COMMUNICATION STRATEGY AND ADOPTION OF INTEGRATED PEST MANAGEMENT (IPM) PRACTICES BY VEGETABLE FARMERS AT THE WEIJA IRRIGATION PROJECT, GHANA.

BY

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DECLARATION

I, ALFRED OSEI, do hereby declare that, this thesis with the exception of the identified quotations is a product of my own research, written entirely by me. None of the materials contained herein, has been presented either in whole or in part for the degree of this University or any other degree elsewhere.

....

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DEDICATION

To my father, Lawrence K. Okyere,

my mother, Dora Korantemaa,

my siblings and my son Lawrence Osei Okyere.

ACKNOWLEDGEMENT

... *'Not by might nor by power, but by My Spirit', Says the LORD of hosts (Zechariah 4:6)*. I am most grateful to the Most High God for seeing me through my education to this level. Glory be to His holy name.

Much of the credit for the successful completion of this research goes to my supervisor, Dr. Owuraku Sakyi-Dawson, for his guidance, encouragement, patience, interest and support throughout the preparation and writing of this work. May the Most High God bless him abundantly.

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ABSTRACT

To enhance food security, crop losses due to disease and pest damage must be reduced. Improved technologies for pest control using appropriate and environmentally sound technologies to promote food security is a major priority for many developing nations. Integrated Pest Management, IPM (also referred to as Integrated Crop Management (ICM)) is one of such approaches to promoting food security. Its adoption by farmers is therefore critical. In Ghana, few empirical evidence about the communication strategies employed to effectively disseminate IPM practices exists. This study .therefore examines the influence of communication strategies on adoption of IPM. The findings are based on data collected from farmers at the Weija Irrigation Project which typifies intensive vegetable farming in the Greater Accra District. It has also been the centre of a lot of agricultural projects especially in the area of Agricultural Extension, such as the IPM *Farmers' Field School.* (IPM/FFS).

Data were collected from 105 vegetable farmers comprising 55 FFS participants and 50 non-participants using structured interview schedule from March to April 2000. The analysis involved frequencies, percentages, cross-tabulations and chi-square test. Practices incorporated in the IPM/FFS for vegetable farmers in the study area and which the study focused on include: use of neem seed extract as bio-pesticide, manure application, mulching, use of improved seeds, reduction or avoidance of use of chemical pesticides, scouting and row planting. The study reveals that there were generally high levels of awareness of all the practices incorporated in the IPM for vegetables in the study area. The main sources of information were AEAs through FFS, agricultural input sellers, co-operative society, other farmers, friends and relatives.

Communication strategy used were mainly individual and group methods and Participatory Action Research (PAR).

The adoption rate of *Farmers' Field Schools* participants was significantly higher than non-participants. Farmers also testified to the advantages of using the IPM practices. These include higher yields, decreased incidence of pests and diseases and increase in crop diversity. However, identified constraints to adoption of IPM practices included: tediousness of some of the practices (high labour input), high cost and lack of availability of some of the inputs.

The use of *Farmers' Field Schools,* which is a Participatory Action Research (PAR) methodology, is recommended since programmes are planned with active involvement or participation of the target beneficiaries, and at their level of information uptake and learning.

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LIST OF ABBREVIATIONS

AEA:	Agricultural Extension Agent
AESA:	Agro-ecosystem Analysis
AIAEE:	Association for International Agricultural and Extension Education
ECC:	European Economic Community
EEC:	Biological Control Committee
FAO:	Food and Agriculture Organisation
FFS:	Farmers' Field School
GDP:	Gross Domestic Product
HYV:	High-yielding Varieties
IDA:	Irrigation Development Authority
IIED:	International Institute for Environment and Development
IITA:	International Institute for Tropical Agriculture
ILEIA:	Information Centre for Low-External-Input and Sustainable Agriculture
IPM:	Integrated Pest Management
IRRI:	International Rice Research Institute
LDC:	Less-Developed Countries
LEISA:	Low External-Input for Sustainable Agriculture
LGB:	Larger Grain Borer
MoFA:	Ministry of Food and Agriculture
NBCC:	National Biological Control
NGO:	Non-governmental Organisation
NPRP:	National Poverty Reduction Programme
OECD:	Organisation for Economic Cooperation and Development
PAR:	Participatory Action Research

PPMED:	Policy Planning, Monitoring and Evaluation Department
PPRSD:	Plant Protection and Regulatory Service Department
SARI:	Sahara Agricultural Research Institute
SDC:	Swiss Development Co-operation
SPSS:	Statistical Package for the Social Scientist
TCP:	Technical Co-operation Project
TOT:	Training of Trainers
UNDP:	United Nations Development Project
USAID:	United States Agency for International Development
WEICO:	Weija Irrigation Company
WHO:	World Health Organisation

CHAPTER ONE

INTEGRATED PEST MANAGEMENT AND FOOD SECURITY

1.0 Introduction

This chapter is the introduction, and covers the background to the study, importance of crop protection, IPM as an option for enhancing food security, `historical review of IPM in Ghana, the status of IPM in Ghana and vegetable IPM in Ghana. In addition, it considers the problem, statement research questions, main and specific objectives, significance of the study, hypotheses, conceptual framework and operational definitions of concepts.

1.1 Background

IPM developed in the 1970s as a response to the negative side effects using pesticides. Pests were becoming resistant to chemical treatments, and the health of farmers, farm workers and consumers was in danger. These hazards were far greater in the Third World countries, and today's evidence suggests that the situation has become even more volatile. The latest WHO figures suggest that at least 3 million, and perhaps as many as 25 million agricultural workers are poisoned each year by pesticides, and some 20,000 deaths can be directly attributed to agro-chemical use. Studies from the Philippines have computed the alarming costs of pesticide to the national economy, showing these negative effects extent far beyond the individual (Pretty, 1995)

IPM has become one of the widely used catchwords in agricultural development and environmental conservation programmes. Successful IPM programmes are of importance for the world's food security and for maintaining a healthy environment. Its success also requires a change from pesticide-dominated management to information management of cropping systems on local up to global scales. Everybody claims to like IPM and even to do IPM, but the actual content of this term differs widely. A particular concern in this regard is that chemical companies redefine the term IPM in order to use it to boost pesticide sales. Hence, the question of measuring the success of IPM programmes becomes crucial. Major goals for an IPM initiative are to reduce dependency on chemical pesticide, and achieve sustainable intensification at a level of pesticide use that corresponds with the social optimum (Waibel, Fleischer, Kenmore, Feder, 1999).

As with the provision of any new on-farm technology, the methods (strategies) used- to disseminate relevant information and skills to farmers and to encourage them towards their sustained practice of IPM-are as important as the technology itself for rallying wide-scale acceptance. Although there are various IPM technologies for different crops and while there are alternative methods to diffusing these practices, all these instruments and efforts uniformly aim at altering existing farm use of pesticides and promoting effective and efficient pest-management practices. Farmers are IPM's main target beneficiaries. However, others may benefit from externalities that derive from sustained IPM practice and /or the IPM dissemination efforts (Waibel *et al*, 1999).

1.1.1 Food Security

Poor people often and consistently lack access to the food required for them to lead a healthy and productive life. Food insecurity is the oldest of humanity's concerns and remains the greatest of contemporary problem (FAO, 1996).

Despite improvements in the world food predicament, the underlying causes of food crises have not disappeared. About 100 million Africans go hungry everyday and a total of about one billion people worldwide are classified likewise (Benneh, Tims and Asenso-Okyere, 1996). Asenso-Okyere, Benneh and Tims, (1997) estimated that the total number of people around the world suffering from chronic under nutrition or chronic food insecurity was between 800 and 900 million people in the last 20 years, but apparently declining slowly. Sub-Saharan Africa however showed an increase over the last period from about 100 million to about 200 million. This demonstrates the difficult problems of Africa in past years and the appropriateness of renewed interest in food security research and other programmes. With the supplies of food aid decreasing around the world, reliance on food aid to supplement domestic supplies in West Africa is becoming an increasingly risky policy (Asenso-Okyere, *et al,* 1997).

The key requirement for food security is availability of adequate food supplies and access to food by the poor (Benneh, *et al,* 1996). The availability of adequate food supplies is a function of agricultural production. The agricultural sector dominates the economies of most countries in sub-Saharan Africa, contributing about one-third of the region's GDP and employing about two-thirds of the economically active population (FAO, 1996).

Chronic food insecurity constitutes a major challenge to efforts to alleviate poverty. Ghana has been struggling with food problems and the situation has reached crises proportions. Although there are local and regional variations in the severity of the problem, one important characteristic of the current food crises is its national character. There have been food shortages in both rural and urban areas. The fact of the matter is that with a population growth rate of 2.5-3.0 percent per annum, food production has not been able to match the annual growth rate of population, let alone outstrip it (Bourenane and Mkandawire, 1987). According to Waibel *et al,* (1999), successful IPM programmes are of central importance for the world's food security and for maintaining a healthy environment.

1.1.2 Constraints to Food Security

Factors that contribute to food insecurity include the following:

- Unfavourable agro-climatic conditions.
- Application of farming practices that are unsustainable.
- Limited opportunity for off-farm employment.
- Low soil fertility.
- High rate of post harvest losses due to lack of effective storage facilities as well as limited knowledge about appropriate food storage and preservation techniques.

Sinha, (1976) also indicated the following:

a) Labour shortages during specific seasons and/or in particular households.

b) Lack of inputs, agricultural services or institutions and appropriate technology.

c) Limited opportunities to cope with food deficits due to a shortage of employment and income-generating activities, low levels of remuneration, lack of incentives or price and marketing constraints.

d) Conflicts and wars.

In addition to the afore mentioned constraints, pests cause significant losses in productivity and their control can therefore contribute to solving the problem of food insecurity and poverty to a large extent.

Global losses in crop production due to pests are of the order of US$300 billion annually. The costs of pesticides to developing countries are a major drain on foreign exchange at the national level, as well as requiring a significant outlay by farmers at the village level. The estimated expenditure by international development agencies on pest control projects in 1988 was at US$150 million (Rothschild, 1991).

FAO estimates indicate that up to 40% of harvests in developing countries are lost due to weeds, diseases and insect attack. Added to this, another 10 to 20% in post-harvest losses implies that more than half of the annual crop production may be destroyed. This figure compares unfavourably to the situation in developed countries, where crop losses total approximately 25%. With pests and diseases being one of the major obstacles to higher agricultural production, much emphasis is put on pest control in the national agricultural programmes and strategies (Farah, 1994).

1.2 IPM as An Option for Enhancing Food Security

World population will increase by 2.5 billion by the year 2020, and overall food requirements in developing countries will double. More food will have to be produced in ways that generate income for poor rural populations and that also make food affordable to poor people in cities.

Growing demand must be met primarily by increasing production on land already under cultivation (productive and marginal lands), and by reducing post-harvest losses. Efforts to intensify production to meet these objectives should be sustainable, i.e. they should conserve natural resources and make minimal use of external inputs. Crop protection,-the reduction of losses caused by pests-is one obvious strategy for increasing the food supply. Pre-harvest and post-harvest agricultural losses are estimated to amount to one-third of potential production. Quality aspects (pest-free and residue-free agricultural products) are becoming important in light of market liberalization and the importance that many developing countries attach to exports (SDC, 1994).

Efforts to intensify agricultural production will continue as a result of the need for food security among rapidly growing populations in developing countries. But changes in agricultural systems and in the intensity of land use have impacts on the pest problem. Crop protection aspects must accordingly be incorporated as an integral part of sustainable efforts to intensify production; they will become even more important in the future (SDC, 1994).

Integrated Pest Management (IPM) is a method of pest control, which combines different pest control techniques and integrates them into the overall farming system. According to Smith and Reynolds's (1966) definition, as cited in Afreh-Nuamah, (1996), a definition, which has been embraced by the Food and Agricultural Organisation (FAO) of the United Nations:

"*IPM is a pest management system which in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible, and maintains the pest population levels below those causing economic injury*".

The ultimate goal of any IPM programme therefore should be sustainable, cost effective, within the capabilities of the users, and should not harm humans or the environment. IPM strategy combines several benign pest control techniques such as the use of natural predators, biological pesticides and adapted cultural practices, including breeding plants for pest and disease resistance, with a diminished and less frequent utilisation of chemical pesticides. As the negative and dangerous impacts of pesticides on human life and on the environment have become better known in recent decades, scientists developed more natural, cost-effective, and less ecosystem-disruptive and harmful methods to control pests without heavily relying on chemical pesticides as in the case of Integrated Pest Management (IPM) (Farah, 1994).

Studies show that some IPM programmes have been and still are very successful in pest management. Examples are rice in Indonesia, cassava in Africa and Soybean in Brazil. IPM implementation has also been successful for tree crops in West Africa (NRI, 1992). This demonstrates that IPM can work in practice, a conclusion supported by the results of case studies mostly based on experiments in farmers' fields (Farah, 1994). It has also been recommended at a workshop held in Addis Ababa that the *IPM Farmer Field School* concept, which is a participatory training methodology, be adapted into Ghana's extension delivery systems. The crops selected as targets for this programme were: vegetable (tomato, okra, garden egg and cabbage), maize (storage), rice (upland and valley bottom) (Afreh-Nuamah, 1996). Ghanaian authorities are now promoting and implementing sustainable agriculture and IPM programmes as an alternative to the sole use of pesticides. Akumadan farmers are used as an example of how the change in policy has benefited the community in general by improving crop yields and lessening the risk of severe exposure to pesticides (Davis, 1997).

1.3 Current Developments in IPM

In 1957, "Integrated Pest Management" was first proposed as a concept, which promoted the use of biological control (mostly free), good agronomic practices (good for crop yields), and other means before investing in chemical pesticides (costly, destroy natural enemies, create environmental and health social costs) to control pests. At that time, as now, many farmers used pesticides on a calendar basis, governments promoted their use, and they were considered an essential aspect of "modern" agriculture. Sometime later, largely due to basic misuse of "economic thresholds", IPM also began to be defined as "spray only when the pest exceeds the threshold". The original concept was to promote good practices; the second concept was useful for selling pesticides. According to Kiss and Meerman, (1991), recent developments have shown that IPM could be more practical and field-oriented to the benefit of the ordinary farmer especially when it is adopted not as a technology, but as an approach and strategy for developing technologies for solving pest and disease problems as and when they occur.

A wider view of IPM has been developed in recent years as a result of farmer focused *Farmer Field School* programmes. The basis of this view is derived from the original biologically intensive IPM concepts. Academic definitions are replaced with understandable straight principles:

- Grow a healthy crop
- Observe field regularly (i.e. weekly)
- Conserve natural enemies; and
- Understand ecology and become expert in the field (Afreh-Nuamah, 1996).

1.4 Historical Review of IPM Implementation in Ghana

According to Dixon, (undated), from 1980 to date, Ghana has been confronted with numerous pest outbreaks which pesticides played important role in controlling. However, in certain cases, such as the cassava and mango mealy bug outbreaks, chemical control was neither effective nor successful. This therefore necessitated the formation of committees to take a critical look at how best to control such pests.

1.4.1 Pest Outbreaks (1980 –1992)

Though there were other outbreaks like the variegated grasshoppers, armyworms etc. the listed pests raised concern of the authorities and led to the formation of various committees at different times and levels:

- Cassava Mealy bugs
- Cassava Green Mite
- Mango Mealy bug
- Larger Grain Borer
- Water Hyacinth

The outbreak of cassava mealy bug was first detected in the Volta Region in Ghana in 1980. In 1981 it had spread to the eastern Region, where students and MoFA (PPRSD) staff formed task forces and embarked on mechanical and chemical control and imposed internal quarantine without any success. In 1982, mealy bug had spread to other regions. Without any success with pesticides and other control methods, MoFA requested for assistance from FAO in 1983. FAO in response approved a Technical Co-operation Project (TCP) for the control of this exotic pest of cassava. In 1984 Cassava Improvement Committee was formed involving the Research Institutions, the Universities, MoFA and the Ministry of Health (Nutrition Department) with the under-listed objectives:

- To find ways and means to control the cassava mealy bug.
- To co-ordinate other cassava improvement activities in the country.
- To adopt the FAO consultants report/recommendations on the biocontrol of the cassava mealy bug.
- To introduce and test improved/tolerant varieties from IITA to pests and diseases.

There was also the implementation of Biological Control Program as a component of African-wide Biological control programme under the leadership of IITA/PHMD. In 1985, the World Bank Team commended the cassava mealy bug control programme as very successful. Between 1986-1991, there were other outbreaks of Variegated grasshoppers, armyworms, Sigatoka, whitefly etc. In 1992, Integrated Pest Management (IPM) was adapted as the official strategy for pest control by MoFA/ PPRSD. There was also the establishment of the National Biological Control Committee (NBCC) with working groups on LGB, vegetable pests, mango mealy bug and Cereal Stem borers.

1.5 The Status of IPM in Ghana

IPM has also been recognised as one of the practical alternative measures that could be used to deal with the many problems emanating from increasing pesticide use, especially at the farm level. However, its implementation had been restricted to few isolated crops in the developed world (Afreh-Nuamah, 1996).

The process of adoption of IPM as a major component of Ghana's Plant Production/ Protection Strategy is documented by Afreh-Nuamah, (1996). This was in recognition of the fact that excessive use of pesticide especially on crops like vegetables (tomato, cabbage and garden eggs) had led to unacceptable residues in market produce resulting in risks to consumers and commodity rejection on the international market. Increasing incidence of farmer poisoning and long-term effects of pesticides on aquatic and terrestrial ecosystems was further causing concern to agriculturists and environmentalists. According to the document, in August-September 1993, two specialists (Director, Plant Protection and Regulatory Services Department of MoFA and an IPM specialist of the University of Ghana, Legon) were sent to represent Ghana at the Global IPM meeting in Bangkok, Thailand. They noted the widespread adoption of participatory IPM (as national strategies) in South East Asian rice fields and the subsequent considerable reduction in the amount of pesticide use.

As a follow-up, a national IPM Advisory Committee (i.e. a National Integrated Crop Protection Advisory Committee) was formed in 1995. This committee chaired by the honourable Deputy Minister of Food and Agriculture (MoFA) in charge of crops, consisted of prominent scientists concerned with IPM from the Universities and research institutions, directors of relevant departments of MoFA (i.e. Extension Services, Crop Services and Plant Protection and Regulatory Services), agrochemical sellers and farmers. After this, number of proposals for funding by the FAO were initiated but because of the experience of the participatory IPM on rice, the FAO accepted to fund a pilot project for the adaptation of the Asian IPM training methodology (the IPM farmer field schools (FFS) concept) to Ghanaian conditions under Government of Ghana/FAO Technical Co-operation Programme (TCP/GHA/4553-Rice IPM). This pilot project was sited at the Dawhenya Irrigation Project (Afreh-Nuamah, 1996). Follow-up training programmes for rice farmers were established at five irrigation sites (Tono in the Upper East Region; Bontanga, Northern Region; Afife, Volta Region; Asutsuare, Eastern Region and Ashaiman, Greater Accra Region) from where the trainers (facilitators) were drawn. The main objective of these follow-up programmes being to extend the experience gained from Dawhenya to other Regions so that farmers on these projects can benefit from IPM training.

The results from both the pilot project at Dawhenya in 1995 and the follow-up training programmes at the five (5) irrigation projects showed marked similarities between Asian and Ghanaian irrigated rice ecosystems. For example a wide varieties of insect pests and their natural enemies have been observed, and without use of pesticides, rice yields were increased, a good indication that IPM as practised in Asia would also work in Ghanaian irrigated rice systems.

The *Farmer Field School* concept has been recommended to be adapted into the Ghanaian extension delivery system. It has also been recommended that pilot programmes on crops which depend on much pesticides and with considerable scientific and technical information available both locally or from elsewhere, be established (Afreh-Nuamah, 1996). Consequently, the following crops were selected as targets for this programme: vegetables (tomato, okra, garden eggs and cabbage), cowpea, cotton, pineapple, plantain, maize (storage) and rice (upland and valley bottom). IPM FFS has actually started on cowpea under the CRSP/ Cowpea programme (Afreh-Nuamah, 1996).

1.6 Vegetable IPM in Ghana

Small scale farmers are the main pillars of Ghana's agricultural production, producing over 90 percent of the country's food crops. Consequently, the Medium term Agricultural Programme (MTADP) of the country focuses attention on increased small holder productivity for food crops through expansion of area cultivated, increased research, efficient supply and utilization of inputs and strengthening of the agricultural extension services (Afreh-Nuamah, 1998).

According to FAO (1993), vegetable production has a great potential in Ghana. Both private and government sectors are involved. The private sector is by far the most important. In general, small holders abound throughout the country and several companies have established vegetable farms near urban areas. Most vegetable farms are small with an area of 0.2-0.4ha, while commercial farms cultivate between 5-10 hectares. Most farmers practise intercropping. They grow vegetables throughout the year but sometimes sowing is so timed as to profit from rainfall. Other swampy areas are reclaimed for vegetable production in the dry season.

The most common vegetables are: onion, shallot, hot pepper, tomato, eggplant, okra, cocoyam leaves, cabbage, cauliflower, beans and pepper. Export-oriented production focuses on pepper and okra. Weed control is reported to be the operation that takes the maximum toll of the farmers' time and energy, and is the reason why many farmers restrict vegetable production to smaller areas (less than an acre). Hand-picking sedentary pests is a common practice among most women vegetable growers. Farmers who can afford pesticides use them but often do so without adhering to proper and safe methods of application.

Experience has shown that *Farmer Field Schools* have the greatest impact on production systems where intensive use and abuse of pesticides and other agro-chemicals is practised. The crops that are best suited for vegetable IPM training are the ones that are most widely grown, that are currently consuming most pesticides and other agro-chemicals, and that have major crop health problems. Two groups of crops have been observed to be the first potential target vegetables for an IPM training programme: solanaceous crops (tomato, pepper, garden egg), crucifers (cabbage, cauliflower). Second priority targets are okra, cowpea and water melon (Janny and Afreh-Nuamah, 1997).

1.7 Problem Statement

The IPM concept is far from new. Farmers used integrated pest control long before scientists coined the term. It has, however, gained widespread scientific recognition in the past two decades (Rothschild, 1991; Lutz, Biswanger, Hazell and McCalla, 1998). Traditionally, farmers have relied on indirect pest control measures of crop rotation or intercropping, supplemented by mechanical means of control such as pulling out of weeds, removal of egg masses from plants, and destroying crop residues (Afreh-Nuamah, 1995). Thus, in traditional farming systems, pest management is inseparable from sound farm management. However, changes in farming systems during the past half century lost sight of this approach, and chemical control methods became the pillar in the control of pests and diseases in modern agriculture (Kiss and Meerman, 1991). Consequently, there have always been the issue of economic risks and positive returns from using IPM rather than conventional, scheduled practices (Smith *et al,* 1989; Anon, 1990, as cited in: Afreh-Nuamah, 1996).

During the past decade, however, growing concerns about the risk and negative effects of chemical methods have spurred agriculturists, environmentalists, and economists to explore pest management strategies that have fewer side effects on public health and the environment. The most well known among these strategies is IPM (Lutz *et al*, 1998).

Integrated pest management [IPM] is increasingly recognised as a vital element in sustainable agricultural development. In IPM, farmers use their knowledge of ecological processes in the agricultural system to combine a variety of compatible tactics to increase the productivity of crops and reduce the impact of pests, diseases and weeds. Pesticides are used as little as possible, if at all, with corresponding benefit to farmers' income, human health and the environment. Although a number of promising IPM options are becoming available, adoption of IPM at farm level, especially in Africa, is disappointingly slow. Poor communication between farmers and researchers is believed by many stakeholders in the agricultural development process to be a constraint limiting IPM adoption (NGO-IPM Workshop Summary, 1999).

IPM appears to present such a clearly preferable approach that it may seem strange that it is not universally adopted (Bull, 1982; Rothschild, 1991; Farah, 1994). Although crop protection specialists generally accept IPM as the ultimate goal of any crop protection measure against pests and diseases, few of them actually practise the concept. Others however, consider it as a sophisticated, theoretical, or largely academic discipline, which cannot solve the real world's problems (Kissman and Meerman, 1991). According to Kenmore (1989), though there is considerable research and demonstration-plot data to show that IPM is workable, there is still a lingering doubt about its reliability under all circumstances. Afreh-Nuamah, (1996) also states that although various institutions involved in research, development and implementation of IPM have made a tremendous effort and have attempted various strategies, these have resulted in limited success. Constraints that limit IPM implementation operate across the entire political, institutional, socio-economic and technical environment in which the pest problem is experienced.

Until recently, relatively little attention has been paid to the incorporation of dissemination and adoption in research programmes (Hainsworth and Eden-Green, 2000). One of the fundamental shifts is the greater emphasis on direct farmer involvement in *Farmers' Field School*. The IPM *Farmers' Field School* is a novel extension mechanism, and thus involves an embodiment of communication strategy

Communication strategies used to disseminate information on innovations influence the adoption of the innovations. Weaknesses in communication strategies therefore seem to contribute significantly to the low adoption. This makes strategies of communicating IPM practices a critical problem, for they are likely to influence their adoption. According to Rogers (1995), the relationship between communication methods and attributes of the innovation interact to slow down or speed up the rate of adoption. Agricultural extension has the role of helping farmers to form sound opinions and to make good decisions by communicating with them and providing them with the information they need. Once the needs of an area or community have been identified, it is the task of extension workers to choose the teaching methods or strategies that are most effective in achieving their educational objectives. This situation is applicable to IPM as well.

Different communication strategies are widely used in different situations in the dissemination of information in agricultural extension delivery activities. There is evidence that whenever innovation information is adequately communicated, there are high levels of adoption of those innovations, which translate into high levels of development (Rao, 1966). He added that there is a strong correlation between communication and social, economic and political development.

One of the major problems of introducing an improved or new idea into a social system is how to adequately communicate the idea. Communication does not take place in a social vacuum. It takes place in a social context of system and sub-system variables and values (Beal, Blount, Powers and Johnson, 1966). This makes the socio-economic characteristics of farmers very crucial in studies of adoption as well.

This study therefore seeks to address the problem that the low adoption of IPM practices may be associated with the communication strategies used in communicating them to farmers.

1.8. Research Questions

1. Which communication strategies (methods) are more effective in the dissemination of IPM messages?

2. To what extent do personal socio-economic characteristics influence adoption of IPM practices?

1.9 Main Objective

To determine ways of enhancing the adoption of IPM practices through use of more effective communication strategies.

1.10 Specific Objectives

1. To describe the various communication strategies used in disseminating IPM practices.
2. To determine the level of adoption of IPM practices.
3. To determine the relationship between communication strategies (methods) and extent of adoption of IPM.
4. To determine the relationships between personal socio-economic characteristics of farmers and adoption.
5. To suggest communication strategies likely to enhance adoption of IPM.

1.11 Significance of the Study

The findings are likely to contribute to understanding of how communication methods or strategies contribute to effectiveness of empowering farmers to make their own decisions with regard to pest management. Through the enhanced adoption, it is hoped to contribute to reducing the problem of crop losses due to pests, thus minimising the problem of food insecurity and poverty.

1.12 Hypotheses

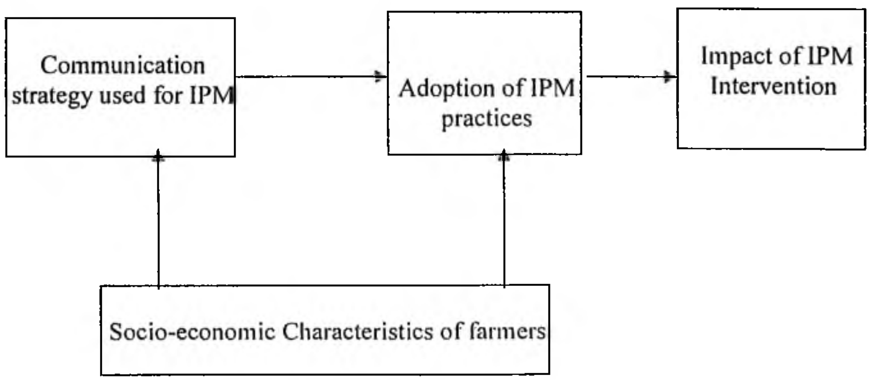
1. There is no relationship between personal socio-economic characteristics of farmers and adoption of IPM.
2. There is no relationship between communication strategies and IPM adoption.

1.13 Conceptual Framework

Figure 1 shows a framework for analysis of the influence of communication strategy or strategies on adoption of IPM practices. It is based on the assumption that adoption of IPM practices is influenced by personal socio-economic characteristics of farmers and communication strategies as well as the nature of the IPM practices themselves.

Also, an IPM project is expected to produce economic and non-economic benefits. On the farm household level, economic benefits for example are: increased yield, more stable income, increased business opportunity and improved health.

Figure 1: A Conceptual Framework of the Impact of Communication Strategy on Adoption of IPM Practices



Operational Definition of Concepts

1.14.1 IPM

Rabb (1972) defined Pest Management as the intelligent selection and use of pest control actions that will ensure favourable economic, ecological, and sociological consequences. Van Schoubroeck, Herens, de Louw, Louwen and Overtoom, (1992), however, defined IPM as a pest management strategy that attempts to apply more than a single pest management technique in such a way that the different methods complement each other. They added that IPM is a broad ecological approach to pest control, utilising a variety of control technologies compatibly in a single pest management System; IPM can draw upon a number of different pest management methods. These include biological and cultural controls, physical controls, the use of pest-resistant varieties and a number of other techniques.

Based on the above definitions, the conceptual definition of IPM for this study is: pest management strategy which utilizes a combination of non-chemical crop protection methods such as the cultivation of resistant varieties, mulching, use of neem extract, manure application, row planting and a number of other methods in a manner that brings under control pests and diseases, whilst ensuring a sound and safe agro-ecosystem.

1.14.2 Communication Strategy

Extension is the conscious communication of information to help people form sound opinions and make good decisions (van den Ban and Hawkins, 1999). MacDonald and Hearle (1984:34) identify different communication strategies that could be used in development work. These include: individual methods, by working with groups and through the mass media. This formed the basis of classification of communication strategies. For the purpose of this study, communication strategy and extension method are synonymous.

Farmers' Field School is a methodology based on a structured learning process in a group context. The concept allows farmers to explore areas of research that are of particular interest and importance to them. This training concept is not only limited to IPM in the strict sense. The flexibility of the concept and the experiential learning on which it is based has made it a widely used extension tool (Stoll, 1997).

1.14.3 Adoption of IPM Practices

Adoption: According to Rogers (1995), adoption is defined as the decision (and behaviour) to make use of a technology or practice. For the purpose of this study, adoption of an IPM practice is the use of the practice as an integral part of pest management. Any farmer who has not adopted any of the practices is designated a non-adopter. If a farmer adopts from one to four of the practices, that farmer is designated a low adopter. If a farmer adopts from five to seven of the practices, that farmer is designated a high adopter

Non-adoption is the situation where a farmer has been introduced to a recommendation but does not use it.

1.14.4 Personal Socio-Economic Characteristics

This is defined to include age, educational status, gender, source of credit, labour and production constraints.

1.14.5 Impacts of IPM Intervention

This is defined as the effect of IPM programme on farmers and their practices. This includes farmers' health status, diversity of crops grown, incidence of pests and diseases, health status, use of pesticides, labour requirement, business opportunity and stability of income.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

IPM has not been widely adopted in spite if its numerous advantages. Whilst the causes of the low adoption are many, inadequate communication methods seem to contribute significantly. Personal socio-economic characteristics of farmers are also likely to contribute to its pattern of adoption. Investigating the causes of low adoption in light of communication strategies and personal socio-economic characteristics would contribute to ways of improving its adoption.

The purpose of this chapter is to review literature relevant to the study. The literature on adoption and diffusion of innovations, the process of adoption and attributes of innovation as related to adoption are reviewed first. The chapter then proceeds to examine personal socio-economic characteristics of target groups in relation to adoption. The chapter also reviews methods of extension and returns to IPM and its diffusion methods of extension and returns to IPM and its diffusion.

2.1 Adoption of Innovations

An innovation is an idea, method or object which is regarded as new by an individual, but which is not always the result of recent research (van den Ban and Hawkins, 1999). According to Feder, Just and Zilbermann (1982), adoption of technological innovations in agriculture has attracted considerable attention among development economists because the majority of the population of less-developed countries (LDCs) derives its livelihood from agricultural production and because new technology apparently offers opportunity to increase production and income substantially. But the introduction of many new technologies has been met with only partial success as measured by observed rates of adoption. The conventional wisdom is that constraints to the rapid adoption of innovations involves factors such as the lack of credit, limited access to information, aversion to risk, inadequate farm size, inadequate incentives associated with farm tenure arrangements, insufficient human capital, absence of equipment to relieve labour shortages (thus preventing timeliness of operations), chaotic supply of complementary inputs (such as seed, chemical, and water) and inappropriate transportation infrastructure. For instance, McGuirk and Mundlak's (1991) analysis of the adoption of high-yield varieties in the Punjab showed that adoption was restrained by the availability of water and fertilizer. Private investment in the drilling of wells, and private and public investment in the establishment of fertilizer production and supply facilities removed these constraints and contributed to the diffusion of modern what and rice varieties in the Punjab.

However, many development projects have sought to remove some of these constraints by introducing facilities to provide credit, information, orderly supply of necessary and complementary inputs, infrastructure investments, marketing network etc. Removal of these constraints was expected to result not only in adoption of the improved practices but also in a change in crop composition, which was thought to further increase average farm incomes. Expectations, however, have been realized only partially. As past experience shows, immediate and uniform adoption of innovation in agriculture is quite rare. In most cases, adoption behaviour differs across socio-economic groups and time. Some innovations have been well received while other improvements have been adopted by only a very small group of farmers (Feder, Just and Zilbermann, 1982),

2.2 The Process of Adoption

Rogers, (1962), as cited in, Feder *et al,* (1982) defines adoption process as "the mental process an individual passes from first hearing about an innovation to final adoption". Final adoption at the individual farmer's level is defined as the use of a new technology in long-term equilibrium when the farmer has full information about the new technology and its potential. This definition corresponds to Schultz's (1975) as cited in Feder *et al*, (1982) contention that the introduction of new technologies results in a period of disequilibrium behaviour where resources are not utilized efficiently by the individual farmer.

Research studies have demonstrated clearly the extensive delays which often occur between the time farmers hear about favourable innovations and the time they adopt them, and what happens during this time. The following stages are often used to analyse the adoption process:

i. Awareness: the individual first hears about the innovation;

ii. Interest: the individual seeks further information about it;

iii. Evaluation: the individual weighs up the advantages and disadvantages of using it;

iv. Trial: the individual tests the innovation on a small scale;

v. Adoption: the individual applies the innovation on a large scale in preference to old methods (van den Ban and Hawkins, 1999).

In most cases, agricultural technologies are introduced in packages that include several components, for example, high-yielding varieties (HYV), fertilizers, and corresponding land preparation practices. While the components of a package may complement each other, some of them can be adopted independently. Thus, farmers may face several distinct technological options. They may adopt the complete package of innovations introduced in the region or subsets that can be adopted individually. In these cases, several adoption and diffusion processes may occur simultaneously. The definition of adoption above refers to the "degree of use" of a new technology as a quantitative measure of the extent of adoption. A distinction needs to be drawn, however, between new technologies which are divisible (such as HYV or new variable inputs) and innovations, which apply to the whole farm and are not divisible, at least at a practical level (e.g., harvesters). For non-divisible innovations, the extent of adoption at the farm level in a given period is necessarily dichotomous (use/ no use); but, in the aggregate, the measure becomes continuous (e.g., the percentage of farmers using harvesters (Feder *et al,* 1982).

2.3 Attributes of Innovations and Adoption

For an innovation to be easily adopted, it must have certain characteristics. The following characteristics of innovations have been identified:

2.3.1 Relative Advantage

Relative advantage is the degree to which a technology is perceived to be better than the idea it supersedes in terms of economic profitability, social prestige, physical convenience, low initial cost, lower perceived risk, decreasing discomfort, psychological satisfaction or saving of time. A cheaper technology will be adopted faster than a more expensive one (Rogers, 1995; Roling, 1990 in: Mwangi, 1998). The relative advantage of an innovation, as perceived by members of a social system, is positively related to its rate of adoption (Rogers, 1995).

Availability and cost also influence technology adoption. In Kenya, for example, many farmers adopted tractor land preparation, though costly, because the government made tractors readily available to farmers for hire. As an example of how physical convenience influences technology adoption, many farmers in Kenya preferred planting maize and beans in the same hole, against research recommendations, because it was more convenient. They also refused to plant two rows of beans between rows of corn, recommended by researchers through the Training and Visit Extension System, because doing so required more labour for planting and weeding which was a major constraint during the weeding period (Mwangi, 1998).

Technologies can be classified as cost-reducing or cost-increasing. Here one may distinguish the impact of innovation on fixed cost and variable cost. Since cost derives from a number of inputs, some cost-reducing innovations are categorized according to their impact on specific inputs to production. For example, a new and improved type of harvesting equipment may be most noted for its labour-saving effect. A new irrigation technology may be described according to whether and to what extent it has a water-saving effect. In some cases an innovation may have multiple effects. For example, the tomato harvester is labour-saving but capital- and energy-using. Modern irrigation technologies are yield-increasing, water-saving, and capital-using (Caswell and Zilberman, 1986).

2.3.2 Compatibility

Compatibility is the degree to which a technology is perceived to be consistent with the farmer's goals and aspirations; socio-cultural values, norms and beliefs, and past experiences; needs of potential adopters; and existing farm practices. Technologies compatible with existing farm practices encourage a positive attitude toward change, improve the agent's credibility, and may be adopted faster. An idea that is more compatible is less uncertain to the potential adopter, and fits more closely with the individual's life situation. Such compatibility helps the individual give meaning to the new idea so that it is regarded, as familiar. An innovation can be compatible or incompatible with socio-cultural values and beliefs, with previously introduced, or with client need for innovation. An innovation's incompatibility with cultural values can block its adoption (Rogers 1995; Mwangi, 1998).

For example, Punjabi farmers covered their new tractors with blankets to keep them warm (as they had done their bullocks) but never thought to replace the oil or air filters, causing the tractors to break down (Rogers, 1995).

An innovation may be compatible not only with deeply imbedded cultural values but also with previously adopted ideas. Compatibility of an innovation with a preceding idea can either speed or retard its rate of adoption. Old ideas are the main mental tools that individuals utilise to assess new ideas. Previous practice provides a familiar standard against which an innovation can be interpreted, thus decreasing uncertainty. Obviously, however, if a new idea were completely congruent with existing practice, there would be no innovation, at least in the minds of the potential adopters. In other words, the more compatible an innovation is, the less of a change in behaviour it represents.

One dimension of the compatibility of an innovation is the degree to which it meets a felt need. Change agents seek to determine the needs of their clients, and then to recommend innovations that fulfil these needs. Discovering felt needs is not a simple matter; change agents must have a high degree of empathy and rapport with their clients in other to assess their needs accurately.

Potential adopters may not recognise that they have a need for an innovation until they are aware of the new idea or its consequences. In these cases, change agents may seek to generate needs among their clients but this must be done carefully or else the felt needs upon which a diffusion campaign is based may be only a reflection of the change agent's needs, rather than those of clients. The compatibility of an innovation, as perceived by members of a social system, is positively related to its rate of adoption (Rogers, 1995).

2.3.3 Complexity

Complexity is the degree to which a technology is perceived as relatively difficult to understand or use. Any new idea may be classified on the complexity -simplicity continuum. Some innovations are clear in their meaning to potential adopters whereas others are not. The complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption (Rogers, 1995; Mwangi, 1998). It may be necessary to introduce a package of several relatively simple but related innovations. Each on its own may be easy, but the relationship between them may be difficult to understand (Rogers, 1995). For instance, a young Bahati farmer attempted to keep pigs without knowing what that entailed. He consulted livestock professionals on housing and feeding but later wondered why his weanors were experiencing unusually low growth rates. He had neglected regular control of internal parasites. For him, swine production was a complex technology that required a thorough understanding for effective implementation (Rogers, 1995).

A committee of rural sociologists has classified practices in terms of their complexity, which roughly represents the speed with which acceptance may be expected to occur. The gradient is as follows:

(1) Change in materials and equipment only, without change in techniques or operation (e.g. new variety of seed);

(2) Change in existing operations with or without a change in materials or equipment (e.g. change in rotation of crop).

(3) Change involving new technologies or operation (e.g. contour cropping).

(4) Change in total enterprise (e.g. from crop to livestock farming).

2.3.4 Trialability

Trialability is the degree to which a technology may be experimented with on a limited basis to determine its efficacy before adopting it on a large scale. New ideas that can be tried on the instalment plan are generally adopted more rapidly than innovations that are not divisible. A farmer will be more inclined to adopt an innovation which he has tried first on a small scale on his own farm, and which proved to work better than an innovation he had tried immediately on large scale. The latter involves too much risk. This trial is a means to dispel uncertainty about the new idea. The trialability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption (Rogers, 1995). A farmer tried to grow 20 acres of maize in Kitale District in Kenya but lost the crop due to drought. A second farmer sowed 100 acres of wheat in Mau Narok but excessive rain destroyed the wheat. If these farmers had grown the crops first on a smaller scale, they would have avoided crippling losses (Mwangi, 1998).

2.3.5 Observability or Visibility

Observability is the degree to which the results of a technology are visible or observable. The result of some ideas are easily observed and communicated to others, whereas some innovations are difficult to observe or to describe to others. Farmers learn much from observing and discussing their colleague's experiences. The observability of an innovation as perceived by members of a social system, is positively related to its rate of adoption (Rogers 1995). The more viable a new practice is and the easier its results are to observe, describe and communicate to others, the more rapidly it will be adopted. Material innovations and concrete ideas that are easily observable are adopted faster than less concrete ones (Mwangi, 1998).

Although it cannot be said with certainty, the following additional generalisations seem likely to apply to practice adoption rates:

1. Practices involving large capital outlay will be adopted more slowly than those requiring small amounts of capital.
2. The more compatible a practice with existing farming operations, the more likely it will be adopted quickly.
3. Traits or practices readily communicated by conventional method used by farmers will be adopted more readily than those that are not.
4. The more difficult it is to retract a decision and the subsequent consequences, the slower adoption is likely to be.
5. Costly and complex practices that can be taken a little at a time will likely be adopted more quickly than where this is not possible (Lionberger, 1968).

2.4 Personal Socio-Economic Characteristics and Adoption

In communication-adoption studies, it is usual to investigate the personal and social characteristics of respondents in order to understand their relative influence in the adoption behaviour (Onu, 1991). Van den Ban and Hawkins (1999) stated that there are many situations in which all farmers cannot be recommended to adopt an innovation because this decision should depend on their resources and personal values. Fliegel (1984) noted that each farmer, male or female, young or old, more or less educated, is ultimately a unique individual with a host of characteristics that may well affect how information is received, processed and either used or not used in the production process.

Lionberger, (1968) also stated that all people are to some degree "set in their ways" and, to a degree, incapable of perceiving pertinent relationships in new situations, or analysing them in terms of adjustment alternatives, and of making satisfactory adjustments to them. Nevertheless, people vary greatly in this respect. The farmer who is inclined to mental rigidity tends to resort to the traditional formula of hard work, persistence, and thrift in matters of farm management. A mentally flexible person is capable of perceiving significant elements in novel situations, of dealing with them mentally, and of making adjustments to them. The latter would most certainly be associated with high adoption rates.

Reasons why farmers adopt farm practices more quickly at one time than another relate to the situation in which they find themselves when alternative courses of action become known. Although situational factors are many and varied, only a few have been the subject of research. These include farm income, size of farm, tenure status, community prestige, sources of farm information used, level of living, and the complexity of the practice or change involved. He adds that individual and personal factors like age, years of school completed and such selected psychological characteristics as mental flexibility and orientation toward farming as a business, also affect adoption (Lionberger, 1968).

2.4.1 Age

Elderly farmers generally seem to be somewhat less inclined to adopt new farm practices than younger ones. However, according to Rogers (1995), there is inconsistent evidence about the relationship of age and innovativeness; about half of some 228 studies on this subject show no relationship, a few show that earlier adopters are younger, and some indicate they are older.

2.4.2 Gender

The issue of misconception and non-recognition of the role of women in agricultural development has been gaining momentum since the early 1970's. It is gradually being recognised that the role of women in agriculture is important, and that the neglect of women in development interventions is a major reason why many programmes fail to reach target goals (Roling, 1988 in: Ahmad and Ismail, 1988). According to Ahmad and Ismail, (1988), there is an increasing recognition of the need to integrate women in mainstream agricultural development. From a global perspective, the Food and Agriculture Organisation of the United Nations developed a plan of action for strengthening the role of women in agricultural development.

2.4.3 Education

Schooling has been valued as a means of increasing knowledge about new farm technology. The assumption is that schooling facilitates learning, which in turn is presumed to instil a favourable attitude toward the use of improved farm practices. Be that as it may, the relationship between years of schooling and farm practice adoption rates is likely to be indirect, except in cases where persons learn specifically about new practices in school. Where this is not the case, education may merely create a supposedly favourable mental atmosphere for the acceptance of new practices (Lionberger, 1968). Rogers (1995) stated that earlier adopters have more years of formal education than later adopters. He added that earlier adopters are more likely to be literate than are later adopters.

Huffman (1977), as cited in: Feder *et al*, (1982), stated that farmers with higher education possess higher allocative ability and adjust faster to reduction in nitrogen prices by adopting nitrogen-intensive technologies. He further noted that education is particularly important when extension activities are less intense. Evenson (1973) as cited in (Feder *et al*, 1982), found that education plays a strong role in determining rates of adoption of technology in developing agriculture. Some indirect support for this assertion can be inferred from other studies surveyed in Lochheed, Jamison, and Lau (1980) in Feder *et al*, (1982). These studies found a significant relationship between education indicators and farm productivity. Since adoption of innovations generally increases productivity, the importance of education (and extension) in affecting adoption behaviour seems to be implied.

2.4.4 Farm Income

High farm income nearly always is associated with high farm practice adoption levels. A reciprocal cause-and-effect relationship is likely. Alertness to change and quick adoption of new farm practices suited to prevailing farming conditions leads to higher incomes. This in turn makes more capital available for the adoption of new practices. However, the fact that low-income farmers are slow to adopt practices that they could well afford suggests that factors other than income are operative. The actual adoption and use of an innovation involves some cost to the farmers, for instance the initial cost of the innovation itself. As such, the individual needs to have a certain level of income if he is to adopt the innovation (Lionberger, 1968).

2. 4.5 Credit

The need to undertake fixed investments may prevent small farmers from adopting new innovations quickly. Access to capital in the form of either accumulated savings or capital markets is necessary in financing the adoption of many new agricultural technologies. Thus, differential access to capital is often cited as a factor affecting differential rates of adoption. This is, in particularly, the case with indivisible technology, such as tractors or other machinery that requires a large initial investment. These implications have been confirmed by descriptive and empirical work on the role of credit as well (Lipton, 1976; Bhalla, 1979; Cline, 1979 in: Feder *et al,* (1982).

On the other hand, others have argued that lack of credit is not a crucial factor inhibiting adoption of innovations that are scale neutral. A number of studies, however, have found that lack of credit is an important factor limiting adoption of HYV technology where fixed pecuniary costs are not large (Feder *et al,* 1982).

2.4.6 Size of Farm

Farm size is one of the first factors on which the empirical adoption literature focused. Farm size can have different effects on the rate of adoption depending on the characteristics of the technology and institutional setting. More specifically, the relationship of farm size to adoption depends on such factors as fixed adoption costs, risk preference, human capital, credit constraints, labour requirements, tenure arrangements etc (Feder *et al*, 1982). However, according to Lionberger, (1968), size of farm is nearly always positively related to the adoption of new farm practices. He added that many new technological advances require large-scale operations and substantial economic resources for their use. Also, use of improved farm practices produces economic benefits which permit expansion of farming operations, which in turn makes it economically possible to use more improved farm practices. An often-mentioned impediment to adoption of new technology by smaller farms relates to fixed costs attached to implementation. Large fixed costs cause a reduced tendency to adopt and a slower rate of adoption on smaller farms Feder *et al*, (1982). These conclusions are supported by Weil, (1970) in Feder *et al*, (1982), who found in Africa that adopters of ox cultivation cropped larger areas and operated significantly larger farms than those using hand cultivation.

Several studies reviewed by Binswanger (1978) in Feder *et al*, (1982) have found a similarly strong positive relationship between farm size and adoption of tractor in south Asia.

Other empirical studies have shown that inadequate farm size also impedes efficient utilization and adoption of certain types of irrigation equipment such as pumps and tubewells (Hodgdon, 1966; Dobbs and Foster, 1972; Gafsi and Roe, 1979 all in: Feder *et al*, (1982).

2.4.7 Tenure Status

It is well known that farm owners have more complete control over farming operations than tenants. Owners can make decisions to adopt new practices, but tenants must often obtain the concurrence of the owner before trial or use. This is particularly true where some financial backing by the owner is required. Consequently, adoption rates are usually higher for farm owners than for those who rent their farms.

According to Lionberger (1960), a farmer may farm on his own land, or he may be a tenant farmer. Tenancy can range from lease, rent or mortgage depending on local conditions. The kind of user or ownership right that an individual has over the farmland tends to affect the farmer's decision to adopt or reject innovations. Where the farmer has individual ownership rights, he has more control over his operations than a tenant who has to rely on the good will and willingness of the landlord to adopt certain innovations. However, differences between owners and renters are likely to vary greatly regionally due to differences in tenancy arrangements and freedom accorded the renters to make decisions.

2.4.8 Labour Availability

Labour availability is another often-mentioned variable which affects farmers' decisions regarding adoption of new agricultural practices or inputs. Some new technologies are relatively labour saving, and others are labour using. For example, ox cultivation technology is labour saving, and its adoption might be encouraged by labour shortage. On the other hand, high yield variety (HYV) technology generally requires more labour inputs so labour shortages may prevent adoption. Moreover, new technologies may increase the seasonal demand on labour so that adoption is less attractive for those with limited family labour or those operating in areas with less access to labour market (Feder *et al*, 1982). Hicks and Johnson (1974) in: Feder *et al*, (1982) have found that higher rural labour supply leads to greater adoption of labour-intensive varieties in Taiwan.

2.5 Communication Strategies

Farmers have need as to the kind of extension methods and channels of communication to be used to present messages to them (Maunder, 1973). For messages to reach farmers effectively, certain methods need to be used. Mwangi, (1998), citing Mung'ala, (1996) and Rudebjer and Temu, (1996) stated that change agents may know the solution to problems confronting farmers, yet be unable to communicate these solutions if they lack effective communication skills, and do not apply sound extension education principles. Maunder, (1973) and MacDonald and Hearle (1984:34) identify different communication methods that can be used in development work. These include individual methods, by working with groups and through the mass media.

Individual methods are important because learning is an individual process so that although extension agents must use group and mass methods to reach large members of people and to stimulate joint action planning and carrying out projects of common interest, personal contacts serve many essential purposes. Individual methods include farm and home visits, office calls, telephone calls, personal letters and informal contact.

Group methods include general meetings, meetings for method demonstrations, results demonstrations, farm walk or tours, field days or farmers' days at agricultural experiment stations. Group methods are essentially effective in moving people from the interest stage to the trial stage of learning. When the reaction of the majority of the group is favourable, the majority of the members may proceed to the adoption stage. Group extension methods, effectively arranged and conducted, take full advantage of the external and internal forces of group dynamics.

Choice of farmers who participate in group meetings and who are visited by extension agents is also very important. If the farmers choose these people themselves, most of the contacts are likely to be with the innovators and the early adopters. The extension agent can try to establish contacts with the opinion leaders in order to increase his impact on a wider group of farmers. Active promotion of an innovation may be taken over from extension agents by farmers who have adopted it already. Such farmers are not always well suited to this task if the innovation is difficult to implement. Such is the case with Integrated Pest Control where management has to be adapted to a farmer's specific situation (van den Ban and Hawkins, 1988).

Mass methods include the use of radio, newspapers, magazines, posters, exhibits and printed materials to reach large numbers of people quickly. These methods are particularly useful in making large numbers of people aware of new ideas and practices or alerting them to sudden emergencies. They serve as an important and valuable function in stimulating farmer interest in new ideas (Maunder, 1973).

Participatory Action Research (PAR) is an extension methodology developed during the 1970s and draws together the personal and the political. Recognising the marginalizing effects of 'universal science' and the ways in which it produces ignorance, PAR aims to challenge relations of inequality by restoring people's self respect and agency. By exploring the experiences and knowledge of poor, oppressed and exploited groups, PAR works to confront systems of domination. Local people are involved at all stages in research. Rather than being the objects of research, they become the producers and owners of their own information.

The techniques employed in PAR include:

- Collective research – meetings, socio-dramas, public assemblies;
- Critical recovery of history – through collective memory, interviews and witness accounts, family coffers;
- Valuing and applying 'folk culture' – through the arts, sports and other forms of expression.
- Production and diffusion of new knowledge through written, oral and visual forms (IIED, 1993).

Extension work deals with people of different educational status, levels of living, cultural background, age and values. These differences therefore demand a wide range of approaches and a great variety of methods in order to arrive at the ultimate aims of the rural extension, which are to increase the knowledge of the rural population, change their attitudes and improve their skill. It has been recognised that the flow of information, both upstream and downstream, could be improved at all levels. Identified constraints include inadequate farmer involvement in identifying problems and in testing technical recommendations, poor information transfer between research organisation and extension services and badly disseminated research results (Iles and Sweetmore, (1991).

2.6 Channels of Communication

A communication channel is the means by which messages get from one individual to another. The nature of information-exchange relationship between a pair of individuals determines the conditions under which a source will or will not transmit the innovation to the receiver, and the effect of the transfer (Rogers, 1995).

Channels of communication, i.e. visual, spoken and written are used to package the message through the various methods to farmers. " Seeing is believing" is an axiom of extension education. Picture writing is an ancient form of communication. Pictures, charts, diagrams, exhibits and posters perform vital communication functions in most advanced society. Visual and oral channels are about the only ones for extension workers to serve illiterate people. Spoken channels are useful for all types of extension methods such as farm and home visits, office calls, meeting of all kinds, radio, and television and telephone calls. Except for radio and television, they allow two-way communication, which is a big advantage. Lack of understanding can be detected and cleared up on the spot. Not only words but also gestures and expressions of both speaker and listener contribute to clear communication. Written communication has greater status and carries more authority than oral communication (Maunder, 1973).

Research has shown that different channels perform different functions in the adoption-diffusion process. Some channels enable the idea to be heard or read while others enable a practice to be seen. Each channel is suited to a particular stage in the adoption-diffusion process. According to Wilkening *et al*, (1962), a farmer may hear about a new idea through one channel; learn more about it through another and learn the specific details needed to put it into practice through still another. Farmers are exposed to similar information from a variety of senders in both the public and private sectors. Those senders use a range of channels to reach audiences and consciously use message repetition to make an impact on their audiences. Different communication channels have different effects (van den Ban and Hawkins, 1988).

Mass media channels are often the most rapid and efficient means to inform an audience of potential adopters about the existence of an innovation. i.e. to create awareness knowledge. It is also good for emergency purpose. Mass media channels include the use of media such as radio, the stage and public platform which enable a source of one or few individuals to reach an audience of many.

On the other hand, inter-personal channels are more effective in persuading an individual to accept a new idea, especially in the channel links two or more people who are similar in socio-economic status, education or other important ways. Interpersonal channels involve a face-to-face exchange between two or more individuals.

2.7 Diffusion of Innovations

The nature and speed of diffusion of innovations depend ultimately on the combined effect of a large number of recurring factors. They include the features of the innovation, the characteristics of the adopters and their situation, the type of information sources that come into play, the structure of the communication relationships, the course of preceding stages of the process and the results of new forces in the psychological field of the potential adopters of the innovation. The dissemination of innovations depends on the specific condition of particular situations. One and the same factor can have a completely different significance and possibly also a completely different effect. Thus the extension worker is well advised to analyse each situation afresh and with great care to find out which factors can cause the target groups to change their behaviour (Albrecht, Bergmann, Diederich, Grosser, Hoffmann, Keller, Payr and Sulzer, 1989).

People do not live apart from others and independent of their influences. We are all members of many social groups or systems. This is a requirement for achieving desired ends for self and society. Few decisions can be made without regard for others whom are involved directly or indirectly. Whether a farmer lives in a neighbourhood or a community, he always has neighbours (Lionberger, 1968).

Farmers are keen observers of how other farmers work, and in some countries, but not all, they spend much time discussing their farm experiences with their friends and neighbours. They learn much in this way, although most realise that they learn more from some colleagues than from others. They know who gets good yields or good results in their village, and who experiments with new methods. Some of these successful or progressive farmers are willing to share their experiences with other farmers. In this way, they become opinion leaders in the village because they help other farmers solve problems they consider to be important. Thus, opinion leaders have considerable influence on the way in which people in their village think and farm (van den Ban and Hawkins, 1988:113). People habitually talk to each other about their farm problems. Advisement is another function. People who seek information from others often want advice along with the facts. They may even seek clear-cut answers to their own personal problems. Others seek reinforcement for decisions already made. Hearing someone agree with them makes them comfortable and confident in the decisions that they have already made. In still other cases, a local stamp of approval is sought from highly respected sources (Lionberger, 1968).

2.8 IPM FFS /TOT Training Methodology

According to Stoll (1997), the concept of *Farmers' Field School* was originally developed as an extension methodology for IPM in rice. This methodology is based on a structured learning process. The concept allows farmers to explore areas of research that are of particular interest and importance to them. This training concept is not only limited to IPM in the strict sense. In Asia, many NGOs and farmers' organisations have adapted and interpreted it to suit their own specific situations and interest. Some of these organisations apply the *Farmers' Field School* concept not to IPM as such, but to agricultural system development in general. The flexibility of the concept and the experiential learning on which it is based have made it a widely used and valuable extension tool.

He added that these approaches start with a participatory problem analysis and local knowledge. The experimental site is usually the farmers' field or a special experimental site identified by the farmers' group. The key to this approach is to teach farmers to experiment with their local knowledge or new/external information in order to make it effective and suitable to their specific situation. Farmers and extension workers gain methodological skills to develop their own solutions. This challenges conventional research paradigms and calls for a new relationship and respect between the various actors involved. Examples of this approach are the development of neem extracts in Thailand, the MASIPAG programme in the Philippines where farmers select and breed rice varieties according to their own criteria, and coffee farmer cooperatives that rear their own beneficial insects.

The FFS approach was designed originally as a way to introduce knowledge on integrated pest management (IPM) to irrigated rice farmers in Asia. The Philippines and Indonesia were key areas in implementing this extension effort. Experiences with IPM-FFS in these two countries have since been documented and used to promote and expand FFS and FFS-type activities to other countries and to other crops. Currently, FFS activities are being implemented in many developing countries, although only a few operate FFS as a nationwide system. The World Bank has incorporated the FFS in some of its agricultural projects (Quizon, Feder , and Murgai, 2001)

At present, a typical FFS educates farmer participants on agro-ecosystems analysis, or what can be more generally described as integrated pest and crop management (IPCM), as it includes practical aspects of "... plant health, water management, weather, weed density, disease surveillance, plus observation and collection of insect pests and beneficials" (Indonesian National IPM Program Secretariat, 1991, p.5). The FFS approach relies on participatory training methods to convey knowledge to field school participants to make them into "...confident pest experts, self-teaching experimenters, and effective trainers of other farmers" (Wiebers, 1993).

The Farmers Field School (FFS) training methodology originated from the FAO Intercountry programme in Asia where it has been used to train over one million rice farmers. The IPM/FFS distinguishes itself from conventional top-down extension packages by its participatory and farmer centred approach. Farmers gain fundamental understanding of the agro-ecosystem and economy of their crops on which they base their crop management decision. Training of Trainers (TOT) courses are organised to prepare extension staff of the Ministry of Food and Agriculture to conduct FFS training. These TOT courses are practical-oriented and require all participants to grow and monitor the target crops and to learn the problems that farmers face throughout a cropping season. Trained extension staff in turn conducts training programmes for farmers (Afreh-Nuamah, 1996).

According to Afreh-Nuamah, (1996), at the farmers' field school, crop management decisions relating to soil preparation, seed selection, nursery establishment etc. are made based on what is referred to as the four key principles of FFS training. These are:

i. **"Grow a healthy crop"** allows plants to recover better from environmental or pest injury, avoids nutrient deficiencies related with pest attack (insects and diseases), and promotes natural defences to many insects and diseases inherent in plants.

ii. **"Conserve natural enemies"** provides free biological control of insects and diseases. Parasites, predators and pathogens have long been recognised to control pest insects, but recent research shows microbial antagonists, and competitors of plant diseases are also important. Vertebrate natural enemies are also essential for control systems. Conservation usually implies avoiding inappropriate pesticide applications (herbicides, fungicides and insecticides all have impact on insect and disease natural enemies) or improving soil organic matter necessary for beneficial soil microorganisms. Natural enemy habitat protection and development are more active methods of conserving natural enemies (e.g. owl houses, mulching for spiders, floral nectaries for parasites).

iii. **"Observe crops regularly"** means informed decision making for appropriate interventions to be made quickly for water, soil and plant management. Inputs used are based on ecological and economic assessment.

iv. **"Farmers become experts"** in their own field is crucial for long-term management of soils, pests and crops. Expertise implies a basic understanding of the agro-ecological system, and decision-making processes (Afreh-Nuamah, 1999).

The formation of clubs or associations of farmers is encouraged so that farmers can meet and interact regularly and find solutions to common concerns (Afreh-Nuamah, 1996). The key features of the IPM/FFS methodology that have made it a more sustainable system for the delivery of extension services include the following:

- Adoption of participatory and farmer-centred and knowledge-based approaches.
- Emphasis on more environmentally sustainable crop production practices
- Adoption of farmer-to-farmer extension practices.
- Thorough training of extension staff and farmers.
- Formation of farmer groups or associations.
- Formation of IPM committees at both national and regional levels.
- Budgeting at regional and district offices of Ministry of Food and Agriculture to cover IPM/FFS activities (Afreh-Nuamah, 1996; Afreh-Nuamah, 1999).

In Ghana, the FFS has been embraced as an emerging extension tool because of the growing realisation that future agricultural growth for resource-poor farmers must be knowledge-intensive and deal with complex environments which have characteristics that are often specific to a particular location (Afreh-Nuamah, 1999). The potential in this training strategy as a novel extension mechanism has been recognised by the relevant government authorities in the country. Arrangements have been made to institutionalise the practice. A National IPM/FFS implementation committee chaired by a Deputy Minister of the Ministry of Food and Agriculture (MoFA) has been established to oversee the institutionalisation of the IPM/FFS. The IPM/FFS is an effective weapon against ignorance. It facilitates change of attitudes and perceptions of farmers (NPRP, undated).

Farmers Field Schools (FFS) are conducted for the purpose of helping farmers to discover and learn about the field ecology and integrated crop management. The field is the primary classroom, both in the TOT courses as well as the FFSs. There are no standard recommendation or packages of technologies offered. In the FFS, farmers collect data in the field and undertake action based on their findings in their own fields (discovery-based decision making). Farmers become active learners and independent decision makers through learning by doing. Farmers compare studies in their own fields and become field level experts in ecology management. The decisions on what action needs to be taken in the field become more and more based on actual finding by participants themselves through 'Exercise'. (Afreh- Nuamah, 1999).

2. 8.1 Gender Issues in Farmers' Field School

During the conduct of Training of Trainers course and *Farmers' Field Schools*, every effort is made to encourage the participation of women or women's groups in these field activities. Women farmers make significant and quality contributions to the planning of *Farmers' Field Schools* and all the associated activities.

In some communities, women are primarily home bound taking care of the children, the home and marginally doing some subsistence farming just to provide supplement to the family food requirements. In such locations, there are usually a low percentage of women in the *Farmers' Field Schools* devoted to discussion of specific gender issues in such schools. In a few other locations, where there are large proportions of women involved in vegetable and irrigated rice production, women voluntarily participate in *Farmers' Field School* activities. Gender composition of *Farmers' Field School* groups vary considerably (Afreh-Nuamah, 1999).

2.9 Real Returns to IPM and Its Diffusion

IPM performance can be evaluated from at least two basic farm levels. The basic farm level analysis investigates whether IPM and its dissemination -in so far as these change farmers' knowledge and thereby effect more efficient farm input use (particularly of pesticides)- result in higher farm profits.

Although there are various IPM technologies for different crops and while there are alternative methods to diffusing these practices, all these instruments and efforts uniformly aim at altering existing farm use of pesticides and promoting effective and efficient pest management practices. IPM's primary objective is to help restrain pest damage at a level that maximises farmers' economic returns, while utilising the smallest level of chemical input. Farmers are IPM's main target beneficiaries. However, others may benefit from externalities that derive from sustained IPM practice and/or the IPM dissemination efforts (Waibel *et al,* 1999).

For IPM and its dissemination, the desired impact on profits comes from raising farmers' knowledge (k). This rise in k leads to a change in the input mix and practices used, and in particular, to a smaller use of pesticides. Supposedly, higher farming returns follow from this decline in farmers' demands for pesticides and perhaps, of other inputs (such as labour) and from the rise in outputs owing to improved plant protection and cultivation practices overall.

Most farmers learn of IPM practices, directly or indirectly, through IPM diffusion programmes. Ceteris paribus, smallholders who have been exposed to some form of IPM dissemination have greater or equal awareness and knowledge than their counterparts who have not been reached by any IPM diffusion programmes. Different dissemination efforts entail varying costs, even though they are focused in like fashion on raising farmers' IPM awareness. Expectations are that these efforts payoff in experimentation and knowledge creation by farmers themselves, and ultimately to sustained IPM practice by them. The degree to which these desired outcomes occur depends on the particular IPM diffusion efforts followed. Briefly stated, a farmer's technical IPM knowledge (K_t) depends on the type of programme exposed. The common belief is that with a more intensive training programme (like FFS), farmers learn and retain more IPM-related knowledge compared with others who undergo less rigorous training, such as the IRRI-type of IPM extension (or FMPR) (Waibel *et al,* 1999).

2.10 Assessment of Household and Village Level Impacts of IPM

The impact of IPM programmes can be viewed from a range of perspectives, from the impact on international trade, the national economy and international organisations at the highest level of aggregation to the effects on the day-to-day decisions made by crop producers at the microeconomic level.

Household and village impacts are among the most profound effects of a given IPM intervention. This should not imply, however, that these effects are easily measured. The application of IPM involves improved understanding of agro-ecological principles under dynamic ecological and economic conditions. New approaches are therefore needed to integrate the relevant technique from both the social and natural sciences to study the impact of IPM on farmers' practices and local decision-making processes (Waibel *et. al.*, 1999).

As a knowledge-intensive technology, IPM requires a more subtle approach than that which has commonly been applied in studies of technology adoption. IPM is not simply a single decision rule, but rather a set of inter-linked concepts. Rather than measure IPM adoption as, for example, a binary variable (adopt/not-adopt) with a fixed effect on input demand and / or production efficiency, we view IPM knowledge as a dynamic continuum, implying a more complex relationship between knowledge acquisition and farmer practice. The evidence shows that knowledge of IPM may be substantially heterogeneous, even among participants in the same IPM programme, and that farming practice itself is an important source of new knowledge. Unlike many other technologies, the impact of IPM depends on the ongoing interactions between natural conditions and farmers' knowledge. In cases where there is no pest infestation, there may be little impact from IPM knowledge other than the knowledge that prophylactic pesticide sprays may be unnecessary. In cases of pest infestation, however, one may observe profoundly different decisions that are rooted in farmers' knowledge of IPM.

IPM techniques are acquired by farmers through some type of communication. Besides the direct link between farmers and IPM programmes, much of the impact of IPM programmes at the household and village level may arise from farmer-to-farmer transfer of information and technology (Waibel *et al*, 1999). They add that the impact of a given IPM intervention can be measured using metrics common to studies of technology adoption such as the impact of technology on yield and yield variability, production and cost efficiency, and demand for inputs. However, farmer practice is not a blank slate upon which IPM training programmes imprint new concepts and decision rules. Instead, improved understanding of agro-ecological principles interacts with existing local knowledge within a framework given by prevailing socio-economic and ecological conditions. Local information networks and power structures also influence the processes of information generation and sharing.

In Ghana, the positive impact of the IPM/FFS on productivity of farmers has led to the extension of the project to cover 9 out of the 10 regions. Yields of particular farmers have increased to between 25%-100% depending on rate of adoption. Crops tackled since the inception of the programme are rice, vegetables, plantain and cassava and ignorance about pests and diseases has been replaced by insight into the ecosystem and the interactions among pests and natural enemy populations (Afreh-Nuamah, 1996).

2.11 Summary

Evidence from literature suggests that factors that need to be considered in studies of adoption include credit, access to information, age, educational status of farmers, farm size, tenure system, and labour availability. Rogers (1995) also indicates that in general, innovations that are perceived by receivers as having greater relative advantage, compatibility, trialability, observability and less complexity will be adopted more rapidly than other innovations.

According to Maunder, (1973), farmers have need as to the kind of extension methods and channels of communication to be used to present messages to them. The available methods include various forms of individual, group and mass extension methods.

In Ghana, the *Farmers' Field School (FFS)* training methodology has been embraced as an emerging extension tool and it distinguishes itself from conventional IPM extension packages by its participatory and farmer centred approach. Literature is also explicit on real returns to IPM and its diffusion and the assessment of household and village level impacts of IPM.

2.12 Conclusion

Adoption of technological innovations in agriculture has attracted considerable attention but the introduction of new technologies has, in several instances, been only partially successful, as measured by their observed rates of adoption. Constraints to the adoption of a technology involves the attributes of the technology itself such as its relative advantage over previously introduced technologies, its compatibility with the existing value, past experiences, and needs of potential adopted, its complexity, trialability and observability.

Personal and socio-economic characteristics of farmers such as age, education, farm income, credit, size of farm, tenure system and labour availability have also been reviewed in relation to adoption of innovations. Communication strategies, channels of communication, diffusion, FFS/TOT training methodology, real returns to IPM and its diffusion, assessment of household and village level impacts of IPM have also been reviewed.

This study will therefore contribute to knowledge and literature on factors contributing to the low adoption of IPM and suggest extension methods of enhancing the diffusion and adoption of IPM messages since extension methods are very crucial in studies of adoption. The implication from the literature is that to enhance the adoption of IPM, the extension methods should be such that the farmers will be able to diagnose their own problems.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter describes the research methodology used for the study. It describes the study area, research design, study population, sampling technique and sample size, pre-testing, instrument development and data collection. This chapter also describes methods for processing and analysing the data collected.

3.1 Research Design

There are several important factors to consider when choosing an appropriate research methodology. One of these is the appropriateness of the methodology to the research objective. Survey was found suitable for this study because according to Kumekpor (1999), survey implies a careful scrutiny or investigation of a demarcated geographical area in order to have a comprehensive view of the nature, conditions and composition of social groups, institutions or processes within such a defined area.

Babbie, (1983:209) also states that survey research is perhaps the most frequently used mode of observation in the social sciences. And they may be used for descriptive, explanatory, and exploratory purposes. They are chiefly used in studies that have individual people as the units of analysis. Survey research is probably the best method available to the social scientist interested in collecting information from a population too large to observe directly. Surveys are also excellent vehicles for measuring attitudes and orientations in a large population. The methodological approaches employed for this study follow the principles of quantitative research. This study involved the development of an instrument and employed mainly quantitative measurement criteria for recording as well as analysing the data.

3.2 Study Area

The study was conducted at Weija in the Greater Accra Region of Ghana, where the Weija Irrigation Company (WEICO), a joint project between the Ministry of Food and Agriculture and the European Economic Community (E.E.C.) is sited. The Weija irrigation project was started in September 1977 with financial backing from the European Economic Community with the following objectives:

1. To raise the nutritional quality of the national diet with the steady supply of good quality vegetables throughout the year at moderate prices.
2. To increase the production of import substitutes and the production of non-traditional export crops to lessen the dependence on cocoa.
3. To contribute directly or indirectly to the provision of employment.
4. To encourage the growth of other sectors through linkage.

The Weija Irrigation Project is part of the Government of Ghana's programme to raise the standard of living of the rural people through the development of modern agriculture. Following the modest successes achieved by the pilot project, WEICO was incorporated in 1982 and became operational in April 1983. WEICO was charged with supervising the operations of farmers at the project site.

The project is located in the driest part of the coastal belt, with a mean annual rainfall of 846mm (33.3 inches). A survey conducted by Janny and Afreh-Nuamah (1997) revealed that there are two main cropping seasons: May-September (rain fed) and October-April (irrigated).

Land ownership at Weija is strictly on lease basis. The land tenure system basically has undergone two stages of development. The first stage is the period before the establishment of Weija Irrigation Company. During that period, land was by and large owned by the people of Weija village, thus, land was communally owned. Land was vested in the chief from whom individuals acquired it for their farming activities. The second stage of development is the period after the establishment of the Weija Irrigation Company, when the land was acquired by the Government in collaboration with the European Economic Community (E.E.C) to establish the Weija Irrigation Project in 1977. From this period, land has been vested in the Weija Irrigation Company (WEICO) from whom individuals acquire their land.

A study conducted at Weija by Freku (1998) revealed that farmers did not have direct problem with the leasehold tenure system in the area. Problems farmers faced in the area were not directly related to the land tenure system. WEICO is charged with supervising the operations of farmers at the project site. Over the years, the project has been achieving modest successes but one of the major problems that has been of grave concern to farmers and officials is pest damage.

Farmers on the Weija Irrigation Project have started cultivating export crops like gowar (cluster beans) and tinda (a cucurbit). They also cultivate a wide range of vegetables such as pepper, tomatoes, garden egg, okra, cabbage and marrow. These crops are mainly grown for export as well as for the local market. Because of high pest damage from a variety of pests and lack of appropriate knowledge and skill in pest and crop management, the project conducted season-long training for farmers at Weija in integrated pest and crop management in *Farmers' Field School* from 24th of August to 18th of December 1998. Participation of farmers in the *Farmers' Field School* programme was voluntary.

3.3 Population of Study

The 'Universe of study' is the population from which the sample is to represent (Poate and Daplyn, 1993). The 'universe of study' for this study comprised vegetable farmers of the WEICO project area. These were made up of those who were trained in the season-long IPM/FFS programme organised by the project and vegetable farmers in the area who did not participate in the training and Agricultural Extension agents (AEAs) in the study area. Some of the farmers were illiterate while others have received formal education to various levels.

3.4 Sampling Technique and Sample Size

In general terms, sampling enables the researcher to study a relatively small number of units in place of the target population, and to obtain data that are representative of the whole target population. Sampling is, thus, the process of choosing the research units of the target population, which are to be included in the study (Sarantakos, 1993). For the purpose of sampling, sampling frames constructed by the extension agents were employed. The sampling frames used for the selection of individual farmers who participated in the season-long *Farmers' Field School* (FFS farmers) and those who did not participate in the programme (NFFS farmers) were the lists of farmers compiled by the AEAs. A total target population of 208 vegetable farmers comprising 109 FFS farmers and ninety-nine (99) NFFS farmers was employed. According to Babbie (1983:158) a sampling frame is the list or quasi-list of elements from which a probability sample is selected. Properly drawn samples provide information appropriate for describing the population elements composing the sampling frame. Surveys of organisations are often the simplest from a sampling standpoint because organisations typically have membership lists. In such cases, the list of farmers constitutes an excellent sampling frame.

In view of the varying sampling frames for the two categories of farmers, a sample size of 55 FFS farmers were selected from the FFS sampling frame, and 50 farmers from the NFFS population to make up a total sample size of hundred and five (105). This represents about 50% of each of the categories. Thus, the sample size for each category of farmers is proportional to its representation as in the constructed sampling frame. *Simple random sampling* was used because it gives all units of the target population an equal chance to be selected (Moser and Kalton, 1971; Babbie, 1983; Sarantakos, 1993). A sample drawn at random is unbiased in the sense that no member of the population has any more chance of being selected than any other member.

Thus, a total of 105 vegetable farmers and three Agricultural extension agents were involved in the study. The 105 vegetable farmers comprised fifty-five FFS-trained farmers and fifty farmers who had not participated directly in the training programme. The Weija Irrigation Project was purposively selected for the study because it has been the focus of extension activities by virtue of the fact high pest damage from a variety of pests and lack of appropriate knowledge and skills in pest and crop management caused significant losses in vegetable production in the area. Thus necessitating the season-long *Farmers' Field School* programme in vegetable IPM in the area.

3.5 Pre-Testing

One way of checking the effectiveness of the research design and other issues related to data collection is to use pre-tests and pilot studies, both of which have become a part of any survey research, and a standard feature of modern methodology (Sarantakos, 1993). Waltz and Strickland (1984) suggest that interviews should be pre-tested. Pre-testing is the final stage in questionnaire construction-and one of the most important. In pre-testing, flaws in the questionnaire are identified and corrected (Bailey, 1987). Morse and

Morse and Field (1996) indicate that pre-testing is important as the quality of the study relies on the quality of the questions. And the aim of the pre-test is to demonstrate the trustworthiness of the research tool and to refine the method of data collection if there is the need for that. According to Kidder and Judd, (1986), pre-testing fulfils the following purposes:

- to clarify unforeseen problems with regards to questions wording, respondent's comprehension of the question, question sequence and questionnaire administration,
- to decide the need for additional questions on some topics and elimination of others,
- to determine the length of administration of a questionnaire (and possibly the need to shorten it),
- to enable the researcher phrase close-ended response alternatives from open-ended responses collected for the final questionnaire.

In line with the above, the questionnaire was pre-tested to ensure its validity, reliability and objectivity. Pre-testing was also done in order to identify some of the IPM practices and communication strategies/methods used to disseminate them. Following the pre-testing exercise, some of the questions were modified. The final questionnaire contained both close- and open-ended questions.

3.6 Instrument Development

Sproull (1988: 176)) defines a research instrument as "any type of written or physical device which is purported to measure variables". The type of instrument used for data collection depends on the data collection method and type of data to be collected. Some factors which, influence the choice and use of specific instruments are that instrument, inter alia;

- Measure the variables appropriately;
- Be sufficiently valid and reliable;
- Yield the appropriate level of measurement for each variable;
- Refuse an appropriate amount of time;
- Be easy to administer;
- Be easy to interpret;
- Incur costs within researchers budget.

The nature or type of information collected for each concept, sources of information and data collection techniques are as contained in Table 3.1.

Table 3.1 Data Collection Scheme Main Concepts, Information Required, Sources of Information, and Data Collection Techniques

Main concepts	Information Required	Source of Information	Data Collection Technique
IPM	• IPM Practices	• Farmers • Extension Agents	• Interview Questionnaire • Focus Group Discussion
Personal Socio-Economic Characteristics of Farmers	• Age • Sex • Marital Status • Main occupation • Production constraints • Source of Credit • Farm Size	• Farmers	• Interview Questionnaire
Communication Strategy	• Sources/channels of Information • Methods of Information Delivery	• Farmers • Extension Agents	• Interview Questionnaire • Focus Group Discussion
Adoption of IPM Practices	• Awareness • Adoption • Non-adoption	• Farmers • Extension Agents	• Interview Questionnaire • Focus Group Discussion
Impact of IPM Practices	• Cop Diversity • Yields • Incidence of Pests and Diseases • Stability of income • Business opportunity • Labour requirement	• Farmers • Extension Agents	• Interview Questionnaire • Focus Group Discussion

3.7 Data Collection

Data were collected from March to April 2000. The interview questionnaire was administered to farmers individually to avoid influence from family members and neighbours. In all, 105 vegetable farmers were interviewed. The farmers were interviewed at home and on their farms.

A Focus Group Discussion interview checklist was developed to obtain information on general information about the study area, IPM practices promoted, communication strategies/method(s) employed in their dissemination and constraints to effective extension delivery from the AEAs of MoFA. Criteria for selection of farmers who participated in the season long *Farmers' Field School* were also obtained through the focus group discussion. Notes made from these interviews were necessary to guide discussions on the findings of the research. Appendix 2 shows the checklist employed for the focus group interview. According to Kumekpor, (1999), focus group discussion takes the form of an exchange of views and opinions through discussion with the group, which is known to be concerned with and knowledgeable about the issues discussed.

3.8 Data Analysis

After the collection of the primary data from the field, the researcher edited them by examining for consistency, accuracy and appropriateness of responses obtained. A coding frame was then prepared for the survey interviews and from that the responses were coded. Using the Statistical Package for the Social Scientists (SPSS), the analysis was carried out. The main statistical tools applied were frequencies, percentages, cross-tabulations and chi-square. According to Morse and Field, (1996), the purpose of data analysis is to impose some order on a large body of information so that some general conclusions can be reached and applied in practice

Chi-square test was used to establish whether or not the two categories of farmers differed significantly with regard to personal and socio-economic characteristics, methods of extension and level of adoption. According to Sarantakos, (1993:385), chi-square tests are the most popular and most frequently used tests of significance in the social sciences in general and in sociology in particular. Basically, it informs whether the collected data are close to the value considered to be typical and generally expected, and whether two variables are related to each other. Chi-square value for each cell was also calculated to establish the contribution of each cell to the significance, in the case of those relationships with significant chi-squares. The chi-square values of cells with minimum expected frequency of less than five exceeding twenty-five percent were considered critical and in such situations some of the cells were merged and the chi-square value recalculated to ensure that the interpretation of significance of the chi-square statistic was valid. Where chi-square values were not valid by virtue of the fact that cells with minimum expected frequency of less than five exceeded twenty-five percent, total frequencies were described. Where there was a significant difference between the two categories of farmers with respect to a particular personal socio-economic characteristic, the total frequencies were subsequently cross-tabulated against the level of adoption of the IPM practices to establish whether that personal or socio-economic characteristic had any relationship with adoption.

The chi-square test was also used to establish whether or not there was a significant relationship between the two categories of farmers with respect to the level of awareness of the IPM practices, sources of information, methods of extension and extent of adoption of the IPM practices.

In addition, in instances where there is an invalid chi-square, in describing the relationships, the following approaches were used:

i. If the total or mean percentage of the independent variable was between 0 and 33.3 percent, it was described as markedly higher if any of the percentages in the column for that row is equal to or more than twice the total percentage. On the other hand, it was described as markedly lower if any of the percentages in the columns for that row was equal to or lower than half of the total or mean percentage.

ii. If the total or mean percentage was between 33.4 percent and 66.7 percent, it was described as markedly higher if any of the percentages in the column for that row is equal to or more than one and half times the total or mean percentage. On the other hand, it was described as markedly lower if any of the percentages in the columns for that row was equal to or lower than one and half times that of the total percentage.

iii. If the total or mean percentage was between 66.8 percent and 100 percent, it was described as markedly higher if any of the percentages in the column for that row is equal to or more than 1.25 times the total or mean percentage. On the other hand, it was described as markedly lower if any of the percentages in the columns for that row was equal to or lower than the total or mean percentage divided by 1.25. (Sakyi-Dawson, Personal Communication, February 28, 2001).

CHAPTER FOUR

INTERGRATED PEST MANAGEMENT PRACTICES

4.0 Introduction

The contents of the extension message depend very much on the goal and the target group, and also on the extension strategy. The actual content of IPM differs widely. However, it advocates the integration of the management of any given pest as well as the appropriate cultural practices into the overall farming systems. There cannot be effective IPM information delivery assessment without critically examining the IPM message since the nature of the message helps in deciding the appropriate channels and communication methods. This chapter therefore examines the IPM practices in the study area given by existing reports, AEAs and supervisors. It thus examines the conceptual basis of IPM; training content of *Farmers Field School*; IPM practices disseminated in the study area and preparation of IPM messages.

4.1 Conceptual Basis of IPM

The concept of IPM is subject to differing interpretations, ranging from simple combination of pesticides with other techniques to ecological habitat management strategies. All actors involved in pest management, from pesticide dealers to ecologically motivated grass roots NGOs, talk about IPM. A coherent pest management policy presupposes a clear conceptual basis. In this regard, Swiss Development Cooperation (SDC) regards IPM as a component of sustainable agriculture, which links objectives in productivity with the need to conserve resources. IPM is thus one strategy that farmers can employ to make agricultural production systems more sustainable. SDC also regards IPM, from a developmental perspective and from the viewpoint of farmers, as a process that enables farmers to develop solutions to their own crop protection problems and make situationally appropriate decisions through experimental learning and their own research (supported by research and extension services). The goal is to increase farmers' income and to ensure that it can be sustained over time, and to reduce environmental and health risks. The salient features of the concept are listed below:

- Farmers are the most important decision-makers and shapers of IPM.
- IPM is specific to each situation (in spatial and temporal terms). General principles can be applied, but there are no universally valid prescriptions.
- Crop management is carried out in such a way that economic loss does not occur. Every possible attempt is made to avoid the need to combat pests.
- Principles, decision-making criteria, and concrete options for action are developed and imparted through applied research and extension services.
- Preference is given to methods of biological control, use of varieties with durable resistance (horizontal, multiple resistance), measures that improve agronomic management, and more stable and frequently diversified cultivation system.
- The use of pesticides is limited. Preference is given to rapidly degradable pesticides and preferably to biological pesticides with narrow-range effects (SDC, 1994).

Recent developments have shown that IPM could be more practical and field-oriented to the benefit of the ordinary farmer especially when it is adopted not as technology, but as an approach and strategy for dealing with pest and disease problems as and when they occur (Kiss and Meerman, 1991). IPM is predominantly a knowledge-driven technology, even though some physical technology is used; its implementation relies heavily on the human element, and is thus influenced by the high variability in the ability to use technology inherent in the diverse social groups. It is obvious that IPM practices will be different for the same crop grown in different ecosystems. According to Altieri (1993), IPM is information based and information feedback requires increased contact and communication among farmers, extensionists, and researchers so that the knowledge and experiences of farmers, the users of the technology, can feed into the research agenda.

4.2 Training Content of Farmers' Field School

Farmer Field Schools (FFSs) are basically defined as "schools without walls" situated very close to or on the field where farmers come together regularly to:

a. learn and share experiences
b. learn and develop agro-skills and farm management tools and
c. bring to 'life' the 4 key IPM principles, viz-
d. growing a healthy crop season-long
e. monitoring fields regularly
f. conserving natural enemies (beneficials)
g. farmers becoming IPM experts in their fields.

At the FFS, the 4 key IPM principles take place within a participatory framework. Growing a healthy crop requires basic agronomic skills like seed selection, soil preparation, planting and nursing/transplanting. Thus, the farmer must be conversant with the cropping calendar so that the crop potential could be achieved. 'Preserving natural enemies' is a positive way of saying 'reduce pesticide use'. To be able to do this requires the ability to recognise different factors in the crop eco-system and to understand their interactions. This involves setting up zoos to enable the farmer appreciate the different insect pests and the natural enemies (friendly insects). It also helps the farmer to appreciate the damage caused by blanket spray of chemical pesticides.

Regular field observations concern learning how to make observations in the field. Observations are based on the collection and analysis of field data. In the learning situations, farmers use a formal process to gain these observational skills. In their own fields these skills would be applied without the formality of the learning process. In so doing, they will become experts in their own farm operations, able to make inductive decisions from observations in the field.

Finally, the purpose associated with 'empowerment' aspects of the training is related to the developmental process necessary to enable farmers to make their own decisions about their farm management activities so that they may employ the IPM principles that they have learned. In addition, farmers conduct on-farm Participatory Action Research (PAR) with facilitators. Also farmers take collective and informed decisions about managing their fields and conducting agro-ecosystem analysis (AESA).

At the field school, a group of about 25-30 farmers agree to meet once a week for at least half a day during an entire crop season. On a typical day, these farmers break into subgroups (of five or six field teams), and spend one or two hours in the field making observations, counting population densities of different insect species, assessing crop physiological conditions and recording observations. Each team then assembles outside the field and discusses, analyses and interprets its data. The interpreted data are then summarised, often in agro-ecosystem diagram and presented to the field school. These diagrams include, for instance, a picture of a typical rice plant at the stage of growth of the crop for that week. Animals that eat rice and may produce symptoms that look damaging are drawn on one side of the picture of the rice plant, whilst animals that eat such animals and thus protect the rice plant are drawn on the other side. This validates, from fresh field observations, the concepts of the balance of nature, and of population regulation in a physical representation that is not only available to farmers, but is created by farmers.

IPM field schools are forums for community action, where farmers and trainers discuss observations. They are 'schools' with curricula, field experiments, agro-ecosystem analysis, problem solving and group dynamics activities, and entry/exit ballot tests; all taking place in and around the farm. Through this process, participants discover the basic principles directly, whilst mastering the processes necessary both to continue their own learning process and to teach others. IPM training assists farmers to transform their observations and create a more scientific understanding of their crop agro-ecosystem (Afreh-Nuamah, 1996).

The content of each TOT and FFS training is developed through a series of baseline surveys, planning workshops, specialists, and with contributions from farmers. Training is extensive and covers a wide range of subjects including:

- Land preparation and nursery practices
- Crop growth and development, crop physiology
- Soil structure, characteristics and nutrient management
- Pest and disease identification and management
- Identification of natural enemies and other beneficial arthropods
- Non-formal education skill, computer skills, report writing
- Economic analysis and marketing strategies (Afreh-Nuamah, 1999).

In the field school, there are no standard recommendations or packages of technology offered. Farmers collect data in the field and undertake action based on their findings in their own fields (discovery-based decision-making) (Afreh-Nuamah, 1999).

Trainers are primarily facilitators of learning and only introduce new information when it seems necessary and appropriate. Three main areas of learning, 'work', 'interact' and 'empowerment' are emphasized in the training programme. The general purposes associated with 'work', include knowledge relevant to making management decisions, concerning agronomic and ecological factors that must be made by a farmer practicing IPM strategies.

4.3 Selected IPM Practices for the Study

A number of IPM components are known and occasionally used with effect, such as seedbed sterilization, crop sanitation, crop rotation, resistant varieties, planting periods, mixed cropping, and the use of trap crops. The farmers and AEAs interviewed in the study area indicated that several practices of IPM had been introduced to the study area. The selection of the IPM practices for the study was made on the basis that they have general application in the area of study. These were: Preparation and application of neem seed extract; manure application; mulching; improved seeds (certified seeds); reduction of pesticide use; agro-ecosystem Analysis (AESA); row planting.

4.3.1 Preparation and Application of Neem Seed Extract

Neem seed extract is an insect repellent, anti-feedant and insecticide. It is suitable for large and small-scale farmers. Discussion with the AEAs revealed that neem leaf extract could also be used as bio-pesticides.

4.3.2 Manure Application

Manuring improves soil organic matter necessary for beneficial soil micro-organisms. Measures that promote soil fertility may improve resistance capabilities in plants.

4.3.3 Mulching

Mulching controls weeds, maintains soil moisture and prevents leaching. It also provides habitat for natural enemies (beneficial insects).

4.3.4 Improved Seeds

Improved seeds are high yielding and disease-resistant. New plant varieties with vertical resistance to specific diseases are being widely adopted over large areas. But as pests adapt to and overcome plant resistance, these varieties quickly become less useful and must be replaced by other new varieties.

4.3.5 Reduction of Pesticide Use

The rapidly increasing and often unskilful use of pesticides in developing countries is proving to be basically unsustainable. It weakens the natural defences of agro-ecological systems and induces new crop problems and forms of resistance; this in turn calls for new active agents and an increased investment of resources. The use of pesticides endangers the health of users and consumers as well as the environment (soil, water).

The economic consequences of pesticide use include rising ecological costs, greater burden on the balance of payments in developing countries caused by pesticide imports, and less effective chemical crop protection for the individual farmer. Therefore, instead of treating symptoms, it is necessary to try new, primarily preventive approaches that are based on a holistic analysis of causes (SDC, 1994). The results of pesticide overuse are well known: pest resistance requiring even higher doses and new chemicals; depletion of natural enemies that could otherwise hold some pest population in check; depletion of micro-organisms in the soil which contribute to proper soil structure and fertility; a chain of effects beyond the locality where the chemicals are applied, including threats to wildlife and pollution of drinking water and direct and indirect health hazards related to transport, storage, use and disposal of pesticides. Added to this are health hazards from pesticide residues in foods sent to market, and the fact that some cheapest pesticides are among the environmentally persistent and acutely toxic. Restrictive use of pesticides might constitute the first step in regenerating natural regulating mechanisms in the ecosystem.

4.3.6 Agro-Ecosystem Analysis (AESA)

Agro-ecosystem analysis (AESA) is a powerful IPM monitoring tool that is used for the empowerment of farmers in the management of their crop production system. As a tool, it deals with the crop and its ecosystem in its totality by considering the following: general information, the crop, soil and water, weather phenology, entomology and pathology.

The aspects of AESA considered for the study were: 'scouting' or 'monitoring'. 'Scouting' or 'monitoring' essentially entails keeping a regular eye on the pest, and if possible on the beneficial organisms too. At the simplest level, this allows a farmer to avoid the expense of spraying when pests are not present in significant numbers. The avoidance of such 'prophylactic' or 'calendar spraying' saves money and reduces the amount of pesticide use, and therefore the hazards associated with such use (Bull, 1982). Scouting methods enable farmers to decide when the use of pesticide is economical.

4.3.7 Row Planting

Row planting at the appropriate distance ensures appropriate crop density and ventilation, which create optimal microclimate so that the crop potential could be achieved.

4.4 IPM Message Preparation

The message prepared by an extension worker must be clear as to its purpose. Objectives must be specified, the content of the message must be relevant to the audience and directly linked to the intent or purpose of the communication. In addition, the treatment of the message must be such as to be intelligible to the intended audience. IPM does not require radical changes in farming systems: it always begins with local agricultural practices. However, it is not a single decision rule but involves farmer-centred decision-making based on peculiar field situation. Complex ideas are not easily encoded in such a way that an intended audience can, in turn, decode and derive the information contained in the message. Preparation of a message which can be understood by an audience requires a considerable depth of understanding of the content of the message. Such depth of understanding ideally includes practical experience with the implementation of ideas involved in the message, and also assumes considerable knowledge of how particular elements fit into the aggregate agricultural production process of farmer clients (Swanson, 1984).

4.5 Conclusion

Critical review of IPM practices reveals that IPM, unlike the conventional approach to crop protection, utilizes a variety of control measures in a single pest management system. It is predominantly a knowledge-driven approach and its implementation therefore relies heavily on the human element, though certain non-human elements are required. The idea to be conveyed to farmers should be simple and encoded in such a way that the intended audience can, in turn, decode and derive the information contained in the message. IPM requires farmers to be more observant and more analytical, and to be able to adopt measures suitable to their needs in each situation. Participation of the people involved in development programmes is often seen as a way to make these programmes more successful, especially for solving problems of poor people.

CHAPTER FIVE
CHARACTERISTICS OF THE FARMERS

5.0 Introduction

In communication-adoption studies, it is usual to investigate the personal and socio-economic characteristics of respondents in order to understand their relative influence in the adoption behaviours. The characteristics of farmers investigated in the study area include their age, gender, marital status and educational level. The rest are economic enterprises (on-farm and off-farm economic enterprises), size of farm holding, source of labour and source of credit. This chapter also examines farmers' production constraints and the strategies they employ to control pests and diseases.

A comparison is made between farmers who have participated in *Farmers' Field School* (FFS) and those who have not (NFFS). Chi-square test was used to establish whether the two categories of farmers differed in the socio-economic characteristics in question. This helps to select critical personal and socio-economic characteristics in which the two sub groups differ and therefore may influence their awareness and adoption of IPM activities.

5.1 Age of Farmers

Elderly farmers generally seem to be somewhat less inclined to adopt new farm practices than younger ones. However, according to Rogers (1995), there is inconsistent evidence about the relationship of age and innovativeness.

Table 5.1 shows the age distribution of farmers in the study area. Those between 15 and 34.5 years were grouped as young, those between 35 and 55 years as middle-aged, and those 55 years and above as old.

Table 5.1 Ages of Farmers

Age range (years)	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
15-34.5(young)	21	38.2	27	54.0	48	45.7
35-54.5(middle aged)	24	43.6	21	42.0	45	42.9
55 and above(old)	10	18.2	2	4.0	12	11.4
Total	55	100.0	50	100.0	105	100.0

$X^2 = 6.06$, df = 2, $P < 0.05$ (S)

The difference in age between the FFS farmers and the NFFS farmers is statistically significant. The significance is due to the fact that a higher than expected number of FFS farmers are old, whilst fewer than expected NFFS farmers are in the old age category. Since participation in the *Farmers´ Field School* was voluntary, it suggests that older farmers at the Weija Irrigation Project are more willing to learn about new practices to improve upon their farming activities.

5.2 Educational Level of Farmers

Formal education has been valued as a means of increasing knowledge about farm technology and thus facilitates learning, which in turn is presumed to instil a favourable attitude towards the use of improved practices. A predominantly literate group 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 increase their knowledge about new farm practices (Onu, 1991). According to Rogers (1995), earlier adopters have more years of formal education than later adopters.

Educational level of farmers was measured by asking respondents to indicate their levels of formal schooling. For the purpose of the study, the categories considered were:

- No Formal Education
- Primary/J.S.S/Middle (Low Formal Education)
- Secondary/S.S.S/ Commercial Education/ Tertiary Education (High Formal Education).

Table 5.2 shows that about 51.0% of the sampled farmers had low formal education, about 31.0% had no formal education, while about 18.0% had high formal education. The difference between the two categories of farmers with respect to educational level is not statistically significant. Since participation in the *Farmers' Field School* was voluntary, this seems to suggest that educational level of farmers in the area did not affect farmers' willingness to learn about more innovations.

Table 5.2 Educational Levels of Farmers

Educational Level	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
No Formal Education	16	29.1	16	32.0	32	30.5
Low Formal Education	29	52.7	25	50.0	54	51.4
High Formal Education	10	18.2	9	18.0	19	18.1
Total	55	100.0	50	100.0	105	100.0

$X^2 = 0.11$, df = 2, $0.9 < P < 1.0$ (NS)

5.3 Gender Distribution of Farmers

Table 5.3 shows the gender distribution of farmers in the area. A markedly lower percentage of the FFS farmers are females. The difference between the two categories of farmers with respect to gender distribution is statistically significant. The significance is due to the fact that a higher than expected farmers in the NFFS category are females, whilst fewer than expected females are in the FFS group.

Table 5.3 Gender Distribution of Farmers

Sex	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Male	50	90.0	35	70.0	85	81.0
Female	5	9.1	15	30.0	20	19.0
Total	55	100.0	50	100.0	105	100.0

$X^2 = 7.43$, df = 1, $P < 0.05$ (S)

The reason for the low level of participation of women in the *Farmers' Field School* could be due to the limited time at their disposal by virtue of other domestic roles they play. According to Afreh-Nuamah, (1999), in communities where women are home bound taking care of children, the home and marginally doing some subsistence farming just to provide supplement to the family food requirement, percentage of women in *Farmers' Field Schools* is low. This was particularly true of the study area. Therefore every effort should be made to encourage their participation in such agricultural development programmes.

5.4 Farm Size

The ownership of land in the study area is strictly on lease basis. Table 5.4 shows the distribution of farm sizes. The average farm size is 3.5 acres. Farm holdings of between 1.0 and 3.0 acres were categorised as small, 3.5-4.5 acres as medium and 5.0 acres and above as large. From Table 5.4, about 50.0% of the farmers cultivated small farms, about 15.0% medium farms and about 35.0% large farms.

Table 5.4 Distribution of Farm Size

Farm Size (Acres)	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
1.0-3.0 acres (small)	25	45.4	27	54.0	52	49.6
3.5-4.5 acres (medium)	10	18.2	6	12.0	16	15.2
5 acres and above (large)	20	36.4	17	34.0	37	35.2
Total	55	100.0	50	100.0	105	100.0

$X^2 = 1.08$, df = 2, $0.50 < P < 0.60$ (NS)

The difference between the two categories of farmers with respect to farm size holding is not statistically significant. Since land ownership at Weija is strictly on lease basis, this finding confirms that both FFS and NFFS farmers have equal access to farmland.

5.5 Economic Enterprises of Farmers

Some farmers may be engaged in off-farm economic enterprises in addition to farming, while others may depend solely on the farm for their income. For the purpose of this study, the on-farm economic enterprises are made up of farm production activities, while off-farm non-salaried economic enterprises include trading, carpentry, masonry, fishing, traditional healing, livestock rearing and vehicle operation. On the other hand, off-farm salaried workers comprised teachers, nurses etc. Farmers engaged in economic enterprises involving both farming and salaried activity have been designated as part-time salaried farmers (SF), while those who undertake farming and non-salaried economic activity have been designated as part-time non-salaried farmers (NSF).

Table 5.5 reveals that markedly lower percentage of the NFFS farmers are engaged in part-time salaried employment (SF). The difference between the two categories of farmers with respect to economic enterprises undertaken is not statistically significant.

This indicates that the type of economic activities undertaken by farmers in the study area is not an important determinant of participation in the *Farmers' Field Schools*.

Table 5.5 Economic Enterprises of Farmers

Economic Enterprise	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Farming Only	38	69.1	34	68.0	72	68.6
Part-time Farming (SF)	2	3.6	0	0.0	2	1.9
Part-time Farming (NSF)	15	27.3	16	32.0	31	29.5
Total	55	100.0	55	100.0	105	100.0

$X^2 = 2.02$, df = 2, $0.30 < P < 0.40$ (NS)

5.6 Source of Farm Labour

Labour is a crucial factor in studies of adoption. This is because labour is required for farm activities like land preparation, weeding, planting, harvesting, manure and fertiliser application and spraying of pesticides. In studies on IPM, labour sources and issues are critical because IPM is labour-intensive. Availability and affordability of labour is likely to contribute to its adoption. The sources of farm labour comprised family/own labour and those who hired some or all labour.

Table 5.6 indicates that about 16.0% of the FFS farmers indicated own/family labour, while 34.0% of the NFFS farmers indicated the same. Also, about 84.0% of the FFS farmers indicated hired some or all labour, while 66.0% of the NFFS farmers indicated the same.

Table 5.7 Source of Credit

Source of Credit	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
None	31	57.4	37	74.0	68	65.4
Others (Traders, Money Lenders, Bank, Friends and Relatives)	23	42.6	13	26.0	36	34.6
Total	54	100.0	50	100.0	104	100.0

$X^2 = 3.16$, df = 1, $0.04 < P < 0.05$ (NS)

The difference between the two categories of farmers with respect to source of credit is not statistically significant. Since greater numbers of farmers indicated not having access to any form of credit, some purchased input may be limited. This may therefore limit the adoption of practices which make higher demand for purchased inputs.

5.8 Production Constraints

Farmers were asked to indicate the production constraints confronting them in the study area. The constraints indicated include poor soil fertility, high cost of inputs (improved seeds, fertilisers and pesticides) high cost of labour and market price fluctuation. Other constraints to production include lack of financial support, pests and diseases. Also, access to good quality seed was often mentioned as a constraint. To reduce costs, seed is often processed on-farm, which could lead to reduction of yield and build-up of seed-borne diseases.

5.8.1 Major Crop Pests and Diseases

Respondents indicated the major crop pests which affect their crop. There were several descriptions of various types of pests and to categorise the pests, the following classification was used:

- Macro Pests (mice, lizards)
- Micro Pests (insects, buds etc)
- Diseases (nematodes, bacteria, fungal, viral and microbial damage).

Farmers frequently mentioned root-knot nematode infestation as a major and persistent threat to vegetable production in the area.

5.9 Pest Control Strategies Used By Farmers

The farmers indicated pest control strategies they undertake in controlling pest infestation of their crop. The strategies employed by farmers in combating pests in the study area include the following: baiting (normally used to control mice), early harvesting, crop rotation, rouging, destruction of diseased plants, using neem seed extracts, using agro-chemical, weeding, mulching and a combination of methods.

5.10 Conclusion

Personal and socio-economic characteristics have often been considered in studies of adoption of innovation as predisposition factors. The findings reveal that the two categories of farmers did not differ significantly in educational level, farm size, source of credit and economic enterprises undertaken. However, they differed in age, gender and source of labour. The significance in gender was due to the fact that a higher than expected females are in the NFFS category, while the significance in age is due to the fact that a higher than expected farmers in the FFS group are in the old age category. Age, gender and source of labour are likely to contribute to the differential adoption of some farming practices, they are of interest in this study, for they could influence the adoption of IPM practices in the study area. Concerning the economic enterprises undertaken by farmers in the study area, about 69.0% of them are in full-time farming, while about 31.0% are in farming in addition to either salaried or non-salaries employment.

Farmers in the study area are confronted with several production constraints such as lack of financial support, pests and diseases, market price fluctuation etc. In combating pests and diseases, farmers in the area indicated the use of both chemical and non-chemical strategies.

CHAPTER SIX
COMMUNICATION OF IPM MESSAGES

6.0 Introduction

The process of communication is fundamental to extension, training and passing on information. Thus learning processes, the dissemination of innovation or social change cannot be explained without reference to communication. People learn in a variety of ways: by reading, hearing, seeing, discussing and doing, and the most effective educational methods employ all these methods (Penders, 1956). Farmers are keen observers of how other farmers work and even spend time discussing their experiences with their friends and neighbours. There is evidence that whenever information is adequately communicated, there are high levels of adoption of those innovations which translate into high levels of development (Rao, 1966). The first effect or outcome of communication is awareness and it is the first stage in the adoption process. This chapter considers farmers' sources of information on the selected IPM practices, extension strategies employed in their dissemination, and also the constraints to effective extension delivery as indicated by extension personnel.

6.1 Sources of IPM Information

Information sources used in the educational process have a significant impact on the adoption of agricultural innovations (Sulaiman, Baggett & Yoder, 1993). Farmers use many different sources to obtain the knowledge and information they need to manage their farms efficiently. These sources include: other farmers; government extension organisations; private companies selling inputs, offering credit and buying products; other government agencies; marketing boards and politicians; farmers' organisations and NGO's and their staff members; farm journals, radio, television and other mass media (van den Ban and Hawkins, 1999).

From the study, sources of information, which attracted a consistent agreement among farmers in the study area, are: AEAS/FFS, agricultural input sellers and others (comprising farmers' co-operative society, other farmers, FFS participants, friends and relatives).

Table 6.1 shows farmers' sources of information on preparation and use of neem seed extract as bio-pesticide. Markedly higher percentage of the FFS farmers indicated AEAs/FFS as the source of information on preparation and use of neem extract as bio-pesticides, while markedly lower percentage of the NFFS farmers indicated the same. On the other hand, markedly higher percentage of the NFFS farmers indicated other sources (among these are FFS participants, friends and relatives), while markedly lower percentage of FFS farmers indicated the same.

Table 6.1 further shows that there is a significant difference between the two categories of farmers with respect to source of information on neem seed extract as a bio-pesticide. The significance is due to the fact that a higher than expected NFFS farmers indicated other sources of information, whilst fewer than expected FFS farmers indicated AEAs/FFS. By implication, very small proportions of the NFFS farmers received information on use of neem seed extract as bio-pesticide directly from AEAs, and therefore obtained this message from other sources, namely, FFS participants, farmers' co-operative society, friends and relatives. This indicates that besides the spread of IPM information through AEAs and *Farmers' Field School* programmes, other farmers, friends and relatives as well as FFS farmers are instrumental in their diffusion as well.

Table 6.1 Source of Information: Preparation and Application of Neem Seed Extract

Source	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
AEAs/FFS	55	100.0	7	14.9	62	60.8
Others	0	0.0	40	85.1	40	39.2
Total	55	100.0	47	100.0	102	100.0

$X^2 = 77.01$, df = 1, $P < 0.05$ (S)

Table 6.2 shows farmers' sources of information on manure application. Markedly lower percentage of the NFFS farmers indicated AEAs, while markedly lower percentage of FFS farmers indicated other sources (among these are FFS participants, friends and relatives).

Table 6.2 Source of Information: Manure Application

Source	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
AEAs/FFS	48	87.3	28	57.1	76	73.1
Others	7	12.7	21	42.9	28	26.9
Total	55	100.0	49	100.0	104	100.0

$X^2 = 11.96$, df = 1, $P < 0.05$ (S)

The difference between the two categories of farmers with respect to source of information on manure application is statistically significant. The significance is due to the fact that higher than expected number of NFFS farmers indicated other sources, whilst fewer than expected FFS farmers indicated the same. By implication, a larger number of NFFS farmers received information on manure application from other sources (FFS participants, friends and relatives) than from AEAs.

Sources of information on mulching is shown in Table 6.3. Markedly lower percentage of NFFS farmers indicated AEAs, while markedly higher percentage of NFFS farmers and markedly higher percentage of FFS farmers indicated other sources (among these are FFS participants, friends and relatives).

Table 6.3 further shows that there is a significant difference between the two categories of farmers with respect to source of information on mulching. The significance is due to the fact that higher than expected number of NFFS farmers indicated other sources, whilst fewer than expected FFS farmers indicated the same. By implication, a higher number of NFFS farmers received information on manure application from other sources (FFS participants, farmers' co-operative society, friends and relatives) than from AEAs, whilst a lower proportion of the FFS farmers received information on mulching from other sources.

Table 6.3 Source of Information: Mulching

Source	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
AEAs/FFS	52	96.3	22	56.4	74	79.6
Others	2	3.7	17	43.6	19	20.4
Total	54	100.0	39	100.0	93	100.0

X^2 =22.16, df = 1, P < 0.05 (S)

Table 6.4 shows farmers' sources of information on planting improved seeds. Markedly lower percentage of the NFFS farmers indicated AEAs/Input sellers, while markedly lower percentage of FFS farmers indicated other sources (among these are FFS participants, agricultural input sellers, friends and relatives). Table 6.4 further shows that there is a significant difference between the two categories of farmers with respect to sources of information on planting improved seeds. The significance is due to the fact that a higher than expected NFFS farmers indicated other sources (among these are FFS participants, friends and relatives), whilst fewer than expected FFS farmers indicated the same. By implication, a higher proportion of the FFS farmers received information on planting improved seeds directly from AEAs, whilst a lower percentage received it from other sources such as FFS farmers, farmers' co-operative society, friends and relatives. The involvement of agricultural input sellers in promoting improved seeds is worth mentioning. This is because, aside of the profit motive in promoting the use of improved seeds, they could serve as major sources of IPM dissemination. They should therefore be involved in IPM programmes to enhance IPM diffusion efforts. Their contribution in the sale of agrochemical is also worthy of mentioning. Their involvement in IPM programmes would also help in prescribing the right agrochemicals (fertilizers and pesticides), if not their elimination from the market.

Table 6.4 Source of Information: Planting Improved Seeds

Source	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
AEAs/FFS/Input Sellers	44	86.3	26	54.2	70	70.7
Input Sellers	5	9.8	5	10.4	10	10.1
Others	2	3.9	17	35.4	19	19.2
Total	51	100.0	48	100.0	99	100.0

$X^2 = 16.39$, df = 2, $P < 0.05$ (S)

Table 6.5 shows farmers' sources of information on the need to reduce pesticide application. Markedly higher percentage of FFS farmers indicated AEAs/FFS, while markedly lower percentage of the NFFS indicated the same. Also, markedly higher percentage of NFFS farmers indicated other sources of information (among these are FFS participants, friends and relatives). Table 6.5 further shows that there is a significant difference between the two categories of farmers with respect to source of information on pesticide reduction. The significance is due to the fact that a higher than expected NFFS farmers indicated other sources, whilst a fewer than expected FFS farmers indicated the same. By implication, a higher proportion of the FFS farmers received information on pesticide reduction directly from FFS/AEAs, whilst a lower percentage of the NFFS farmers received it from other sources such as FFS participants, farmers' co-operative society, friends and relatives.

Table 6.5 Source of Information: Reduction of Pesticide Application

Source	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
AEAs/FFS	54	100.0	22	46.8	76	75.2
Others	0	0.0	25	53.2	25	24.8
Total	54	100.0	47	100.0	101	100.0

$X^2 = 38.17$, df = 1, $P < 0.05$ (S)

Table 6.6 shows farmers' sources of information on scouting. Markedly higher percentage of the FFS farmers indicated AEAs/FFS, while markedly lower percentage of the NFFS farmers indicated AEAs. Also, markedly higher percentage of NFFS farmers indicated other sources (among these are FFS participants, farmers' co-operative society, friends and relatives), while markedly lower percentage of the FFS farmers indicated the same.

Table 6.6 Source of Information: Scouting

Source	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
AEAs/FFS	55	100.0	6	23.1	61	75.3
Others	0	0.0	20	76.9	20	24.7
Total	55	100.0	26	100.0	81	100.0

$X^2 = 56.18$, df = 1, $P < 0.05$ (S)

Table 6.6 further shows that there is a significant difference between the two categories of farmers with respect to source of information on Scouting. The significance is due to the fact that a higher than expected NFFS farmers indicated other sources, whilst fewer than expected FFS farmers indicated the same. By implication, very high proportions of the FFS farmers received information on Scouting directly from FFS/AEAs, whilst NFFS farmers used others sources such as FFS participants, farmers' co-operative society, friends and relatives.

Table 6.7 shows farmers' sources of information on row planting. Markedly lower percentage of NFFS farmers indicated AEAs, while markedly lower percentage of the FFS farmers indicated other sources (among these are FFS participants, friends and relatives). Table 6.7 further shows that there is a significant difference between the two categories of farmers with respect to source of information on row planting. The significance is due to the fact that a higher than expected NFFS farmers indicated other sources, whilst fewer than expected FFS farmers indicated the same. By implication, higher proportions of the FFS farmers received information on row planting directly from FFS/AEAs, whilst a lower percentage of NFFS farmers received it from other sources such as FFS farmers, farmers' co-operative society, friends and relatives.

Table 6.7 Source of Information: Row Planting

Source	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
AEAs/FFS	50	90.9	28	57.1	78	75.0
Others	5	9.1	21	42.9	26	25.0
Total	55	100.0	49	100.0	104	100.0

$X^2 = 15.76$, df = 1, $P < 0.05$ (S)

The above findings indicate that AEAs and/ or *Farmers Field Schools* are the main sources of IPM information in the study area. This notwithstanding, social interaction among farmers in the area has also contributed to the high awareness of the IPM practices.

6.2 Methods through which farmers received IPM practices

Extension methods comprise techniques of communication between extension workers and target groups with the aim of motivating and enabling the latter to find ways of solving their problems. Depending on the particular methods, communication can be on a mutual basis (e.g. conversation, group discussion) or one-way directed (e.g. information through brochure) (Albrecht *et al*, 1989). Extension plays an important role in increasing the knowledge of farmers about improved practices that can increase their yields and incomes in a sustainable manner.

Participatory Action Research (PAR) is an FFS methodology that aims to provide farmers with analytical ability and skills to investigate the cause-effect relationships of local farming problems and thereby to stimulate farmers to design a set of actions for solving problems in the field. PAR especially has sought actively to involve people in generating knowledge about their own condition and how it can be changed to stimulate social and economic change based on the awakening of the common people, and to empower the oppressed (Chambers, 1999). According to Cornwal *et al,* (1993:25) in: Chambers (1999), the techniques used in PAR include collective research through meetings and socio-dramas, valuing and applying folk culture, and the production and diffusion of new knowledge through written, oral and visual forms.

In general, two main communication strategies were employed in disseminating IPM practices to farmers in the study area. These are individual and group methods. Individual methods comprised farm and home visits by AEAs. Individual farmer-to-individual farmers also played an important role. On the other hand, group methods used comprised discussions and demonstrations, as well as PAR, which is an FFS methodology.

The methods used to introduce neem seed extract preparation and application as a bio-pesticide is shown in Table 6.8. Markedly higher percentage of the NFFS farmers indicated individual method, while markedly lower percentage FFS farmers indicated the same. On the other hand, markedly higher percentage of the FFS farmers indicated group method/PAR, while markedly lower percentage of the NFFS farmers indicated the same. Table 6.8 further shows that the difference between the two categories of farmers with respect to extension methods used is statistically significant. The significance is due to the fact that none of the FFS farmers indicated individual method. All FFS farmers indicated group method

Table 6.8 Methods of Extension: Preparation and Application of Neem Seed Extract

Extension method	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Individual Method	0	0.0	40	85.1	40	39.2
Group Method/PAR	55	100.0	7	14.9	62	60.8
Total	55	100.0	47	100.0	102	100.0

X^2 =77.01, df = 1 P < 0.05 (S)

The methods used to introduce manure application to farmers in the study area are shown in Table 6.9. Markedly lower percentage of the FFS farmers indicated individual method, while markedly lower percentage of NFFS farmers indicated group method/PAR. Table 6.9 further shows that there is a significant difference between the two categories of farmers with respect to communication strategies or methods used in the area. The significance is due to the fact that that a higher than expected NFFS farmers indicated individual method, whilst a fewer than expected FFS farmers indicated individual method.

By implication, FFS farmers were introduced to manure and its application mainly through PAR/group method, while the NFFS farmers were introduced to manure and its application mainly through individual contact.

Table 6.9 Methods of Extension: Manure Application

Extension Method	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Individual Method	11	20.0	25	52.1	36	35.0
Group Method /PAR	44	80.0	23	47.9	67	65.0
Total	55	100.0	48	46.6	103	100.0

$X^2 = 11.60$, df = 1, $P < 0.05$ (S)

The extension methods employed in teaching mulching to farmers in the area are shown in Table 6.10. Markedly lower percentage of the FFS farmers indicated individual method, while markedly higher percentage indicated group method/PAR. Table 6.10 further shows that there is a significant difference between the two categories of farmers with respect to extension methods or communication strategy. The significance is due to the fact that a higher than expected NFFS farmers indicated individual method, whilst fewer than expected FFS farmers indicated individual method. This confirms that PAR/group methods are important methodology in *Farmers' Field School.*

Table 6.10 Methods of Extension: Mulching

Extension method	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Individual method	1	2.6	19	48.7	20	25.6
Group method/PAR	38	97.4	20	51.3	58	74.4
Total	39	100.0	39	100.0	78	100.0

X^2 =21.79, df= 1, P < 0.05 (S)

The communication strategies used to introduce planting improved seeds to farmers in the study area are shown in Table 6.11. Markedly higher percentage of NFFS farmers indicated individual method, while markedly lower percentage of FFS farmers indicated the same. On the other hand, markedly lower percentage of NFFS farmers indicated group method/PAR.

The difference between the two categories of farmers with respect to communication strategies used to educate farmers on the need to plant improved seeds as IPM practice is statistically significant. The significance is due to the fact that a higher than expected NFFS farmers indicated individual method, whilst fewer than expected FFS farmers indicated the same.

Table 6.11 Methods of Extension: Planting Improved Seeds

Extension Method	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Individual Method	10	19.6	29	60.4	39	39.4
Group Method /PAR	41	80.4	19	39.6	60	60.6
Total	51	100.0	48	100.0	99	100.0

X^2 =17.25, df= 1, P < 0.05 (S)

The communication methods used to educate farmers on the need to stop or limit pesticide application as well as methods involved in limiting its use are shown in Table 6.12. Markedly higher percentage of NFFS farmers indicated individual method, while markedly lower percentage of the FFS farmers indicated individual method. On the other hand, markedly higher percentage of FFS farmers indicated group method/PAR, while markedly lower percentage of NFFS farmers indicated the same. The difference between the two categories of farmers is statistically significant. The significance is due to the fact that a higher than expected NFFS farmers indicated individual method, whilst fewer than expected FFS farmers indicated the same.

Table 6.12 Methods of Extension: Reduction of Pesticide Use

Extension Method	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Individual Method	2	3.6	26	55.3	28	27.5
Group Method /PAR	53	96.4	21	44.7	74	72.5
Total	55	100.0	47	100.0	102	100.0

$X^2 = 33.99$, df = 1, $P < 0.05$ (S)

The strategies used in communicating scouting as an integral part of IPM practice is shown in Table 6.13. A markedly higher percentage of the NFFS farmers indicated individual method, while markedly lower percentage of the FFS farmers indicated the same. On the other hand, all FFS farmers indicated group method/PAR, while about 23% of the NFFS indicated the same.

Table 6.13 Methods of Extension: Scouting

Extension Method	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Individual Method	0	0.0	20	76.9	20	24.7
Group Method/PAR	55	100.0	6	23.1	61	75.3
Total	55	100.0	26	100.0	81	100.0

$X^2 = 56.18$ df = 1 $P < 0.05$ (S)

The difference between the two categories of farmers with respect to the communication strategies is statistically significant. The significance is due to the fact that a higher than expected NFFS farmers indicated individual method, whilst fewer than expected FFS farmers indicated the same.

The strategies used in communicating row planting to farmers in the study area are shown in Table 6.14. Markedly lower percentage of FFS farmers indicated individual method, while markedly lower percentage of NFFS farmers indicated group method/PAR.

Table 6.14 Methods of Extension: Row planting

Extension Method	FFS		NFFS		Total	
	Freq	%	Freq	%	Freq	%
Individual Method	5	9.1	21	42.9	26	25.0
Group Method /PAR	50	90.9	28	57.1	78	75.0
Total	55	100.0	49	100.0	104	100.0

$X^2 = 15.76$, df = 1, $P < 0.05$ (S)

The difference between the two categories of farmers with respect to communication strategy used is statistically significant. The significance is due to the fact that a higher than expected NFFS farmers indicated PAR/group method, whilst a fewer than expected NFFS farmers indicated individual method.

6.3 Awareness

Farmers were asked to indicate whether or not they were aware of the selected IPM practices. From Table 6.15, markedly higher percentage of the FFS farmers were aware of neem seed extract. In the case of manure application, markedly higher percentage of FFS farmers indicated awareness, while markedly lower percentage of NFFS farmers were not aware. With respect to improved seeds, both FFS farmers and NFFS farmers indicated about 98.0% awareness. Markedly higher percentage of FFS farmers were aware of the need to reduce pesticide use, while markedly lower percentage of the FFS farmers were not aware. Table 6.15 further reveals that markedly lower percentage of FFS farmers were not aware of mulching. Also, markedly higher percentage of the FFS farmers were aware of scouting, while markedly lower percentage of the NFFS farmers were aware of the same practice. In addition, markedly higher percentage of NFFS farmers were not aware of scouting, while markedly lower percentage of FFS farmers were not aware.

The difference between the level of awareness of farmers who participated in the *Farmers' Field School* and those who did not participate in it is statistically significant in the case of mulching and scouting. The significance in both cases is due to the fact that a higher than expected number of NFFS farmers are not aware of mulching and scouting, whilst fewer than expected number of FFS participants are not aware. The high level of awareness of scouting recorded by FFS farmers, for instance, could be attributed to the fact that at the *Farmer' Field School*, farmers made collection of pests and natural enemies for identification. They were also made to draw these pests and their natural enemies. All these helped in creating awareness. However, NFFS farmers did not have such learning experiences. This suggests that participation in *Farmer Field School* definitely enhanced farmers' awareness of aspects of IPM. The higher percentage of awareness of most of the IPM practices in the study area could be due to social interaction. There are not marked differences in the level of awareness between the two categories of farmers with regard to manure application, improved seeds, pesticide reduction and row planting. This is likely to be due to the fact that these practices have been an important part of farming in Ghana.

Table 6.15 Awareness of IPM Practices by FFS and NFFS Farmers

IPM components	Level of Awareness	Type of Farmer				Total		X^2 Results
		FFS		NFFS				
		Freq	%	Freq	%	Freq	%	
Neem Extract	Aware	55	100.0	47	95.9	102	98.1	*
	Not aware	0	0.0	2	4.1	2	1.9	
	Total	55	100.0	49	100.0	104	100.0	
Manure application	Aware	55	100.0	49	98.0	104	99.0	*
	Not aware	0	0.0	1	2.0	1	1.0	
	Total	55	100.0	50	100.0	105	100.0	
Mulching	Aware	54	98.2	38	77.6	92	88.5	$X^2 = 10.8$
	Not aware	1	1.8	11	22.4	12	11.5	df = 1
	Total	55	100.0	49	100.0	104	100.0	$P < 0.05$, (S)
Planting Improved Seeds	Aware	54	98.2	49	98.0	103	98.1	*
	Not aware	1	1.8	1	2.0	2	1.9	
	Total	55	100.0	50	100.0	105	100.0	
Pesticide Reduction	Aware	55	100.0	48	96.0	103	98.1	*
	Not aware	0	0.0	2	4.0	2	1.9	
	Total	55	100.0	50	100.0	105	100.0	
Scouting	Aware	54	100.0	26	52.0	80	76.9	$X^2 = 33.69$
	Not aware	0	0.0	24	48.0	24	23.1	df = 1
	Total	54	100.0	50	100.0	104	100.0	$P < 0.05$, (S)
Row Planting	Aware	55	100.0	50	100.0	105	100.0	*
	Not aware	0	0.0	0	0.0	0	0.0	
	Total	55	100.0	50	100.0	105	100.0	

*Chi-square test not valid

6.4 Sources of Information and Awareness of IPM Practices

Table 6.16 reveals that farmers in the study area were made aware of the selected IPM practices mainly through agricultural extension agents and/or *Farmers' Field Schools* and other sources (mainly farmers' co-operative society, fellow farmers, relatives and friends).

With regards to use of neem seed extract as bio-pesticide, about sixty-one percent of the respondents who were aware indicated AEAs/FFS as the source, while about 39.0% indicated other sources; 73.1% of farmers who were aware of manure application indicated AEAs/FFS, while about 29% indicated other sources. With reference to mulching, about 79.0% and 21.0% of the awareness created were by AEAs/FFS and others respectively. Also, about 71.0%, 10.0% and 19.0% of the farmers reported AEAs/FFS, agricultural input sellers and others, respectively as the sources of awareness of improved seeds, while about 75.0% and 25.0% of the respondents indicated AEAs/FFS as sources of awareness of reduction of pesticide application respectively. In the case of scouting and row planting, about 75.0% and 25.0% of the respondents indicated AEAs/FFS and others as sources of awareness.

The above results tend to emphasize the importance of AEAs and *Farmers' Field Schools* in creating awareness and thus influencing agricultural extension communication. The findings also reveal the importance of cooperative society, friends, relatives and agricultural input sellers, as relay mechanisms for disseminating farm information since about 25.0% of the respondents indicated this cohort as source of farm information. The issue of the credibility of AEAs and *Farmers' Field Schools* as sources of awareness is very crucial. This is by virtue of the fact that about 75.0% of the respondents indicated these two main sources in the study area. Loss of credibility in AEAs/FFS could therefore adversely affect adoption.

Table 6.16 Sources of Information and Awareness of IPM Practices

Practices	Information sources	Awareness	
		Freq	%
Neem Extract	AEAs/FFS	62	61.4
	Others	39	38.6
	Total	101	100.0
Manure Application	AEAs/FFS	76	73.1
	Others	28	26.9
	Total	104	100.0
Mulching	AEAs/FFS	73	79.3
	Others	19	20.7
	Total	92	100.0
Planting Improved Seeds	AEAs/FFS	70	70.7
	Input sellers	10	10.1
	Others	19	19.2
	Total	99	100.0
Pesticide Reduction	AEAs/FFS	76	75.2
	Others	25	24.8
	Total	101	100.0
Scouting	AEAs/FFS	60	75.0
	Others	20	25.0
	Total	80	100.0
Row Planting	AEAs/FFS	77	75.0
	Others	26	25.0
	Total	104	100.0

6.5 Communication Strategies and Awareness Creation of IPM Practices

Communication strategies are very important in creating awareness. People can be made aware of the existence of practices through several methods. These include: reading, hearing, seeing and discussion, among others. Based on the number of people reached and the nature of media, extension methods can be grouped into individual, group and mass methods.

Since awareness is the first stage of the adoption process, the method or combination of methods is very crucial in stimulating mental and physical activity that produce the desire to learn. This section therefore examines the methods used in creating awareness of the IPM practices.

Table 6.17 reveals that individual and group methods were used in creating awareness of the selected IPM practices. Higher percentage of the respondents who indicated that they were aware of the IPM practices indicated group method or through *Farmers' Field School*, while lower percentage indicated individual method. Group and individual methods are therefore important in creating awareness in the study area. However, it should be noted that no single method is better than the other in creating awareness. The choice of a method may therefore depend on the situation and the facilities available. For instance, mass methods are particularly useful in making large numbers of people aware of new ideas and practices or alerting them to sudden emergencies. They serve as an important and valuable function in stimulating farmer interest in new ideas (Maunder, 1973).

Table 6.17 Extension Methods and Awareness of IPM Practices

Practices	Extension Method	Awareness	
		Freq	%
Neem Extract	Individual Method	39	38.6
	Group Method	62	61.4
	Total	101	100.0
Manure Application	Individual Method	39	34.9
	Group Method	67	65.1
	Total	103	100.0
Mulching	Individual Method	21	27.3
	Group Method	56	72.7
	Total	77	100.0
Planting Improved Seeds	Individual Method	39	39.4
	Group Method	60	60.6
	Total	99	100.0
Pesticide Reduction	Individual Method	28	27.5
	Group Method	74	72.5
	Total	102	100.0
Scouting	Individual Method	20	25.0
	Group Method	60	75.0
	Total	80	100.0
Row Planting	Individual Method	26	25.0
	Group Method	78	75.0
	Total	104	100.0

Table 6.18 shows the relationship between information sources and extension methods used in disseminating the selected IPM practices in the study area. The relationship between source of information and extension method used is statistically significant. With regard to manure application, mulching, improved seeds, pesticide reduction, scouting and row planting, the significance is due to the fact that a higher than expected respondents who indicated individual methods mentioned other sources (such as farmers' co-operative society, friends and relatives), while fewer than expected respondents who indicated group method mentioned AEAs/FFS as sources. In the case of neem extract, the significance is due to the fact that a higher than expected respondents indicated that group method was employed by AEAs/FFS. A significant relationship exists between source of information of the selected IPM practices and extension methods.

Table 6.18 Sources of Information and Extension Methods

Practices	Source of Information	Extension Method				Total		X^2 Results
		Individual Method		Group Method				
		Freq	%	Freq	%	Freq	%	$X^2 = 102.0$
Use of Neem Seed Extract	AEAs/FFS	0	0.0	40	100.0	40	39.2	df=1
	Others	62	100.0	0	0.0	62	60.8	$P < 0.05$ (S)
	Total	62	100.0	40	100.0	102	100.0	
Manure Application	AEAs/FFS	9	25.0	67	100.0	76	73.8	$X^2 = 68.1$
	Others	27	75.0	0	0.0	27	26.2	df= 1 ,
	Total	36	100.0	67	100.0	103	100.0	$P < 0.05$ (S)
Mulching	AEAs/FFS	2	10.0	58	100.0	60	76.9	$X^2 = 67.9$
	Others	18	90.0	0	0.0	18	23.1	df= 1 ,
	Total	20	100.0	58	100.0	78	100.0	$P < 0.05$ (S)
Planting Improved Seeds	AEAs/FFS	10	25.6	60	100.0	70	70.7	$X^2 = 63.1$
	Input sellers	10	25.6	0	0.0	10	10.1	df= 2 ,
	Others	19	48.8	0	0.0	19	19.2	$P < 0.05$ (S)
	Total	39	100.0	60	100.0	99	100.0	
Pesticide Reduction	AEAs/FFS	3	10.7	73	10 0.0	76	75.2	$X^2 = 86.6$
	Others	25	89.3	0	0.0	25	24.8	df= 1 ,
	Total	28	100.0	73	100.0	101	100.0	$P < 0.05$ (S)
Scouting	AEAs/FFS	1	5.0	60	98.4	61	75.3	$X^2 = 70.6$
	Others	19	95.0	1	1.6	20	24.7	df= 1 ,
	Total	20	100.0	61	100.0	81	100.0	$P < 0.05$ (S)
Row Planting	AEAs/FFS	0	0.0	78	100.0	78	75.0	$X^2 = 104.0$
	Others	26	100.0	0	0.0	26	25.0	df= 1 ,
	Total	26	100.0	78	100.0	104	100.0	$P < 0.05$ (S)

6.6 Constraints to effective extension delivery in the study area

Training of Trainers programmes in IPM are very essential in promoting IPM. This is because only one extension agent in the study area had been trained in IPM. TOT courses are very essential in equipping AEAs with communication skills. This will help them to adapt their teaching methods to farmers' personal and socio-economic situation in order to provide an opportunity for farmers to learn and to stimulate mental and physical activity that will produce the desire to learn. AEAs in the area also indicated the lack of teaching aids as a major constraint to their performance. Availability of teaching aids like audio-visuals will help extension agent overcome the barrier of low educational level of the farmers in the area.

6.7 Conclusion

Sources of IPM practices include: AEAs/FFS, agricultural input sellers, co-operative society, other farmers, friends and relatives. This finding is supported by Stavis (1979) who indicated that farmers get information from friends, relatives, skilled local farmers, merchants and salesman. He called this information network a 'spontaneous extension system' and was quick to say that efforts should be made to find how formal extension could make a crucial initial input and take advantage of the 'spontaneous extension system'.

The study also revealed that individual method (namely farm and home visits by AEAs) and group methods (namely result and method demonstrations, and Participatory Action Research-FFS methodology) were the two main communication strategies used in the dissemination of IPM practices in the study area. Mass media were not used. Farmer-to-farmer contact also played an important role in the dissemination of the IPM practices.

This section has confirmed that the FFS farmers received IPM messages mainly through group methods, especially, through Participatory Action Research (PAR). On the other hand, apart from messages on row planting and mulching, the communication of IPM messages for NFFS farmers have been mainly through individual methods. It is likely that since the sources of IPM messages differ for the two groups of farmers significantly, the extension methods used in the communication of messages is directly related to the sources of the message.

Awareness is the first stage of the adoption process. Awareness of the IPM practices was generally high. However, there was a significant difference in level of awareness between FFS and NFFS farmers with respect to scouting and mulching, with higher level of awareness among the FFS category.

The findings also reveal that AEAs/FFSs have made a major contribution in creating awareness of IPM than the other sources of information. Also, group methods play a very important role in creating awareness more than individual methods in the study area. There is therefore the need to organise more programmes for farmers through group methods like *Farmers' Field Schools* which uses Participatory Action Research. To enhance AEAs' performance, they should be provided with the requisite training, logistics and teaching aids.

CHAPTER SEVEN

ADOPTION OF INTEGRATED PEST MANAGEMENT

7.0 Introduction

This chapter describes the adoption of the selected IPM practices in the study area. In doing this, the extent of adoption of each of the practices as well as the overall adoption pattern of the selected component technologies were established. The selected practices are: preparation and application of neem extract, manure application, mulching, planting improved seed, pesticide reduction, scouting and row planting. In addition, it examines the relationships between communication strategies (methods); personal and socio-economic characteristics of farmers and extent of adoption of these selected IPM practices. It further examines reasons for non-adoption of the selected IPM practices.

7.1 Adoption of the Selected IPM Practices

The choice of pest management techniques may be a function of costs (purchased inputs, other variable costs such as labour and fixed costs such as sprayers) and returns (such as labour-saving, prevention of crop loss in monetary or subsistence terms as well as information. (Lutz *et al,* 1998).

According to Waibel, *et al,* (1999), adoption studies on IPM require a more subtle approach than that which has commonly been applied in studies of technology adoption. They argue that IPM is not simply a single decision rule, but rather a set of inter-linked concepts. Rather than measure IPM adoption as, for example, a binary variable (adopt/non-adopt) with a fixed effect on input demand and/ or production efficiency, they rightly view IPM knowledge as a dynamic continuum, implying a more complex relationship between knowledge acquisition and farmer practice.

Consistent with the above thinking, to establish the extent of adoption of the selected practices, the following criteria were used which address the complex relationship involved in adoption:

1.Any farmer who had incorporated any of the selected basket of IPM practices into his/her farming operation was designated an adopter of that practice.

2.Any farmer who had not adopted any of the IPM practices at all was designated a non-adopter.

The practices considered as IPM components for the study are: use of neem seed extract as bio-pesticide, manure application, mulching, planting improved seeds, reduction of pesticide application, scouting and row planting.

7.1.1 Adoption of Neem Seed Extract

Table 7.1 shows the extent of adoption of neem seed extract as bio-pesticides by FFS and NFFS farmers. Markedly lower percentage of adopters are in the NFFS group, while markedly lower percentage of non-adopters are in the FFS group. This is further strengthened by the fact that statistical test shows a significant difference between the two categories of farmers with regards to the adoption of use of neem seed extract as bio-pesticide. The significance is due to the fact that a higher than expected non-adopters are NFFS farmers, while a fewer than expected non-adopters are FFS farmers. Together, these indicate that farmers who had participated in the farmers' field schools directly tend to have adopted the use of neem seed extract as bio-pesticide component of IPM more than the non-participants.

Table 7.1 Extent of Adoption of Neem Seed Extract

Extent of Adoption	Type of Farmer				Total	
	FFS		NFFS			
	Freq	%	Freq	%	Freq	%
Adoption	45	81.8	15	30.6	60	57.7
Non-Adoption	10	18.2	34	69.4	44	42.3
Total	55	100.0	49	100.0	104	100.0

$X^2 = 27.84$ df = 1, $P < 0.05$ (S)

This indicates that participation in the *Farmers Field Schools* has positive influences on adoption of neem seed extract in pest control in vegetable farming in the coastal plains/ Weija Irrigation Project in Ghana.

7.1.1.1 Reasons for Non-Adoption of Neem Seed Extract

Though farmers gave various reasons for adopting neem seed extract as a biological pesticide such as: cost effectiveness, effectiveness against insect pests and also the fact that neem seed extract has no harmful effect on human health and is biodegradable, it is however, of interest to know why some people did not adopt use of neem seed extract as bio-pesticide. Table 7.2 shows multiple reasons why some FFS and NFFS farmers did not adopt neem seed extract as bio-pesticide. These include perceptions that neem seed extract is not effective; its preparation is tedious and time wasting. Others include seasonal availability of neem seeds, and lack of knowledge/know-how (expressed by only NFFS farmers). An AEA who was trained in IPM indicated that neem leaves could as well be used to prepare the extract. Communicating this to farmers could solve the problem of seasonality of neem seed extract.

What is interesting is the difference in reasons for non-adoption given by the two groups of farmers. A significant proportion of non-adopting participants of *Farmers' Field School* compared to NFFS farmers did not adopt use of neem seed extract because they perceived the preparation of neem extract to be tedious and time consuming, and non-availability of neem seeds during certain seasons. This is in contrast with the non-participants of *Farmers' Field School* whose reasons for non-adoption is lack of knowledge and perception that neem seed extract is not effective. The deduction is that participation in *Farmers' Field Schools* enhances farmers' knowledge or awareness of the use of neem seed extract for pest control. However, concerns of tedious nature of preparation and time involved limit adoption. This raises two issues. The first is whether the process of preparation of neem seed extract could not be more efficient, or whether it would not be possible for village/community level preparation of extracts with more stable shelf life. This could address the seasonal availability problem.

Table 7.2 Multiple Reasons for Non-Adoption of Neem Seed Extract

Non-Adoption Of Neem Seed Extract	Type of Farmer					
	FFS		NFFS		Total	
	N=10	%	N=34	%	N=44	%
Extract Preparation is Tedious/Time Wasting	9	90.0	18	52.9	27	61.4
Not Effective	5	50.0	30	88.2	35	79.5
Seasonality of Neem Seeds	3	33.3	0	0.0	3	6.8
Lack of Insight/Knowledge	0	0.0	32	94.1	32	72.2

7.1.2 Adoption of Manure Application

The extent of adoption of Manure application as indicated by farmers is shown in Table 7.3. About 92.0% of the sampled farmers had adopted, while about 8.0% had not adopted at all. Statistical test shows that the difference between the two categories of farmers is not significant.

Table 7.3 Extent of adoption of manure application

Extent of Adoption	Type of Farmer				Total	
	FFS		NFFS			
	Freq	%	Freq	%	Freq	%
Adoption	50	92.6	46	92.0	96	92.3
Non-Adoption	4	7.4	4	8.0	8	7.7
Total	54	100.0	50	100.0	104	100.0

$X^2 = 0.01$ df = 1, $0.1 < P < 1$ (NS)

This implies that participation in the *Farmers Field School* has not influenced adoption of manure application. Both groups of farmers have largely adopted the application of manure. This is likely to be due to the fact that use of manure has been an important part of backyard farming and vegetable cultivation in Ghana.

7.1.2.1 Reasons for Non-Adoption of Manure Application

Reasons given by the large population of FFS and NFFS farmers for adopting manure application include: cost effectiveness and improvement of soil conditions. However, reasons given by small number of non-adopting FFS and NFFS farmers include: not effective in fertilising the soil, high cost of transport due to the bulkiness of manure, and also scarcity. The transportation cost associated with the use of manure requires alternatives, which enhances soil fertility but requires less transportation. One such alternative is the use of green manure.

7.1.3 Adoption of Mulching

The extent of adoption of Mulching as indicated by farmers is shown in Table 7.4. About 12.0% of the sampled respondents had adopted, while about 88.0% had not adopted at all.

Table 7.4 Extent of Adoption of Mulching

Extent of Adoption	Type of Farmer				Total	
	FFS		NFFS			
	Freq	%	Freq	%	Freq	%
Adoption	7	12.7	5	10.6	12	11.8
Non-Adoption	48	87.3	42	89.4	90	88.2
Total	55	100.0	47	100.0	102	100.0

$X^2 = 0.11$ df = 1, $0.7<P<0.8$ (NS)

Statistical test shows that the difference between the two categories of farmers is not significant. This indicates that there is a low level of adoption of mulching as part of the IPM practices, by both participants and non-participants of the *Farmers' Field Schools*. This raises issues as to why the levels of adoption of mulching.

7.1.3.1 Reasons for Non-Adoption of Mulching

Reasons given by the few adopters among both FFS and NFFS farmers for adopting mulching include: weed control, maintenance of soil moisture and prevention of leaching. It is also believed to provide habitat for natural enemies.

On the other hand, reasons given by both non-adopting FFS and NFFS farmers for not adopting mulching include: time wasting; tediousness/high cost of labour; scarce materials for mulching and also the perception that mulches 'harbour insect pests' (Table 7.5).

Table 7.5 Multiple Reasons for Non-Adoption of Mulching

Non-Adoption of Mulching	Type of Farmer					
	FFS		NFFS		Total	
	n=48	%	n=42	%	n=90	%
Time Wasting	48	100.0	42	100.0	90	100.0
Tedious/High Cost of Labour	47	97.9	42	100.0	89	98.9
Scarce Materials	45	93.8	42	100.0	87	96.7
Harbour Insect Pests	3	6.3	1	2.4	4	4.4
Lack of Knowledge	0	0.0	35	83.3	35	38.9

The reasons for non-adoption of mulching is very interesting, considering that whilst about 83% of the NFFS farmers indicated lack of knowledge as the reasons for non-adoption, none of the FFS farmers indicated this. In other words, participation in farmers' field school greatly enhanced the farmers' knowledge of mulching as part of the IPM practices. However, even where farmers are aware of mulching, factors such as additional time, labour and scarcity of mulching material were dominant factors influencing adoption.

7.1.4 Adoption of Improved Seed Varieties

Table 7.6 shows the extent of adoption of improved seed varieties as indicated by farmers. About 32.0% of the FFS farmers had adopted, while only 14.0% of the NFFS farmers had adopted it.

Table 7.6 Extent of Adoption of Improved Seed Varieties

Extent of Adoption	Type of farmer				Total	
	FFS		NFFS			
	Freq	%	Freq	%	Freq	%
Adoption	17	32.1	7	14.0	24	23.3
Non-adoption	36	67.9	43	86.0	79	76.7
Total	53	100.0	50	100.0	103	100.0

$X^2 = 4.7$ df = 1 , $P < 0.05$ (S)

The difference between the two categories of farmers is statistically significant. The significance is due to the fact that a higher than expected FFS farmers have adopted the planting of improved seeds, whilst fewer than expected adopters are NFFS farmers. Thus this confirms that farmers who participated in the farmers' field school tend to adopt the planting of improved seed varieties compared to the non-participants.

7.1.4.1 Reasons for Non-Adoption of Improved Seeds

Reasons given by both FFS and NFFS farmers for adopting improved seed varieties included: the high yielding, disease resistant and high germination percentage characteristics.

Reasons for not adopting improved seed varieties included: high cost of improved seeds; scarce to obtain; low germination percentage (Table 7.7). There was no differences between reasons given by the participants and non-participants in the *Farmers' Field School,* except for perceptions of low germination percentage in which a markedly higher percentage of non-participants indicated as reasons for non-adoption.

Table 7.7 Multiple Reasons for Non-Adoption of Improved Seed Varieties

Non-Adoption of Improved Seeds	Type of Farmer					
	FFS		NFFS		Total	
	n=36	%	n=43	%	n=79	%
Costly	33	91.7	43	100.0	76	96.2
Scarce to Obtain	10	27.8	15	34.9	25	31.6
Low Germination Percentage	2	5.6	10	23.3	12	15.2

Thus, high cost, availability and perceptions of viability of the seeds are critical determinants of adoption of improved seed varieties. The question of knowledge difference did not arise in this case.

7.1.5 Adoption of Reduction of Pesticide Use

The extent of adoption of reduction of pesticide use as indicated by farmers is shown in Table 7.8. All the participants in the *Farmers' Field School* have reduced their insecticide use, whilst about 82% of the non-participants have also reduced insecticide use. About 91.0% of the sampled farmers had adopted, while 9.0% had not adopted at all. Markedly higher percentage of adopters are FFS farmers, whilst markedly higher percentage of non-adopters are NFFS farmers.

Table 7.8 Extent of Adoption of Reduction of Pesticide Use

Extent of Adoption	Type of Farmer				Total	
	FFS		NFFS			
	Freq	%	Freq	%	Freq	%
Adoption	53	100.0	40	81.6	93	91.3
Non-Adoption	0	0.0	9	18.4	9	8.7
Total	53	100.0	49	100.0	102	100.0

*Chi-square test not valid.

Reasons given by farmers who had adopted the reduction of pesticide application include: danger to the health of farmers and consumers, as well as the environment (soil, water), and also high cost of pesticides.

Reasons for not adopting pesticide reduction was however, expressed by only NFFS farmers to the effect that pesticides are very effective against pests. Obviously, the basis of the difference is perception of use of pesticides, which can be attributed to inaccurate knowledge since over and over in various areas it has been shown that IPM is rather effective in pest control. This calls for more widespread use of Farmers' Field Schools as a strategy for agricultural technology application.

7.1.6 Adoption of Scouting

Scouting for pests, identification of organisms, and correct diagnosis of problems are very critical in pest management. This allows a farmer to avoid the expense of spraying when pests are present in insignificant numbers. The avoidance of 'calendar spraying' saves money and reduces the amount of pesticide use and its associated health and environmental problems.

The extent of adoption of scouting as indicated by farmers is shown in Table 7.9. Markedly higher percentage of adopters are FFS farmers, while markedly lower percentage of non-adopters are FFS farmers. This is further strengthened by the fact that statistical test shows a significant difference between the two categories of farmers with regard to the extent of adoption. The significance is due to the fact that a higher than expected FFS farmers are adopters of scouting, whilst fewer than expected adopters are in NFFS category.

Table 7.9 Extent of Adoption of Scouting

Extent of Adoption	Type of farmer				Total	
	FFS		NFFS			
	Freq	%	Freq	%	Freq	%
Adoption	32	62.7	2	4.3	34	37.7
Non-Adoption	19	37.3	45	95.7	64	65.3
Total	51	100.0	47	100.0	98	100.0

$X^2 = 36.93$ df = 1, $P < 0.05$ (S)

This suggests that more participants in the *Farmers' Field Schools* adopted scouting as a practice than non-participants. Scouting methods are knowledge-based. This might, therefore, have accounted for its low adoption by NFFS farmers since it is knowledge-based and require skills.

7.1.6.1 Reasons for Non-Adoption of Scouting

Reasons for not adopting scouting were given by both FFS farmers and NFFS farmers who had been introduced to this practice. These include: scouting is tedious/time wasting and also 'have no knowledge' as expressed by NFFS farmers only (Table 7.10).

Table 7.10 Multiple Reasons for Non-Adoption of Scouting

Non-Adoption of Row Scouting	Type of Farmer					
	FFS		NFFS		Total	
	n=19	%	n=45	%	n=64	%
Time Wasting /Tedious	19	100.0	2	4.4	21	32.8
Have No Knowledge	0	0.0	43	95.6	43	67.2

The reason for non-adoption of scouting is very interesting, considering that whilst about 96% of the NFFS farmers indicated lack of knowledge as the reason for non-adoption, none of the FFS farmers indicated this. In other words, participation in *Farmers' Field*

School greatly enhanced the farmers' knowledge of scouting as part of the IPM practices. However, even where farmers are aware of scouting, factors such as additional time/labour were dominant factors influencing adoption of this practice.

7.1.7 Adoption of Row Planting

The extent of adoption of row planting as indicated by farmers is shown in Table 7.11. About 83.0% of the sampled farmers had adopted row planting, while about 17.0% had not adopted at all. Statistical test shows that the difference between the two categories of farmers is not significant. This could be attributed to the fact that promotion of row planting has been in the study area for a long time.

Table 7.11 Extent of Adoption of Row Planting

Extent of Adoption	Type of farmer				Total	
	FFS		NFFS			
	Freq	%	Freq	%	Freq	%
Adoption	45	83.3	41	82.0	86	82.7
Non-Adoption	9	16.7	9	18.0	18	17.3
Total	54	100.0	50	100.0	104	100.0

$X^2 = 0.03$ df = 1, $0.8 < P < 0.9$ (NS)

7.1.7.1 Reasons for Non-Adoption of Row Planting

Reasons given by both FFS and NFFS farmers for adopting row planting were: increased plant/acre (i.e. plant density); easy weeding, easy harvesting; easy fertilizer application: free air circulation (ventilation); easy to replant. On the other hand, reasons given for not adopting row planting included: tediousness/time wasting and lack of labour. All the non-adopting FFS and NFFS farmers indicated that row planting is tedious/time wasting, while about 67% and about 89% of FFS and NFFS farmers respectively indicated lack of labour as the reason for not adopting row planting (Table 7.12).

Table 7.12 Multiple Reasons for Non-Adoption of Row Planting

Non-Adoption of Row Planting	Type of Farmer					
	FFS		NFFS		Total	
	n=9	%	n=9	%	n=18	%
Time Wasting /Tedious	9	100.0	2	4.4	21	32.8.
Lack of Labour	6	66.7	43	95.6	43	67.2

Clearly, lack of knowledge about row planting is not an issue in non-adoption. This is because it is one of those technologies which have been around for a long time in Ghana. Concerns with row planting, rather, are to do with other characteristics.

7.2 Communication Strategies and Adoption of Selected IPM Practices

In this section, we examine the relationship between communication strategies and adoption of IPM package. The communication method or combination of methods has far reaching effects on the goal of extension work. There is evidence that whenever innovation information is adequately communicated, there are high levels of adoption of those innovations which translate into high levels of development (Rao, 1966).

MacDonald and Hearle (1984:34) identify different communication strategies/methods that can be used in development work. These include individual methods, by working with groups and through the mass media. This formed the basis of classification of communication methods. The communication methods used in the *Farmers' Field School* is mainly group work with a Participatory Action Research framework. However, in certain cases, individual methods are used.

7.2.1 Extension Method and Adoption of Neem Seed Extract

The extent to which the type of extension methods is related to adoption of neem seed extract as bio-pesticide is shown in Table 7.13. Markedly higher percentage of the non-adopters of neem seed extract indicated individual method, whilst markedly lower percentage of the adopters indicated the same. Also, markedly lower percentage of non-adopters of neem extract indicated group contact/PAR. The relationship between extension method used and adoption of neem seed extract is statistically significant. The significance is due to the fact that higher than expected non-adopters indicated individual method, whilst a fewer than expected adopters indicated the same.

Table 7.13 Extension Method and Adoption of Neem Seed Extract.

Extent of Adoption	Extension Method				Total	
	Individual Contact		Group Contact/PAR			
	Freq	%	Freq	%	Freq	%
Adoption	12	20.0	48	80.0	60	100.0
Non-Adoption	27	65.9	14	34.1	41	100.0
Total	39	38.6	62	61.4	101	100.0

$X^2 = 21.60$, df = 1, $P < 0.05$ (S)

This implies that group contact/PAR is very important in enhancing the adoption of neem seed extract more than individual methods.

7.2.2 Extension Method and Adoption of Manure Application

The result of extension method and adoption of manure application is shown in Table 7.14. About 35% of the adopters of manure application indicated individual method, while 43% of the non-adopters indicated the same. On the other hand, about 65% of the adopters indicated group method/PAR, while about 57% of the non-adopters indicated the same. This suggests that group method/PAR enhances adoption of manure application more than individual methods.

Table 7.14 Extension Method and Adoption of Manure Application

Extent of Adoption	Extension Method				Total	
	Individual Contact		Group Contact/PAR			
	Freq	%	Freq	%	Freq	%
Adoption	33	34.7	62	65.3	95	100.0
Non-Adoption	3	42.9	4	57.1	7	100.0
Total	36	35.3	66	64.7	102	100.0

Chi-square test not valid

7.2.3 Extension Method and Adoption of Mulching

Table 7.15 shows the result of Extension method and adoption of mulching. About 36.0% of the adopters of mulching indicated individual method, while about 23.0% of the non-adopters indicated the same. Also, about 64.0% of the adopters indicated group method, while about 77.0% indicated the same. The relationship between extension method and adoption of mulching is not statistically significant as indicated by the chi-square value.

Table 7.15 Extension Method and Adoption of Mulching

Extent of Adoption	Extension Method				Total	
	Individual Contact		Group Contact/PAR			
	Freq	%	Freq	%	Freq	%
Adoption	4	36.4	7	63.6	11	100.0
Non-Adoption	15	22.7	51	77.3	66	100.0
Total	19	24.7	58	75.3	77	100.0

$X^2 = 0.94$ df = 1, $0.3 < P < 0.4$ (NS)

7.2.4 Extension Method and Adoption of Improved Seed Varieties

Table 7.16 displays the result of Extension method and adoption of improved seed varieties (certified seeds). About 44% of the adopters indicated individual method, while about 38% of the non-adopters indicated the same. Also, about 57% of the adopters indicated group contact/PAR, while about 62% of the non-adopters indicated the same.

Table 7.16 Extension Method and Adoption of Improved Seed Varieties

Extent of Adoption	Extension Method				Total	
	Individual Contact		Group Contact/PAR			
	Freq	%	Freq	%	Freq	%
Adoption	10	43.5	13	56.5	23	100.0
Non-Adoption	28	37.8	46	62.2	74	100.0
Total	38	39.2	59	60.8	97	100.0

$X^2 = 0.23$ df = 1 $0.6 < P < 0.7$ (NS)

The relationship between extension method and adoption of improved seeds is not statistically significant as indicated by the chi-square value.

7.2.5 Extension Method and Adoption of Pesticide Reduction

Table 7.17 displays the result of extension method and adoption of Reduction of pesticide use. Markedly lower percentage of the non-adopters of this practice indicated group contact/PAR.

Table 7.17 Extension Method and Adoption of Pesticide Reduction

Extent of Adoption	Extension Method				Total	
	Individual Contact		Group Contact/PAR			
	Freq	%	Freq	%	Freq	%
Adoption	23	25.3	68	74.7	91	100.0
Non-Adoption	4	50.0	4	50.0	8	100.0
Total	27	27.3	72	72.7	99	100.0

$X^2 = 2.27$, df = 1, $0.1 < P < 0.2$ (NS)

The chi-square value indicates that there is no significant relationship between extension method and adoption of pesticide reduction.

7.2.6 Extension Method and Adoption of Scouting

Table 7.18 displays the result of extension method and adoption of scouting. Markedly lower percentage of the adopters of scouting indicated individual method. In addition, markedly higher percentage of the adopters indicated group contact/PAR, while markedly lower percentage of the non-adopters indicated group method.

Table 7.18 Extension Method and Adoption of Scouting

Extent of Adoption	Extension Method				Total	
	Individual Contact		Group Contact/PAR			
	Freq	%	Freq	%	Freq	%
Adoption	0	0.0	34	100.0	34	100.0
Non-Adoption	20	46.5	23	53.5	43	100.0
Total	20	26.0	57	74.0	77	100.0

$X^2 = 21.36$, df = 1, $P < 0.05$ (S)

The relationship between extension method and adoption of Scouting is statistically significant. The significance is due to the fact that a higher than expected non-adopters of scouting indicated individual method, whilst a fewer than expected adopters indicated the same.

7.2.7 Extension Method and Adoption of Row Planting

Table 7.19 displays the result of Extension method and adoption of Row planting. About 23.0% of the adopters indicated individual method, whilst about 33.0% of the non-adopters indicated the same. Also, about 76.0% of the adopters indicated group method/PAR, whilst about 67.0% of the non-adopters indicated the same.

Table 7.19 Extension Method and Adoption of Row Planting

Extent of Adoption	Extension Method				Total	
	Individual Contact		Group Contact/PAR			
	Freq	%	Freq	%	Freq	%
Adoption	20	23.5	65	76.5	85	100.0
Non-Adoption	6	33.3	12	66.7	18	100.0
Total	26	25.2	77	74.8	103	100.0

$X^2 = 0.76$, df = 1, $0.3 < P < 0.4$ (NS)

The relationship between extension method and adoption of row planting is not statistically significant as indicated by the chi-square value. The reason that could be assigned to this is that availability of labour is an important factor in adopting this practice.

7.3 Overall Adoption Pattern of IPM in the Study Area

To establish the overall adoption pattern of the seven IPM practices, the following criteria were used:

1. Any farmer who had not adopted any of the practices was designated a non-adopter.
2. Any farmer who had adopted from one to four of the practices was designated a low adopter.
3. Any farmer who had adopted from five to seven of the practices was designated a high adopter.

Table 7.20 shows the overall adoption pattern of the IPM practices. The overall adoption pattern shows that markedly lower percentage of the high adopters are NFFS farmers. This is further strengthened by the fact that statistical test shows a significant difference between the two categories of farmers with regard to the overall adoption pattern. The significance is due to the fact that a higher than expected high adopters are FFS farmers, whilst a fewer than expected adopters are NFFS farmers.

Table 7.20 Overall Adoption of IPM

Adopter Category	Type of Farmer				Total	
	FFS		NFFS			
	Freq	%	Freq	%	Freq	%
High Adopters	31	56.4	3	6.0	34	32.4
Low Adopters	24	43.6	47	94.0	71	67.6
Total	55	100.0	50	100.0	105	100.0

$X^2 = 5.2$, df = 1, $P < 0.05$ (S)

Together, this confirms that farmers who had participated in the *Farmers' Field School* tended to adopt IPM more than those who had not participated in *Farmer Field School.* Farmer field school is therefore a very important methodology for enhancing the adoption of IPM.

7.4 Characteristics of Farmers and Adoption of IPM Practices

In communication-adoption studies, it is usual to investigate the characteristics of respondents in order to understand their relative influence in the adoption behaviours.

Table 7.21shows the distribution of age and overall adoption. About 41% of the high adopters were young, while about 48% were low adopters; about 44% of the high adopters were middle aged, while about 42% were low adopters. Also, about 15% of the high adopters were old, while about 10% were low adopters. The relationship between age and adoption is not statistically significant.

Table 7.21 Age and Overall Adoption Pattern

Overall Adoption Pattern	Age (years)						Total	
	15-34.5 (young)		35-54.5 (middle aged)		55+ (old)			
	Freq	%	Freq	%	Freq	%	Freq	%
High Adoption	14	41.2	15	44.1	5	14.7	34	100.0
Low Adoption	34	47.9	30	42.3	7	9.9	71	100.0
Total	48	45.7	45	42.9	12	11.4	105	100.0

X^2 =0.72, df = 2, 0.6<P < 0.7 (NS)

Though elderly farmers generally seem to be somewhat less inclined to adopt new farm practices than younger ones, there was no significant difference between age and overall adoption pattern. This finding is supported by Rogers (1995), who stated that there is inconsistent evidence about the relationship between age and innovativeness (adoption).

Table 7.22 shows the distribution of gender and overall adoption. About 35% of the high adopters are males, while 20% are females; also about 65% of the low adopters are males, while 80% are females.

Table 7.22 Gender and Overall Adoption Pattern

Overall Adoption Pattern	Gender				Total	
	Male		Female			
	Freq	%	Freq	%	Freq	%
High Adoption	30	35.3	4	20.0	34	32.4
Low Adoption	55	64.7	16	80.0	71	67.6
Total	85	100.0	20	100.0	105	100.0

X^2 =1.73 df = 1, 0.1<P < 0.720 (NS)

There is no difference between gender and overall adoption pattern. This indicates that gender is not a dominant factor in the overall adoption pattern in the study area.

Table 7.23 shows the distribution of source of farm labour and overall adoption pattern. With respect to the high adopters, about 23% indicated own/family labour, while about 35% indicated the same. Also, about 77% of the low adopters indicated hired some/all labour, while about 65% of the low adopters indicated the same.

Table 7.23 Source of Farm Labour and Overall Adoption

Overall Adoption Pattern	Source of Farm Labour				Total	
	Own/Family Labour		Hired Some/All Labour			
	Freq	%	Freq	%	Freq	%
High Adoption	6	23.1	28	35.4	34	32.4
Low Adoption	20	76.9	51	64.6	71	67.6
Total	26	100.0	79	100.0	105	100.0

X^2 =1.37, df = 1, 0.2<P < 0.4 (NS)

There is no significant difference between source of farm labour and overall adoption pattern. This indicates that, though labour is an important factor in studies of adoption of IPM, it was not the dominant factor in the overall adoption pattern in the study area.

7.5 Conclusion

The results of the chi-square analysis of the adoption rates for the *Farmers' Field School* participants and the *non-Farmers' Field School* participants reveal that a statistically significant difference exists between the two categories of farmers with respect to adoption of neem seed extract, improved seed varieties and scouting. FFS farmers showed a higher level of adoption than NFFS farmers. This is confirmed by the overall adoption pattern of the IPM package, where FFS farmers showed a significantly higher level of adoption than the NFFS farmers. In the case of adoption of neem seed extract and improved seeds, the significance is de to the fact that a higher than expected non-adopters are NFFS farmers, while fewer than expected non-adopters are FFS farmers.

With scouting, the significance is due to the fact that a higher than expected FFS farmers are adopters, whilst fewer than expected adopters are in the NFFS category. However, no significant difference exists between the two categories of farmers with respect to the adoption of manure application, mulching and row planting.

In spite of the demonstrated advantages of the selected IPM practices, various factors accounted for the non-adoption of some of them. These include: tediousness of some of the practices, lack of labour, ineffectiveness of some of the practices, seasonality (need seeds), cost, scarcity of certain inputs and lack of knowledge (expressed only by non-adopting NFFS farmers). This indicates that participation in *Farmers' Field Schools* greatly enhances farmers' knowledge of IPM practices such as the preparation and application of need seed extract, mulching and scouting.

Table 7.24 gives a summary of the extent of adoption of the selected IPM practices, various reasons for their non-adoption and their implications.

Table 7.24 Extent of Adoption, Reasons for Non-Adoption and Implications

IPM Practices	Extent of Adoption			Reasons for Non-Adoption	Implications
	FFS	NFFS	Significance		
Neem as Bio-Pesticide	H	L	S	FFS:-tedious/time wasting; seasonal seed availability. NFFS:-Lack of knowledge; ineffective	➢ Less tedious, machined, village/community level preparation of an extract with more stable shelf life. ➢ *Farmers' Field School* is an effective way to introduce innovations to farmers.
Manure Application	H	H	NS	FFS & NFFS:-High transportation cost :bulkiness: scarcity	-Alternative-compost, -in situ green manure
Mulching	L	L	NS	FFS & NFFS:-time wasting, tedious, high cost, scarcity NFFS:-Lack of knowledge	➢ Less time wasting and tedious methods should be developed ➢ Farmers' Field Schools enhance farmers' knowledge
Improved Seeds	H	L	S	FFS:- costly; scarce NFFS:- costly; scarce; low % germination	➢ Improved seeds should be made more affordable and available ➢ Improve quality of certified seeds for right perceptions of farmers ➢ Farmers need more insight into proper ways of extracting seeds themselves
Reduction Of Pesticide Use	H (All)	L	*	NFFS:- Normal pesticides are more effective	➢ NFFS farmers need to participate in *Farmers' Field Schools* to know effective methods of reducing the use of pesticides. ➢ *Farmers' Field Schools* is an effective way to train farmers to reduce pesticide use.
Scouting	H	L	S	FFS :Time wasting/tedious NFFS: Lack of knowledge	➢ *Farmers' Field Schools* expose farmers to practical aspects of training and enhance farmers' knowledge
Row Planting	L	L	NS	FFS & NFFS: tedious/ time wasting	➢ Hired labour to compliment family labour to increase adoption

*chi-square test not valid H=High adoption L= Low adoption

Given that factors such as availability and affordability of inputs are favourable, FFS farmers are more likely to demonstrate a very high level of adoption rate than NFFS farmers since most of the reasons given for non-adoption had to do with lack of factors like labour and other inputs, but not with the practices themselves. This is by virtue of the fact that Participatory Action Research (PAR) – the methodology employed at the *Farmers Field School,* improves farmers' understanding of the values of the recommended IPM components.

The findings also reveal that significant relationship exists between communication strategies and adoption of neem seed extract and scouting. Use of group method/PAR as an IPM extension methodology therefore results in higher adoption of these practices in the study area. However, with regard to mulching, improved seeds, pesticide reduction and row planting, no significant difference exists. This implies that though, communication strategies (methods) have far-reaching effects on adoption, according to Lutz *et al*, (1998), adoption of innovations is a function of other factors such as cost and returns.

Also from the study, farmers' personal and socio-economic characteristics such as age, gender and source of labour did not have a significant relationship with the overall adoption pattern.

CHAPTER EIGHT

IMPACT OF IPM INTERVENTION

8.0 Introduction

IPM intervention is expected to produce economic and non-economic benefits that accrue to farm households and the wider society. These include: cheaper and safer food, improved environmental quality and savings in foreign exchange. Also natural regulating mechanisms will be strengthened resulting in less soil and water pollution by toxic substances. The following possible impacts of IPM projects have also been identified: improved economic well-being; improved knowledge and analytical capacity; diffusion of knowledge farmer-to-farmer; decreased health risk; and healthier ecosystem as result of improved understanding of the ecosystem. Further, a successful IPM intervention is expected to induce a process that will not only lead to better crop management decision-making but also stimulate a discovery process, strengthens the build-up of institutional capacities at village level and intensifies interaction. In effect, the grouping of Farmers in field schools offers additional opportunities for farming communities to address, as powerful groups, development issues that will lead to reduction in poverty.

At the household level, economic benefits for example are: savings on pesticide purchase, increased yield, more stable income, increased business opportunities and improved health status. Among the non-market benefits which nevertheless can be of economic relevance to individual decision-makers but which are not directly measured in terms of farm profit are: increased understanding of the agro-ecosystem and increased self-confidence. In addition, the national economy will be less dependent on imports (food, crop protection agents) accompanied by corresponding hard currency savings (SDC, 1994; Waibel *et al.*, 1999).

Against this background, this chapter examines the impact of IPM interventions in the study area. The areas that are examined include: the impact of IPM intervention on crop diversity, yields, farm size, pest/disease incidence, income stability, business opportunity and labour requirement.

8.1 Impact of IPM Intervention in the Study Area

Farmers were asked to indicate the changes they had observed since the introduction of IPM to the study area. The indicators of change employed for the study include: diversity of crops grown, yields of crops, farm size, incidence of pests and diseases, income stability, business opportunity and demand for labour. The impact of IPM programmes as perceived by farmers in the study area is shown in Table 8.1

Table 8.1 Impact of IPM Interventions

Indicators	Changes Observed	Type of Farmer				Total		X^2 Results
		FFS		NFFS				
		Freq	%	Freq	%	Freq	%	
Crop Diversity	Increased	29	54.7	13	27.1	42	41.6	$X^2 = 7.92$
	No Change	24	45.3	35	72.9	59	58.4	df = 1,
	Total	53	100.0	48	100.0	101	100.0	$P > 0.05$ (S)
Yields	Increased	49	96.1	28	56.0	77	76.2	$X^2 = 22.39$
	No Change	2	3.9	22	44.0	24	23.8	df = 1,
	Total	51	100.0	50	100.0	101	100.0	$P > 0.05$ (S)
Farm Size	Increased	9	16.4	5	10.0	14	13.3	$X^2 = 0.92$
	No Change	46	83.6	45	90.0	91	86.7	df = 1,
	Total	55	100.0	50	100.0	105	100.0	$0.3<P < 0.4$ (NS)
Pest/Disease Incidence	Increased	2	3.7	9	18.4	11	10.7	$X^2 = 5.79$
	No Change	52	96.3	40	81.6	92	81.3	df = 1,
	Total	54	100.0	49	100.0	103	100.0	$P > 0.05$ (S)
Income Stability	Increased	39	84.8	28	71.8	67	78.8	$X^2 = 1.95$
	No Change	7	15.2	11	28.2	18	21.2	df = 1,
	Total	46	100.0	39	100.0	85	100.0	$0.1<P < 0.2$ (NS)
Business Opportunity Resulting from Improved Quality	Increase	19	57.6	13	54.2	32	56.1	$X^2 = 0.07$
	No Change	14	42.4	11	45.8	25	43.9	df = 1,
	Total	33	100.0	24	100.0	57	100.0	$0.2<P < 0.3$ (NS)
Labour Requirement	Increased	28	56.0	13	27.7	41	42.3	$X^2 = 7.97$
	No Change	22	44.0	34	72.3	56	57.7	df = 1,
	Total	50	100.0	47	100.0	97	100.0	$P > 0.05$ (S)

8.1.1 Crop Diversity

A basic understanding of the agro-ecological system and informed decision by farmers could enable them to spread IPM principles (such as crop rotation, traditional crop management methods, sound nutrition) to other crops. This is because IPM requires farmers to be more observant and more analytical, and to be able to adopt measures suitable to their needs in each situation.

Farmers' responses regarding changes in their farming enterprises resulting from IPM intervention with respect to crop diversity is shown in Table 8.1. About 55% of the FFS farmers indicated an increase in crop diversity, while about5 27% of the NFFS farmers indicated the same. On the other hand, about 45% of the FFS farmers indicated no change in crop diversity, while about 8% of the NFFS farmers indicated the same.

The relationship between type of farmer and crop diversity is statistically significant. The significance is due to the fact that higher than expected FFS farmers indicated an increase in crop diversity, while fewer than expected NFFS farmers indicated the same. This finding is supported by Afreh-Nuamah (1999), who stated that high pest damage from a variety of pests and lack of appropriate knowledge and skills in pest and crop management at Weija caused farmers to abandon, for example, cabbage production for several years. Some farmers, however, resumed cabbage production after the introduction of IPM.

8.1.2 Yields of Vegetables

Increased yield is one of the economic benefits of an IPM project. Improved yield, as indicated by farmers, derived from effective control of pests and diseases, sound plant nutrition, use of improved crop varieties, reduced incidence of pests and diseases, use of appropriate pesticides and neem seed extract as bio-pesticides. The relationship between type of farmer and change in yields of vegetables grown in the area is shown in Table 8.1. About 96% of FFS farmers indicated an increase in yield, while 56% of NFFS farmers indicated the same. On the other hand, about 4% of FFS farmers indicated no change in yield, whole 44% of FFS farmers indicated the same.

The relationship between type of farmer and yields of crop is statistically significant. The significance is due to the fact that higher than expected NFFS farmers indicated no change in yield, while fewer than expected FFS farmers indicated the same. This is supported by SDC, (1994); Waibel *et al,* (1999) and Afreh-Nuamah, (1999) who indicated that adoption of IPM recommendations results in higher yields.

8.1.3 Farm Size

Adoption of improved farm practices produces economic benefits, which permit expansion of farm size. Table 8.1 reveals that about 13% of farmers in the area indicated an increase in farm size, while about 87% indicated no change in farm size. The relationship between the two categories of farmers with respect to change in farm size is not statistically significant. This could be attributed to the limited irrigable farmland in the area.

8.1.4 Incidence of Pests and Diseases

Pests (including weeds) and diseases affect crop yield, quality and appearance of the products and therefore the income of the farmer. Limited spraying with chemical pesticides encourages the proliferation of beneficial insects which then bring pests under control. Adopting certain cultural practices like rouging and destruction of diseased crops also minimizes the incidence of pests and diseases. The incidence of pests and diseases as indicated by respondents is indicated in Table 8.1. About 98% of FFS farmers indicated a decrease in the incidence of pests and diseases, while about 82% of the NFFS farmers indicated the same. On the other hand, about 2% of FFS farmers indicated an increase in pests and diseases, while about 18% of NFFS farmers indicated the same.

The relationship between the two categories of farmers with respect to change in incidence of pests and diseases is significant. The significance is due to the fact that a higher than expected FFS farmers indicated a decrease in incidence of pests and diseases, while fewer than expected NFFS farmers indicated the same. This finding is supported by Afreh-Nuamah (1999) that at *Farmers' Field Schools*, farmers learn about effective pests/disease control strategies. Decrease in the incidence of pests and diseases invariably increases farmers' income and hence improve their standard of living.

8.1.5 Business Opportunity and Stability of Income

Less damaged and quality vegetables as a result of effective control of pests and diseases make the vegetables produced more attractive and marketable. Also, there are savings on money which other wise would have been spent on agrochemicals like fertilizers and chemical pesticides.

The state of business opportunity and stability of income of farmers are as shown in Table 8.1. Markedly lower percentage of NFFS farmers indicated an increase in income. The relationship between income stability and type of farmer is not statistically significant.

On the issue of business opportunity, about 58% of FFS farmers indicated an increase in business opportunity, while about 54% of NFFS farmers indicated the same. Also, about 42% of FFS farmers indicated no change in business opportunity, while about 46% of NFFS farmers indicated the same. The relationship between change in business opportunity and type of farmer is not statistically significant. Fluctuating market prices in the study area seem to militate against income stability. This was confirmed by AEAs in the area. According to the AEAs, during a focus group discussion, some farmers in the area do not cultivate vegetables based on the cropping calendar in the hope of making more profit during lean seasons. In effect, grouping of farmers into strong functional associations would offer opportunities for farming communities to address the problem of fluctuating market prices.

8.1.6 Labour Requirement

Crop management practices are variable. In general, vegetable cultivation requires high inputs and is labour-intensive. The changes observed in labour requirement as indicated by farmers is shown in Table 8.1. About 56% of FFS farmers indicated an increase in labour requirement, while 28% of NFFS farmers indicated the same. On the other hand, about 44% of FFS farmers indicated no change in labour requirement, while about 72% of NFFS farmers indicated the same. The relationship between the two categories of farmers with respect to labour requirement is statistically significant. The significance is due the fact that a higher than expected FFS farmers indicated an increase in labour requirement, while fewer than expected NFFS farmers indicated the same. Introduction of more labour saving practices would therefore go a long way to solving farmers' labour problem.

8.1.7 Health Status

Health hazards are associated with the transport, storage, use and disposal of pesticides. Added to these are health hazards resulting from pesticide residues in foods sent to markets and the fact that some pesticides are environmentally persistent and acutely toxic. Use of neem seed extract, safer spraying techniques, the use of appropriate spraying equipment and timely spraying, are among the causes of improved health status as indicated by farmers. Efficient and effective spraying techniques taking the necessary precautionary measures like the use of masks and gloves, educating farmers no' to eat or sell vegetables, which have been freshly sprayed with pesticides, are some of the positive impacts of IPM intervention.

8.1.8 Development of Functionary Groups

According to Afreh-Nuamah, (1999), through participation in the *Field Schools*, farmers quickly realise that the *Farmers' Field School* environment can be effectively used to address other community issues such as improved health status of the farming community due to drastically reduced pesticide poisoning and education for the youths. He added that a typical programme of an FFS session involves group dynamics, which aim to strengthen group cohesion among farmers. These exercises emphasise group processes that play an important role in the implementation of local IPM programmes in the field such as team building, cooperation, problem solving, decision making and leadership.

8.2 Conclusion

This chapter has confirmed that several benefits accrue to IPM interventions. The direct benefits derived by farmers using the crop production and protection skills acquired from the training and its diffusion efforts include crop diversity as a result of empowerment of farmers to make informed decisions, thus spreading IPM principles to other crops, high yields, improved health status due to drastically reduced exposure to pesticides as a result of significant reductions in the use of pesticides for crop production, a better understanding of the agro-ecosystem, reduced incidence of pests and diseases, increased business opportunity and a more stable income. FFS farmers were at advantage compared to NFFS farmers.

However, there was no significant relationship between the two categories of farmers with respect to stability of income and business opportunity. With respect to labour, introduction of labour saving devices would go a long way to reducing the drudgery associated with the adoption of certain IPM practices.

Other benefits of IPM include:

- safer environment resulting from drastic reduction in pesticide residues
- minimum contamination of food to the community,
- researchers fine-tune their agricultural research agenda to become more targeted and particularly relevant and more responsive to small holder farmer's field problems,
- better organised farmer community groups that can be exploited to address overall community development (Afreh-Nuamah, 1999).

CHAPTER NINE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

9.0 Introduction

Generally, adoption of IPM has been reported to be below expectation. Whilst reasons for the low adoption may be many, this study was undertaken with the main purpose of identifying the effect of communication strategy on IPM adoption. Thus, it sought to verify two main postulates: firstly, whether IPM adoption is related to communication strategy used in its dissemination and secondly, whether there is a relationship between personal socio-economic characteristics of farmers and adoption. Other reasons for non-adoption of the IPM practices were also identified. The study also sought farmers' perception about the impact of IPM interventions.

Chapter 1 examines background. This comprises: the problem of food insecurity, constraints to food security, IPM as an option for enhancing food security, current developments in IPM, historical review of IPM implementation in Ghana, the status of IPM in Ghana and vegetable IPM in Ghana. Further to this, chapter one looks at the problem statement, research questions, main objective, specific objectives, hypotheses, conceptual framework and operational definition of concepts. In chapter two, literature relevant to the study is reviewed. Methodology used to carry out the study has been presented in chapter three and IPM practices disseminated to farmers in the study area have been discussed in chapter four. Characteristics of farmers, communication of IPM practices, adoption of IPM and impact of IPM intervention have been discussed as results in chapters five, six, seven and eight respectively.

This chapter therefore aims at summarising all activities and findings based on related literature and the implications of the results of the whole research exercise. It examines socio-economic characteristics and adoption, communication strategies/methods, adoption and benefits that accrue from adopting IPM practices. The chapter ends with conclusion, theoretical implication, research implication and recommendations.

9.1 Summary

In chapter 1, the potential of IPM as a means of reducing commodity losses due to pests and diseases and thus enhance food security is outlined. In addition, special reference has been made to vegetable production and expenditure on pesticides and their harmful effects on humans and the environment, hence the need for IPM for food security and sustainability. Chapter 1 further examines the historical review of IPM implementation in Ghana, the status of IPM in Ghana and vegetable IPM in Ghana.

Chapter 1 further talks about the research problem. In the problem statement, the widespread recognition, yet low adoption of IPM as pest control measure, is outlined. The role of communication strategy in enhancing adoption of IPM and thus enhance food security is emphasized. The main and specific objectives of the study have also been indicated in this chapter. The research hypothesised that: i. there was no relationship between socio-economic characteristics of farmers and adoption of IPM and ii. there was no relationship between communication strategy and adoption of IPM. A conceptual framework indicating IPM practices, communication strategy and socio-economic characteristics as they simultaneously influence adoption, was developed.

In chapter 2, literature and documents are reviewed on adoption of innovations, the process of adoption, attributes of innovations and adoption vis-à-vis their relative advantage, compatibility, complexity, trailabilty and observability or visibility. Further to this, personal socio-economic characteristics and adoption (age, gender, education, farm income, credit, farm size, tenure status, labour availability) were also indicated.

This chapter also reviews various communication strategies including the methodology and principles underlying the *Farmers' Field School* concept. Gender issues in *Farmers' Field Schools*, real returns to IPM and its diffusion and assessment of household and village level impacts of IPM have also been reviewed.

The research methodology used for the study was developed and outlined in chapter 3. Taking cognisance of the objectives of the study, survey was found suitable for this study. Weija Irrigation Project was purposively chosen as the research site since it typifies intensive vegetable production in Ghana and has attracted many extension programmes including IPM *Farmers' Field School.* Two categories of farmers were interviewed. They were vegetable farmers who had taken part in the season long *Farmers' Field School* (FFS farmers) and those who did not take part (NFFS farmers), using interview questionnaire. Simple random sampling was used to obtain the sample for both categories of farmers. One hundred and five (105) farmers comprising 55 FFS farmers and 50 NFFS farmers were selected. Using the focus group interview checklist, the researcher had discussion with AEAs assigned to the area.

Data gathered were analysed using the Statistical Package for the Social Scientist (SPSS) software programme. The chi-square test of significance was used to test the research hypotheses. Prior to data collection, the questionnaire was pre-tested and identified flaws were corrected. The questions finally contained open-ended and close-ended questions. Data were collected over a one-month period.

Chapter 4 examines IPM practices given by existing reports and AEAs during the focus group discussion. It examines the conceptual basis of IPM, training content of *Farmer*

Field Schools, IPM practices disseminated to farmers in the study area, preparation of IPM messages and decision making in IPM.

The results of the study have been discussed in chapters 5,6,7 and 8. These have been broadly discussed under two main headings. These are: socio-economic characteristics and adoption of IPM and, communication strategies, adoption and benefits of IPM

9.2 Socio-Economic Characteristics and Adoption of IPM

Onu (1991) suggests that it is usual to investigate the personal and social characteristics of respondents in order to understand their relative influence in the adoption behaviour. In chapter 5, personal and socio-economic characteristics of the two categories of the farmers are compared. The personal socio-economic characteristics studied were age, farmers' level of education, gender, and farm size. Others include economic enterprises of farmers, source of farm labour and source of credit. This chapter also examines farmers' production constraints and the strategies employed to control pests and diseases.

Though elderly people seem to be somewhat less inclined to adopt new practices than younger ones, evidence from this study suggests that there is no such relationship. Rogers (1995) supports this inconsistent evidence about the relationship of age and adoption. Educational level, gender and source of labour did not have any significant relationship with adoption. However, with respect to source of labour, though the findings reveal that there is no relationship between source of labour and adoption, Hicks and Johnson (1974) in Feder *et al*, (1982) have found that higher rural labour supply leads to greater adoption of labour-intensive varieties in Taiwan. Also, Njoku (1989) in a research on costs and returns of rice production found that labour input was the greatest constraint to increased rice production particularly for land preparation, weeding and harvesting.

The findings reveal that personal and socio-economic characteristics of farmers such as age, gender and source of labour did not have a significant relationship with adoption. The second research question: "To what extent do personal and socio-economic characteristics influence adoption of IPM practices? " is duly answered.

9.3 Communication Strategies, Adoption and Benefits of IPM

Farmers in the area have available a range of pest management practices based primarily on cultural, physical, and mechanical techniques to the use of biological or chemical pesticides. Farmers' awareness of the selected IPM practices was very high. However, there was a significant difference between the two groups of farmers with respect to awareness of scouting and mulching; the significance was due to the fact that a higher than expected farmers who are aware of these practices were FFS farmers. *Farmers' Field Schools* are therefore a very effective approach of enhancing awareness knowledge of farmers.

From the study, farmers' sources of information on crop protection include: AEAs/FFS, friends and relatives and agricultural input sellers. This is supported by van den Ban and Hawkins (1999), who stated that sources used by farmers to obtain the knowledge and information they need to manage their farms include: other farmers; government extension organisations; private companies selling inputs, offering credit and buying products; other government agencies; marketing boards and politicians; farmer' organisations and NGO's and their farm staff members; farm journal, radio, television and other mass media. There was a significant difference between the two categories of farmers with respect to sources of information. FFS farmers obtained information on IPM recommendation mainly through AEAs/FFS, whereas NFFS obtained their information from AEAs and other farmers and friends. None of the farmers in both categories indicated mass and print media. Promotion of IPM through mass and print media will therefore go a long way to increase farmers' awareness of general IPM practices in the study area.

Extension work is a paramount component in the development of IPM programmes. Methods of extension were found to be important determinants in the adoption of IPM. The results indicate that individual and group methods/PAR were the main methods employed in communicating IPM practices. There is a significant difference between FFS farmers and NFFS farmers with respect to methods of communicating IPM practices. Whereas FFS farmers indicated mainly Participatory Action Research (PAR), NFFS farmers indicated individual methods such as farm and home visits by AEAs, as well as farmer-to-farmer contact and group methods (namely result and method demonstration). According to Afreh-Nuammah, (1999) the IPM *Farmer Field School* is participatory and farmer-centred. Also, Bull (1982) states that unless IPM is carried out sensitively and with the fullest possible participation of farmers, it will not succeed and it will not help the poor. According to Escalada and Heong (1993), as cited in Lutz *et al*, (1998), most IPM success stories have been preceded by research done in farmer's fields with the farmer actively participating in all stages of the research process.

The results of the chi-square analysis of differential adoption rates for *Farmers' Field School* participants and *non-Farmer Field School* participants reveal that *Farmers' Field School participants* had a statistically significant higher adoption level than *non-participants* with respect to neem seed extract, improved seeds and scouting. Also, FFS farmers showed a markedly reduced pesticide application than the NFFS farmers. This is a significant finding in a farming system in which chemical pesticide application had become almost a routine. The overall adoption pattern of the practices indicated that FFS farmers showed a significantly higher adoption than NFFS farmers. This finding therefore addresses the research question 1: Which communication strategies or methods are more effective in the dissemination of IPM practices?

The difference between the two categories of farmers with respect to the adoption of manure application, mulching and row planting was not significant. The identified constraints to adopting IPM practices include: tediousness, tediousness of some of the practices, time wasting/lack of labour, perceived ineffectiveness of some of the practices, seasonality (neem seeds extract), high cost of inputs (such as improved seeds), scarcity of certain inputs and lack of knowledge (expressed only by non-adopting NFFS farmers with respect to neem seed extract, mulching and scouting). These findings are supported by Lutz *et. al.* (1998) who stated that if IPM is to become widespread, farmers must have the appropriate incentives, relevant knowledge, and practical techniques to make use of non-chemical based approaches.

Therefore, economic considerations for the farmer (e.g. how affordable in terms of time, labour and money) are of immense importance in enhancing the adoption of IPM. On the issue of labour, they state that to apply IPM, farmers need to accept a practice that is usually more management and labour-intensive than the use of chemical agents. They also added that ultimately, the choice of pest management technology will be influenced by the costs, benefits, and availability of competing alternatives, as well as any rules or other social norms governing their use.

The impact of IPM and its diffusion efforts in the study area include crop diversity, increase in yields of vegetables, decrease in incidence of pests/diseases, improved health status, increase in income stability, increased business opportunity and increased labour requirement. Increase in labour requirement associated with the adoption of IPM practice has been confirmed by this study (Chapter 8)

9.4 Conclusion

From the study, participants of *Farmers' Field School* showed a higher level of adoption than the non-participants. This implies that participation in *Farmers' Field Schools* greatly enhances farmers' knowledge and skill in IPM practices. According to Lutz *et al,* (1998), the involvement of farmers in helping to generate locally specific techniques suitable for particular farming systems appears to be an important factor determining the success of efforts to implement IPM, a finding that is likely to apply equally to other sustainable production technologies and resource management approaches. Also different factors do affect the adoption of different innovations and this was particularly true of the farmers' adoption of the IPM practices. The findings also indicate that adoption of IPM does not only depend on communication strategy/methods employed in disseminating IPM practices, but also on perceived economic advantages of the practice. Socio-economic characteristics of farmers did not have significant relationship with the overall adoption pattern.

9.5 Policy Implications

Different factors do affect the adoption of different innovations and this was particularly true of farmers' adoption of the IPM practices for the study. The findings reveal, however, that farmers' personal socio-economic characteristics do not influence adoption of IPM. The findings also reveal that strategies/methods of communicating

IPM practices to target beneficiaries do influence their adoption. The findings of this research therefore validate the theoretical framework upon which the research is based.

The findings also validate the fact that adoption of IPM practices leads to increased yield, informed decision by farmers to enable them spread IPM principles to other crops, reduced incidence of pests and diseases, a more stable income and improved business opportunity. The findings also support the perception that IPM is labour-intensive. There is therefore the need to develop more labour-savings methods of pests and disease control. Education should continue to be the main tool for disseminating IPM strategies. Once farmers have had a minimum of exposure to new technology that offer clear benefits, they are often quite prepared to accommodate these methods of pest control into their traditional agricultural practices, either in whole or in part. However, unless IPM is carried out sensitively and with the fullest possible participation of farmers, it will not succeed and it will not help the poor. Participatory Action Research (PAR), experimental learning and teaching farmers to teach others are the strategies preferred to achieve these aims. Through this, farmers' real needs would be identified and appropriate strategies.

9.6 Research Implications

The findings indicate that communication strategies/methods have effect on adoption of IPM. The *Farmers' Field School* approach has a very significant impact on adoption. However, different factors such as labour availability and affordability, follow-up programmes etc. do affect the adoption of different innovations. Due to time and financial constraints, the research could not delve into labour, financial service availability and extension agents' competence in extension delivery on adoption of IPM. I therefore suggest that further research be carried out in this direction.

9.7 Recommendations

Based on the findings and conclusions of the research, the following recommendations have been made:

- IPM requires farmers to be more observant and analytical, and to be able to adopt measures suitable to their needs in each situation. Farmers need encouragement in the process of adoption. Therefore, routine field evaluation of adoption rates should be promoted and institutionalised by both extension and research organisations to enable them obtain undated impacts of the technologies that they develop and promote.
- The overall costs of training farmers could be reduced through training a core group of farmers within a geopolitical unit, such as a municipality, and then rely on farmer-to-farmer training for disseminating the IPM messages to wider group of farmers. There are definite scale economies to the farmer-to-farmer training approach if the quality of the message transmitted does not deteriorate as it gets passed down the line.
- Mass media methods should be employed to enhance awareness of environmentally sound practices not only to farmers but the general public. Farmers already use many of the practices traditionally. They simply have to become aware of the value of such practices in the context of crop protection.
- It is also recommended that farmers form clubs or associations so that they can meet and interact regularly and find solutions to common concerns.

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PERSONAL COMMUNICATION

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APPENDIX 1

DEPARTMENT OF AGRICULTURAL EXTENSION
UNIVERSITY OF GHANA
LEGON, ACCRA

TOPIC: COMMUNICATION STRATEGY AND ADOPTION OF INTEGRATED PEST MANAGEMENT (IPM) PRACTICES BY VEGETABLE FARMERS AT THE WEIJA IRRIGATION PROJECT

INTERVIEW QUESTIONNAIRE FOR THE FARMER

This questionnaire aims at studying the communication methods and adoption of IPM messages in your community. I would be grateful if you could answer the questions below. Any information will be treated confidentially.

A. Personal/ Socio-Economic Data.

1.Name...

2.Name of settlement (Town/village)...

3. Age [ ] years

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

5.Ethnicity ....

6. Religion: (Tick the appropriate response)
1. Traditional/Indigenous
2. Islam
3. Christianity
4. Others (Specify)..

7. Marital Status: 1.Single 2.Married
3.Divorced/separated 4.Widowed

8. Highest educational level attained:
1. No formal school
2. Primary
3. M.S.L.C./J.S.S.
4.Secondary school/ S.S.S.
5.Post Secondary

9. What is your major occupation?..

10. What other income generating activity are you engaged in?
....
....

11.How long have you been farming?

1. 1- 4 [ ]
2. 5-9 [ ]
3. 10-14 [ ]
4. 15-19 [ ]
5. 20yrs and above

12. What is/are your main purpose (s) for farming?

1. Subsistence [ ]
2. Commercial [ ]
3. Both commercial& commercial [ ]
4. Other specify)...............................

13.What are your major crops?

Crops	Rank	Main Purpose	Production Constraints

14. What is the total farmland available to you for farming?
..................Acres

15. What are the constraints associated with the land you are using? (e.g. Size, quality, location, animal destruction).
....

16.What are your sources of credit for your agricultural activity?

1. None
2. Friends
4. Money lender
8. Co-operative society
16. Credit union
32.Banks
64.Government programme
128.Traders
256. Other (Specify)...................................

17. What are the sources of labour on your farm?

1. Family labour (FL)
2. Hired Labour (HL)
4. Own Labour (OL)
8. Reciprocal Labour (RL).
16. Others............................

18. Number of members of household available to provide labour to you?...............

19.What are the major pests and diseases, which affect your crops, and how do you control them? (Crops may be repeated if there are more than 1 pest/disease).

Crop	Pest/ Disease	Control Strategy	Is Strategy Effective? 1=Yes, 2=No
1.			
2			
3.			
4.			
5.			
6.			

B. IPM Information, Communication Strategy/Methods and Adoption.

20. What are your sources of information on agricultural practices? (May indicate more than one).

1. Other farmers
2. Friends
4. People selling agric Inputs
16. IPM FFS/AEAs
32. Others (Please specify)..

21. Have you been introduced to any of the following IPM practices?

Practice	Awareness 1=Yes 2=No	Information Source	Communication Strategy/Method Used	Is Information Sufficient? 1=Yes 2=No	Is Follow-Up Available?
Neem Seed Extract					
Manure Application					
Mulching					
Improved Seeds					
Reduction of Pesticide Use					
Scouting					
Row Planting					

Information Source:
1.AEAs/FFS
2.Friends & Relatives
4.Input sellers
8. Co-operative Society

INDIVIDUAL METHOD
1.Farm visit
2.Home visit
GROUP METHOD
4.Method demonstration
8.Result demonstration
16. PAR
MASS METHOD
1.Radio
2. Posters
4.None

22 Which of the IPM Practices have you adopted or not adopted and why?

Practices	1=Adopted 2=Not Adopted	Reason(s) for Adoption or Non- Adoption	Follow-up Required for Adoption? 1=Yes 2=No
Neem Seed Extract			
Manure Application			
Mulching			
Improved Seeds			
Reduction of Pesticide Use			
Scouting			
Row Planting			

C. Impact of IPM

23. How has the introduction of IPM Practices impacted on the following?

Indicators of Change	Changes 1=Increased 2=Decreased 3= No Change	Reason for Change
Crop Diversity		
Yields of Vegetables		
Farm Size		
Pest/Disease Incidence		
Income Stability		
Business Opportunity		
Labour Requirement		

Thank you for your help.

APPENDIX 2

DEPARTMENT OF AGRICULTURAL EXTENSION
UNIVERSITY OF GHANA
LEGON, ACCRA

TOPIC: COMMUNICATION STRATEGY AND ADOPTION OF INTEGRATED PEST MANAGEMENT (IPM) BY VEGETABLE FARMERS AT THE WEIJA IRRIGATION PROJECT

CHECKLIST FOR AEAs

1. What types of crops are grown in the area?

2. What production constraints have you identified in the area?

3. A discussion on IPM and *Farmers' Field School* in the study area.

4. What IPM practices have been introduced to vegetable farmers in your area and why?

5. What communication strategies/methods do you employ in disseminating these practices to farmers and what are your reasons for your choice?

6. What are the problems associated with extension delivery in the study area?

7. What teaching aids do you use?

8. What are the bases upon which farmers are selected for participation in *Farmers' Field School*?

9. What are the constraints associated with the adoption of the IPM practices disseminated to farmers?

10. How has the promotion of IPM impacted on farmers and their enterprises in the area?