	37	43	10	12	26	31	12	14	85 100
	$\chi^2 = 0.02, df=2$ $p < .10$ (NS)		$\chi^2 = 1.06, df=2$ $p < .6$ (NS)		$\chi^2 = 0.99, df=2$ $p < .7$ (NS)		$\chi^2 = 2.23, df=2$ $p < .4$ (NS)		

#### 7.4. Perceptions and Adoption Levels:

Perceptions can play different roles in adoption for different individuals (Agarwal & Prasad, 1998). To get an idea of the strength of the relationship between perceptions of the attributes of the selected improved cowpea preservation technologies and their adoption, a cross tabulation of the overall perception and adoption of the various technologies was done (Ref. Appendix 15A & 15B). The chi - square values were used as basis of ranking (Table 7.11 & 7.12.). The degree of relationship reveals there was a highly significant relationship between adoption and perception of attributes of Actellic dust, followed by Phostoxin, Actellic liquid, and Edible oil in descending order. This confirms evidence from literature that perceptions influence adoption of innovations (Lin & Milon, 1993; Adesina & Zinnah, 1993; Agarwal & Prasad, 1998). With traders on the other hand, the highest significant relationship between adoption and perception of attributes was rather with Phostoxin, followed by Actellic dust, Actellic liquid, and Edible oil in descending order.

Table 7.11: Degree of Relationship Between Producers Overall Perception of Attributes of ICPTs and Adoption.

Overall Perception of Attributes & Adoption	Chi - square	Ranking
Actellic liquid	$\chi^2 = 24.54$ $df = 1$ $p = 0.0000$ (S)	3
Actellic dust	$\chi^2 = 42.09$ $df = 1$ $p = 0.0000$ (S)	1
Phostoxin	$\chi^2 = 34.52$ $df = 1$ $p = 0.0000$ (S)	2
Edible Oils	$\chi^2 = 0.36$ $df = 1$ $p = 0.77$ (NS)	4

Table 7.12: Degree of Relationship Between Traders Overall Perception of Attributes of ICPTs and Adoption.

Overall Perception of Attributes & Adoption	Chi - square	Ranking
Actellic liquid	$\chi^2 = 2.93$ $df = 1$ $p = 0.056$ (NS)	3
Actellic dust	$\chi^2 = 12.15$ $df = 1$ $p = 0.0001$ (S)	2
Phostoxin	$\chi^2 = 18.11$ $df = 1$ $p = 0.0000$ (S)	1
Edible Oils	$\chi^2 = 0.0$ $df = 1$ $p = 1.0$ (NS)	4

Considering the specific, general, and overall attributes,(Ref. Table 7.13.) the perception of specific attributes gives the closest prediction of adoption levels. Phostoxin was considered the most highly positively perceived preservation technology by both producers and traders, followed by Actellic dust, Actellic liquid and Edible oil in descending order. This confirms findings that perceptions help predict peoples reaction to an innovation that is whether they adopt or not (Rogers, 1995; Agarwal & Prasad, 1998). In terms of relationships with adoption levels, this trend is consistent with that of the awareness-adoption gap, which is an improved measure of adoption levels. Producers and traders considered Phostoxin the most highly perceived technology and Edible oil, the least.

Table 7.13: Summary of Ranking of the Key Aspects of the Perceived Attributes and Adoption:

ICPTs	Producers						Traders				
	Perceived Attributes			Adoption Level			Perceived Attributes		Adoption Level		
	SA	GA	O	PA	AG	P	SA	O	PA	AG	P
Actellic liquid	3	1	1	3	3	3	3	4	3	3	3
Actellic dust	2	1	1	1	2	1	2	1	1	2	2
Phostoxin	1	1	1	2	1	2	1	1	2	1	1
Edible oil	4	4	1	4	4	4	4	4	4	4	4

SA = Specific Attributes

GA = General Attributes

O = Overall Attributes

1 = Best / Highest

PA = Percentage Adoption

AG = Adoption Gap

P = Degree of Relationship between perceptions and adoption

4 = Worst / Lowest

To fully understand the degree of relationship between the variables in Table 7.14., the Spearman's rank order correlation coefficient was used. An analysis of this Table revealed that there was a strong positive correlation between specific attributes and percentage adoption of ICPTs ( $.8 > p < .25$ ). There was also a perfect one-to-one positive correlation between the general attributes and percentage adoption ( $.5 > p < .25$ ), and general attributes and the adoption gap ( $.5 > p < .25$ ). There was a negative correlation between overall perception of attributes and the

adoption gap, overall perception and the percentage adoption ( $-.4 > p < .25$ ). This shows that the perceptions of specific attributes of ICPTs, gives the closest prediction of adoption levels and the overall perceptions gives the least prediction.

With cowpea traders on the other hand, there was a strong positive correlation between specific attributes and the percentage adoption ( $.667 > p < .25$ ). There was a perfect correlation between specific attributes and adoption gap ( $1 > p < .25$ ). The perception of the overall attributes and Percentage adoption, overall attributes and adoption gap, also indicated there was strong positive correlation. Unlike cowpea producers, the perceptions of specific and overall attributes of ICPTs gave the prediction of adoption levels of cowpea traders.

Table 7.14. Ratings of Key Aspects of Perceived Attributes and Adoption using Spearmans Rank Order Correlation Co - efficient

	Variables	$\Sigma d^2$	$r_s$	Correlation
PRODUCERS	SA & PA	2	.8	Strongly Positive**
	SA & AG	0	1	Perfect
	SA & P	2	.8	Strongly Positive**
	GA & PA	5	.5	Positive
	GA & AG	5	.5	Positive
	GA & P	5	.5	Positive
	O & PA	14	-.4	Negative
	O & AG	14	-.4	Negative
	O & P	14	-.4	Negative
TRADERS	SA & PA	2	.667	Strongly Positive**
	SA & AG	0	1	Perfect
	SA & P	0	1	Perfect
	O & PA	2	.667	Strongly Positive**
	O & AG	2	.667	Strongly Positive**
	O & P	2	.667	Strongly Positive**

Critical value = .600 for  $p < .25$  (one - tailed)\*\* Significant

SA = Specific Attribute

PA =Percentage Adoption

AG = Adoption Gap

GA = general Attributes

O =Overall Perception

P = Degree of relationship between perceptions and adoption

### **7.5. Summary & Conclusion:**

An analysis of variables influencing adoption of improved cowpea preservation technologies was done and these results were obtained. The highest adoption level of ICPTs was for Actellic dust and least for Edible oil. The trend of adoption was similar for both producers and traders. The percentage of those aware of selected ICPTs who adopted them was highest for Phostoxin and least for Edible oil. Producers also generally had lower adoption levels of ICPTs than traders with the exception of Phostoxin. There was comparatively low levels of adoption of all ICPTs.

The study revealed adopter characteristics influenced the adoption of ICPTs. These adopter characteristics (Gender, Age, Farm size and Crop yield ) influenced the adoption of Actellic Dust but did not influence the adoption of the other ICPTs. With the exception of Actellic dust, the quantity of cowpea stored influenced the adoption of ICPTs. The variety of cowpea stored also influenced the adoption of Actellic liquid.

An analysis of the relationship between the method of extension delivery used and adoption revealed there was statistically no significant relationship between the method of extension delivery used and the adoption of Actellic liquid and Edible oil but there was a significant relationship between the method and adoption of Actellic dust and Phostoxin. The use of a combination of the individual and group methods brought about a higher adoption levels of Actellic dust and Phostoxin.

There was also no significant relationship between the frequency of contact and the adoption of Actellic liquid and Edible oil but was significantly related to adoption of Actellic dust and Phostoxin. Higher proportions of respondents tended to adopt Actellic dust and Phostoxin with

an increase in the frequency of contact. AEAs therefore need to increase their frequency of contact with their clientele and use a combination of the individual and group extension teaching methods when extending information of ICPTs, if they want to increase adoption of these innovations.

The relationship between perception of attributes of ICPTs revealed there was a positive relationship between perceptions of attributes and adoption. With producers, the trend especially reflected more in the specific perception of attributes of ICPTs than in the general and overall perceptions whereas with traders it reflected not only in the perceptions of specific attributes but also in their overall perceptions of attributes. The degree of relationship of overall perception of attributes and adoption was highest for Phostoxin and least for Edible oil. The trend was consistent with the awareness - adoption gap. By implications, therefore, there was an inverse relationship between negative perceptions and adoption levels.

# **PART THREE:**

# **CONCLUSION**

## CHAPTER EIGHT

### SUMMARY, CONCLUSION & RECOMMENDATIONS

#### 8.1. Summary & Conclusion:

The study on Adoption of Improved Cowpea Preservation Technologies was carried out in the Akatsi District of the Volta Region. The research problem was to find out how personal characteristics, the perception of characteristics of ICPTs determine the utilization of these technologies and to what extent the mode and effort of extension delivery influences these perceptions.

The specific objectives set were to:

- identify various cowpea preservation technologies available in the study area.
- describe and analyse the extension delivery efforts in disseminating ICPT messages in Akatsi district by the public Agricultural Extension Agents (AEAs).
- describe and analyse some important characteristics of producers, traders, and AEAs in the district
- determine cowpea producers and traders perception of characteristics of selected cowpea preservation technologies
- find out the pattern of adoption of ICPTs in the district
- determine the relationship between perception of characteristics of ICPT messages, mode of effort of dissemination, personal and enterprise characteristics and the adoption of selected ICPTs.

The study was a descriptive case study research. The following techniques were used to find answers to the research problem: questionnaire, personal interview of cowpea producers and

traders, Rapid Rural Appraisal method (RRA - Checklist). The questionnaire was administered to sixty (60) cowpea producers who were selected using the two stage random sampling method, twenty - five (25) cowpea traders using systematic random sampling, and fifteen (15) AEAs using the simple random sampling technique. Respondents for the community survey were selected using purposive sampling. An analysis of the interview schedules, questionnaire, and checklist resulted in the following findings and conclusions.

*Attributes of Respondents:*

Cowpea farmers were mainly males while cowpea traders were all females. Majority of cowpea farmers and traders were between the ages of 31 - 40 years, had some form of formal education and they had more than five years working experience. The average farm size of cowpea producers was 2 acres, and their average crop yield was 4 bags of cowpea. Cowpea producers mainly grew a combination of the local and improved varieties of cowpea while cowpea traders mainly sold a combination of the local and improved varieties of cowpea. Whereas most cowpea producers stored less than 2 mini bags of cowpea (60%), most traders stored more than 2 bags (96%).

Apart from gender and the quantity of cowpea stored, there were no significant differences between the characteristics of cowpea producers and traders. This implies gender and quantity of cowpea stored may be important sources of difference in their adoption behavior.

Majority of AEAs in the study area were males and the language mostly used for communication was “Ewe.” Most of them had more than five years working experience in the Akatsi district. The educational qualification of majority of AEAs was a Certificate in Agriculture. These

characteristics of AEAs in the Akatsi District shows that they have the capacity to deliver messages on selected ICPTs effectively.

*Extension Delivery Effort:*

Messages on traditional as well as improved cowpea preservation technologies were disseminated by AEAs in the study area. ICPTs mainly extended by AEAs in ranked order are: Actellic, Edible oil, and Phostoxin and traditional cowpea preservation technologies extended include the use of naphthalene balls or camphor for storage of cowpea in a sealed container, the use of the local keg, wood ash, neem products and the use of sea sand.

Extension workers have acquired information on cowpea preservation mainly through monthly training sessions and to a limited extent, from literature and pre - service training. Methods indicated to be used by the AEAs in extension delivery are a combination of the individual and group methods to contact farmers thrice or more within a month.

There was also a vast inequality in access to extension messages on cowpea preservation technologies between producers and traders, in favour of producers. The infrequent contact is detrimental to the achievement of the objectives of reducing post-harvest losses through the use of improved cowpea preservation methods since cowpea traders store more cowpea and for longer periods of time than the producers. Extension agents need to widen their target net and make preservation messages more accessible to cowpea traders. Constraints to the delivery of cowpea preservation messages, were categorised into three namely: institutional, economic and social in descending order. These constraints need to be addressed for effective dissemination of information to occur.

*Perception of Attributes of Improved Cowpea Preservation Technologies (ICPTs)*

The study revealed that both producers and traders were aware of five ranges of methods of cowpea preservation technologies and the highest level of awareness was in the use of mechanical method. Generally producers had higher knowledge levels of ICPTs than traders. Comparatively, the level of awareness of traditional cowpea preservation technologies was higher than awareness of ICPTs. The levels of awareness of ICPTs for both producers and traders were highest for Actellic dust, Actellic liquid, Edible oil and Phostoxin, in descending order. Intensive education which would increase awareness and subsequently, adoption of ICPTs is therefore necessary to foster production increases needed to sustain current population growth.

Phostoxin was perceived as having the highest range of positive specific attributes, whilst Edible oil had the least. Qualitatively, the seven main attributes on which perception of the attributes of improved cowpea preservation technologies differed were perception of work and time involved in the use of the technology, extent of marketing problems, extent of similarity of technology to traditional practices, ease in use of technology, piloting cost, visibility of advantage of use of ICPTs.

With the exception of Edible oil, the perceptions of general attributes of ICPTs revealed that the use of ICPTs offered an advantage over the use of traditional cowpea preservation technologies (relative advantage), and the results of use of these technologies was visible (observability). All ICPTs were also perceived to be easy to understand and use (complexity) whereas their trial on a limited basis was perceived to involve too much money (trialability).

The perception of overall attributes of ICPTs revealed that Actellic dust and Phostoxin were perceived positively whiles Actellic liquid and Edible oil were perceived negatively. Extension workers need to increase extension delivery efforts so as to create more awareness, which would not only help change negative perceptions but help in the development of more positive perceptions which subsequently would lead to high innovation adoption.

An analysis of the relationship between adopter characteristics, extension delivery method, frequency of contact and perceptions of attributes revealed that with the exception of Actellic liquid ICPTs were not influenced by these variables. With the exception of the quantity of cowpea stored, all adopter characteristics brought about a difference in the perception of overall attributes of Actellic liquid. Adopter characteristics that brought about a difference in the perception of general attributes were age, working experience and variety of cowpea grown or sold, and quantity of cowpea stored.

It would be advantageous if AEAs took note of extension methods that result in more positive perceptions of attributes (the group method only and a combination of the group and individual method). and used more of it since this would help more producers and traders have positive perceptions of ICPTs which ultimately would help the adoption of ICPTs. An increase in AEAs frequency of contact resulted in producers and traders having more positive perceptions of Actellic liquid. It is suggested therefore that AEAs should increase extension contact so as to ensure their clientele develop more positive perceptions of the attributes of ICPTs.

Although five attributes have been shown to be predictors of adoption behaviour ( Rogers, 1995; Agarwal & Prasad, 1998), only two have consistently emerged as salient in this study, as being

influenced by adopter characteristics, extension delivery methods and frequency of contact. They are the relative advantage and complexity. These attributes influenced mostly the perception of Actellic liquid but not the other technologies. Technology developers need to re - examine this technology and refine items that the target group had negative perceptions about so as to make the technology more acceptable.

#### *Adoption of Improved Cowpea Preservation Technologies:*

The highest adoption level of ICPTs was for Actellic dust and least for Edible oil. The trend of adoption was similar for both producers and traders. The percentage of those aware of selected ICPTs who adopted them was highest for Phostoxin and least for Edible oil. With the exception of Phostoxin, producers also generally had lower adoption levels of ICPTs than traders. There was comparatively low levels of adoption of all ICPTs.

The study revealed adopter characteristics influenced the adoption of ICPTs. These adopter characteristics (Gender, Age, Farm size and Crop yield ) influenced the adoption of Actellic Dust but not the adoption of the other ICPTs. With the exception of Actellic dust, the quantity of cowpea stored influenced the adoption of ICPTs while the variety of cowpea stored also influenced the adoption of Actellic liquid.

An analysis of the method of extension delivery, frequency of contact and adoption revealed there was statistically no significant relationship between the method of extension delivery used and the adoption of Actellic liquid and Edible oil but there was a significant relationship between the method and adoption of Actellic dust and Phostoxin. The use of a combination of the individual and group methods brought about a higher adoption levels of Actellic dust and Phostoxin.

Higher proportions of respondents tended to adopt Actellic dust and Phostoxin with an increase in the frequency of contact. AEA's therefore need to increase their frequency of contact with their clientele and use a combination of the individual and group extension teaching methods when extending information on ICPTs, if they want to increase adoption of these innovations.

The relationship between perception of attributes of ICPTs revealed there was a positive relationship between perceptions of attributes and adoption. With producers, the trend especially reflected more in the specific perception of attributes of ICPTs than in the general and overall perceptions whereas with traders it reflected not only in the perceptions of specific attributes but also in their overall perceptions of attributes. The degree of relationship of overall perception of attributes and adoption was highest for Phostoxin and least for Edible oil. The trend was consistent with the awareness - adoption gap.

## **8.2. Recommendations:**

In order to influence a higher proportion of cowpea producers and traders to adopt the use of improved cowpea preservation technologies, the following recommendations are offered based on the findings of the study. Improved cowpea preservation technologies were used by a minority of respondents (who can afford the cost of storage). A contributory factor to the less use of selected improved cowpea preservation technologies was the cost of the preservatives. If these preservatives could be made available at subsidized rates, more respondents could use it thus increase the adoption of these technologies.

More information on traditional preservation methods that are cheap, and effective should be made available by subject - matter - specialists at monthly training sessions ( which are AEAs main source of extension information) so that AEAs could extend these to help cowpea producers and traders reduce post harvest loss of cowpea.

Cowpea producers also use less preservation technologies as compared to traders because they have less cowpea to preserve among other reasons. This is because they generally dispose of their cowpea immediately after harvest. To encourage producers to use more preservation technologies, information needs to be extended to help them increase their crop yield then they are likely to adopt cowpea preservation technologies to increase the shelf - life of their produce.

The most appropriate target group for extension messages on cowpea preservation technologies by AEAs should be traders (who preserve cowpea in larger quantities and for longer periods of time than producers meanwhile they have minimum contact with extension). Extension therefore needs to re - direct cowpea preservation technology messages to traders.

Perceptions may be the truth about technologies, so the negative perception of attributes may not be appropriate for adoption of technologies but need to change. The negative perceptions and their inverse relationship with adoption levels suggest that these need to be addressed by AEAs and technology developers. Technology developers need to continuously re - examine and refine specific items of improved cowpea preservation technologies that the target group had negative perceptions about, and if possible, refine these aspects. The methodology of this study provides a possible way in which such social and cognitive variables could be incorporated during the technology integration stage of its development.

It is however possible that the negative perceptions do not reflect real situation about the technology thus intensive education on specific attributes that the target group had negative perceptions about and on the use of improved cowpea preservation technologies is necessary.

Detailed technical knowledge emphasizing positive attributes should be delivered by AEs. These should be delivered through regular contact (that is thrice or more within a month) and the use of interpersonal channels of extension delivery (use of a combination of the group and individual methods of extension delivery) for increased adoption of cowpea preservation technologies. This would reinforce the acceptance decision of the adopters and counteract competing negative influences. Based on the findings of the study, more attention must be given to constraints to extension delivery since they limit the extension agents ability to effectively disseminate cowpea preservation messages

An analysis of the characteristics of respondents and adoption revealed there was higher adoption of ICPTs by males than females although preservation was a female task. AEs therefore need to target females in their extension delivery so as to increase adoption of ICPTs.

### **8.3. Suggestions for Further Research:**

The variables studied are by no means the only ones likely to influence adoption behaviour. Future research may be necessary, to find out the influence of variables not studied, which are empirically and theoretically known to influence the adoption of innovations, on the adoption of ICPTs.

Due to practical, financial and time constraints, the researchers work was limited to adoption of selected improved cowpea preservation technologies extended by AEAs in the study area. Future work could study other non-extension recommended cowpea preservation technologies so as to find their adoption levels.

Several avenues for future research still remain. In the study, communication channels were classified into three main categories prior to examining their effect on adoption. Other researchers might wish to investigate the interpersonal and mass communication channels in the development of perceptions and adoption of ICPTs. This would provide greater insight into the value of the specific channels.

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15. How many bags of cowpea do you store/preserve? -----

16. What do you do to your produce immediately after harvesting?

- 1. Sell it fresh (immediately) without drying [ ]
- 2. Dry it in the pod and sell [ ]
- 3. Dry, it in the pod store, and sell later [ ]
- 4. Dry it, preserve, and store for home consumption [ ]
- 5. Others specify -----

17. If you store it, do you encounter any problems during storage of cowpea?

- 1. Yes [ ]
- 2. No [ ]

18. What problems do you encounter when storing/preserving the cowpea?-----

-----

**SECTION C: UTILIZATION OF IMPROVED COWPEA PRESERVATION**

**METHODS**

19. Are you aware of any cowpea preservation technologies?      1. Yes [ ]    2. No [ ]

20. If yes, what are these? (list them )

- i.-----
- ii.-----
- iii.-----

21. Have you ever heard of any preservation technology recommended by Extension agents to solve your cowpea storage problem?    1. Yes [ ]    2. No [ ]

22. If yes, list and describe them?

PRESERVATION TECHNOLOGY	DESCRIPTION

23. Who did you get the information on the improved cowpea preservation technology from

- 1. fellow farmers [ ]
- 2. input suppliers [ ]
- 4. Extension agent [ ]
- 16. Produce buyers [ ]
- 32. Others specify -----

24 Have you ever used the preservation technology recommended by the Extension agent?

1. Yes [ ]      2. No [ ]

25 If yes, which of the recommended preservation technologies do you use?

- i. -----  
 ii. -----  
 iii. -----

26. Why do you use the improved preservation technologies? (tick the ones applicable )

1. because it is cheaper to use [ ]  
 2. it yields higher income than the traditional method [ ]  
 3. it stores longer when I use this method [ ]  
 4 it involves less work [ ]  
 5. it is time saving [ ]  
 6. it is similar to the existing traditional practice [ ]  
 7. it is easier to use [ ]  
 8. I understand the innovation and can use it easily [ ]  
 9. others specify -----

27. If you do not use the improved preservation technology, why don't you use it? (tick the ones applicable )

1. it yields less marginal returns [ ]  
 2 I fear the effect of the chemicals [ ]  
 3. because of the high cost of chemicals [ ]  
 4. it is labour consuming [ ]  
 5. it is time consuming [ ]  
 6. it is not similar to the existing traditional cowpea preservation practice [ ]  
 7. the cowpea tastes different after preserving with chemicals [ ]  
 8. cowpea preserved with chemicals takes a longer time to cook [ ]  
 9. it is difficult to get access to the chemicals [ ]  
 10. it is difficult to understand & use the innovation [ ]  
 11. others specify -----

28. What problems do you encounter with the use of these recommended preservation technologies

-----  
 -----

## SECTION D: PERCEPTIONS OF CHARACTERISTICS OF PRESERVATION TECHNOLOGIES:

29. Rank the characteristics of cowpea preservation technologies you are aware of using the rating provided below.

### A: RELATIVE ADVANTAGE:

i. The cost of the technology is -----.

4. very low                      3. low                      2. moderate                      1. high

ii. The technology is ----- income yielding.

4. high                      3. average                      2. low                      1. very low

iii. The shelf life of cowpea when the technology is used is ----- .

4. long                      3. medium                      2. short                      1. very short

iv. There is ----- work involved.

4. very low                      3. low                      2. average                      1. high

v. The time frame for application of the technology is -----.

4. very short                      3. short                      2. medium                      1. long

vi. The technology is -----.

4. very effective                      3. averagely effective                      2. effective                      1. not effective

vii. There are ----- marketing problems.

4. no                      3. a few                      2. average                      1. a lot of

### B: COMPATIBILITY:

viii. The technology is ----- to traditional practices.

4. very similar                      3. averagely similar                      2. similar                      1. not similar

ix. The taste is ----- after preserving with the method.

4. not different                      3. slightly different                      2. different                      1. very different

x. There is ----- of the chemical.

4. no smell /fear of effect                      3. slightly strong smell/fear of effect

2. strong smell/fear of effect                      1. very strong smell /fear of effect

### C: COMPLEXITY:

xi. The technology is ----- to use.

4. very easy                      3. Easy                      2. slightly easy                      1. not easy

xii. The technology is ----- to understand.

4. very easy                      3. Easy                      2. slightly easy                      1. not easy

**D: TRIALABILITY:**

xiii. The use of the technology involves ----- money.

4. very little            3. a little            2. much            1. too much

xiv. The technology was used out of ----- curiosity.

4. high            3. average            2. low            1. no

**E: OBSERVABILITY:**

xv. It is ----- to see the advantage of the technology.

4. very easy            3. easy            2. slightly easy            1. not easy

FACTOR	SUB- FACTOR	RECOMMENDED TECHNOLOGIES			
		Actellic liquid	Actellic dust	Phostoxin	Edible oils
RELATIVE ADVANTAGE	Cost				
	Income yielding				
	Shelf life				
	Work involved				
	Time involved				
	Effectiveness				
	Marketing problems				
COMPATIBILITY	Similarity to traditional practice				
	Taste after preserving				
	Smell of chemical				
COMPLEXITY	Ease of use				
	Ease in understanding tech.				
TRIALABILITY	Use involves ----- money				
	Use out of curiosity				
OBSERVABILITY	Advantage of the innovation				

**SECTION E : EXTENSION CONTACT / ACTIVITIES :**

30. If you have information on cowpea preservation from the extension agent, in what way did the agent pass on the information?
1. lecture [ ]                      2. A demonstration [ ]  
 3. radio discussion                      4. Others specify-----
31. How many times have you taken part in extension activities at which cowpea preservation technologies have been discussed ?
1. never have [ ]                      2. once [ ]  
 3. twice [ ]                      4. thrice [ ]  
 5 more than thrice[ ]
32. In what way did you come into contact with the Extension agent before discussing cowpea preservation technologies ?
- 1.individually [ ]                      2. in a group [ ]                      3. Both [ ]
33. How often was your contact with the extension agent ?
- 1.no contact [ ]                      2. Once a week [ ]  
 3. Fortnightly [ ]                      4. Once a month [ ]  
 5. others specify -----
34. Did you find the way the information was sent to you satisfactory ?
- 1.yes [ ]                      2. No [ ]
35. If yes to Question 34 , give reasons . -----  
 -----
36. If no ,to Question 34 give reasons . -----  
 -----
37. Do you require further training to fully understand the preservation technology being recommended by the Extension agent ?                      1.yes [ ]                      2. No [ ]
- 38 If yes to Question 37 , give reasons . -----  
 -----
39. If no to Question 37 , give reasons -----  
 -----
40. Was the message timely enough for you to put to practice ?                      1.Yes [ ]                      2. No [ ]
41. Briefly indicate any other issues you wish to address with regards to cowpea preservation technologies ?

**APPENDIX 2****STRUCTURED INTERVIEW SCHEDULE FOR COWPEA TRADERS****SECTION A: PERSONAL INFORMATION :**

1. Name /No. of Respondents -----
2. Town/Village:-----
3. Hometown: -----
4. Sex:                            1. Male [ ]    2. Female [ ]
5. Age: -----
6. Marital status :            1. single [ ]    2. widowed [ ]    2. married [ ]    4. divorced[ ]
7. Size of family -----
8. Educational level :
  1. None [ ]
  2. Elementary[ ]
  3. Secondary [ ]
  4. Tertiary (polytechnic, etc[ ]
  5. Others specify-----

***SECTION B: COWPEA STORAGE/PRESERVATION***

9. Where do you sell your cowpea ? -----
10. Which varieties of cowpea do you sell .-----
11. How long have you been selling cowpea ? -----
12. Where do you buy your cowpea?-----
13. Which of the cowpea varieties stays long before getting infested/spoilt? -----
14. How many bags of cowpea do you store/ preserve within a month?-----
15. How do you store/ preserve your cowpea? -----
16. If you store it, do you encounter any problems during storage?
  1. Yes [ ]
  2. No [ ]

17. What problems do you encounter when storing/preserving the cowpea?-----  
-----

18. How long do you store it before encountering the problems? -----  
-----

**SECTION C: UTILIZATION OF IMPROVED COWPEA PRESERVATION**

**METHODS**

19. Are you aware of any cowpea preservation technologies?      1. Yes [ ]    2. No [ ]

20. If yes, what are these? (list them )

i.-----

ii.-----

iii.-----

21. Have you ever heard of any preservation technology recommended by Extension agents to solve your cowpea storage problem?    1. Yes [ ]    2. No [ ]

22. If yes, list and describe them?

PRESERVATION TECHNOLOGY	DESCRIPTION

23. Who did you get the information on the improved cowpea preservation technology from

1. fellow farmers [ ]

2. input suppliers [ ]

4. Extension agent [ ]

16. Produce buyers [ ]

32. Others specify -----

24 Have you ever used the preservation technology recommended by the Extension agent?

1. Yes [ ]    2. No [ ]

25 If yes, which of the recommended preservation technologies do you use?

i. -----

ii. -----

iii. -----

26. Why do you use the improved preservation technologies? (tick the ones applicable )

1. because it is cheaper to use [  ]
2. it yields higher income than the traditional method [  ]
3. it stores longer when I use this method [  ]
4. it involves less work [  ]
5. it is time saving [  ]
6. it is similar to the existing traditional practice [  ]
7. it is easier to use [  ]
8. I understand the innovation and can use it easily [  ]
9. others specify -----

27. If you do not use the improved preservation technology, why don't you use it? (tick the ones applicable )

1. it yields less marginal returns [  ]
2. I fear the effect of the chemicals [  ]
3. because of the high cost of chemicals [  ]
4. it is labour consuming [  ]
5. it is time consuming [  ]
6. it is not similar to the existing traditional cowpea preservation practice [  ]
7. the cowpea tastes different after preserving with chemicals [  ]
8. cowpea preserved with chemicals takes a longer time to cook [  ]
9. it is difficult to get access to the chemicals [  ]
10. it is difficult to understand & use the innovation [  ]
11. others specify -----

28. What problems do you encounter with the use of these recommended preservation technologies

-----  
-----

#### SECTION D: PERCEPTIONS OF CHARACTERISTICS OF PRESERVATION TECHNOLOGIES:

29. Rank the characteristics of cowpea preservation technologies you are aware of using the rating provided below.

A: RELATIVE ADVANTAGE:

i. The cost of the technology is -----.

4. very low                      3. low                      2. moderate                      1. high

- ii. The technology is ----- income yielding.  
 4. high                      3. average      2. low                      1. very low
- iii. The shelf life of cowpea when the technology is used is ----- .  
 4. long                      3. medium      2. short                      1. very short
- iv. There is ----- work involved.  
 4. very low                      3. low                      2. average                      1. high
- v. The time frame for application of the technology is -----.  
 4. very short                      3. short                      2. medium                      1. long
- vi. The technology is -----.  
 4. very effective                      3. averagely effective      2. effective                      1. not effective
- vii. There are ----- marketing problems.  
 4. no                      3. a few                      2. average                      1. a lot of

**B: COMPATIBILITY:**

- viii. The technology is ----- to traditional practices.  
 4. very similar                      3. averagely similar      2. similar                      1. not similar
- ix. The taste is ----- after preserving with the method.  
 4. not different                      3. slightly different      2. different                      1. very different
- x. There is ----- of the chemical.  
 4. no smell /fear of effect                      3. slightly strong smell/fear of effect  
 2. strong smell/fear of effect                      1. very strong smell /fear of effect

**C: COMPLEXITY:**

- xi. The technology is ----- to use.  
 4. very easy                      3. Easy                      2. slightly easy                      1. not easy
- xii. The technology is ----- to understand.  
 4. very easy                      3. Easy                      2. slightly easy                      1. not easy

**D: TRIALABILITY:**

- xiii. The use of the technology involves ----- money.  
 4. very little                      3. a little                      2. much                      1. too much
- xiv. The technology was used out of ----- curiosity.  
 4. high                      3. average                      2. low                      1. no

**E: OBSERVABILITY:**

- xv. It is ----- to see the advantage of the technology  
 4. very easy                      3. easy                      2. slightly easy                      1. not easy

FACTOR	SUB- FACTOR	RECOMMENDED TECHNOLOGIES			
		Actellic liquid	Actellic dust	Phostoxin	Edible oils
RELATIVE ADVANTAGE	Cost				
	Income yielding				
	Shelf life				
	Work involved				
	Time involved				
	Effectiveness				
	Marketing problems				
COMPATIBILITY	Similarity to traditional practice				
	Taste after preserving				
	Smell of chemical				
COMPLEXITY	Ease of use				
	Ease in understanding tech.				
TRIALABILITY	Use involves ----- money				
	Use out of curiosity				
OBSERVABILITY	Advantage of the innovation				

### SECTION E : EXTENSION CONTACT / ACTIVITIES :

30. If you have ha information on cowpea preservation from the extension agent, in what way did the agent pass on the information?

1. lecture [ ]

2. A demonstration [ ]

3. radio discussion

4. Others specify-----

31. How many times have you taken part in extension activities at which cowpea preservation technologies have been discussed ?

1. never have [ ]

2. once [ ]

3. twice [ ]

4. thrice [ ]

5 more than thrice[ ]

32. In what way did you come into contact with the Extension agent before discussing cowpea preservation technologies ?

1. individually [ ]      2. in a group [ ]      3. Both [ ]

33. How often was your contact with the extension agent ?

1. no contact [ ]      2. Once a week [ ]  
 3. Fortnightly [ ]      4. Once a month [ ]  
 5. others specify -----

34. Did you find the way the information was sent to you satisfactory ?

1. yes [ ]      2. No [ ]

35. If yes to Question 34 , give reasons . -----  
 -----

36. If no ,to Question 34 give reasons . -----  
 -----

37. Do you require further training to fully understand the preservation technology being recommended by the Extension agent ?      1. yes [ ]      2. No [ ]

38 If yes to Question 37 , give reasons . -----  
 -----

39. If no to Question 37 , give reasons -----  
 -----

40. Was the message timely enough for you to put to practice ?      1. Yes [ ]      2. No [ ]

41. Briefly indicate any other issues you wish to address with regards to cowpea preservation technologies ?



13a Indicate the year /time the cowpea preservation technologies mentioned in Question 12 were introduced in the operational area ?

-----  
-----

13b. Was there a need for re - introduction of these technologies mentioned in Question 12 above?

1. Yes [ ]                      2. No [ ]

13c If yes to Question 13b , why was this necessary ?

-----  
-----

13d Indicate according to effectiveness , three Extension teaching methods you often use to extend cowpea preservation messages ?

i.-----

ii.-----

iii.-----

13e. Why did you choose the extension teaching methods mentioned in Question 13d above ?

i.-----

ii.-----

iii.-----

13f How often do you use the Extension teaching methods mentioned in Question 13d within a farming season ?

i.-----

ii.-----

iii.-----

13g. Briefly indicate any disadvantage(s) if any of using the extension teaching methods indicated in 13d.

i.-----

ii.-----

iii.-----

14. Who provided the input for the training?

- 1 the extension agent [ ]      4. the clientele [ ]  
 2.the extension supervisor [ ]      5.the researcher [ ]  
 3.others specify-----

15. Was any demonstration done ?      1. Yes [ ]      2 No [ ]

16. If yes , which Extension method was used ?

1. method [ ]      2. Result [ ]      3. Both [ ]

17. How often was your contact with your clientele within a month?

1. no contact [ ]      2. once [ ]  
 3. twice [ ]      4. thrice or more [ ]

18. Indicate any problems encountered with transfer of technical message on preservation of cowpea.-----  
 -----

19. Apart from the cowpea preservation technologies ,you or other Extension workers have disseminated to your clientele, do you know of any other cowpea preservation technologies      1. Yes [ ]      2.No [ ]

20. If yes to Question 19 , list these ?-----  
 -----

21. Do you take these other preservation technologies listed in Question 20 into consideration when you extend messages on cowpea preservation to farmers in your operational area ?

1. Yes [ ]      2.No [ ]

22. If yes , how and why do you extend information on the preservation methods mentioned in Question 20 ?  
 -----  
 -----

23. If no to Question 21 , why don't you extend that information ?  
 -----  
 -----

**SECTION C: ADOPTION OF THE TECHNOLOGY**

24 Indicate any constraints to the adoption of cowpea preservation technologies . ?

-----

-----

25. Have the farmers in your operational area been using the cowpea preservation technologies recommended by Extension agents ?

1. Yes [ ]                      2. No [ ]

26. If no to Question 25 , why do you think they are not using the technologies ( tick the ones applicable )

1. inadequate information about the technology [ ]  
 2 cost of inputs [ ]  
 3. availability of inputs [ ]  
 4.cost of labour [ ]  
 5. others specify -----

27.Do your clientele show interest in the cowpea preservation technologies you recommend?

1. Yes [ ]                      2. No [ ]

28. If yes to Question 25, how is this revealed to you ?

-----

-----



29 . If no , why do you think they are not interested ?

-----

-----

30 Briefly indicate any other issues you wish to address with regards to the technology, its introduction , and adoption ?

-----

-----

31. Personally do you believe in the use of chemicals for preserving food ?

1. Yes [ ]                      2. No [ ]

32. If no , why don't you like the use of chemicals for preservation ?

-----

-----

33. Which villages are in your operational area ?-----

**APPENDIX 4****FOCUS GROUP DISCUSSION  
(COWPEA PRODUCERS, TRADERS & EXTENSION AGENTS)****SECTION A : BIO - PHYSICAL CHARACTERISTICS****A. Climate : ( Seasonal Calendar )****1. Normal distribution of rainfall ( monthly )**

- major/minor season
- dry season
- relationship with farming/economic activities
- relationship with growth & storage of cowpea

**SECTION B : ECONOMIC DEVELOPMENT / CHARACTERISTICS:****A. Crop production****1 Crops grown****2 Output level of crops (especially cowpea)**

For each crop especially cowpea indicate :

- a. length and possible range of growing season
  - b. normal variation in growing season ( early/late )
  - c. normal harvesting season- normal variation in harvesting season ( early/late)
  - d. varieties of cowpea grown
  - e. time for performing critical operations ( practices with respective dates )
  - f. input/output associated with the practice
    - g. given the total agricultural activity within the area indicate the relative seasonal demand for most critical inputs
  - h. seasonal demand for other critical inputs  
( eg Preservatives )
- 3. Level of Agricultural technology**

**B. Cowpea yield & Returns**

Estimate of cowpea yields & returns per year ( reported yield in bags for the last two years )

**C. Storage facilities**

- place of storage/storage area
- availability of storage facilities
- adoption pattern of cowpea storage recommendation
- description of Cowpea preservation practices
- For each practice , indicate:
  1. what the practice is called locally
  2. specific input(s) associated with the practice & amounts applied per bag
  3. mode of application
  4. time of application

**D. Marketing & Price of Cowpea**

- a. Identify principal/minor local market outlets ( buyers )
  - b. Estimate the quantity of product marketed ( in bags )
    - recent prices ( at time of sale )
  - c. Seasonality of marketing & prices ( Seasonal Calendar )
- Is the crop all sold at harvest, part sold at harvest , part held for higher prices etc.
  - seasonal fluctuations of prices. (average over the last 5yrs if possible)

**E. Extension Service**

- availability of extension service
- professional services ( pest control & storage )
- Indicate whether public/private

**F. : Communication :**

1. Formal / Informal channels of information diffusion within the community .
2. Prevailing extension teaching methods
3. Barriers to effective communication between extension workers and farmers after they receive extension message

APPENDIX 5: Perceptions of Specific Attributes of Selected ICPTs.

General Attributes	Specific Attribute	Per.	Selected Improved Cowpea Preservation Technologies									
			Actellic liquid (% not aware = 65%)		Actellic Dust (%not aware = 50%)		Phostoxin (% not aware = 75%)		Edible Oils (% not aware = 69%)		Norm = 100%	
			F	%	F	%	F	%	F	%	F	%
Relative Advantage	Cost	(+)	0	0	1	1	0	0	0	0	1	1
		(-)	30	35	42	49	19	22	27	31	118	99
	Income Yielding	(+)	28	33	40	47	17	20	21	25	106	89
		(-)	2	2	3	3	2	2	6	6	3	11
	Shelf Life	(+)	26	30	40	47	17	20	15	18	98	82
		(-)	4	5	3	3	2	2	12	13	21	18
	Work Involved	(+)	4	5	16	19	15	17	2	2	37	31
(-)		26	30	17	31	4	5	25	29	82	69	
Time Involved	(+)	2	2	9	10	16	19	7	8	34	29	
	(-)	28	33	34	40	3	3	20	23	85	71	
Effectiveness	(+)	26	30	42	49	19	22	25	29	112	94	
	(-)	4	5	1	1	0	0	2	2	7	6	
Marketing Problems	(+)	12	14	14	16	10	12	13	15	49	41	
	(-)	18	21	29	34	9	10	14	16	70	59	
Compatibility	Similarity	(+)	0	0	43	50	19	22	1	1	63	53
		(-)	30	35	0	0	0	0	26	30	56	47
	Taste	(+)	27	32	38	45	18	21	25	29	108	91
(-)		3	3	5	5	1	1	2	2	11	9	
Smell	(+)	22	26	35	41	12	14	23	27	92	77	
	(-)	8	9	8	9	7	8	4	4	27	23	
Complexity	Ease of Use	(+)	21	25	42	49	19	22	3	3	85	71
		(-)	9	10	1	1	0	0	24	28	34	29
Ease in understanding	(+)	24	28	41	48	19	22	21	25	105	88	
	(-)	6	7	2	2	0	0	6	6	14	12	
Triability	Piloting Cost	(+)	8	9	25	29	13	15	2	2	48	40
		(-)	22	26	18	21	6	7	25	29	71	60
Generation of curiosity	(+)	9	10	11	13	1	1	3	3	24	20	
	(-)	21	25	32	37	18	21	24	28	95	80	
Observability	Visibility of advantage	(+)	27	32	40	47	19	22	12	14	102	86
		(-)	3	3	3	3	0	0	15	17	17	14

Appendix 6: Perceptions of General Attributes of Selected ICPTs

General Attributes	Perception	Selected Improved Cowpea Preservation Technologies									
		Actellic Liquid (% Not aware = 65%)		Actellic dust (%Not aware = 50%)		Phostoxin (% Not aware = 75%)		Edible oils (%Not aware = 69%)		Norm = 100%	
		F	%	F	%	F	%	F	%	F	%
Relative Advantage	(+)	16	19	32	38	15	25	4	5	71	60
	(-)	14	16	11	13	0	0	23	27	48	40
Compatibility	(+)	26	30	43	51	15	25	23	27	111	93
	(-)	4	5	0	0	0	0	4	5	8	7
Complexity	(+)	18	21	37	44	15	25	7	8	81	68
	(-)	12	14	6	7	0	0	20	24	38	32
Triability	(+)	7	8	10	12	2	3	4	5	24	20
	(-)	23	27	33	39	13	22	23	27	95	80
Observability	(+)	22	26	34	40	14	23	8	9	81	68
	(-)	8	9	9	11	1	2	19	23	38	32

Appendix 7: Overall Perceptions of Attributes of Selected ICPTs

Improved Cowpea Preservation Technologies	Perception	Overall Perception of Attributes of ICPTs	
		FREQ.	%
Actellic liquid	Positive (+)	13	15
	Negative (-)	17	20
Actellic dust	Positive (+)	42	49
	Negative (-)	1	1
Phostoxin	Positive (+)	16	19
	Negative (-)	3	4
Edible oil	Positive (+)	2	2
	Negative (-)	25	29

Appendix 8: Personal Characteristics &amp; Overall Perceptions of Attributes of ICPTs

Characterist	Category	Per	Selected Improved Cowpea Preservation Technologies									
			AL		AD		P		EO		Norm	
			F	%	F	%	F	%	F	%	F	%
Gender	Male	(+)	7	8	23	27	9	11	2	2	41	48
		(-)	6	7	0	0	3	4	11	13	20	24
	Female	(+)	6	7	19	22	7	8	0	0	32	38
		(-)	10	12	1	1	0	0	15	18	26	31
Age	40 years or less	(+)	11	13	27	32	9	11	2	2	49	58
		(-)	11	13	1	1	0	0	16	19	38	45
	More than 40 years	(+)	2	2	15	18	7	8	0	0	24	28
		(-)	5	6	0	0	3	4	9	11	17	20
Educational Level	None	(+)	7	8	12	14	4	5	2	2	25	29
		(-)	6	7	0	0	0	0	9	11	15	18
	Formal & Non - Formal	(+)	6	7	30	35	12	14	0	0	47	55
		(-)	10	12	1	1	3	4	17	20	31	36
Professional Experience	5 years or less	(+)	8	9	18	21	7	8	2	2	35	41
		(-)	6	7	1	1	6	7	8	9	15	18
	More than 5 years	(+)	6	7	24	28	9	11	0	0	39	46
		(-)	9	11	2	2	1	1	17	20	29	34
Farm Size (Producers)	2 acres or less	(+)	4	7	15	25	5	6	2	2	26	31
		(-)	8	13	1	2	0	0	10	12	19	22
	More than 2 acres	(+)	7	8	15	25	7	8	0	0	29	34
		(-)	3	4	0	0	3	4	9	11	15	18
Crop Yield (Producers)	4 bags or less	(+)	5	8	12	20	5	6	1	1	23	27
		(-)	4	7	3	5	0	0	8	9	15	18
	More than 4 bags	(+)	6	10	18	30	7	8	1	1	32	38
		(-)	7	12	0	0	3	4	11	18	21	25
Variety Grown	Local Only	(+)	5	6	10	12	7	8	0	0	22	26
		(-)	6	7	1	1	0	0	10	12	17	20
	Improved Only	(+)	3	4	6	7	4	5	1	1	14	16
		(-)	2	2	0	0	0	0	4	5	6	7
	Local & Improved	(+)	9	11	26	31	5	6	1	1	38	45
		(-)	7	8	2	2	3	4	11	18	23	27
Quantity Stored	2 bags or less	(+)	4	5	17	20	6	7	2	2	29	34
		(-)	5	6	2	2	0	0	7	8	14	16
	More than 2 bags	(+)	10	12	25	29	10	12	0	0	35	41
		(-)	10	12	1	1	1	1	15	18	30	35

Appendix 9: Personal Characteristics & Perceptions of General Attributes of ICPTs

ICPTs	GA	Per.	Personal Characteristics											
			Gender						Age					
			Male		Female		Norm		<41		>40		Norm	
			F	%	F	%	F	%	F	%	F	%	F	%
AL	RA.	(+)	7	8	9	11	16	18	13	15	3	4	16	18
		(-)	6	7	8	9	14	16	10	12	4	5	14	16
	C.	(+)	11	13	15	18	26	31	20	23	5	6	26	31
		(-)	2	2	2	2	4	5	3	4	2	2	4	5
	Co.	(+)	7	8	11	13	18	27	14	16	3	4	18	27
(-)		6	7	6	7	12	14	9	11	4	5	12	14	
Tria.	(+)	4	5	3	4	7	8	4	5	3	4	7	8	
	(-)	9	11	14	16	23	27	19	22	4	5	23	27	
Obs.	(+)	10	12	12	12	23	27	16	18	7	8	23	27	
	(-)	3	4	5	6	7	8	7	8	0	0	7	8	
AD	RA.	(+)	19	22	13	15	32	38	20	23	12	14	32	38
		(-)	4	5	7	8	11	14	9	11	2	2	11	14
	C.	(+)	23	27	20	23	43	51	29	34	14	16	43	51
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	Co.	(+)	19	22	18	21	37	44	24	28	13	15	37	44
(-)		4	5	2	2	6	7	5	6	1	1	6	7	
Tria.	(+)	9	11	1	1	10	12	7	8	3	4	10	12	
	(-)	14	16	19	22	33	39	22	26	11	13	33	39	
Obs.	(+)	18	21	16	19	34	40	20	23	14	16	34	40	
	(-)	5	6	4	5	9	11	9	11	0	0	9	11	
P.	RA.	(+)	12	14	7	8	19	22	10	12	9	11	19	22
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	C.	(+)	11	13	7	8	19	22	10	12	9	11	19	22
		(-)	1	1	0	0	0	0	0	0	0	0	0	0
	Co.	(+)	12	14	7	8	19	22	10	12	9	11	19	22
(-)		0	0	0	0	0	0	0	0	0	0	0	0	
Tria.	(+)	2	2	1	1	3	4	1	1	2	2	3	4	
	(-)	10	12	6	7	16	18	9	11	7	8	16	18	
Obs.	(+)	11	13	6	7	17	20	8	9	9	11	17	20	
	(-)	1	1	1	1	2	2	2	2	0	0	2	2	
EO.	RA.	(+)	3	5	1	1	4	5	4	5	0	0	4	5
		(-)	10	17	13	15	23	27	14	16	9	11	23	27
	C.	(+)	12	20	11	13	23	27	16	18	7	8	23	27
		(-)	1	2	3	4	4	5	2	2	2	2	4	5
	Co.	(+)	3	5	4	5	7	8	6	7	1	1	7	8
(-)		10	17	10	12	20	24	12	14	8	9	20	24	
Tria.	(+)	2	3	4	5	6	7	2	2	4	5	6	7	
	(-)	11	18	10	12	21	25	16	18	5	6	21	25	
Obs.	(+)	6	10	1	1	7	2	5	6	2	2	7	2	
	(-)	7	12	13	15	14	7	13	15	7	8	14	7	

Appendix 9 Contd: Personal Characteristics &amp; Perceptions of General Attributes of ICPTs

ICPTs	GA	Pcr	Personal Characteristics											
			Educational Level						Professional Experience					
			None		F & N.F.		Norm		<6		>5		Norm	
			F	%	F	%	F	%	F	%	F	%	F	%
AL	RA.	(+)	6	7	10	12	16	18	10	12	6	7	16	18
		(-)	6	7	8	9	14	16	5	6	9	11	14	16
	C.	(+)	11	13	15	18	26	31	14	16	12	14	26	31
		(-)	1	1	3	4	4	5	1	1	3	4	4	5
	Co.	(+)	7	8	11	13	18	27	10	12	8	9	18	27
(-)		5	6	7	8	12	14	5	6	7	8	12	14	
Tria.	(+)	4	5	3	4	7	8	4	5	3	4	7	8	
	(-)	8	9	15	18	23	27	11	13	12	14	23	27	
Obs.	(+)	9	11	14	16	23	27	11	13	12	14	23	27	
	(-)	3	4	4	5	7	8	4	5	3	4	7	8	
AD	RA.	(+)	11	13	21	25	32	38	12	14	20	24	32	38
		(-)	3	4	8	9	11	14	6	7	5	6	11	14
	C.	(+)	14	16	29	34	43	51	18	21	25	30	43	51
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	Co.	(+)	11	13	26	31	37	44	16	18	21	25	37	44
(-)		3	4	3	4	6	7	2	2	4	5	6	7	
Tria.	(+)	3	4	7	8	10	12	6	7	4	5	10	12	
	(-)	11	13	22	26	33	39	12	14	21	25	33	39	
Obs.	(+)	9	11	25	29	34	40	12	14	22	26	34	40	
	(-)	5	6	4	5	9	11	6	7	3	4	9	11	
P.	RA.	(+)	4	5	15	18	19	22	8	9	11	13	19	22
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	C.	(+)	4	5	15	18	19	22	8	9	11	13	19	22
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	Co.	(+)	4	5	15	18	19	22	8	9	11	13	19	22
(-)		0	0	0	0	0	0	0	0	0	0	0	0	
Tria.	(+)	0	0	3	4	3	4	2	2	1	1	3	4	
	(-)	4	5	12	14	16	18	6	7	10	12	16	18	
Obs.	(+)	3	4	14	16	17	20	6	7	11	13	17	20	
	(-)	1	1	1	1	2	2	2	2	0	0	2	2	
EO.	RA.	(+)	4	5	0	0	4	5	2	2	2	2	4	5
		(-)	7	8	16	18	23	27	8	9	15	18	23	27
	C.	(+)	10	12	13	15	23	27	9	11	14	16	23	27
		(-)	1	1	3	4	4	5	1	1	3	4	4	5
	Co.	(+)	2	2	5	6	7	8	3	4	4	5	7	8
(-)		9	11	11	13	20	24	7	8	13	15	20	24	
Tria.	(+)	2	2	4	5	6	7	1	1	5	6	6	7	
	(-)	9	11	12	14	21	25	9	11	12	14	21	25	
Obs.	(+)	4	5	3	4	7	2	2	2	5	6	7	2	
	(-)	7	8	13	15	14	7	8	9	12	14	14	7	

Appendix 10: Enterprise Characteristics &amp; Perceptions of General Attributes of ICPTs

ICPTs	GA	Per.	Enterprise Characteristics											
			Farm Size (Producers)						Crop Yield (Producers)					
			<3		>2		Norm		<5		>4		Norm	
			F	%	F	%	F	%	F	%	F	%	F	%
AL	RA.	(+)	4	7	7	12	11	18	9	15	2	3	11	18
		(-)	8	13	3	5	11	18	8	13	3	5	11	18
	C.	(+)	9	15	10	17	19	32	14	23	5	8	19	32
		(-)	3	5	0	0	3	5	3	5	0	0	3	5
	Co.	(+)	6	10	6	10	12	20	9	15	3	5	12	20
		(-)	6	10	4	7	10	17	8	13	2	3	10	17
	Tria.	(+)	4	7	2	3	6	10	6	10	0	0	6	10
		(-)	8	13	8	13	16	27	11	18	5	8	16	27
	Obs.	(+)	9	15	7	12	16	27	13	21	3	5	16	27
		(-)	3	5	3	5	6	10	4	7	2	3	6	10
AD	RA.	(+)	9	15	15	25	24	40	21	35	3	5	24	40
		(-)	7	12	0	0	7	12	3	5	4	7	7	12
	C.	(+)	16	27	15	25	31	52	24	40	7	12	31	52
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	Co.	(+)	12	20	13	22	25	42	21	35	4	7	25	42
		(-)	4	7	2	3	6	10	3	5	3	5	6	10
	Tria.	(+)	6	10	4	7	10	17	8	13	2	3	10	17
		(-)	10	17	11	18	21	35	16	27	5	8	21	35
	Obs.	(+)	10	17	15	25	25	42	21	35	4	7	25	42
		(-)	6	10	0	0	6	10	3	5	3	5	6	10
P.	RA.	(+)	7	12	8	13	15	25	11	18	4	7	15	25
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	C.	(+)	7	12	8	13	15	25	11	18	4	7	15	25
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	Co.	(+)	7	12	8	13	15	25	11	18	4	7	15	25
		(-)	0	0	0	0	0	0	0	0	0	0	0	0
	Tria.	(+)	1	2	1	2	2	3	2	3	0	0	2	3
		(-)	6	10	7	11	13	22	9	15	4	7	13	22
	Obs.	(+)	7	12	7	11	14	23	11	18	3	5	14	23
		(-)	0	0	1	2	1	2	0	0	1	2	1	2
EO.	RA.	(+)	4	7	0	0	4	7	3	5	1	2	4	7
		(-)	8	13	9	15	17	28	13	22	4	7	17	28
	C.	(+)	11	18	9	15	20	33	15	25	5	8	20	33
		(-)	1	2	0	0	1	2	1	2	0	0	1	2
	Co.	(+)	3	5	4	7	7	12	6	10	1	2	7	12
		(-)	9	15	5	8	14	23	10	17	4	7	14	23
	Tria.	(+)	1	2	2	3	3	5	2	3	1	2	3	5
		(-)	11	18	7	11	18	30	14	23	4	7	18	30
	Obs.	(+)	2	3	5	8	7	12	7	12	0	0	7	12
		(-)	10	17	4	7	14	23	9	15	5	8	14	23

Appendix 10 Contd: Enterprise Characteristics & Perceptions of General Attributes of ICPTs

ICPTs	GA	Per	Enterprise Characteristics													
			Variety Grown / Sold						Quantity Stored							
			L		I		L&I		Norm		<3		>2		Norm	
			F	%	F	%	F	%	F	%	F	%	F	%	F	%
AL	RA.	(+)	4	5	5	6	7	8	16	18	4	5	12	14	16	18
		(-)	7	8	1	1	6	7	14	16	5	6	9	11	14	16
	C.	(+)	9	11	6	7	11	13	26	31	7	8	19	22	26	31
		(-)	2	2	0	0	2	2	4	5	2	2	2	2	4	5
	Co.	(+)	5	6	4	5	9	11	18	27	3	4	15	18	18	27
(-)		6	7	2	2	4	5	12	14	6	7	6	7	12	14	
Tria.	(+)	2	2	1	1	4	5	7	8	2	2	5	6	7	8	
	(-)	9	11	5	6	9	11	23	27	7	8	16	18	23	27	
Obs.	(+)	9	11	5	6	9	11	23	27	7	8	16	18	23	27	
	(-)	2	2	1	1	4	5	7	8	2	2	5	6	7	8	
AD	RA.	(+)	9	11	4	5	19	22	32	38	12	14	20	24	32	38
		(-)	2	2	2	2	7	8	11	14	6	7	5	6	11	14
	C.	(+)	11	13	6	7	26	31	43	51	18	21	25	30	43	51
		(-)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Co.	(+)	10	12	5	6	22	26	37	44	14	16	23	28	37	44
(-)		1	1	1	1	4	5	6	7	4	5	2	2	6	7	
Tria.	(+)	0	0	0	0	10	12	10	12	6	7	4	5	10	12	
	(-)	11	13	6	7	16	18	33	39	12	14	21	25	33	39	
Obs.	(+)	9	11	5	6	20	23	34	40	13	15	21	25	34	40	
	(-)	2	2	1	1	6	7	9	11	5	6	4	5	9	11	
P.	RA.	(+)	7	8	4	5	8	9	19	22	7	8	12	14	19	22
		(-)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C.	(+)	7	8	4	5	8	9	19	22	7	8	12	14	19	22
		(-)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Co.	(+)	7	8	4	5	8	9	19	22	7	8	12	14	19	22
(-)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Tria.	(+)	1	1	0	0	2	2	3	4	1	1	2	2	3	4	
	(-)	6	7	4	5	6	7	16	18	6	7	10	12	16	18	
Obs.	(+)	6	7	4	5	7	8	17	20	6	7	11	13	17	20	
	(-)	1	1	0	0	1	1	2	2	1	1	1	1	2	2	
EO.	RA.	(+)	1	1	1	1	2	2	4	5	3	4	1	1	4	5
		(-)	9	11	4	5	10	12	23	27	6	7	17	20	23	27
	C.	(+)	9	11	4	5	10	12	23	27	8	9	15	18	23	27
		(-)	1	1	1	1	2	2	4	5	1	1	3	4	4	5
	Co.	(+)	2	2	2	2	3	4	7	8	2	2	5	6	7	8
(-)		8	9	3	4	9	11	20	24	7	8	13	15	20	24	
Tria.	(+)	2	2	2	2	2	2	6	7	1	1	5	6	6	7	
	(-)	8	9	3	4	10	12	21	25	8	9	13	15	21	25	
Obs.	(+)	2	2	1	1	4	5	7	8	2	2	5	6	7	8	
	(-)	8	9	4	5	8	9	14	17	7	8	13	15	14	17	

Appendix 11: Extension Method Used &amp; Perceptions of Overall Attributes of ICPTs

ICPTs	Perception.	METHOD USED					
		Individual.		Group		Individual & Group	
		F	%	F	%	F	%
Actellic liquid	(+)	6	7	12	14	11	13
	(-)	1	1	1	1	1	1
Actellic dust	(+)	6	7	13	20	16	19
	(-)	1	1	1	1	0	0
Phostoxin	(+)	4	5	4	5	8	9
	(-)	0	0	1	1	0	0
Edible Oil	(+)	1	1	1	1	0	0
	(-)	2	2	6	7	6	7
Norm	(+)	17	20	30	35	34	37
	(-)	4	5	9	11	7	8

## Appendix 12: Extension Method Used and Perceptions of General Attributes of ICPTs

GA	P.	Improved Cowpea Preservation Technologies															
		Actellic liquid								Actellic dust							
		I		G		I&G		Norm		I		G		I&G		Norm	
		F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
RA	(+)	2	2	6	7	5	6	13	15	5	6	10	12	12	14	27	32
	(-)	3	4	2	2	2	2	7	8	2	2	3	4	3	4	8	9
C.	(+)	3	4	8	9	7	8	18	21	7	8	14	16	15	18	36	42
	(-)	2	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0
Co.	(+)	2	2	6	7	5	6	13	15	5	6	11	13	15	18	31	36
	(-)	3	4	2	2	2	2	7	8	2	2	3	5	0	0	5	6
Tria	(+)	1	1	2	2	0	0	3	4	1	1	12	14	2	2	9	11
	(-)	4	5	6	7	7	8	17	20	6	7	7	8	13	15	27	32
Ob.	(+)	5	6	5	6	7	8	17	16	6	7	10	12	13	15	29	34
	(-)	0	0	3	4	0	0	3	6	1	1	4	5	2	0	7	8

## Appendix 12 Contd: Extension Method Used and Perceptions of General Attributes of ICPTs

GA	P.	Improved Cowpea Preservation Technologies															
		Phostoxin								Edible Oil							
		I		G		I&G		Norm		I		G		I&G		Norm	
		F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
RA	(+)	4	5	5	6	9	11	18	21	1	1	2	2	1	1	4	5
	(-)	0	0	0	0	0	0	0	0	2	2	5	6	5	6	12	14
C.	(+)	5	6	2	2	8	9	15	18	3	4	7	8	5	6	15	18
	(-)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Co.	(+)	4	5	5	6	9	11	18	21	1	1	3	4	1	1	5	6
	(-)	0	0	0	0	0	0	0	0	2	2	4	5	5	6	11	13
Tria	(+)	0	0	2	2	3	4	2	2	1	1	0	0	0	0	1	1
	(-)	4	5	3	4	6	7	15	18	2	2	7	8	6	7	15	18
Ob.	(+)	4	5	5	6	8	9	16	19	0	0	1	1	4	5	5	6
	(-)	1	1	0	0	1	1	1	1	3	4	6	7	2	2	11	13

Appendix 13: Frequency of Contact and Perceptions of Overall Attributes of ICPTs

ICPTS	Perception.	FREQUENCY OF CONTACT							
		No Contact		Once		Twice		Thrice or More	
		F	%	F	%	F	%	F	%
Actellic liquid	(+)	3	4	1	1	7	8	3	4
	(-)	6	7	2	2	5	6	2	2
Actellic dust	(+)	9	11	5	6	17	20	11	13
	(-)	1	1	0	0	0	0	2	2
Phostoxin	(+)	1	1	3	4	7	8	5	6
	(-)	0	0	0	0	1	1	0	0
Edible oil	(+)	0	0	0	0	2	2	0	0
	(-)	11	13	1	1	9	11	4	5
NORM	(+)	13	15	9	11	33	39	19	22
	(-)	20	24	3	4	15	18	8	9

Appendix 14: Frequency of Contact &amp; Perceptions of General Attributes of ICPTs.

ICPTS	P.	Selected ICPTs & Frequency of Contact																			
		Actellic Liquid					Actellic Dust														
		NC		O		T.	TM.	Norm	NC		O		T.	TM.	Norm						
		F	%	F	%	F	%	F	%	F	%	F	%	F	%						
RA.	(+)	3	4	1	1	8	9	4	5	16	19	7	8	4	5	14	16	7	8	32	33
	(-)	7	8	2	2	4	5	1	1	14	16	2	2	1	1	3	4	5	6	11	13
C.	(+)	8	9	3	4	10	12	5	6	26	31	9	11	5	6	17	20	12	14	43	51
	(-)	2	2	0	0	2	2	0	0	4	5	0	0	0	0	0	0	0	0	0	0
Co.	(+)	5	6	2	2	8	9	4	5	19	22	7	8	5	6	15	18	9	11	36	42
	(-)	5	6	1	1	4	5	1	1	11	13	2	2	0	0	2	2	3	4	7	8
Tria.	(+)	4	5	0	0	3	4	0	0	7	8	2	2	1	1	5	6	2	2	10	12
	(-)	6	7	3	4	9	11	5	6	23	27	7	8	4	5	12	14	10	12	33	39
Obs.	(+)	7	8	3	4	8	9	4	5	22	26	7	8	5	6	14	16	8	9	34	40
	(-)	3	4	0	0	4	5	1	1	8	10	2	2	0	0	3	4	4	5	9	11

Appendix 14 Contd. : Frequency of Contact Perceptions of General Attributes of ICPTs

ICPTS	P.	Selected ICPTs & Frequency of Contact																			
		Phostoxin					Edible Oil														
		NC		O		T.	TM.	Norm	NC		O		T.	TM.	Norm						
		F	%	F	%	F	%	F	%	F	%	F	%	F	%						
RA.	(+)	2	2	3	4	8	9	6	7	19	22	0	0	0	0	4	5	0	0	4	5
	(-)	0	0	0	0	0	0	0	0	0	0	11	13	1	1	7	8	4	5	23	27
C.	(+)	2	2	3	4	8	9	6	7	19	22	8	9	1	1	10	12	4	5	23	27
	(-)	0	0	0	0	0	0	0	0	0	0	3	4	0	0	1	1	0	0	4	5
Co.	(+)	2	2	3	4	8	9	6	7	19	22	6	7	0	0	5	6	1	1	12	14
	(-)	0	0	0	0	0	0	0	0	0	0	5	6	1	1	6	7	3	4	15	18
Tria.	(+)	0	0	0	0	1	1	2	2	3	4	3	4	0	0	0	0	0	0	3	4
	(-)	2	2	3	4	7	8	4	5	16	19	8	9	1	1	11	13	4	5	24	28
Obs.	(+)	2	2	3	4	7	8	5	6	17	20	3	4	0	0	1	1	0	0	4	5
	(-)	0	0	0	0	1	1	1	1	2	2	8	9	1	1	10	12	4	4	23	27

Appendix 15A: Relationship between Producers Overall Perceptions of Attributes of Selected ICPTs and Adoption.

Actellic Liquid	Overall Perception					
	Positive		Negative & No Knowledge		Total	
	F	%	F	%	F	%
Adoption	9	15	4	7	13	22
Non Adoption	2	3	45	75	47	78
Total	11	18	49	82	60	100
$\chi^2 = 24.54$		df = 1		P = 0.0000(s)		
Actellic Dust	Overall Perception					
	Positive		Negative & No Knowledge		Total	
	F	%	F	%	F	%
Adoption	26	43	1	2	27	45
Non Adoption	4	7	29	48	33	55
Total	30	50	33	55	60	100
$\chi^2 = 42.09$		df = 1		P = 0.0000(s)		
Phostoxin	Overall Perception					
	Positive		Negative & No Knowledge		Total	
	F	%	F	%	F	%
Adoption	11	18	3	5	14	23
Non Adoption	1	2	45	75	46	77
Total	12	20	48	80	60	100
$\chi^2 = 34.52$		df = 1		P = 0.0000(s)		
Edible Oil	Overall Perception					
	Positive		Negative & No Knowledge		Total	
	F	%	F	%	F	%
Adoption	0	0	7	12	7	12
Non Adoption	2	3	51	85	53	88
Total	2	3	58	97	60	100
$\chi^2 = 0.36$		df = 1		P = 0.77 (NS)		

Appendix 15B: Relationship between Traders Overall Perception of Attributes of Selected ICPTs &amp; Adoption.

Actellic Liquid	Overall Perception					
	Positive		Negative & No Knowledge		Total	
	F	%	F	%	F	%
Adoption	2	8	2	8	4	16
Non Adoption	1	4	20	80	21	84
Total	3	12	22	88	25	100
$\chi^2 = 2.93$		df = 1		P = 0.0000(s)		
Actellic Dust	Overall Perception					
	Positive		Negative & No Knowledge		Total	
	F	%	F	%	F	%
Adoption	9	36	0	0	9	36
Non Adoption	3	12	13	52	16	64
Total	12	48	13	52	25	100
$\chi^2 = 12.15$		df = 1		P = 0.0000(s)		
Phostoxin	Overall Perception					
	Positive		Negative & No Knowledge		Total	
	F	%	F	%	F	%
Adoption	4	16	0	0	4	16
Non Adoption	0	0	21	84	46	84
Total	4	16	21	84	60	100
$\chi^2 = 18.11$		df = 1		P = 0.0000(s)		
Edible Oil	Overall Perception					
	Positive		Negative & No Knowledge		Total	
	F	%	F	%	F	%
Adoption	0	0	2	8	2	8
Non Adoption	0	0	23	92	23	92
Total	0	0	25	100	23	100
$\chi^2 = 0.0$		df = 1		P = 1.0 (NS)		