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PESTICIDE USE INFORMATION FLOWS AND COMPETENCIES OF AGRITEX EXTENSION AGENTS IN THE MIDLANDS AND MASHONALAND CENTRAL PROVINCES OF ZIMBABWE

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ABSTRACT

PESTICIDE USE INFORMATION FLOWS AND COMPETENCIES OF AGRITEX EXTENSION AGENTS IN THE MIDLANDS AND MASHONALAND CENTRAL PROVINCES OF ZIMBABWE

By

Raymond Tafungiswa Kujeke

There is an insufficient knowledge base on the effectiveness of public extension systems in developing countries. Specifically, little is known about the interaction of technology use by small-scale farmers and the extension organizational behavior, and, the technical competencies required of extension agents. The main objective of this study was to determine the nature of information flows and the technical competencies of public extension agents in Zimbabwe with respect to pesticide use.

Data were collected from a sample of 209 Agritex extension agents in the Midlands and Mashonaland Central provinces using a questionnaire. The data related to extension agent technical competence, use of information sources and channels, attitudes, and technical support needs with respect to pesticide use.

There was wide variance in technical competence. Using multiple regression, the following independent variables had a significant influence on variation in competence scores: age, gender, level of in-service training received, contact and use of private sector representatives as information sources. There were no significant relationships between

This work is dedicated to Mashoko Alfred Kujeke,

alias Mao, who would have been first.

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The study was made possible by the cooperation of the Zimbabwe Ministry of Lands, Agriculture and Water Development, the Agritex director, and all the Agritex extension staff who took the time to participate despite the arduous drought conditions at the time.

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TABLE OF CONTENTS

CHAPTER III

CHAPTER IV

CHAPTER V

Table of Contents (cont'd)

LIST OF TABLES

List of Tables (cont'd)

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AGRITEX - Department of Agricultural, Technical and Extension Services

CILCA - International Liaison Committee for Food Crops Programs

CSO - Central Statistical Office

DCC - Drug Control Council

DR&SS - Department of Research and Specialist Services

ESAP - Economic Structural Adjustment Program

EW - Extension Worker

HSB - Hazardous Substances Board

IPM - Integrated Pest Management

MLAWD - Ministry of Lands, Agriculture and Water Development

MTU - Mobile Training Unit (Agritex)

NARS - National Agricultural Research Systems

NGO - Non-governmental Organization

PPRI - Plant Protection Research Institute

PVO - Private Voluntary Organization

PSC - Public Service Commission

SMS - Subject Matter Specialist

T&V - Training and Visit System of Extension

ZFC - Zimbabwe Fertilizer Corporation

ZIDS - Zimbabwe Institute of Development Studies

CHAPTER I

INTRODUCTION

There is an abundance of literature on the shortcomings of importing agricultural technology for small-scale farmers in the developing world. Agricultural technology, like machinery and agricultural chemicals, has often led to spectacular increases in farm production and improvements in the quality of life in industrially-developed countries. However, it has somehow failed to prove itself when put to the test in developing countries. The common reasons for this failure include the inappropriateness of the technology, and, a lack of compatibility between the technology and the social environmental setting in which it is used. The technology transfer systems of most developing countries are inappropriate. A common assumption in most transfer systems is that there is a natural, and inevitable, unidirectional relationship between the formal research process and the process of transferring the research know-how and its adoption by farmers.

Research emphasis has now broadened from focusing on why agricultural technology does or does not diffuse in these environments, to ways of understanding and developing the institutions responsible for technology transfer, and on the indigenous knowledge systems of different farmers. This is an acknowledgement of the obvious findings that knowledge transfer is not always a unilateral movement from the research system to the farmer, and, of the need for research on communication as a process.

Farmers and service institutions generate knowledge which also needs to be developed and disseminated by extension organizations. Extension, the conscious use of communication of information, and the institutions responsible for technology transfer are

important elements in the diffusion process. There is a need for better understanding of the processes of technological innovation and dissemination of useful technical knowledge *within* the extension systems of developing countries. Human resource development and multi-dimensional technology transfer capacity are critical areas in determining the effectiveness of public agricultural extension systems.

Pesticides, by controlling pest populations directly or reducing/preventing pest damage, provide a novel and relatively fast technology for increasing agricultural production. While there is evidence that pesticides alone do not lead to sustainable pest management in agriculture, most developing countries experience constraints in resources to generate a body of knowledge on alternate pest management strategies. The use of pesticides and other agricultural inputs by small-scale farmers in Zimbabwe is increasing. This increase is likely to continue before other means of pest control become cost-effective for small-scale users.

There is still an inadequate empirical base on the subject of agricultural service provision in developing countries. Specifically, little is known about the manner in which organization network structure affects information flow. Knowledge about the relationship between agricultural extension organization structures and information flow has remained at a global level because there has been a paucity of research attempts to address, empirically, the features of organizational systems and the flow of specific information.

The goal of this study was to identify and/or generate useful information for the improvement of the technical competencies of Zimbabwean extension agents through the development of more appropriate training and technical information networks. The study focused on pesticide use, as one example of agricultural technology, to assess the technical

competency of extension agents, and the technical information flows within the public extension organization, Agritex.

Problem Statement

It has been shown that the efficient use of agricultural chemicals by farmers requires adequate support from extension. The technical competence of agricultural extension agents regarding appropriate pesticide use is an important factor in their ability to meet the technical advisory needs of farmers. Technical competency of extension agents is likely to be influenced by a variety of factors, such as their educational qualifications, the quantity and quality of in-service training they receive, and the availability of relevant technical information and/or other resources to assist and update.

The formal qualifications of public extension agents in Zimbabwe, as in other developing countries, are relatively low, especially as one goes down the ranks of the organizational hierarchy. Small-scale farmers tend to have limited interaction with the extension system, and specifically with adequately trained extension agents. There is no formal evaluation of extension agents for specific knowledge or skills regarding the use of pesticides. Private companies manufacture and market agricultural chemicals with minor formal obligations regarding both farmer and extension agent knowledge and skills. The technical support provided by pesticide companies to farmers is narrow, generally limited to the purchased products, and not extended to the broader range of agricultural production and management problems.

The promotion of improved agricultural practices, is, and will likely remain, primarily a public sector function. Agritex is the predominant public agricultural extension

organization in Zimbabwe. Agritex's ability to create and/or disseminate relevant technical information is therefore critical. For an "external" technology like pesticides, this ability is influenced by the strength of its communication links with pesticide research, manufacturing, and, marketing organizations.

The knowledge levels of extension agents, and the technical, funding and administrative limitations of Agritex to facilitate the flow of technical information, are key factors in determining the level of effectiveness of technical support for pesticide use available to small-scale farmers. Extension efforts have generally been inadequate in promoting learning of agricultural technology by extension agents.

Study Objectives

The primary purpose of this study was to determine the nature of technical information flows, and the technical competencies and needs of selected Agritex field extension agents regarding the use of pesticides. The secondary purpose was to evaluate the perceptions of key personnel in the pesticide industry, pesticide use organizations, and senior Agritex personnel regarding the technical support needs of Agritex field extension agents.

Research Questions

To meet the purposes of the study, the major questions that guided the research process were:

1. What are the technical competencies of Agritex extension agents regarding pesticide use?

2. What sources and channels are used to disseminate technical information related to pesticide use within Agritex?

3. What are the attitudes of Agritex extension agents toward pesticide use?

4. What are the technical support needs of Agritex extension agents regarding pesticide use management?

Research Hypotheses

The following research hypotheses were set a priori, and tested in an attempt to provide answers to the research questions:

Question 1: Technical Competence of Extension Agents Regarding Pesticide Use

(1) Technical competence is related to the extension agents' formal qualifications.

(2) Technical competence is related to the level of in-service training received by extension agents.

(3) Technical competence is related to the extension agents' level of on-the-job experience.

(4) Technical competence is related to other demographic characteristics of extension agents.

Question 2: Pesticide Use Information Sources and Channels

(1) Other organizations are perceived by extension agents as more important sources of information than Agritex.

(2) Extension agents use formal more than informal channels in the acquisition of pesticide use information.

(3) Media richness affects the extension agents' use of pesticide information sources and channels.

(4) Use of information sources and channels is related to the extension agents' demographic characteristics.

Question 3: Extension Agents' Attitudes toward Pesticide Use

(1) Extension agents' attitudes toward pesticide use are related to demographic characteristics.

Question 4: Technical Support Needs Regarding Pesticide Use Management

(1) There is a need to improve technical support to Agritex field extension agents regarding pesticide management.

(2) Agritex should be responsible for supporting field extension agents in pesticide use management.

(3) Pesticide companies should be responsible for supporting extension agents in pesticide use management.

(4) There is a need for formal communication between field extension agents and the pesticide company's technical specialists.

Assumptions and Limitations of the Study

The main focus of the study was limited to Agritex extension agents for practical and financial considerations. Data was not collected from other extension agents, for example those in the private sector, or farmers, who are the primary end-users of pesticides. Because of the severity of the drought at the time of data collection, only two of Zimbabwe's eight provinces were selected for the study. There was selection bias in that the two provinces, Midlands and Mashonaland Central, were somewhat less affected by the drought, and, are usually more productive. The findings are therefore not generalizable nationally, and also may have been influenced by the unusual environmental conditions at the time of data collection.

The study was limited to management and use of pesticide information. The findings, conclusions and recommendations are bound to the characteristics of this technology, which may not be applicable to other types of agricultural technology.

Assessment of the extension agents' technical competence was by proxy, using responses to written questions. Lack of a more practical assessment of competence was therefore a methodological limitation. The underlying assumption was that written responses could provide a reliable measure of competence, and further, that honest responses would be disclosed.

Definition of Terms

Agrochemical/agricultural chemical/pesticide - a chemical used to control pest populations (including weeds) directly, or to reduce or prevent pest damage.

Attitude - a general and enduring positive or negative feeling about some person, object or issue.

Communication - the process of creating shared meaning among two or more people through verbal and nonverbal transaction.

Competence - an underlying characteristic of a person that results in effective and/or superior performance in a job.

Electronic media - used broadly to refer to radio, telephone, television and computers.

Extension agent - Agritex personnel employed in the field and technical divisions.

Extension approach - the style of action within an extension system.

Extension system - an extension organization, such as a ministry of agriculture extension system or university-based extension system.

Extension strategy - the chosen course of action, such as multi-step information flow strategy or multimedia strategy.

Extension methods - educational techniques used by the extension system, particularly by its field staff in communicating with farmers.

Formal channels - official paths of message/information flow prescribed by the organization's chain of command.

Informal channels - unofficial and informal networks ("the grapevine") used by organization members for message/information flow.

Information channel - a means of passage, for example verbal, print or electronic media, for transmitting a message from one point to another.

Information flow - the transmission of messages between two or more persons, or, discrete points in a system.

Information source - a person or point of origin, such as an individual or organization, that provides or initiates a message.

Media richness - the capacity of a medium to facilitate shared meaning. Rich media (for example, face-to-face communication or telephone) has the highest capacity to facilitate shared meaning. Lean media (newspapers or journals) has the lowest capacity.

Sales representative - person employed in a sales capacity by or for a pesticide company.

Small-scale farmers - farmers engaged in agricultural activities in the communal and resettlement areas. Used synonymously with communal farmers.

Technical competency/skill - implies an understanding of, and proficiency in, a specific kind of activity, particularly one involving methods, processes, procedures or techniques.

Technology transfer - in a broad sense, information that is put to use.

Scope and Significance of the Study

There is growing concern regarding the cost-effectiveness of public agricultural services in developing countries. With increasing competition for public resources, agricultural extension organizations have to show their relevance in more specific terms, rather than the old adage of attempting to help all farmers, everywhere, with all their needs. This may require refocusing public extension programs to doing only that which they are capable of doing. One potential alternative to the traditional public extension system is

greater involvement and cooperation with private extension. Attempts at revamping public extension systems require closer scrutiny of what they are currently doing and a listing of their specific capabilities and needs in the various facets of extension programming. The study considered the case of pesticide use amongst small-scale farmers in Zimbabwe, and attempted to evaluate the role of the public extension system and the competencies of its field extension staff. The general aim was to add more knowledge and insights for strengthening the extension system, especially in the area of extension agent performance and integrating public and private extension.

Overview of the Dissertation

Chapter I has provided a brief introduction, statement of the problem, and the major research questions and hypotheses that guided the study. The key assumptions and limitations of the study were summarized. Chapter II sets the conceptual framework, gives an overview of pertinent issues related to extension and extension organizations in developing countries. The chapter concludes with a brief description of Zimbabwe, background information on the public extension organization, Agritex, and lastly, pesticide use.

Chapter III is a review of literature related to the research problem. The research design and procedures used in the study are detailed in Chapter IV. Chapter V presents details of the study findings. The final Chapter is a summary of the study, the conclusions, and recommendations. Copies of the main protocol documents, and relevant and/or lengthy secondary and primary data items are listed in the appendices.

CHAPTER II

BACKGROUND OF THE STUDY

This chapter begins by setting out the conceptual framework for the research problem. A discussion of some key concepts and issues related to the provision of agricultural extension services in developing countries follows. The chapter concludes with some background information on Zimbabwe and its agricultural systems, the public extension organization, Agritex, and, lastly pesticide use.

Conceptual Framework

While there is almost universal agreement on the need for extension in agricultural development, there are diverse views on extension organization and functions. A key criterion for this divergence is how one defines extension. Extension can be viewed as a purely technology transfer function, or, as a non-formal agricultural education or rural human capital development function (Maalouf, 1991). How one defines extension is an important consideration in planning, implementing and evaluating interventions aimed at improving agricultural performance.

The Technology Transfer Paradigm

The phrase "technology transfer" often has different interpretations to different writers, and in different disciplines. Most definitions of technology transfer tend to emphasize the physical product(s) and its attributes. The concept of technology transfer is broader than the common, narrow notion of the *product* and/or its features. It includes the *process* of knowledge transfer. The knowledge and skills of extension agents regarding agricultural chemical use, for example, should be considered as technology. In this context, the movement of technical information between the organization's members, formally or otherwise, can therefore be viewed as technology transfer. Technology transfer can be broadly defined as the communication of information that is put to use (Dearing, 1993). Thus theories from organizational communication are useful in understanding how technology and organizations interact. To make technology transfer successful requires overcoming the many barriers to communication encountered when individuals use different vocabularies, have different motives, represent organizations of widely differing cultures, and when the referents of the transactions may vary from highly abstract concepts to concrete products (Williams and Gibson, 1990). The underlying assumption of most extension programs in Africa has been that the main cause of farmer resistance to new technologies is psychological (Lele, 1976).

The adoption and use of new technologies is necessary for the achievement of food security (UNDP, 1991). Rukuni (1991), identifies new technology produced by public and private investments in agricultural research, as one of five "prime movers" necessary for sustainable agricultural development. The need for technology and its adoption differs greatly within the diverse agricultural systems and farmers of developing regions. The

technological innovations promoted by extension agents are seldom aimed at resource-poor farmers (Kesseba, 1989). The absence of a specific policy framework for an effective technology generation and transfer system in public extension institutions leads to inadequate organizational and institutional arrangements for meeting extension goals.

There are many cases of failed technology in developing countries. The material impact of this failure is illustrated by broken-down machinery in the rural countryside, for example. The lack of ownership, or access to technology, is not the central element contributing to the poverty of small farmers (Kesseba, 1989). Technological developments also have psychological effects; if imported technology seems all-powerful, people may feel that their efforts to improve the land and grow better crops are futile (IDS, 1991). While a strong case can be made against the negative impact of "external" technology, especially if this involves ignoring resource constraints and the capacity of farmers to generate knowledge, there is also danger in being unreceptive to outside innovations.

Diffusion of Agricultural Innovations

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1983). Rogers describes it as a special type of communication in that the messages are concerned with new ideas. Agricultural extension services are a common form of public-sector support of knowledge diffusion (Birkhaeuser, 1991). Early work on diffusion of agricultural innovations tended to focus on the innovation and the adopters[1]. Innovation was thought to be the best single

[1]Rogers (1983) and Feder (1985) provide reviews of adoption and diffusion of agricultural innovations studies.

indicator of the multi-faceted dimension called modernization, the individual-level equivalent of development (Rogers, 1976).

In most diffusion studies, information is collected from the potential adopters, commonly farmers, to access the pattern of acceptance or rejection of an innovation. The pro-innovation bias of most diffusion studies is reflected in the terminology used to describe the spread of an innovation. Typically those who accept the innovation early are referred to as pioneers, innovators and/or progressive. Conversely, those taking up the innovation either late or not at all are called laggard, resistant to change, backward, and, a variety of other terms that blame them for not taking up the innovation.

Mahajan and Peterson (1985) provide quantitative explanations of various diffusion models. They argue that for the basic diffusion model, the rate of diffusion of an innovation at any given time is a function of the gap between the total number of possible adopters at that time, and the number of previous adopters. The classical diffusion model is inadequate for explaining multiple adoptions, innovation modifications, and discontinuance[2].

Research findings on the specific effects of access to agricultural information on adoption behavior are limited. Thomas, et al. (1990) argue that part of the difficulty of specifying the effects of information is due to researchers' use of few types of information sources, or their lumping of information sources into a single construct. The source or system in which diffusion occurs has generally been given less attention for most agricultural innovations. A common underlying assumption is that the social system is static relative to the innovation. Diffusion was, and in some cases still is, conceived as a unidirectional

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[2]Mahajan & Peterson (1985) discuss these limitations and provide extensions and refinements of the classical diffusion model.

process in which knowledge and the desire to change originates in the research and/or extension systems, and then "diffuses" to the potential adopters.

It is only recently that communication networks within agricultural organizations have begun to be regarded as an important criterion of organizational efficiency in diffusing technical innovations. The processes of organizational communication are critical in determining the efficiency of information flow. Within the organization, the interaction between technology development sources and receivers, both in and out of the organization, will differ and thus affect the knowledge transfer process. Rogers (1983) contends that agricultural diffusion is relatively centralized, in that key decisions about which innovations to diffuse, how to diffuse them, and to whom, are made by a small number of technically expert officials near the top of a diffusion system.

The Non-formal Agricultural Education Paradigm

Since most people cannot come to school, school must go to them.
Anonymous.

Technology is not a sufficient condition for increasing agricultural productivity. The premise of non-formal education is the existence of knowledge differences between what the farmer knows and available knowledge. New technology in not a necessary condition for improving productivity if farmer practices lag behind available knowledge. Extension is therefore primarily a deliberate intervention aimed at raising the knowledge level of farmers.

Learning Theory

Theories of learning provide a philosophical basis of the non-formal education paradigm. Many education experts have observed that understanding how a person learns, and helping people understand how to learn is a major requisite for a successful educational program[3]. This understanding is especially important for adult education programs since participants have different needs than those in more conventional learning situations (Pigg et al., 1980). On the value of learning theories, Hill (1977) notes that theories do not give us solutions, but they do direct our attention to those variables that are crucial in finding solutions.

Learning theories abound in the literature of psychology and education, a situation that reflects both the variety of approaches taken in conceptualizing learning and the lack of consensus on any one of them (Griffith, 1984). Three areas of direct relevance to the non-formal education paradigm are the ideas of behaviorist, cognitive and experiential learning theorists[4].

Behaviorists emphasize the need for carefully studying the changes associated with attempting to change the learner's ways of doing things using stimulus-response studies. Most notable amongst the early behaviorists was Pavlov and his famous work demonstrating the effects of "conditioned" and "unconditioned" stimulus on dogs. Pavlov also advanced the concept of inhibition which illustrated how learners can be distracted by external stimuli or if the conditioned stimulus is repeated without a reward. Skinner developed the latter to the concept of operant conditioning, which is the process of presenting and withholding rewards to shape behavior. Another behaviorist, Thorndike put less emphasis on the role

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[3]See for example Knowles (1973).

[4]Bower & Hilgard (1981) provide a comprehensive review of learning theories.

of understanding, but on the bonds between sense impressions and impulses to act. This bond, commonly called connectionism, stresses the importance of practice because it permits the power of the reward to strengthen the bond between the stimulus and the response.

Cognitive theorists emphasize the organization of experience within the mind of the learner as a major variable of learning. The Gestalt and functionalism are two prominent cognitive theories. Gestalt theory deals with the ways experience is recorded in the mind and how it is used to provide solutions to problems and conflicts. Learning is viewed, not as an isolated event, but a process occurring within the larger context of the learner's experience. Extension education programs should therefore be guided by the learner's background of experience in the presentation of new information. John Dewey was one of the more prominent advocates of the functionalism theory which asserts that human beings solve problems through thoughtful interaction with their environment (Griffith, 1984). Extension educators are most helpful when they teach their clients approaches to problem-solving instead of simply giving answers to their questions.

Experiential learning theory defines learning as a sequence of events with one or more identified learning objectives, requiring active involvement by participants in one or more points in the sequence (Walter & Marks, 1981). Active involvement requires experience-based training and engages learners in deciding what is to be learned, how it is to be learned and how their achievement is to be assessed. Unlike the other learning theories, experiential learning is normative and expresses a value position.

The non-formal education agricultural paradigm emphasizes the value of change through teaching. It falters in not explicitly examining the basis for choosing the changes to be promoted. Education is not a neutral experience. Every educative experience

expresses a value position either explicitly or implicitly (Griffith, 1984). Paulo Freire (1990) sums up the nature of knowledge transfer:

> Knowledge is not *extended* from those who consider that they know to those who consider that they do not know. Knowledge is built up in the relations between human beings and the world, relations of transformation, and perfects itself in the critical problematization of these relations.

The research problem was also conceptualized as arising from other general areas in extension and agricultural development. The following background reviews concepts and issues from three areas: (1) organizational behavior and communication, (2) agricultural extension in developing countries, (3) the country setting and Agritex.

Organizational Behavior

Understanding how organizations work provides insights into possible ways in which they can be more effective. Organizational issues are of central importance when reviewing reasons for the low productivity of Africa's present extension services (Moris, 1991). To analyze the issue of administrative and management incapacity, for the improvement of communication networks, it is necessary to examine how organizations function and how they respond to internal and external problems. Bureaucracy is the most common form of public organizational structure in developing countries.

There is an abundance of literature on the characteristics of bureaucracies. The concept of "bureaucracy" is commonly used to describe huge, inflexible and impersonal organizations. Max Weber is credited with specifying the characteristics of the bureaucracy, as an ideal organizational form (Schermerhorn et al., 1988). The reasons for this assertion lie in the bureaucracy's organizational form. Using Weber's criteria, the ideal bureaucracy

is not hindered by the personal whims of the leader or by traditional procedures since the means used are those which will best achieve stated goals. The typical bureaucracy also has a well defined hierarchy of authority, which ranks members of the organization in terms of power and a system of rules. The result is a highly efficient system of coordination and control. This system perspective can be developed further to the contingency theory of behavior. The basic proposition of contingency theory is that there are no universal principles of management that can be applied uncritically (Gannon, 1979). Each situation needs to be analyzed in terms of such key variables as technology and external environmental uncertainty before an appropriate course of action is taken. This is the essence of the situational theory of behavior.

Weber's concept of an ideal bureaucracy has been criticized for a number of reasons. Mullins (1985) lists some of the criticisms. In the case of public sector bureaucracies there is a demand for uniformity of treatment, regularity of procedures and accountability for their operations. The overemphasis on rules and procedures, record-keeping and paperwork may become more important in its own right, than as a means to an end. Officials may develop a dependence upon bureaucratic status, symbols and rules. Initiative may be stifled and when a situation is not covered by a complete set of rules or procedures there is a lack of flexibility or adaptation to changing circumstances. Position and responsibilities in the organization can lead to officious bureaucratic behavior. There also may be a tendency to conceal administrative procedures from outsiders. Impersonal relations can lead to stereotyped behavior and a lack of responsiveness to individual incidents or problems.

Other critics of Weber's work have also indicated its lack of attention to the informal organization and the development of groups with goals of their own. Argyris (1964) claims that bureaucracies restrict the psychological growth of the individual and cause a feeling of

failure, frustration and conflict. In most bureaucracies there is a tendency toward "goal displacement," where the means become ends in themselves and more important than the actual goals.

Schwartz (1991) argues that the administration of a public sector extension service requires some bureaucracy but the critical question is its appropriate size. She notes that bureaucracies expand far more easily than they contract; between 1959 and 1980 African countries added 1,000 new extension agents per year. The public extension system in Zimbabwe increased its personnel by 40% during the period 1981-90 (Pazvakavambwa, 1991). In 1990 the Zimbabwean government initiated economic reforms which include a 25% reduction in the size of the civil service (Zimbabwe Government, 1991). Agritex is not "immune" to the reductions and organizational changes proposed in the World Bank-initiated economic structural adjustment program (ESAP) in Zimbabwe[5]. The key question is whether the organization can remain focused on the substance of extension, given the difficulties bureaucracies have in implementing significant organizational changes.

Organizational Communication

Communication is a process in which participants create and share information with one another in order to reach mutual understanding (Rogers, 1983). Mutual understanding or shared meaning occurs when information is placed within a context. There are three basic models of communication: linear, interactional and transactional.

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[5]C. Chidavanyika, World Bank Harare Office, personal communication (December, 1992).

The linear model provides the simplest description of the communication process. It represents communication as the one-way flow of a message from a source to a receiver. A source transmits a message through a channel to a receiver. The source must encode the message and the receiver must decode it. The linear model is similar to, and is often described as, radio transmission. The interactional model emphasizes the two-way nature of communication. The receiver provides feedback to the source, therefore reversing or exchanging roles during the process. The transactional model emphasizes communication as mutual and reciprocal. Both parties are equally important and influential in determining the outcome of the communication process. Encoding and decoding is a simultaneous process and not step-wise as in the interactional model. There is therefore no sharp distinction between source and receiver roles.

The models of communication used in an organization are key factors influencing the learning styles of its members and consequently its clientele, the credibility of the organization and the messages transmitted, and, the relative use of formal and informal sources and channels of information.

Agricultural Extension in Developing Countries

Extension is a key component of the development strategies for the agricultural sector in most developing countries. Agricultural extension services were established throughout Africa during the colonial period (Eicher & Baker, 1982). During this period, the role of the extension agents was essentially coercive. With independence, the focus of most extension services in African countries has shifted to a more persuasive approach, and, on increasing the availability of extension services to farmers. Despite the numerous efforts

to improve the effectiveness of national extension programs, resources invested in extension services generally have a low return (Arnon, 1989; Gill, 1989).

An extension approach is the style of action within a system (Axinn, 1988; Contado, 1990). There are various approaches to the provision of extension. Differences in extension approaches are influenced by the source of funds and the type of organization responsible for organizing extension activities (UNDP, 1990). The major extension approaches can be broadly divided into those provided by public and private sector organizations.

Public Sector Extension

Most public sector extension in developing countries is provided through government ministries of agriculture or rural development. The justification for government assuming responsibility for extension is that the extension program, though aimed at improving the efficiency of agricultural production, can actually contribute to general economic growth and in many cases to export earnings (Arnon, 1989). Ministries of rural development tend to emphasize socioeconomic goals, while those of agriculture are more production and technology transfer oriented (UNDP, 1990). The general ministry-based agricultural extension approach is the most widely found type of extension service in Sub-Saharan Africa (FAO, 1990; Kesseba, 1989; Moris, 1991). There is however, great variability between countries and different systems within each country. For example, in Francophone Africa, the Ministry of Agriculture often does not have major implementation responsibilities (Moris, 1991).

The ministry-based approach is typically multi-purpose and multi-functional, and the extension agents are frequently the only continuing governmental presence in their service

area (UNDP, 1990). The staff in public extension systems tend to see themselves as civil servants rather than farmers' advisers; typically they spend a significant amount of time on "non-extension" activities. It is partly for this reason that management systems like the World Bank-promoted Training and Visit System (T&V) have been introduced in a number of public extension systems in developing countries. To a lesser extent, public extension in Sub-Saharan Africa is organized through University-based, Commodity-based, and, Integrated approaches.

Public sector extension was criticized in the 1980s for not doing enough, not doing it well, and for not being relevant (Rivera, 1991). Rivera further argues that there were at least three major responses to the criticism of public extension. First were the efforts to improve or revitalize these systems; second were the moves to privatize public extension. The third response was to encourage alternative diffusion practices.

Private Sector Extension

Private sector extension tends to focus on technology transfer. The UNDP (1990) classifies private sector extension into four categories: commodity, input, knowledge, and client group served. Commodity-based extension systems are usually organized through quasi-government organizations or private sector companies for an important cash or export crop. Input-supply systems are typically organized by private firms offering technical advice on the use of a specific agricultural input(s), such as pesticides, seed varieties or equipment. Knowledge systems are often provided by consultants who provide specialized technical and managerial advice and services on a fee basis. Such specialized services are generally tailored to large-scale specialized firms and individuals and do not cater for most small-scale

producers. Client-based systems are generally provided by private voluntary organizations (PVOs) or nongovernmental organizations (NGOs).

Input supply companies consider extension services as part of the backstopping and promotion activities of their enterprise (Cornelissen, 1991). Cornelissen estimates that input supply firms in Zimbabwe employ approximately 160 representatives/extension workers who generally spend 8 months a year on extension services; these firms spend a total of about Z$9.6 million per year on extension services[6]. The private sector is playing an increasingly important role in agricultural research and technology transfer in developing countries and, in general spends more money on linking the two activities, than is the case in the public sector (Pray & Echeverria, 1990).

Extension Organization

Most government extension services are organized as territorial hierarchies, with headquarters staff in the capital city, subordinate levels at province, region or district, and a broad base of geographically dispersed field workers in the lowest sub-areas (Arnon, 1989). The conventional extension model is based on "top-down" diffusion of technical innovations, from research or other external sources, and down through the ranks of the extension organization.

Extension services in most developing countries are provided in a complex environment, making it difficult and usually inappropriate, to focus on a few specific aspects. Moris (1991) discusses the complexity of the organizational contexts of agricultural extension in developing countries. Agricultural extension can be analyzed from a policy, social, or

[6]Estimate includes extension services in commercial and small-scale agricultural sectors.

natural science perspective. For example, those who conceive of extension as technology transfer may focus on communicating information about new technology like pesticides to farmers; those who deal with community problems could emphasize issues like leadership, empowerment and participation within the community; while the natural scientist may analyze trends using a geographical or biological approach.

Problems with Public Extension Systems

Public extension organizations in developing countries face a variety of problems. The effects of specific problems will vary between organizations and also at different times in the development process. Common problems of public extension organizations include organizational defects and operational weaknesses, ineffective extension personnel, economic constraints, deficient linkages with other institutions involved in development and, political, cultural, social and institutional constraints (Arnon, 1989). Within the organizational and operational sphere, specific problems include (1) insufficient numbers of well-trained extension personnel, (2) extension services that emphasize the higher potential areas and well-to-do farmers, (3) lack of adequate transportation, facilities, and equipment for the extension field staff, (4) lack of career development opportunities and adequate incentives for good work, (5) poor organization and management of resources, (6) insufficient linkage between extension and research, and with other rural service agencies, and, (7) the failure of extension to reach small-scale subsistence farmers, especially women-headed farm households and young families, with appropriate technology and other effective services (FAO, 1990).

Many factors contribute to these problems, making it difficult to design simple strategies for strengthening public agricultural systems. The World Bank concedes that *".....evaluations of its own efforts indicated that extension systems were poorly managed and that the technology being promoted was often irrelevant"* (Cleaver, 1992). A significant number of these problems originate from within the extension organization, not from the external environment (Orie, 1982). This would indicate a need for the improvement of both administrative and technical capacity within the public agricultural extension organizations in developing countries.

Evidence shows that the low professional competencies of extension agents, common in developing countries, are a key factor that limits their effectiveness. Without adequate well-trained staff members, extension organizations are limited in their ability to plan and execute sound educational programs and related technology transfer activities. The educational qualifications of extension personnel in most developing countries tend to be very low in relation to the assignments and responsibilities they are expected to carry out (FAO, 1990).

The capacity of the educational institutions is limited and not well linked to extension. Recommendations after studies of the Kenyan extension system, point to "an urgent need to catalog the technical competencies needed by the extension personnel in their various work areas" (Ongondo, 1984). There is need to put more emphasis on the quality of staff rather than focus only on the quantitative issue of extension agent to farmer ratio. There is evidence to indicate that even when the agent : farmer ratio is favorable, extension workers tend to seek out a minority of better-off farmers (Moris, 1991).

Country Setting

Zimbabwe is a land-locked country situated between the Zambezi and Limpopo rivers in southern Africa. The total land area is 389,370 square kilometers (150,333 square miles), which is about the same size as Japan or California. The population in 1992 was estimated at 10.4 million, with an annual growth rate of 3.1% (Daily Gazette, 1992). By developing country standards, Zimbabwe has a well diversified economy with advanced industrial and monetary sectors. With an estimated per capita income of US $670 in 1989, it is classified as a lower-middle income country (World Bank, 1992). The country has a markedly dualistic economy with a strong, modern sector that produces most of the consumer goods found in industrialized countries accompanied by massive urban unemployment (Muir, 1991). The annual inflation rate averaged about 15% per annum in the 1980-90 decade.

Agriculture

Zimbabwe is divided into five natural regions on the basis of soil type, rainfall and other climatic factors. The first three regions are suitable for intensive crop and livestock production whereas the remaining two offer limited scope for agricultural development (CSO, 1985). Agriculture is divided into three main sub-sectors, large-scale commercial, small-scale commercial, and, communal and resettlement. Large-scale commercial farms occupy most of the intensive farming regions, while the communal and resettlement are located in semi-intensive and extensive farming regions. Commercial farmland is privately owned, while communal and resettlement land is farmed under a traditional tenure system.

At least 60% of the national population resides on communal and resettlement land under traditional tenure rights. The division of Zimbabwe's farmland, summarized in Table 1, is estimated as 58% communal (including resettlement areas), 38% large-scale commercial, and 4% small-scale commercial (former Purchase Areas). Land distribution per person is highly skewed in favor of large-scale commercial farming. Land resettlement and policy issues are possibly the most central critical issue in the agricultural sector. For example, there are proposals for the resettlement of 110,000 families on about 5 million hectares currently in the large-scale commercial sector, and also the possibility of a higher land tax for under-utilized land to bring more land onto the market (Zimbabwe Government, 1991).

Table 1: Zimbabwe - Land Use Categories

Sector	Total area (million ha)	% of total area	% of arable land	Families
Non-agricultural	5.84	15.0	-	-
Large-scale commercial	12.65	32.5	38.3	4300
Small-scale commercial	1.42	3.7	4.3	8530
Communal & Resettlement	18.99	48.8	57.5	900,120
TOTAL	38.90	100	100	912,950

Sources: Central Statistical Office, 1985; Agritex, 1990.

Since independence in 1980, the volume of agricultural production has been increasing at an erratic pace, with an average annual growth rate of 4.5% between 1979 and 1985 (Zimbabwe Government, 1986). Agriculture is a priority sector of government policy, with the small-scale farming sub-sector identified as a key area of focus. This policy is aimed at redressing imbalances resulting from the country's pre-independence, colonial era. The agricultural sector is coordinated by the Ministry of Lands, Agriculture and Water Development (MLAWD). Through its departments and parastatals (quasi-government corporations), the ministry is responsible for the entire array of agricultural activities (Zimbabwe Government, 1986). The budget for the ministry averaged 6.2% of the national budget for the period 1985-92[7].

Extension

The dominant agricultural extension system in Zimbabwe can be classified as a general, ministry-based approach. There are a number of other extension systems, such as the commodity-centered system for tobacco, private sector extension centered on agricultural inputs, and, many relatively small nongovernmental organizations (NGOs) using a variety of extension approaches. The different systems are mainly a result of political and economic factors, and the diverse nature of the agricultural sector in agro-ecological potential, clientele character and production systems.

The major agricultural extension organization is the Department of Agricultural, Technical and Extension Services (Agritex), based in the MLAWD. Agritex's main objective

[7]Calculated from data in World Bank Agriculture Sector Memorandum, May 1991.

is the implementation of government agricultural policy through the provision of technical and extension services. Agritex (1990) states its official mandate as:

> To assist in the implementation of the policy of government in relation to the development of the agricultural industry of the country, taking into consideration the rural development essential for successful, productive and stable agriculture.
>
> Increase the productivity of agriculture with special emphasis on the communal, resettlement, cooperatives, small-scale farmer and large scale farmers in that priority order.
>
> Stimulate the adoption of appropriate proven agricultural conservation and management practices leading to increased, sustained and profitable production.
>
> Promote the development of people on the land, thus improving the standard of living and the quality of life.
>
> (p. 3)

Its target clientele, in order of priority, are: communal and resettlement area farmers, small-scale commercial area farmers, and large-scale commercial area farmers (Agritex, 1990). Before independence in 1980, two separate extension systems served the communal and commercial farmers, respectively. Agritex is a relatively new organization, created in 1981 after the merger of the two extension departments[8]. Although Agritex is the only government department with a widespread representation at grass roots level, it covers only about 60% of communal area farmers (Cornelissen, 1991).

Like other departments in the public sector, Agritex has undergone many substantial policy changes since 1980. There has been a shift away from the coercive and prescriptive approach that was typical of the colonial era.

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[8]Agritex was created through the amalgamation of the Dept. of Conversation and Extension (CONEX) within the former Ministry of Agriculture, the Dept. of Agricultural Development (DEVAG) within the former Ministry of Lands, Natural Resources and Rural Development. Under the previous structure, CONEX was responsible for providing technical and extension services to commercial and former African Purchase Land farmers, while DEVAG provided those services in the former Tribal Trust Lands.

Agritex obtains most of its funding from government budgetary allocations. For the period 1981-92, Agritex budget allocations were approximately 0.6% and 11% of the national and MLAWD budgets, respectively. In the 1990-91 fiscal year, about 80% of the departmental budget was spent on personnel costs; 65-70% is considered as a workable maximum percentage to ensure sufficient funds for extension activities (Cornelissen, 1991).

Agritex is headed by a director, assisted by three deputy directors, each responsible for a division. These divisions are Technical, Field and Irrigation services (Appendix 2). The technical services division is made up of six specialist branches: crop production, livestock production, planning, training, agricultural engineering, and agricultural management services. It serves as the main link between agricultural research and the field extension services. The field services division is mainly engaged in communication of extension messages to farmers. It is also tasked with liaising with other government and non-government organizations in the agricultural sector. The irrigation division is relatively new, created in 1985, specifically to address the issue of stabilizing production in low rainfall areas (Zimbabwe Government, 1986).

The department employs approximately 2,500 field technical and extension personnel. Human resources in Agritex are decentralized with over 90% of the field staff stationed at provincial or district offices. Most the field staff are frontline extension workers and supervisors, who reside within the small-scale farmers' community. At the officer level, the staff is divided into administrative and technical. The administrative staff, like regional and agricultural officers are responsible for the day-to-day management activities while technical staff are more engaged in advising and training within their respective specialist areas. With an extension worker to farmer ratio of 1 to 485, Zimbabwe has a higher intensity of

extension coverage than the 1 to 1,809 average for Sub-Saharan Africa[9] (Ashworth, 1990; FAO, 1990). Female field extension agents comprise about 10% of the total field staff, which is slightly higher than the average for Sub-Saharan Africa of 7% (Appendix 2; FAO, 1990). The breakdown of Agritex staff in the technical and field divisions by their official ranks, is shown in Table 2.

In 1983 the government obtained a World Bank/IFAD loan to strengthen agricultural research and extension (World Bank, 1983). Agritex experimented with the World Bank-promoted Training and Visit System (T&V) during the early 1980s. After assessment of the impact of the T&V system in the two districts (Shurugwi and Chiwundura) in which the system was tried, the department does not intend to adopt the major components of the system[10]. Pazvakavambwa (in press) summarizes the main concerns with the pilot T&V as:

> The Training & Visit system of extension is more suitable in the case where extension staff are not previously trained in agriculture.
>
> The system is too rigid in approach and lacks the flexibility to make it more relevant to the needs and environment of the small scale farmer.
>
> The system is too mechanical in its implementation and does not allow for multiple diversity in cropping enterprise as is characteristic of the small farmers.
>
> Training and Visit is heavy on resources, some of which are extremely limiting e.g. transport. Although Zimbabwe has a good network of rural roads, the provision of adequate transport facilities for the extension service is still to be achieved.

Pazvakavambwa concludes that the pilot T&V system had limited success and needs to be modified to suit clientele needs by injecting sufficient flexibility to match available resources.

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[9]Ratio for Zimbabwe includes extension supervisors.

[10]J. Makadho, Agritex Director, personal communication, October, 1992.

Table 2: Agritex - Technical and Extension Personnel[11]

Rank	Number	%
Director	1	2
Assistant Directors (Field, Technical & Ag. Engineering)	3	
Chief Agricultural Extension Officers	9	
Chief Agricultural Specialists	8	
Principal Agricultural Extension Officers	16	
Principal Agricultural Specialists	8	
District Agricultural Extension Officers	49	2
Subject Matter Specialists	164	6.5
Agricultural Extension Officers	211	8
Agricultural Extension Supervisors	322	13
Technicians	29	
Research Assistants	10	1.5
Agricultural Extension Workers	1 679	67
TOTAL	2 509	100

[11]Source: Hakutangwi, 1992; staff numbers exclude the engineering division and administrative section.

Pesticide Use

Pesticide use is regulated mostly by the Plant Protection Research Institute (PPRI) which is a branch of the Department of Research and Specialist Services (DR&SS) in the MLAWD. All pesticides offered for sale and distribution, except for veterinary remedies, fall under the Pesticides Regulations of the Fertilizer, Farm Feeds and Remedies Parliamentary Act of 1977. The Hazardous Substances and Articles Regulations of 1985 specify the policies for the safe use of pesticides. The official purpose of registration is to ensure the least hazardous and most efficient use for all sectors of the community (Allcock & Leece, 1980).

The agro-chemical industry has about 14 companies, of which 6 are subsidiaries of international corporations. The Agricultural Chemicals Industry Association (ACIA) represents the interests of pesticide companies. All pesticides for agricultural use require a license from the DR&SS before their release onto the market. Efficacy evaluation of new pesticides is a prerequisite for licensing. Efficacy evaluation is conducted by several organizations including the PPRI, the Cotton Research Institute, the Department of Veterinary Services, the University of Zimbabwe, the Tobacco Research Board, and pesticide companies.

There are over 450 registered pesticides in the country and it is estimated that the country uses pesticides worth Z$250 million per annum (Financial Gazette, 1992). Eighty percent of the pesticides are used directly in agriculture (FAO, 1991). Small-scale farmers account for only about 5% of pesticide sales; the bulk of the pesticides are used in the large-scale commercial sector and state farms. Only one pesticide, copper oxychloride, is wholly manufactured in the country; the active ingredients for the rest of the pesticides are imported, using scarce foreign exchange, and only the formulation takes place locally.

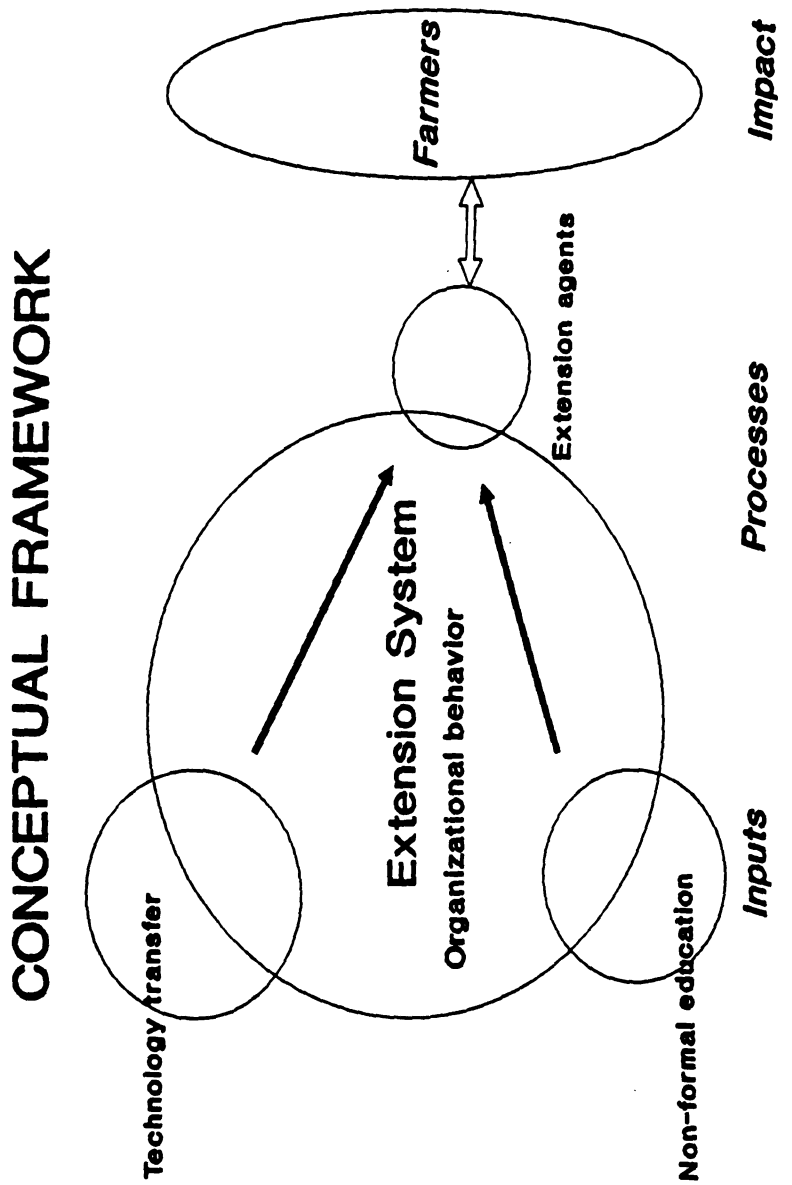


Figure 1: Conceptual Framework

Summary

Extension is neither a purely technology transfer nor a rural human capital development function. Figure 1 provides a schematic view of the issues considered in the conceptual framework. In conceptualizing the research problem elements of both paradigms guided the general direction of the study. Knowledge transfer and stimulation of problem-solving capacity are important issues for more effective extension programs. Concepts from organizational behavior and the specific setting in terms of the country and it's agricultural and technological systems were incorporated for greater focus.

CHAPTER III

LITERATURE REVIEW

This chapter details the pertinent issues that guided the research process. While there is overlap in some relevant articles identified during the literature search, this review discusses and summarizes the issues with specific reference to pesticides and pesticide use in developing regions. The review is structured to cover five main areas: (1) information needs and sources, (2) information channels, (3) technical competence, (4) extension agent technical support needs, and, (5) attitudes to pesticide use. The chapter concludes with some findings and insights from the secondary data search.

Information Needs and Sources

New technology is a necessary, but not sufficient condition for increased farm productivity with given natural resources (Feder & Slade, 1985). It is not a necessary condition if there is a gap between available knowledge and typical farmer practices. A major constraint in improving pest management in developing countries is the gap between knowledge needed at the farm and that of which the farmer is aware. This gap may be due to lack of provision of the required information, poor dissemination or poor reception (Hoeng, 1989). The collection, management and distribution of pesticide information may serve many purposes. For example, lack of information, uncertainty, and perceived risks inhibit adoption decision-making (Abelson & Levi, 1985). Wete (1991) argues that progress

in agriculture is based on information and its transfer; information transfer is therefore the main function of extension.

Information management is a complex process that has many stages and components. The process should be considered as holistic since the stages and components are inter-related. Articles included in this review focus on pesticide use information in problem-focused, solution-generating decisions. To improve farmers' pest management practices, it is important to examine the flow of information to farmers.

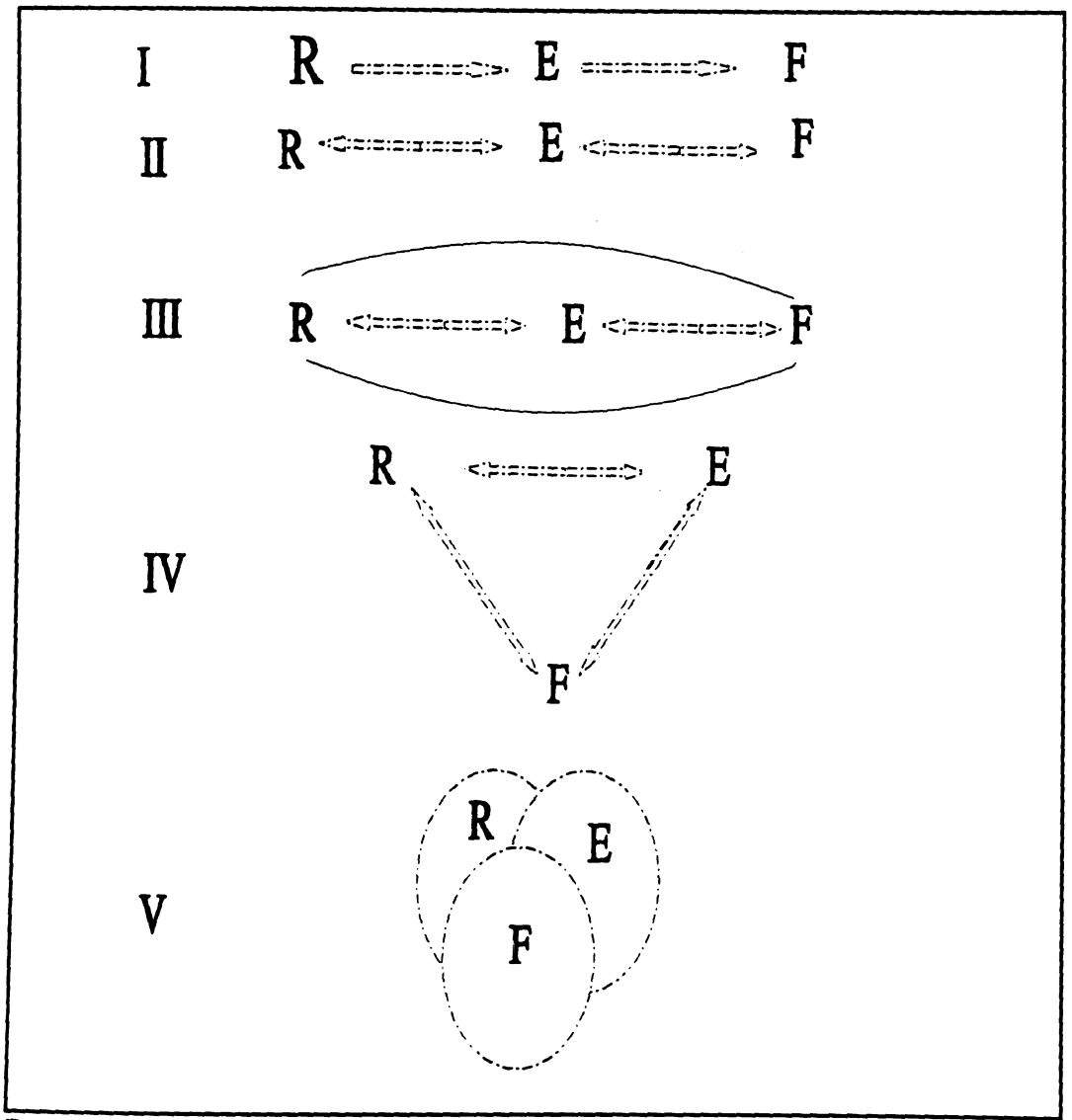
For sometime now, it has been recognized that the flow of information between researchers, extension workers and farmers, has been inadequate (Kinara, 1984; Merrill-Sands & Kaimowitz, 1990). In some extension systems there is little evidence of interaction and collaboration between these sub-components in the processes of knowledge generation and utilization (Dandhanin, 1984). For example, in Pakistan research findings show that interaction and communication between researchers and extension agents, and, between researchers and farmers are "tenuous and scarce" (Malik, 1988).

Analysis of the information needs of researchers, extension agents and farmers will help identify constraints in the flow of knowledge and ways in which it might be improved. The primary sources of technical information for pesticides are organizations involved in pesticide research, development, manufacturing and marketing. Most of these sources are multinational corporations, research institutions and universities located in industrialized countries.

Hoeng (1989) uses an information systems model to illustrate the transmission of agricultural knowledge. The model has four functional sub-systems: (1) basic research, (2) applied research and development, (3) practice, and, (4) consumption. Hoeng concludes that effective knowledge utilization takes place when the sub-systems are inter-related and

coordinated into one system. Formal links are not always enough to ensure effective links between the sub-systems. Eponou (1990) argues that the effectiveness of an information system depends not only on structural interdependence, but also on goal consensus.

There are several other conceptual models of knowledge transmission. Figure 2 illustrates the evolution of a conceptual framework of agricultural knowledge transmission systems. Agricultural knowledge systems began with a unidirectional researcher-to-farmer view with no feedback (I). A two-way flow of information between scientists and farmers was recognized with extension playing a mediator-facilitator role (II). Gradually, it became evident that direct contact between researchers and farmers would be useful because feedback from extension on farmers' needs and problems is often inadequate (III). Then more emphasis was placed on the exchange of knowledge among researchers, extension workers and farmers as equal partners (IV). The latest concept is overlapping functions of research, extension and farmers (V), such as the farmer-back-to-farmer model (Hoeng, 1989).



R = Research, F = Farmers, E = Extension.

Figure 2: Conceptual Framework of Agricultural Knowledge Systems

Pesticide use information is required by a variety of users for decision-making in pest management. The decision-makers can be divided into four main categories: farmers, extension services, legislation and regulation services, and the private sector. Figure 3 illustrates the main categories and institutions requiring pesticide use information for the small-scale agricultural sector in Zimbabwe.

SMALL-SCALE FARMERS (Communal & Resettlement) * Cost-effective control * Marketing and technical information	REGULATORY SERVICES (PPRI, DCC & HSB) * Monitoring * Regulation * Legislation
EXTENSION SERVICES (Agritex, Company reps & others) * Advisory service * Education * Monitoring	PRIVATE SECTOR (Pesticide companies) * Manufacturing * Marketing * Research

Figure 3: Categories of Decision-makers in Pest Management in Zimbabwe

Each category can be further sub-divided in terms of their specific requirements: why they need the information, what kind of information they need, how it should be managed and distributed, and how best to ensure that it is cost-effective and focused on practical decision-making (Putter & Van der Graaff, 1989). For information gaps to be reduced, it is necessary first, to identify the information needs of users.

Farmer Pesticide Use Information Needs and Sources

In the forefront of pest management is the farmer, who is supported by state institutions and the private sector. While there is now substantial literature on the need for farmer involvement, Roling argues that understanding the need for farmer participation is often clouded by the metaphors used to describe the process by which technology is developed and delivered:

> Farmers tend to be seen as passive recipients - users of technology developed by other people. At best, it is acknowledged that some feedback on farmers' reactions to a new technology is desirable in order to refine that technology, but this is likely to be regarded as a need for mere fine-tuning.
>
> Roling, 1989.

About 15% of the estimated 900,000 families in the communal and resettlement areas use chemicals or pesticides for pest and disease control on their crops. Use of pesticides and other inputs is greater in the higher potential agro-ecological zones (Chipika, 1990). Most of the pesticide use is on maize and cotton where 85% and 50% of the small-scale farmers growing these respective crops in 1989 applied pesticides (Sunga et al., 1990). The most common pesticide for maize pests is Thiodan (endosulfan), which is used for controlling stalkborer, *Busseola fusca*. At 3%, herbicide use has had one of the lowest

adoption rates; most small-scale farmers continue to practice hand weeding using family or hired labor (Chipika, 1990). A survey of communal farmers in Makonde district estimated that 70% of the respondents needed instruction in the use of agro-chemicals (Mutuma et al., 1987). Technical information on pesticide use in small-scale farming areas is limited, and, generally unreliable.

Research on the relationship between farmer awareness of specific technologies and agricultural productivity is limited. Studies by Govereh (1991) on the impact of technology adoption in marginal rainfall areas of Zimbabwe showed a positive relationship between farmer awareness of recommended technologies and maize yields. Awareness and use of recommended technologies contributed for about 15.3% of the variation in maize yields (Govereh, 1991). Studies of small-scale farmers in Transkei showed significant positive correlations between total crop yield and three communication factors: extension contact, group media contact and mass media contact (Brembridge, 1986).

An economic study of cotton farmers in Tanzania concluded that there is a positive correlation between knowledge of cotton-growing recommendations and technical efficiency but no significant correlation between technical efficiency and *seeking* agricultural information (Shapiro & Muller, 1977). In a survey of the Training and Visit (T&V) Project in Shurugwi and Chiwundura districts of the Midlands province in Zimbabwe, 12.5% of farmers in the T&V groups attributed lack of knowledge about pest control and pesticide use as the main reason for not using pesticides (Agritex, 1992). The proportion was higher (25.8%) for farmers who were not in T&V groups.

Errors in farmer's estimates of the productivity of pesticides result from uncertainty about the levels and effects of pest populations, or, uncertainty about the effectiveness of pest control. Pingali and Carlson (1985) modelled behavior in a sample of apple farmers

in North Carolina (U.S.A.) in an uncertain environment, and identified the human capital variables with the largest effect in reducing subjective errors as farmer experience (age), formal schooling, data collection time (scouting), and, attendance at specialized extension training sessions.

Many communication channels can be used to provide links between farmers and the external sources of information. Choice of the most appropriate channel will depend on farmers' access and their ability to use the channel. Illiteracy is a common problem limiting the information channels farmers can use. In developing technical information for farmers, emphasis needs to be placed on unambiguous design and on tailoring the content for particular target groups (Hoeng, 1989).

Sophisticated pest management techniques like integrated pest management (IPM) are relatively more knowledge-intensive. Studies by Hanneman and Farnsworth (1981) on crop input use decisions, found information to be the major determinant in the decision to adopt IPM for cotton farmers in California. Adoption of IPM in less developed regions also could be facilitated by improving the flow of information to farmers. Thomas et al. (1990) propose an adoption-agrisystem model using diffusion theory and aspects of farming systems theory. Using this model they found significant relationships between sources of information, personal and farm characteristics, and beliefs about IPM amongst Texas cotton growers.

Agritex Pesticide Use Information Needs and Sources

Contact between Agritex extension agents and communal area farmers varies. A 1990 nationwide survey by the Zimbabwe Institute of Development Studies (ZIDS) reports that less than half of communal area farmers have some contact with extension (ZIDS, 1990). A 1982 study of four districts however showed a higher level of contact (55%) between communal farmers and Agritex extension workers (Bratton, 1986)[12]. Bratton noted that membership in farmer organizations was the major factor explaining differences in the level of contact; 86% for group members compared to 31% for individual farmers.

There is limited empirical research on the content and appropriateness of extension messages to communal farmers. Historically, the tendency within Agritex has been to import, wholesale, the recommendations for the resource-endowed commercial sector. Studies by Agritex (1985), Ashworth (1990) and Govereh (1991) indicate that the extension advice given to small-scale farmers is biased toward better-off farmers in the more productive agro-ecological zones.

Most of the extension workers' advice to farmers is given for management practices that occur early in the agricultural season (Agritex, 1983). Relatively less attention is given to mid- and late-season practices like weeding, pest control and harvesting. Results from an Agritex/Cilca Project in Wedza found that 62.7% of the farmers surveyed considered extension worker advice as inappropriate especially with regard to labor and financial requirements (Agritex, 1985). There is evidence showing that overall, Agritex extension efforts have a positive influence on communal farmer productivity; there is also evidence

[12]Guruve, Wedza, Gutu and Dande districts.

that some of the recommendations are not sensitive to the diverse agricultural production patterns and resource endowments of small-scale farmers.

Field extension agents require a great variety of pesticide use information to meet the technical needs of farmers. Information is needed on: (a) symptoms of pest attack, (b) field diagnosis of pests, (c) life cycles of pests, (d) pest frequency, (e) pest movement between countries and regions, (f) survey methods, (g) data collection and processing, (h) safe and efficient pesticide use, and, (i) pesticides application methods. The potential farmer demand for information on pest management is therefore very high. It is not likely that an individual extension agent will have adequate and first-hand information on all the aspects of pests and pest management. Field extension agents are therefore likely to require support from their colleagues, technical experts and other sources to meet their information requirements.

With specialization and diversification, the information needs of Agritex will increase. Cornelissen (1991) contends that Agritex will not be able to expand horizontally (number of activities) and vertically (level of sophistication) sufficiently to cope with the increasing information requirements. This increasing inability might affect Agritex's credibility. Ashworth (1990) expresses concern with respect to the content of a variety of extension messages delivered by Agritex, indicating that the credibility of extension is at risk when communal area farmers view many recommendations as inappropriate.

Agritex extension agents are frequently the only links between the rural community and outside organizations. They tend to be involved in "non-extension" activities like organizing the supply of agricultural chemicals on behalf of farmers. Agritex extension agents are involved in facilitating farmer "Supply Marketing Groups" as part of their work activities. In 1990, a total of 175 supply marketing group meetings were organized by

Agritex field staff; 36 of these meetings were in Mashonaland Central province[13] (Agritex, 1990). Such meetings reduce the time available for educational activities on input use between extension agents and their clients. Where production and distribution facilities are inadequate, technology transfer agents tend to concentrate more on input delivery than on information dissemination, which inevitably weakens the research-technology links (Merrill-Sands & Kaimowitz, 1989).

Private Sector Pesticide Use Information Needs and Sources

The pesticide industry in Zimbabwe has about 14 companies that are affiliated to the Agricultural Chemicals Industry Association (ACIA). The primary need for technical information by pesticide companies is to secure local registration for their products, which is a prerequisite for distribution and sale. To meet this end, companies require information from the developers and manufacturers of the pesticide, and also data on the product's efficacy.

Private sector extension activities vary widely and tend to be closely aligned with marketing activities. Private sector input and extension services are biased toward the larger and more commercially-oriented farmers. Since information has a value and can be marketed (the price is determined by the merits of the information to the user), the knowledge generated by the private sector will not always be diffused or made a public good (Cornelissen, 1991).

After meeting the requirements for pesticide registration, commercial firms are under no legal obligation to provide more technical information on their product, except that

[13]No figures were reported for Midlands province.

on the product label. In general, very little technical information is provided by marketing companies to Agritex extension agents and small-scale farmers; companies tend to provide advertising or other marketing information to support product sales.

PPRI Pesticide Use Information Needs and Sources

The Plant Protection Research Institute (PPRI), a branch of the Department of Research and Specialist Services (DR&SS) in the MLAWD, is the major legislation and regulation organization for pesticide use in Zimbabwe. The Drug Control Council (DCC) in the Ministry of Health and Child Care regulates the use of veterinary remedies like cattle and dog dips that are also used by farmers. The main requirements for pesticide registration are:

> (a) Phytotoxicity data, short and long-term toxicological information for the specific pesticide,
>
> (b) Registration of the pesticide in the manufacturer's country of origin,
>
> (c) Local evaluation of the new pesticide for efficacy; were possible a pesticide registered for similar pests is used for comparison in the evaluation trials, and,
>
> (d) Registration of the applicant(s) as a commercial company in Zimbabwe.
>
> Allcock & Leece, 1980; Dzemwa & Muchena[14]

A substantial amount of technical information, especially on efficacy against local pests, is generated through local evaluation of new pesticides. The information generated is however more applicable to large-scale commercial farms and research stations, where

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[14]Ms Dzemwa, Pesticide Registration Officer & Dr. Muchena, former head of the Plant Protection Research Institute, DR&SS, personal communication, October, 1992.

most evaluation and registration trials are conducted. No pesticide registration trials are conducted in small-scale farming areas although representatives of pesticide companies occasionally put in demonstration trials in communal areas.

The enforcement of pesticide legislation is a general problem throughout the southern Africa sub-region (FAO, 1991). The Pesticides Regulations in the Fertilizer, Farm Feeds and Remedies Act of 1977 are the basis for public policy and strategy decisions regarding pesticide use in Zimbabwe. This legislation was formulated before the initiation of the Economic Structural Adjustment Program (ESAP), which recommends the gradual deregulation of most imports. There are some "loopholes" in the current legislation on pesticide use. Inadequacies in the current pesticide policies include:

(1) Lack of a clear policy governing the importation of pesticides by individual users, especially in view of the recently introduced open general import license (OGIL), and,

(2) There is no legal requirement for a minimum level of competence for both users (farmers and other applicators) and technical advisers (for example extension agents and representatives of commercial companies).

Post-registration activities are necessary to ensure the effectiveness of a registration scheme. The FAO (1991) lists such activities as including: monitoring the quality of pesticides in the market, determination of residue levels on food crops, evaluation of compliance to labelling requirements, environmental effects, enforcement of regulations, training programs on safe use of pesticides, licensing of various activities pertaining to pesticides, disposal of unwanted pesticides, and control of advertisements. The PPRI is

involved in very limited post-registration activities, and has generally depended on the goodwill of pesticide companies for compliance with the regulations.

In summary, the issue of the most appropriate source of information for small-scale farmers is complex and therefore debatable. Cornelissen (1991) argues that neither the public sector nor the private sector will provide farmers with unbiased information. The public sector tends to be influenced by national priorities and goals, and by its bureaucratic agenda. Private sector information is usually tied to the sale of a product, limited to specific commodities, or to religious and/or political objectives (common in NGOs). For this study, the researcher decided it would not be feasible to collect adequate information directly from all four categories of decision-makers; primary data collection was limited to ranking currently used, and preferred sources of information sources from selected Agritex extension agents.

Information Channels

Channel or media choice involves more than simple common sense; it is a complex process that is influenced by the interplay of messages, symbols and contextual influence (Trevino et al., 1990). The main channel for public sector dissemination of agricultural knowledge is usually the extension service (Feder & Slade, 1985). Common channels used for transmitting pesticide information to farmers include:

(a) mass media, such as radio, television, newspaper, and leaflets from government and commercial sources,

(b) personal contact with extension agents, dealers, stockists and representatives of commercial firms, either on an individual basis or in groups, and,

(c) personal contact with other farmers.

The capacity of a medium to facilitate communication is called media richness (Trevino et al., 1990). Media richness can be classified based on a blend of four criteria:

> 1. The availability of instant feedback, making it possible for communicators to converge quickly upon a common interpretation or understanding.
>
> 2. The capacity of the medium to transmit multiple cues such as body language, voice tone, and inflection, to convey interpretations.
>
> 3. The use of natural language, rather than numbers, to convey subtleties.
>
> 4. The personal focus of the medium.
>
> Trevino et al., 1990.

To assess the role of various channels of information diffusion, it is necessary to review farmers' ranking of information sources for that particular technology. Because the main characteristic of new technology is the lack of familiarity by farmers, public involvement through the utilization of agricultural extension and mass media is an obvious policy tool (Feder & Slade, 1985). Studies conducted in the 1950s and 1960s to evaluate different types of media in agriculture concluded that no one medium is best, but the selected medium must be adapted to the message, target audience, and social environment (Wete, 1991). There is general agreement in the literature that media should be used as a complement to personal contact with front line extension staff (Schwartz, 1991). Face-to-face communication is considered as the richest media or channel for transmitting messages (Figure 4).

MEDIA RICHNESS	MEDIUM
^	
HIGH	Face-to-face
	Telephone
	Letters
	Memos
	Special reports
LOW	Newspapers
	Technical bulletins
	Technical journals

Adapted from Trevino et al. (1990)

Figure 4: Hierarchy of Media Richness

Use of face-to-face communication in agriculture is limited because of the relative dispersion of researchers, extension agents and farmers, which make it very inefficient and at times impractical, for transmitting technical messages. Studies by Feder & Slade in Northwest India indicate that the more available extension agents are, the more likely they are to be the main source of technical information. Irrespective of the availability of extension, the more complex or risky practices have a higher tendency to be learned from extension. This implies that for complex practices, extension agents should try to maximize their direct interaction with farmers, while simpler practices can be diffused through contact farmers (Feder & Slade, 1985).

Because of the limitations of face-to-face communication in field extension, mass media has an important role to play in supporting extension activities. Participants at a World Bank African extension specialists' workshop agreed that:

> (a) mass media is very effective in creating awareness and farmers can always approach the extension agent for details,
>
> (b) media, such as radio, can efficiently reinforce the convictions of farmers that new technologies are worthwhile,
>
> (c) an environment for adoption can be promoted through mass media,
>
> (d) mass media can be a morale-booster for the farmers, when the extension recommendations confirm what the farmers themselves have been doing, and,
>
> (e) mass media provides the quickest way of reaching a large number of farmers in a very short time and would therefore be very useful in times of emergencies, such as a large-scale pest attack.
>
> Venkatesan & Schwartz, 1992.(p. 59).

Communication devices such as publications, audio-visual materials, radio programs, training courses and seminars can be used to disseminate information in a variety of situations. They require careful planning, adequate funding, and strong commitment; in many cases they require specific skills and creative talents (Merrill-Sands & Kaimowitz, 1989). Information about relatively simple technologies, such as seed varieties, can often be disseminated through informal channels since they generally do not entail major changes in the production system. More complex technologies require formal links, such as training technology transfer agents and producing detailed information materials. Such technologies may therefore require a larger direct role from extension agents (Bindlish & Evenson, 1993).

Mass Media Channels

In Sub-Saharan countries, mass media channels are generally controlled by government and managed by ministries or departments other than those of agriculture. Radio is the oldest communication technology used for the transfer of agricultural information, and also the most diversified and widely accessible of all modern mass media (Wete, 1991). It is the most common mass media vehicle in many African countries. Radio has a relatively low cost, high potential reach and the capacity to transcend literacy and language barriers. In Zimbabwe, the state-controlled Zimbabwe Broadcasting Corporation (ZBC) has an exclusive educational channel, Radio Four, which occasionally broadcasts agricultural programs.

Agritex beams regular radio programs on various topics aimed at communal farmers. A survey of farmers in Makonde district found that 37.5% had access to a radio; 34% of the farmers with access found the programs educative, informative and useful (Mutuma, et al. 1987). Sixty-six percent of the respondents felt that the radio programs were not worthwhile due to scheduling constraints, and lack of access to a radio or to the resources advised in the programs. Although radio can be an effective tool for communication with field staff and farmers, it is for the most part one-way. Since most of the target audience is generally unavailable during normal working hours, there may be scheduling constraints and competition from the usual entertainments channels or programs. Though Agritex has promoted radio listening groups, the existence of information/communication systems becomes practically negligible in the more remote communal area regions (Moyo & Page, 1992).

Television, like radio, is useful for one-way transmission of messages. It has the added advantage of providing visual images that enhance the quality of the message. Television's main limitation is cost, which severely limits coverage for rural communities. There are relatively few examples of the successful application of television in agricultural information transfer (Wete, 1991). Wete concludes that until cost-effective solutions to production, distribution and maintenance problems are found, television will remain an elitist medium favoring wealthier consumers and urban over rural areas. Within the Agritex Training Branch there is a Mobile Training Unit (MTU), which uses audio-visual aids for farmer training. To make the program content appropriate for specific areas, the actual production of video tapes is decentralized; this approach requires training staff all over the country in the use of equipment and has led to some problems with equipment maintenance (Schwartz, 1991). Evaluations of the programs of the MTU indicate that the visits by the unit are too infrequent for tangible results, and that the conditions in which farmers are shown the audio-visual aids are not conducive to learning (Gwekwerere, 1991).

The emergence of new forms of electronic media like TV, audio and video cassettes, has led to the neglect of the potential role of print media in information transfer. Print media has a distinct cost advantage over electronic media. It is less subject to scheduling constraints and the messages in print can usually be retrieved for future use. The usefulness of print media is subject to the level of literacy of the audience. Illiteracy of the audience reduces the potential for print media to diagrams and pictorial forms.

There is an inadequate empirical base on the subject of agricultural information sources and channels for small-scale farmers in Zimbabwe. Much of the focus has been on generating new knowledge with little regard for how, and if, the knowledge is transmitted. This study used self-appraisal to identify the sources and channels available to extension

agents for pesticide use information, and, also to rank these and other preferred modes of information transfer.

Technical Competence

Competence is commonly determined by a person's being able to perform a given task. It implies an understanding of, and proficiency in, a specific kind of activity, particularly one involving methods, processes, procedures or techniques. Task performance provides an indication of the required competencies, but does not define the competencies directly.

There are many ways of defining competence. The most popular and dangerous technique for defining competence is to accept the judgement of experts, as happens in expert consensus (Pottinger, 1979). Selective perception, beliefs and value systems contaminate objectivity. Colley (1989) defines competence as "skills developed through learned knowledge that will be applied in a practical and meaningful way." Klemp (1980) defines job competency as an underlying characteristic of a person which results in effective and/or superior performance in a job. An underlying characteristic, in a sense, may be knowledge, skill, trait, self-schema or motive which a person may possess. Klemp (1979) defines these underlying characteristics as:

> Knowledge is a set of usable information organized around a specific content area, for example, knowledge of mathematics.
>
> Skill is the ability to demonstrate a set of related behaviors or processes, like logical thinking.
>
> Self-schema is a person's image of himself or herself, and his or her evaluation of that image, for example self image as a professional.

> Motive is a recurrent concern for a goal state or condition which drives, selects, and directs behavior of the individual, for example the need for efficacy. (p. 43)

These underlying characteristics are referenced to an external performance criteria. The idea that a competence is causally related to effective performance means that the development of competency should lead to increased effectiveness. Therefore competence precedes performance.

Academic and other professional credentials are the major criteria for the recruitment of public extension agents. In spite of significant empirical evidence that credentials are not causally related to, and often not even correlated with performance in the world of work, the common sense notion that an academic credential represents at least a minimal level of competence is hard to overcome (Pottinger, 1979).

The method by which a competency is measured becomes the operational definition of that competency. For example, an operational definition of competence might be the score obtained on an assessment instrument. According to Pottinger (1979) it is necessary to differentiate measuring techniques according to two separate but important dimensions to predict who will be competent performers. First, it is necessary to differentiate techniques which identify critical dimensions of the job from those that identify critical characteristics of job performers. Second, one must differentiate techniques that identify critical job or performer characteristics that are task, situation, or level specific from those which identify critical job or performer characteristics that are broad or generalizable across job situations and widely varied career performance levels.

There have been some studies conducted to evaluate the competence of extension agents in public extension systems in developing countries. Most studies are centered on

perceptions and/or ranking of a variety of broad job or performer characteristics that are related to performance. Using a list of 150 competencies divided into nine categories, a case study of public extension agents in Swaziland found no differences in the perceptions of the professional extension competency categories when examined by the individual's demographic characteristics (Easter, 1985). In Nigeria, Ayewon (1983) surveyed public extension agents in Bendel State to assess the needed competencies using perceptions to 61 professional competency statements. Respondents indicated that 98.4% of the competency statements were highly needed, and that they should be learned on the job or through in-service training.

In a survey in Uganda, extension agents, supervisors and trainers considered 31 competencies as important, with the competency *"knowing sources of desired technical information,"* ranked as the most important; few significant relationships were found between the professional competencies and the respondents' demographic characteristics (McCaslin & Najjingo, 1991). The researchers concluded that the needs for professional competencies were independent of the type of extension worker in the region. Skill areas Nigerian extension agents indicated most competency, were not necessarily the most important to them; in other words there, there was no perfect match or convergence between skills and competencies presented and the importance of such skill areas for extension work (Igodan et al., 1990).

Factors Influencing Performance

Job performance is the single most pervasive outcome variable in micro-organizational research.

Staw, 1984.

Waldman and Spangler (1989) provide a comprehensive review of the theory and research of the determinants of job performance. They note that job performance has been researched from different subject areas like abilities, motivation, leadership, group processes and feedback, with little attempt to piece together these subject areas together into an overall model. They propose an integrated model of job performance with three areas: ability, motivation and opportunity[15]. Zuidema (1989) suggests a simpler framework, consisting of five categories of factors that influence performance:

1. Extension agent attributes - these include the personal characteristics and traits that contribute to the behaviors and attitudes of the agent; many civil service appraisal systems focus on these characteristics and traits.

2. Extension agent knowledge and skills - these include the technical knowledge and skills resulting from education and experience, and, the professional skills achieved through training and experience.

3. Organizational policies and procedures - these are personnel policies (including remuneration) that influence motivation, and, organizational procedures that set the conditions for the work environment; they can have significant influence on extension agent performance.

4. Management and support services - this includes the level of financial support for important inputs for extension activities.

5. Program opportunities and activities - the mandates and defined programs of the extension organization set the limits for extension agents and form the basis for allocation of resources.

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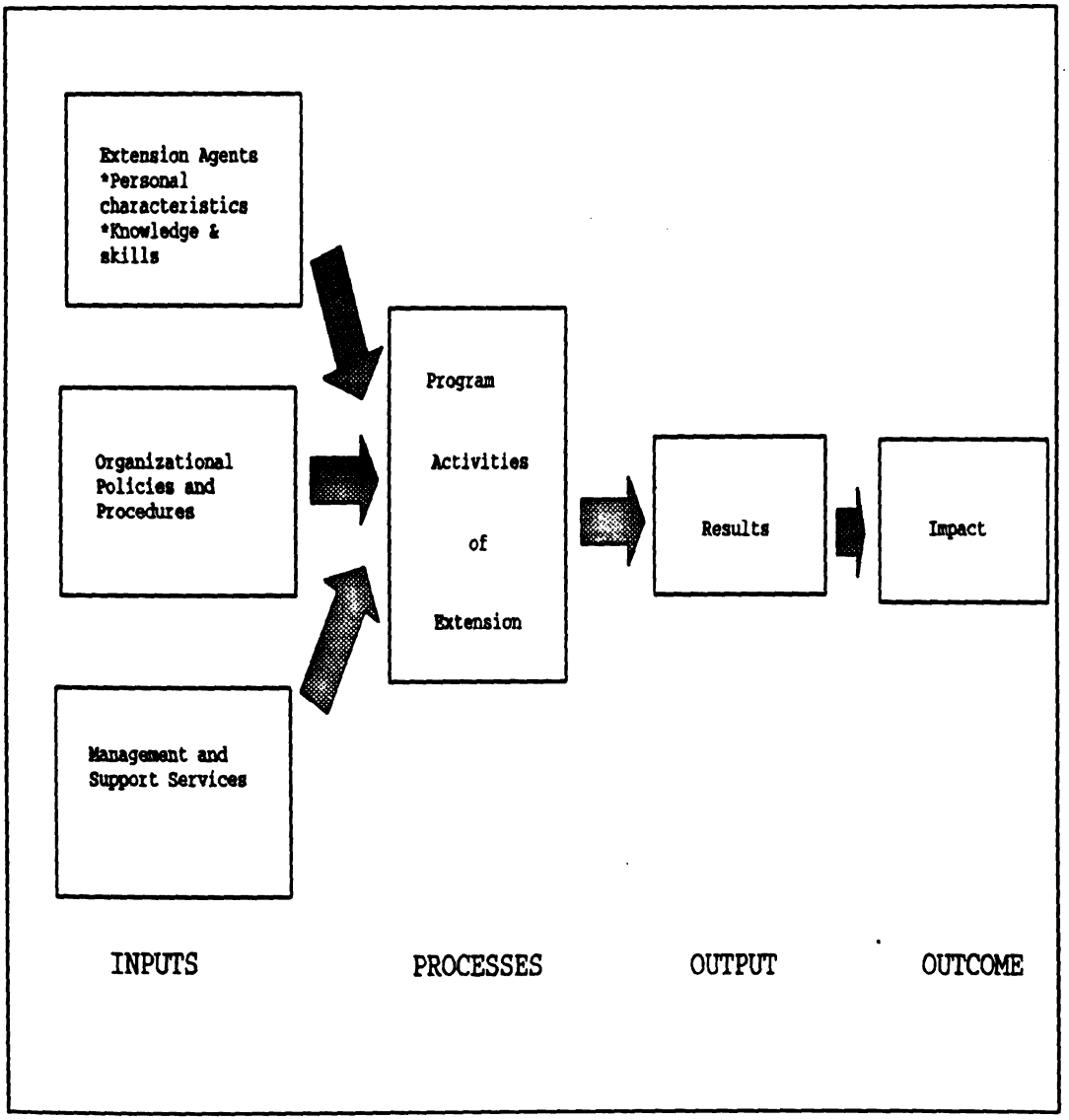
[15]Opportunity variables are factors in the individual's work environment such as tools & information, work conditions, leadership behavior, and, rules & procedures.

Figure 5 illustrates the components of extension agent performance assessment and demonstrates the relationship of these five factors to the results and impact of extension efforts. The inputs are the extension agents (personal attributes, knowledge, and skills), organizational policies and procedures, and, management and support services. These inputs are applied to the processes that correspond to the program activities of extension agents. The activities result in outputs and eventually outcomes. Performance assessments can, and often do, take account of all these components (Zuidema, 1989).



Adapted from Zuidema, 1989.

Figure 5: Components of Extension Agent Performance Assessment

There is a need for more job performance research in the extension institutions of developing countries. As suggested by Waldman and Spangler (1989), research should include causal modelling with an appropriate mix of antecedent variables, longitudinal studies to assess the effects of interventions, and, investigations of the causal differences between various aspects of performance. This study was limited to assessing abilities and the interactions between antecedent variables and abilities in one specific performance area.

For this study, variation in extension agent competence regarding pesticide use (Y) was conceived as dependent on three general independent variables: demographic characteristics (X_1), training (X_2), and access to information sources and channels (X_3). Each general variable was composed of a set of specific variables identified in the literature review or judged to be potentially influential to the competence variable.

Therefore:

$$\text{Extension agent competency, } Y = f \{ X_1, X_2, X_3 \}$$

The extension agents' age, gender, formal qualifications (academic and agricultural), position in the organization and length of experience were included in the demographic variable set. The training variable set included both pre- and in-service formal training in pest management. The information variable set consisted of items measuring the level and frequency of contact between extension agents and various sources and channels of pesticide use information.

Extension Agent Technical Support Needs

Training

Extension staff training is coordinated by the Training Branch in Agritex. Almost all of the department's funding for training comes from government budgetary allocations. For the period 1982 to 1987, only about 4% of the Agritex budget was allocated for training, field trials and irrigation (Table 3). During the same period, over 70% of the government budget allocation was used for staff salaries, wages and allowances.

Table 3: Agritex - Budget Allocations and Expenditure (1982-87)[a]

	82/83	83/84	84/85	85/86	86/87
Government Sources	14,642	17,302	19,988	23,406	27,724
External Sources	149	344	2,064	3,895	**
Salaries, Wages, Allowances	11,559	12,860	15,150	17,857	21,404
Subsistence and Transport	2,000	3,000	3,473	4,037	4,367
Incidental Expenses	360	400	380	385	425
Training, field trials, Irrigation	600	867	748	854	1,250
Land use Planning	25	25	41	50	75
Farm Running Expenses	18	30	49	57	63
Buildings & equipment	130	120	147	165	140

Source: Ndimande, 1988.
[a] - Z$ '000
** - figures not available

Most extension agents participate in at least one Agritex course every year. During the period 1981-91, the Training Branch offered 28 different types of in-service courses with a total of 3,895 participants (Cornelissen, 1991). The average duration of Agritex courses is 4 days (Agritex, 1990). The Training Branch also produces an in-house magazine, "News and Views."

There are very few documented studies evaluating the quality of Agritex staff training in the department. While the services provided by Agritex expanded tremendously during the 1980's, particularly in the small-holder sector, the quality of service has been steadily deteriorating and coverage has been inadequate mainly as a result of underfinancing of the department's operational budget (Cornelissen, 1991). The services have also suffered from high staff turnover caused by the unattractive conditions of service prevailing in the civil service (Cornelissen, 1991). Pazvakavambwa (1991) claims that Agritex has a very strong in-service training branch which "*.....has almost dispensed of the need to follow the Training and Visit guidelines.*"

The technical support needs of extension agents depend on the tasks they are to perform, their basic training, and their ability to upgrade and update knowledge and skills on the job. The basic training for extension workers in Agritex is a two or three-year agricultural certificate or diploma. There is evidence indicating that extension agents often receive adequate technical training, but with minimum preparation in communication skills and extension methodology (Lindley & Gonzalez, 1983). Hakutangwi (1990) contends that basic training at certificate, diploma and graduate levels is inadequate in preparing personnel for extension, and that there is a limit to which in-service training can correct the inadequacies of basic training. There may therefore be a gap between the curriculum in agricultural training institutions and the knowledge and skills required of extension agents.

For example, this gap is reflected by the lack of a full course in agricultural extension in the certificate and diploma level agricultural institutions (Dengu, 1988). Further, there is no comprehensive course in crop protection in the current curricula for the agricultural certificate course. Hakutangwi (1990) concludes that the need for more formal links between Agritex and the agricultural training institutions is critical.

At the pre-service level, training must emphasize extension methodology, communication skills, understanding human behavior and the development of a clear philosophical approach to the principles of extension (Lindley & Gonzalez, 1983). A study by Brooks (1982) of the in-service training needs of county extension agents in Florida concluded that, overall, a greater degree of competence perception was found associated with greater number of years employed. However, a greater degree of competence perception was associated with *least* man/days of training annually. Research in Sierra Leone refutes the importance of formal training alone in job performance. Using a Job-Design, Satisfaction, and Performance (DSP) Model to evaluate village extension workers (VEWs) in India, Lakoh (1988) concludes:

> More technical training in agriculture and high social status did not relate positively with job satisfaction. Similarly, a high level of formal training in agriculture does not necessarily mean that job performance is also high. The findings show that VEWs with a more formal training in agriculture and high social status are less likely to make frequent visits to farmers. Those who are well-versed with local dialects and well-skilled in establishing interpersonal relations perform well in their job. They are likely to make more frequent contacts with farmers.

This finding suggests that relational analysis of homophily (similarity) and heterophily (dissimilarity) between extension agents and farmers may require closer consideration since they influence performance. Rogers and Bhowmik (1970) discuss some

propositions on the utilization of homophily and heterophily as "sensitizing concepts" in different communication situations.

With increasing diversification and specialization, Agritex will not be able to provide specialist services and should therefore discontinue to pretend delivering services on "all crops everywhere" (Cornelissen, 1991). Cornelissen recommends that Agritex demarcates areas of competence for their own services and for those which could be provided by the private sector, without creating parallel structures, but only a continuum of complementary functions. Such services could include sub-contracting for mass media programs and inviting the private sector for the sponsorship of dissemination materials, formal joint ventures for applied research, demonstration fields, field days, and, the training of Agritex extension agents (Cornelissen, 1991).

For this study, pesticide use technical support needs for extension agents were assessed from extension agents' responses on the questionnaire, and, person-to-person interviews with available senior personnel in Agritex, PPRI, the MLAWD, and the pesticide industry.

Attitudes to Pesticide Use

Attitude can be defined as a general positive or negative feeling about some person, object or issue (Petty & Cacioppo, 1981). Attitude and its measurement are common features of social science research. O'Keefe (1990) notes that there are three underlying points of consensus concerning the concept of attitude:

> (1) Attitudes are learned, as opposed to being innate. Attitudes are generally taken to be a function of the sorts of experiences a person has; with changing experiences, a person's attitude may change.
>
> (2) Attitudes are taken to be relatively enduring, as distinct from a temporary emotional state like a mood.
>
> (3) Attitudes are taken to influence conduct. Attitudes exert an influence on behavior. This influence may not be simple and direct but attitudes are presumed to play some role in action.
>
> (p. 18)

There are a variety of techniques for measuring attitudes. Measuring procedures can be divided into two major categories: direct and indirect (Petty & Cacioppo, 1981). With direct procedures, a person is asked to provide a self-report of his or her attitude. With indirect procedures, an attempt is made to measure a person's attitude without the person knowing it. For this study, the direct procedure, using a Likert-type scale for opinion statements, was used to assess the attitudes of extension agents to aspects of pesticide use amongst small-scale farmers.

Summary

A major constraint in improving pest management in developing countries is the gap between knowledge needed at the farm and that of which the farmer is aware. This gap may be due to lack of provision of required information, poor dissemination or poor reception. There is some evidence from Zimbabwe and other developing countries that awareness, and use of technical information on pesticide use, has a direct impact on farm productivity. The four broad categories of pesticide information users are farmers, regulatory agencies, extension services and private companies.

About 15% of the estimated 900,000 small-scale farmers in Zimbabwe use agricultural chemicals. Pesticide use is greater in the higher potential agro-ecological zones. Most of the pesticide use is on cotton and maize. There is evidence of farmer adaptation of the technological recommendations from extension agents. Technical information on pesticide use for small-scale farmers is limited and generally unreliable. Agritex has the most widely spread extension service catering for about 60% of the small-scale farmers. It uses a variety of information channels for dissemination of information.

The extension service has minimal involvement in the pesticide registration system. Most of the Agritex recommendations for pesticide use are based on commercial application rates. A small portion of the department budget is used for staff training. There is a paucity of empirical studies on the professional and technical competencies of Agritex extension agents regarding the tasks they are expected to perform.

There are about 14 companies involved in formulating and marketing pesticides. After meeting the requirement for registration, companies have few obligations to provide more technical information on their products. The small-scale farming sector accounts for only about 5% of pesticide sales, making it unattractive for companies to invest heavily in this sub-market. Pesticide companies tend to get involved in the small-scale sector for political rather than profit reasons.

The pesticide registration and monitoring services in Zimbabwe are generally better than in most other Sub-Saharan African countries. With the current deregulation of the economy there are however some weaknesses in the pesticide registration and post-registration policies and procedures.

There are relatively few knowledge-attitude-practice (KAP) studies of extension agents in Zimbabwe. Specifically, there are few documented studies evaluating the attitudes

of Agritex extension agents to technology, farmer practices and know-how, and, the extension organization.

CHAPTER IV

RESEARCH PROCEDURES

This chapter details the research procedures used for addressing the study objectives. It consists of the following eight sections in order: study design, target population and sampling, development of the survey instrument, instrument validity and reliability, distribution and collection of the questionnaire, and, data analysis. The research hypotheses listed in Chapter 1 are restated as null hypotheses in the data analysis section.

Study Design

The primary purpose of this study was to determine the nature of pesticide use information flows, and the technical competencies and needs of selected Agritex field extension agents. A descriptive research design was chosen as appropriate. Descriptive research is concerned with "what is" (Borg & Gall, 1983). It is aimed at describing systematically a situation or area of interest factually and accurately. Quantitative and qualitative data was collected through a survey of selected extension agents in two provinces and interviews with senior personnel in organizations involved in pesticide use. The author conducted the survey in Zimbabwe over a five-month period, from August to December of 1992.

During the time of the survey, the country was going through a severe drought which necessitated some changes in the research design. Time and scheduling constraints precluded the possibility of formal and systematic interviews with all relevant senior officers

in the Agritex. The study therefore focused on junior officers although some relevant comments from the available senior officers are incorporated in the discussion sections of the study findings chapter. Most field extension agents were actively involved in drought relief activities, like organizing food handouts, which limited the time available for them to participate in the study. To increase efficiency in data collection, the questionnaire was administered to groups of respondents wherever possible.

Target Population

After consulting with senior Agritex staff on the details of conducting the fieldwork, two alterations were made to the original research design. First, it was decided to select two, rather than four, of the country's eight provinces, Midlands and Mashonaland Central, as the primary areas of focus. This was mainly because the effects of the drought in these two provinces were relatively less severe, therefore increasing the likelihood of finding field staff available to participate in the study. In normal rainfall years these two provinces are relatively more productive with a higher proportion of small-scale farmers engaged in market agriculture. Consequently the inferences from the final sample are limited to Midlands and Mashonaland Central provinces, and not generalizable nationally. Secondly, it was decided to focus on junior extension staff as they are the primary contacts for farmers; senior field staff are stationed at district or provincial offices and their responsibilities, though varied, tend to be more administrative.

The target population was Agritex field extension agents stationed in the Midlands and Mashonaland Central provinces of Zimbabwe. This population has approximately 500

male and female extension agents working in the eleven districts that make up the two provinces.

Sampling

A probability-proportional-to-size (PPS) sample was used to select respondents in Midlands province. Respondents were randomly selected from the districts using the staff lists at the provincial office as a sampling frame. In Mashonaland Central province, the sample consisted of available extension agents in five of the six districts. The latter sampling technique in Mashonaland Central province was adopted due to difficulties encountered in attempting to select respondents randomly. Most Agritex personnel were engaged in drought-related activities, and consequently no responses could be obtained from Guruve district. The final sample was 209 extension agents; 133 from Midlands province and 76 from Mashonaland Central (Tables 4 & 5). Two extension agents declined to respond to the questionnaire; one was due to a personal bereavement, and the other had less than one day as an employee of Agritex.

Table 4: Extension Agent Sample by Rank in Organization

Rank	Population	Sample
Extension officers	52	15
Senior extension supervisors	12	3
Extension supervisors	55	18
Extension workers	375	160
TOTAL	494	196[16]

[16]Thirteen respondents did not indicate their rank in the questionnaire.

Table 5: Extension Agent Sample by Location

Province	District[17]	Population[18]	Sample	Sampling fraction
MIDLANDS	Mvuma	29	15	.52
	Zvishavane	21	15	.71
	Gokwe	107	40	.37
	Kwekwe	38	20	.52
	Mberengwa	38	20	.52
	Shurugwi/Gweru	56	23	.41
	Sub-total	289	133	.46
MASHONALAND CENTRAL	Bindura	28	3	.11
	Mazowe	23	20	.87
	Guruve	35	0	-
	Darwin/Rushinga	50	31	.62
	Centenary	11	6	.55
	Shamva	25	16	.64
	Sub-total	172	76	.44
TOTAL		461	209	.45

[17]Based on Agritex and not administrative boundaries.

[18]From provincial staff lists as at October, 1992.

Development of Survey Instrument

In surveys it is usually not possible to assess the correctness of the respondents' answer(s). Accuracy or "veridicality" of recall is a major concern in survey methodology (Strube, 1987). Determination of an appropriate survey instrument was based on a review of the information needs of the study, an assessment of the costs and available resources, and the likely environment to be encountered by the researcher in the survey area.

Agritex extension agents were considered as the primary information source for the study. The limited agricultural activities due to the drought, and other resource constraints, reduced the opportunity for field observation or interviews as alternate information sources. Time and cost factors favored the use of a structured questionnaire as the data collection instrument. Agritex is a typical bureaucratic government agency with a top-down management approach. Consequently, both written and a verbal explanation of the objectives of the study were provided for most respondents by the author (an outsider), to minimize the potential bias and suspicion in subject responses.

A self-administered questionnaire was selected as a convenient data collection method. The questionnaire was developed from the research questions and hypotheses listed in Chapter I. The questionnaire was structured as four sections, to solicit responses as per the basic research questions. A copy of the questionnaire, the cover letter and explanation used in the field is included in Appendix 4. The survey instrument was submitted to, and approved by, the Michigan State University Committee on Research Involving Human Subjects (UCRIHS) prior to data collection (Appendix 3).

Validity

Validity is a descriptive term that the instrument accurately reflects the concept that it is intended to measure (Babbie, 1986). A survey is considered valid to the extent that it measures what, and only what it is supposed to measure. Validity attempts to measure the degree to which the survey data or results are free from systematic bias. To be valid the instrument must not be affected by extraneous factors that systematically "push" or "pull" the results in one particular direction (Alreck & Settle, 1985). There are four types of validity that are generally considered in competency assessment (Klemp, 1979). These are content, construct, concurrent and predictive validity.

Content validity, the most common measure, emphasizes the extent to which the indicators measure the different aspects of the concept. To insure content validity of the questionnaire, the following steps were taken:

(a) A panel of experts comprising of the members of the author's dissertation committee, and other selected faculty at Michigan State University were engaged to assess the content validity of the instrument.

(b) Senior Agritex personnel and faculty from the University of Zimbabwe reviewed and made comments on the drafts of the questionnaire.

(c) Discussions were held with respondents in two pre-test groups and with other researchers to determine the appropriateness of the level of language used, and to modify aspects of language use to local norms.

Construct validity is the degree to which a test relates statistically to other tests of the same competency or to tests of different competencies with which it is expected to have a theoretical relationship. The objective in gathering construct evidence is to determine

what psychological construct is being measured by a test and how well it is being measured (Ary et al., 1990). It combines both a logical and an empirical approach.

Two aspects of the logical approach are, to ask if the elements the test measures are the elements that make up the construct, and, to inspect the items to determine if they seem appropriate for assessing the elements in the construct (Ary et al., 1990). The empirical approach was incorporated into the instrument by adapting some of the sample questions used in the Michigan Certification of Applicators Test (CES, 1991).

Concurrent validity is a measure of statistical correlation between test performance and the criterion measure of interest, in this case, job performance (Klemp, 1979). Concurrent validity was assessed by determining the correlation between product knowledge test scores and self-assessment of job performance items on the questionnaire. This procedure yielded a significant correlation of .52 ($p<.001$). According to Klemp (1979), if construct validity has been established and the concurrent validity is high, there is evidence that the competency has been "operationalized" correctly and its measurement is related to performance.

Evidence of predictive validity is demonstrated if an intervention aimed at increasing a competency led to both higher test scores and a greater performance effectiveness in relation to the external criterion. Predictive validity was not established since no intervention was planned for in the study objectives. It is seldom possible to obtain predictive validity in educational settings and concurrent validity is a more practical measure (Klemp, 1979).

Reliability

Reliability means the freedom from random error (Alreck & Settle, 1985). The key question in determining reliability is whether the same data values would be obtained each time in repeated observations of the same phenomenon. A test that is unreliable will show variation in scores due more to weaknesses of the test itself than to differences among the people taking it.

The respondents' ability to recall specific items/issues was of particular concern because of the drought which had suppressed most agricultural activity in the preceding season. Questions that required the respondent to assess the frequency of repeatedly experienced events, or time dating of events were therefore kept to a minimum. Since there had been few farming activities in the survey area in the preceding agricultural season, questions of the "have you ever" type were preferred to those of the "how often" or "when did you last" type. This is because the latter type of questioning increases memory load and requires a complicated judgement step (Strube, 1987).

The questionnaire was pilot tested on two groups of respondents similar to, but not included in the final sample. After each session, a discussion was held with each group to obtain feedback on aspects of the questionnaire. This included determining that the questions were clear and appropriately structured, for example avoiding double questions and negatives, and threatening and/or sensitive questions. An attempt was made to ensure that the questionnaire terminology and expected knowledge was at a level appropriate for the respondents.

Reliability was also assessed by the consistency of responses using item-item correlations. Cronbach's alpha, a measure of internal consistency, was used as a measure

of reliability on selected Likert-type questions. Cronbach's alpha computed for the selected items ranged from .70 to .89, which is acceptable. A split-half reliability model based on eight attitudinal items yielded the following acceptable coefficients:

Correlations between forms	= .71
Equal-length Spearman-Brown	= .83
Guttman split-half	= .77

Correlation between forms is the correlation between the two halves. The equal length Spearman-Brown coefficient is what the reliability would be if it was made up of two equal parts that have a four-item reliability of .71. The Guttman split-half is the coefficient if no assumption is made about equal reliability or variance between the two halves. A disadvantage of split-half coefficients is that the results depend on the allocation of items to halves (Norusis, 1988).

Distribution and Collection of the Questionnaire

After meeting with the Agritex director, and the chief of crop production, introduction letters and a summary of the research procedures were sent to the provincial heads of extension in Midlands and Mashonaland Central provinces (Appendix 1). Meetings were then held with the provincial heads to clarify any outstanding issues and to finalize plans for data collection. Wherever possible the author administered the questionnaire during regular staff meetings at district and provincial offices. When this was not feasible, the author requested the assistance of the district agricultural extension officer (DAEO) of that area to administer the questionnaires. About sixty percent of the questionnaires were administered by the author. In all cases, respondents were not allowed to communicate with

one another, or to have access to secondary material (for example books and technical bulletins) since most of the objective-type questions in the instrument were simple and readily available from manuals or books.

All questionnaires were collected by the researcher or the DAEO after completion by the respondents. On average, the respondents took approximately thirty minutes to complete the questionnaire. The questionnaires were manually checked and the data entered into a computer soon after collection; the period from data collection to entry was four days on average.

Non-response error was insignificant in Midlands since only two of the selected agents did not respond. In Mashonaland Central it was not possible to estimate the non-response error since the sampling plan was compromised to selecting available agents. This was an inevitable limitation of the study design.

Data Analysis

Before data analysis, consideration was given to the question of inference of the findings in Mashonaland province as the sample was not totally random due to constraints in accessing all the selected subjects. Statistical tests revealed no significant differences in extension agents' demographic characteristics between the two provinces, and within the five districts of Mashonaland Central sampled. The author considered that the reasons for lack of randomness (the unforeseen drought relief commitments of the target population in Mashonaland Central, and, the study's timing and resource constraints) were unlikely to have introduced obvious bias in subject selection given the high sampling fraction (40%). Further there was no uniqueness in the Mashonaland Central sub-sample demographic

characteristics when compared with Midlands province and some available population parameters. The author's subjective judgement was that the results were likely to be applicable to all the extension agents in Mashonaland Central province. However, statistical tests were conducted separately for the two sub-samples and are reported as such where the results and/or conclusions were different.

SPSS PC+ Version 4.0 statistical analysis package was used for data entry and analysis. The first part of the analysis was a description of the sample using basic distributional characteristics like response frequencies, means and standard deviations. Relationships between selected variables, for example demographic characteristics and attitudes, were also analyzed.

The second part of the analysis involved testing the following null hypotheses for each research question stated in Chapter 1.

Null Hypotheses

Question 1: Technical Competence in Pesticide Usage

(1) There is no significant difference in extension agents' technical competence related to the formal qualifications attained.

(2) There is no significant difference in extension agents' technical competence related to the level of in-service training in pesticide use received.

(3) There is no significant difference in extension agents' technical competence related to the level of on-the-job experience.

(4) There is no significant difference in extension agents' technical competence related to other demographic characteristics.

Question 2: Pesticide Use Information Sources and Channels

(1) There is no significant difference between extension agents' perception of Agritex and pesticide companies as sources of pesticide use information.

(2) There is no significant difference between extension agents' use of formal and informal channels in the acquisition of pesticide use information.

(3) There is no significant difference in extension agents' acquisition of pesticide use information related to media richness.

(4) There are no significant differences in extension agents' use of information sources and channels related to other demographic characteristics.

Question 3: Extension Agents' Attitudes toward Pesticide Use

(1) There are no significant differences in extension agents' attitudes to pesticide use related to age.

(2) There are no significant differences in extension agents' attitudes to pesticide use related to gender.

(3) There are no significant differences in extension agents' attitudes to pesticide use related to formal qualifications.

(4) There are no significant differences in extension agents' attitudes to pesticide use related to position in Agritex.

(5) There are no significant differences in extension agents' attitudes to pesticide use related to length of service in Agritex.

Question 4: Technical Support Needs Regarding Pesticide Use Management

(1) There is a need to improve technical support to Agritex field extension agents regarding pesticide management.

(2) Agritex should be responsible for supporting field extension agents in pesticide use management.

(3) Pesticide companies should be responsible for supporting extension agents in pesticide use management.

(4) There is a need for formal communication between field extension agents and the pesticide company's technical specialists.

Factor analysis was used to identify and aggregate item responses to attitudinal questions using item-item correlations. Semi-partial and stepwise multiple linear regression analysis were used to identify specific independent variables which contributed to the variance in extension agents' competency scores. Throughout the analysis, a .05 probability level was used as the basis for testing hypotheses.

CHAPTER V

STUDY FINDINGS

The major objectives of this study were to determine the nature of technical information flows, and the technical competencies of selected Agritex extension agents in the Midlands and Mashonaland Central provinces of Zimbabwe regarding the appropriate use of pesticides. This chapter presents the study findings. The findings are presented and discussed in six major sections: (a) Demographic characteristics of respondents, (b) Extension agent technical competence, (c) Information sources and channels, (d) Attitudes to pesticide use, (e) Pesticide use technical support needs, and, (f) Comments on the questionnaire. The results for the null hypotheses listed in Chapter IV are presented in the respective sections for the research question.

Demographic Characteristics of Respondents

The usable sample consisted of 209 extension agents. Demographic variables provide some insights into the characteristics of Agritex extension agents. This section summarizes the following demographic characteristics of the respondents: age, gender, formal qualifications (academic and agricultural), position and years of service in Agritex.

Extension Agent Age

The average age of extension agents in the sample was 39 years. The average for female agents was lower at 29 years. There was a wide range in age, with the youngest agent being 21, and the oldest 60 years of age; the range for female agents was 23 to 40 years. Figure 6 shows the age distribution for all the respondents. About 30% of agents were in the 31 to 40 age range. The normal retirement age for Agritex personnel, like other civil servants is 65 years. Early voluntary retirement is one option being considered for the proposed reduction in the size of the civil service (Zimbabwe Government, 1991).

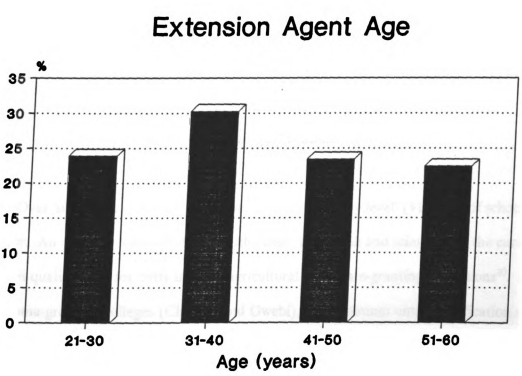


Figure 6: Extension Agent Age Distribution

Gender

There were 20 (10%) female extension agents in the sample (Figure 7). This proportion is similar to the overall representation of females within the field division (Appendix 2). Agritex started actively recruiting female extension agents in the 1980s when the agricultural institutions increased their intakes of female students. Most of the communal farmers serviced by extension agents are female[19]. There are few empirical studies on farmers' gender preferences for Agritex extension support. A survey of women farmers in Makonde district by Mutuma, et al. (1987) found that while communication was perceived as better with female than male extension workers, 41.9% of the respondents were indifferent to the gender of the agent. Validity of gender-based studies is limited since the majority of farmers in communal areas have never been serviced by a female extension agent.

Academic Qualifications

Over half of the respondents had attained an "ordinary level" (11 years) of schooling or higher. An ordinary level certificate, with passes in English and science, was the current minimum qualification for entry into the agricultural certificate-granting institutions[20]. For the diploma-granting colleges (Chibero and Gwebi), the minimum entry qualification was at least two "advanced level" passes. Since the late 1980s, the recruitment tendency has been

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[19]Mutuma, et al. (1987) estimate the number of female farmers as 60-70% of all communal farmers; due mainly to labor migrancy, an average of 45% of rural households are headed by females.

[20]There are 4 institutions: Mlezu, Kushinga Phikelela, Rio Tinto and Esigodini.

to select candidates with higher academic grades due to a tremendous increase in applications[21]. Figure 8 shows the highest academic level attained for the total sample. The 27 respondents (13.4%) with the lowest academic qualification (Grade 7 or Standard 6) were all males.

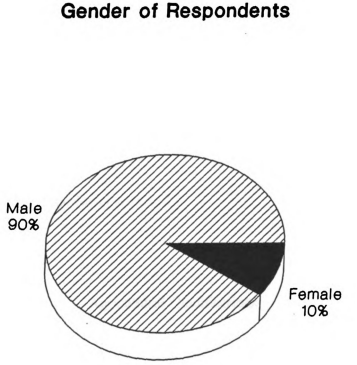

Figure 7: Extension Agent Gender

[21]In 1987 Chibero College received 10,800 applications for about 70 places (Mutuma et al., 1987).

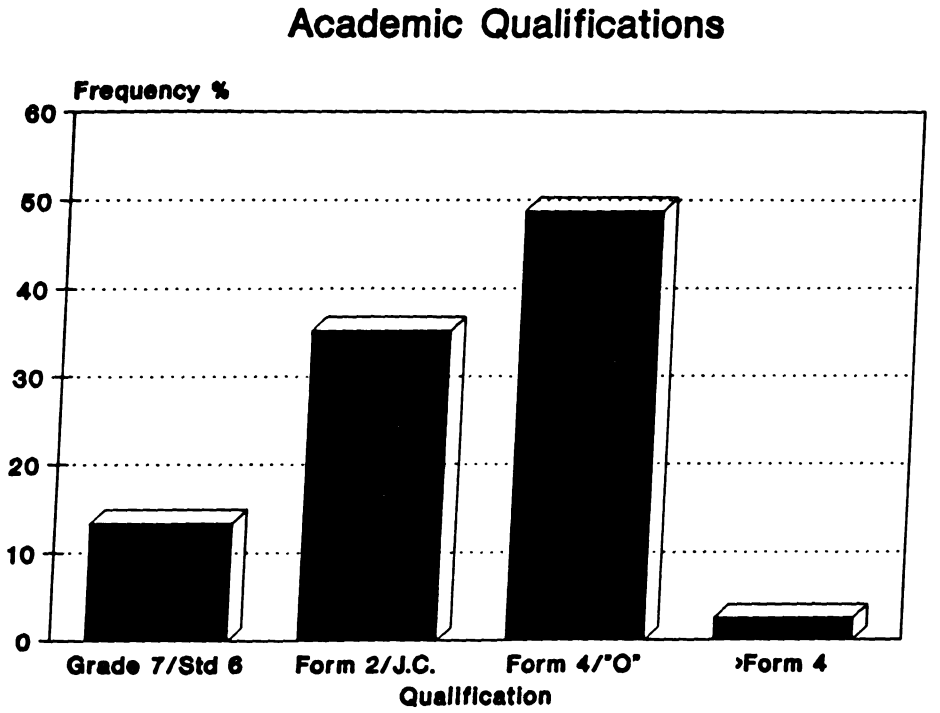

Figure 8: Highest Academic Level Attained

Agricultural Qualifications

Most extension agents, 92%, are agricultural certificate holders (Figure 9). Those with an agricultural diploma and/or university degree have the rank of agricultural extension officer or higher. The entry qualifications for the agricultural certificate training institutions were raised in the early 1980s. The extension agents recruited since then have higher academic qualifications than their predecessors.

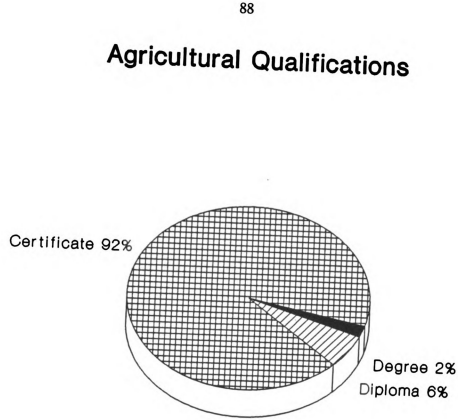

Figure 9: Highest Agricultural Qualification Attained

Rank in Agritex

Most of the extension agents sampled were extension workers (Figure 10). Extension workers are the front-line extension agents who have relatively close contact with farmers. All extension workers reside in the communal areas in which they work. Like other government departments, the entry position, promotions and other conditions of service are governed by the Public Service Commission (PSC). There are two distinct entry level positions, extension worker or officer. Public service regulations stipulate that

agricultural certificate holders cannot be promoted to the rank of agricultural extension officer without attaining a higher academic qualification, such as a diploma or university degree. Therefore most extension workers are likely to remain at the same rank for the rest of their careers within the organization.

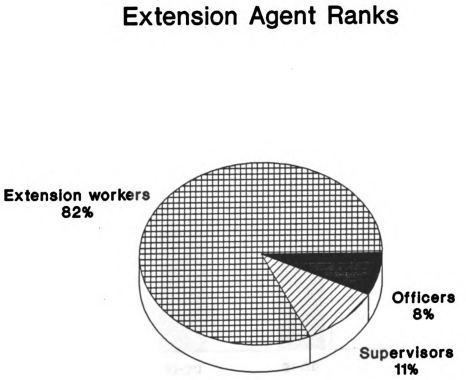

Figure 10: Position in Agritex

Length of Working Experience

The average length of working experience in Agritex was 13.7 years. There was a wide range, 37 years (0.4 to 38), in the length of service between the extension agents. About 46% of the agents had worked in the department for less than 10 years (Figure 11).

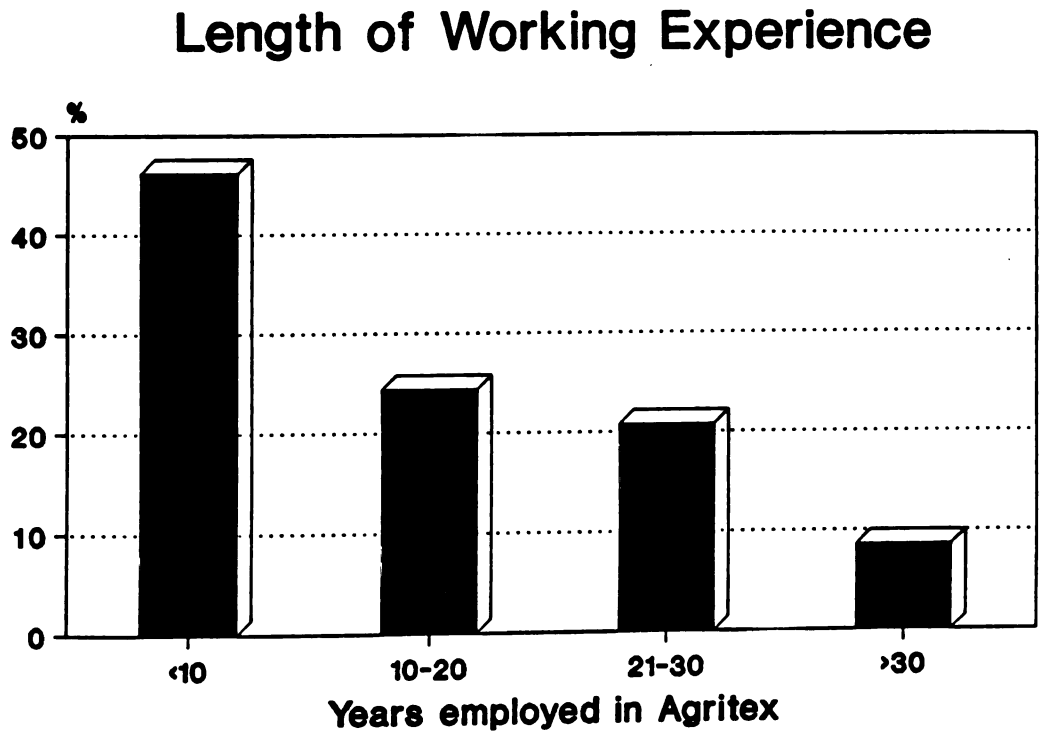

Figure 11: Extension Agent Length of Service

Relationships Between Demographic Characteristics

There was a high frequency of correlation between the demographic variables measured in the questionnaire. Table 6 summarizes the relationships between demographic characteristics for the total sample. There was a relationship between gender and age (.33), and between gender and the length of service in the organization (.32). Female extension agents were significantly younger than their male counterparts. This was to be expected because Agritex started recruiting female agents in the 1980s. There was a strong negative correlation (-.70) between age and the highest level of schooling attained, and a moderate negative correlation between age and highest agricultural qualification attained (-.19). Younger extension agents had higher academic and agricultural qualifications overall. The minimum entry qualifications for the agricultural certificate training institutions (Mlezu, Esigodini, Rio Tinto and Kushinga Phikelela) were raised from junior certificate (form 2) to ordinary level (form 4), during the 1980s. The negative correlations between length of service and the level of schooling, and the former and level of basic agricultural training indicates that in general, extension agents do not attain higher formal credentials on the job. Agritex policy on long-term formal training is to support only selected extension officers who already have diplomas or degrees for post-graduate training[22].

The correlation between the various demographic variables made it necessary to use statistical tests that simultaneously account for other compounding variables.

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[22]Hakutangwi, Agritex Chief Training Officer, personal communication, September, 1992.

Table 6: Correlation Matrix of Extension Agent Demographic Variables

	Age	Gender	Schooling	Training	Rank	Service
Age	1.0	.33**	-.70**	-.19*	.01	.91**
Gender		1.0	-.25**	-.05	.03	.32**
Schooling			1.0	.48**	.26**	-.69**
Training				1.0	.83**	-.18*
Rank					1.0	.03
Service						1.0

*<p .01 **<p.001 n - 192

Technical Competence

The operational definition of technical competence was the respondent's total score on questions related to pesticide application skills, knowledge of recommended products for specific pests and crops, and, general pest management. Proficiency in pesticide application skills was based on respondent's self assessment on the questionnaire. The total scores for specific pesticide application skills are summarized in Table 7. Most of the extension agents were skilled in insecticide skills; the majority were unable to calibrate a tractor-mounted sprayer. An average of 72% of the respondents rated themselves as capable of various pesticide application skills.

Table 7: Extension Agent Pesticide Application Skills

Skill	# capable*	%
Insecticide application	196	94
Calibration of knapsack sprayer	180	86
Calibration of ultra-low-volume (ULV) sprayer	169	81
General calibration calculations	140	78
Herbicide application	117	56
Calibration of tractor-mounted sprayer	73	35
AVERAGE	150	72

* - Based on responses to self-assessment questions N - 209

An average of 60% of the extension agents provided correct responses to pesticide product knowledge questions. Knowledge of recommended products for maize, cotton and other crops are summarized in Table 8. Most of the pesticides used by small-scale farmers are for cotton and maize pests.

Table 8: Extension Agent Pesticide Products Knowledge

Products	Frequency of correct responses	%
Maize pesticides	146	70
Cotton pesticides	132	63
Other pesticides	96	46
AVERAGE	125	60

* Calculated from knowledge-type questions N= 209

The results for responses to pest management questions are summarized in Table 9. The average percentage of correct responses to general pest management questions was 64. About 43% of the extension agents were unable to provide correct responses to terms like "annual and perennial weeds," which are frequently used on product labels.

Table 9: Extension Agent Knowledge of General Pest Management

Pest Management	Frequency of Correct Responses	%
Pesticide use safety	146	70
Plant biology	119	57
AVERAGE	134	64

* Calculated from knowledge-type questions N - 209

Analysis of incorrect responses to product knowledge questions shows that 41 respondents (20%) mentioned a product that had been withdrawn from the market (Table 10). This lack of awareness of de-registered products by field extension agents indicates some inadequacies in the pesticide information system. Most extension agents do not have a comprehensive list of registered pesticides. At the .05 level, there were no significant relationships between respondents who mentioned de-registered products and demographic characteristics.

Table 10: Withdrawn/Banned Products Mentioned in Product Recommendations Test

Trade Name	Common Name	Frequency	%
Morocide (b)	binapacryl	29	71
Hostathion (w)	triazophos	7	17
Aldrin/Shelldrite (b)	aldrin	3	7
Planavin (w)	nitralin	2	4
TOTAL		41	100

b = banned, w = withdrawn. N=209

Regression Analysis

Competence was computed by adding each respondent's score in the three sub-areas: application skills, product knowledge and pest management. The technical competence "test" had a total of 18 items. The average score for the sample was 66%, with a range of 2.94 standard deviations. Because of the significant relationships between independent variables, multiple regression analysis was used to control for simultaneous interaction effects. Multiple regression analysis can be viewed as method of adjusting a set of correlated variables so that they become uncorrelated (Kerlinger & Pedhazur, 1982). Semi-partial multiple regression analysis was used to determine the amount of variance explained in the competency score by three sets of independent variables: demographic characteristics, training, and access to pesticide use information sources and channels (Table 11). Each set was composed of independent variables which were then regressed on the dependent variable. The three sets were significantly related to the dependent variable, with the

demographic variable set explaining about one-fifth of the variance (sR^2 =.18). The total R^2 was .41.

Table 11: Semi-partial Multiple Regression Coefficients for Independent Variable Sets

Variable Set	K_a	K_b	sR^2	F
Demographic Variables	5	2	.18	9.51**
Training Variables	6	2	.13	4.75**
Information Variables	18	4	.15	2.60*

R^2 = .41; * $p<.05$, ** $p<.001$
K_a = no. of variables controlled, K_b = no. of variables in set.
n = 190

Stepwise multiple regression was used to determine the combination of variables that best described variation in extension agent competency in pesticide use. Categorical variables were entered into the equation as dummy- or effect-coded variables. Units of measurement, means and standard deviations for the independent variables used in the regression analysis are listed in Table 12.

Variables found to significantly influence competency scores were: age of the respondent (X_1), the level in-service training received (X_2), gender of the respondent (X_3), use of sales representatives as information sources (X_4), contact with a sales representative in the preceding year (X_5) (Table 13). The age of respondents was highly correlated (.91 $<p$ .001) with length of employment in the organization, thus presenting a multicollinearity problem in the specification of the equation; length of employment in Agritex was removed from the analysis. There was a negative relationship between competency score and age;

positive relationships between the score and level on in-service training, contact with, and use of sales representatives. Female extension agents scored significantly higher than their male counterparts.

Table 12: Units of Measurement, Means and Standard Deviations for Independent Variables in the Regression Analysis

Variable(s)	Unit of Measurement	Mean	S.D.
Age	years	38.9	10.3
Academic qualifications	years of formal schooling	9.9	1.7
Agricultural qualifications	ordinal (cert., diploma or degree)	-	.36
In-service training	courses attended	1.1	.85
Use of sales reps/Agritex officers/publications/Gender	categorical (yes/no; male/female)	-	-
Contact with sales reps	frequency of contact/year	.5	.5
Position in Agritex	ordinal (ext. worker, supervisor or officer)	-	.98

As a group the variables in the equation explained 30.5% of the variance in the dependent variable. The equation for estimating the competency score was:

$$Y = 12.92 - .13X_1 + 2.33X_2 + .77X_3 + 1.25X_4 + .81X_5$$

Table 13: Multiple Regression Analysis of Independent Variables on Extension Agent Competency Score

Variables in the Equation

Variable	*b*	β	t-value
Age of respondent (X_1)	-.13	-.47	-6.66**
Gender (X_2)	2.33	.26	3.77**
In-service training (X_3)	.77	.23	3.17**
Use of Sales Reps (X_4)	1.25	.18	2.68**
Contact with Sales Reps (X_5)	.81	.14	2.16*
Constant	12.92	_	_
Variables not in the Equation			
Use of Agritex Publications	-	.06	.896
Use of Agritex Officers	_	.02	.228
Academic Qualifications	-	-.03	-.538
Agricultural Qualifications	-	-.03	-.484
Position in Agritex	-	-.04	-.672

** $p<.01$, * $p<.05$
b - Unstandardized coefficient, β - Standardized coefficient.
n = 190

Null Hypothesis 1.1: There is no significant difference in extension agents' technical competence related to formal qualifications attained.

Formal qualifications were considered as the extension agent's highest academic and agricultural credentials. The range in number of years of formal school was 9 years (7-16). Forty nine percent of the respondents had attended 11 years of formal school. There was no relationship between the respondent's academic qualification and score on the competency assessment test (Table 13). Three categories of agricultural qualification were considered and entered as effect-coded variables. In ascending order these are certificate, diploma and university degree. There was no relationship between the respondent's agricultural qualification and score on the competency assessment test (Table 13). Therefore there was no evidence to support the alternate hypothesis.

Conclusion: At the .05 level, there is no significant relationship between the extension agent's formal qualification and technical competency in pesticide use.

Null Hypothesis 1.2: There is no significant difference in extension agents' technical competence related to the level of in-service training in pesticide use received.

Three formal in-service training courses were identified: (1) the safe use of pesticides course, (2) the cotton production training course at Cotton Training Centre, and (3) formal courses offered by some pesticide companies. The safe use of pesticides course is an Agritex 2-day course covering the basics of pesticide use and safety. It is an optional course for extension staff[23]. The cotton production course at Kadoma Training Centre is an intensive course that covers the major aspects of cotton production. Pesticide companies

[23]In-service courses provided by the Agritex Training Branch are divided into obligatory and optional; extension agents do not have to attend the optional courses.

occasionally offer some training sessions for Agritex extension agents. The most intensive of these courses was the "Kohwa Pakuru Program" initiated in the early 1980s by the Ciba-Geigy Corporation. This program has since been terminated and there was no notable training on pesticide use offered for Agritex staff by pesticide companies. There was no relationship between attendance at the pesticide company courses and the competency score. Attendance at the safe use of pesticides and the cotton training courses were significantly related to the competency scores. Therefore there was enough evidence to reject the null hypothesis (Table 13).

Conclusion: At the .05 level, there is a significant positive relationship between the level of in-service training in pesticide use and the extension agent's technical competency in pesticide use. Respondents who had attended the safe use of pesticides course and cotton production training courses had higher competency scores.

Null Hypothesis 1.3: There is no significant difference in extension agents' technical competence related to the level of on-the-job experience.

The level of on-the-job experience was measured by the number of years each respondent had been employed in Agritex. There was a wide range (.4 to 38) in the number of years employed. There was a moderate negative correlation ($r = -.32$, $p < .001$) between the number of years employed and the competency score. There was no other evidence to corroborate this result but one speculation could be that on-the-job experience is not necessarily related to experience with pesticide use. Extension agent competence could therefore be associated with other issues like farmer pesticide adoption and usage patterns, which were not considered in the study. Alternately, it could be age rather than working

experience effects since there was a very high correlation ($r=.91$, $p<.001$) between respondent age and working experience.

Conclusion: At 95% confidence interval, there is a significant relationship between the level of experience on the job and extension agents' technical competence in pesticide use. Extension agents with longer service in Agritex had lower competence scores in pesticide use than those who had shorter service.

Null Hypothesis 1.4: There is no significant difference in extension agents' technical competence related to other demographic characteristics.

The following demographic characteristics were included in the regression equation to determine relationships with the dependent variable: age, gender, and the extension agent's rank within Agritex (Table 13). At .05 chance probability, there was a significant negative relationship between the age and the competency score ($t = -6.60$ $<p.001$). Older extension agents scored lower than their younger counterparts on the competency test. There was a significant relationship between gender and the competency score ($t= 3.70$ $<p.002$). The mean score for female extension agents was significantly higher than that for males. Three ranks or positions in the organization were included in the sample: (1) extension workers, (2) extension supervisors and senior extension supervisors, and, (3) agricultural extension officers. When entered as an effect-coded variable, there were no significant relationships at alpha = .05, between the rank of the extension agent in Agritex and the respective competency score.

Information Sources and Channels

Information Sources for Pesticide Use

Extension agents listed a variety of sources they use to obtain information on pesticide use (Table 14). Agritex, pesticide company sales representatives and/or dealers, and, printed materials were the three most frequently mentioned sources of pesticide use information. Sales representatives, publications and product labels were the main supply-side information sources listed. Radio and television were the most frequently mentioned mass media sources.

Table 14: Importance of Pesticide Use Information Sources Mentioned by Extension Agents

Source	Total[a]	%
Agritex	107.6	36
Sales reps/Dealers	98.2	33
Publications	44.6	15
Product labels	24.3	8
Mass media	15.4	5
Other[b]	10.0	3
TOTAL		100

[a] - Responses weighted for the order of relative importance (first = 1, second = .5, third = .3).

[b] - DR&SS, field days and college course-notes.

n = 190

Null Hypotheses 2.1: There is no significant difference in extension agents' perception of Agritex and pesticide companies as sources of pesticide use information.

Extension agents' perception of information sources was measured using a Likert type scale for attitudinal questions. Both Agritex officers and sales representatives/dealers were perceived as important sources of pesticide use information (Table 15). At the .05 level, paired t-tests of the mean values for the two groups showed a significant difference in the perceived level of importance. Although Agritex officers and pesticide company sales representatives/dealers were both perceived favorably, the latter were perceived as significantly more important than the former.

Table 15: Extension Agents' Perceived Importance of Agritex Officers and Sales Representatives/Dealers as Pesticide Use Information Sources

Source	Mean[1]	S.D.	t-value	*p*
Agritex Officers	3.61	1.21	-5.09	.001
Sales reps/Dealers	4.17	1.04		

[1] - Based on a 5-point Likert scale ranging from (1) strongly disagree to (5) strongly agree. n = 191

Conclusion: At the .05 level, there is a significant difference between the perceived importance of Agritex and pesticide companies as sources of pesticide use information. Extension agents perceive sales representatives and dealers as more important sources of pesticide use information compared to Agritex officers.

Use of Information Sources

Use of information sources was calculated from the responses to a set of information sources provided in the questionnaire. Overall, Agritex publications were the most frequently mentioned source of information on pesticide use (Table 16). A surprising 18.8% of the respondents indicated that they used television as a pesticide information source. Farmers were generally not used as a source of information, being ranked last of the 7 alternative information sources listed in the questionnaire.

Table 16: Ranking of Information Sources based on Frequency of Use

Source	Frequency*	%	Rank
Agritex publications	178	90.8	1
Sales representatives	159	80.7	2
Agritex officers	127	64.5	3
Newspapers/magazines	110	56.1	4
Radio	102	51.8	5
Television	37	18.8	6
Farmers	15	7.8	7
Other sources	7	3.7	8

* - Sources not mutually exclusive.

n = 191

Null Hypotheses 2.2: There is no significant difference between extension agents' use of formal and informal channels in the acquisition of pesticide information.

Formal channels were defined as the official paths of message/information flow prescribed by the organization's chain of command. Included in this group were Agritex officers and publications, and, sales representatives. Informal channels were defined as unofficial and informal networks used by the extension agents as sources for pesticide use information. Newspapers and magazines, radio, television and farmers were considered as informal channels of pesticide use information acquisition. This definition is atypical; informal channels are generally regarded as person-to-person interactions outside of the prescribed communications within the organization.

About 72% of the respondents used at least one formal channel compared with 32% for the informal channels (Table 17). Formal channels were used significantly more than informal ones in the acquisition of pesticide information.

Table 17: Extension Agents' Frequency of Use of Formal and Informal Channels for Pesticide Use Information

Channel	Frequency	t-value	*p*
Formal	150	20.09	.001
Informal	64		

n = 190

Conclusion: At the .05 level, there is a significant difference between the use of formal and informal channels in the acquisition of pesticide use information. Extension agents use more formal than informal channels in the acquisition of pesticide use information.

Null Hypotheses 2.3: There is no significant difference in extension agents' acquisition of pesticide use information channels related to media richness

Media richness is the capacity of a medium to facilitate shared meaning (Trevino et al, 1990). Rich media was classified as that which allows for a two-way flow of information. Person-to-person medium (Agritex officers, sales representatives and farmers) were grouped as rich media. Lean media was classified as one-way information flow with no interaction between the sender(s) and receiver(s). Lean media included Agritex publications, newspapers and magazines, radio and television.

Table 18: Extension Agents' Frequency of Use of Rich and Lean Media Channels

Channel	Frequency	t-value	*p*
Rich media	103	1.29	.20
Lean media	97		

n = 191

Conclusion: At the .05 level, there is no significant difference in the use of pesticide information channels by extension agents related to media richness. Rich and lean media sources are both used by extension agents. Lack of a distinct media preference could be related to the general inadequacy of regular information sources.

Contact with Pesticide Companies

Contact with pesticide company representatives was estimated from the 1991-92 agricultural season. This period was particularly unusual due to the serious drought in the survey area which had literally halted most agricultural activities. For reliability concerns discussed in the research design chapter, respondents were asked only about whether or not they had contact with pesticide company representatives in the preceding agricultural season. Half the respondents had at least one contact with a pesticide company representative in the preceding year. Agricura, Zimbabwe Fertilizer Corporation (Z.F.C.) and Windmill were the most frequently mentioned companies (Table 19). The level of contact between Agritex extension agents and sales representatives is consistent with market shares for the pesticide companies[24]. Contact between extension agents and pesticide company representatives is likely to be higher in normal rainfall years due to increased agricultural activities.

Contact between sales representatives and extension agents does not necessarily translate to transfer of technical information. Results from the attitudinal questions indicate that pesticide company sales representatives are more likely to contact extension agents for sales rather than technical information. The variations in estimates for extension agent-pesticide company representative contact may therefore be more of an indication of marketing aggressiveness rather than an indication of the level of extension activities of pesticide companies.

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[24]Kietzman, W. (Agrochemicals Manager, Shell Developments Zimbabwe), personal communication, September 1993.

Table 19: Extension Agents' Contact with Pesticide Company Representatives (1991-92)

Company	Frequency	% Total Contact
Agricura	44	31.9
Z.F.C.	40	29.0
Windmill	38	27.5
Shell Chemicals	5	3.6
Sprayquip	4	2.9
Other[a]	7	5.1
Total	138	100

[a] - Cooper/Wellcome, Pfizer Hoechst, Farmer's Co-op, Farm-Aid and Ciba-Geigy

Null Hypothesis 2.4: There are no significant differences in extension agents' use of pesticide information sources and channels related to other demographic characteristics.

Use of sources and channels of pesticide use information by extension agents was assessed for relationships with demographic variables. At the .05 level, there was no relationship between demographic variables and use of Agritex officers and publications, sales representatives, newspapers and magazines, farmers, and television. Only use of the radio had some significant variations with demographic variables (Table 20). There was a positive relationship ($F = 5.51$ $<p.001$) between use of the radio as a source of pesticide use information and the age of the respondent; older extension agents use radio as an information source more than younger extension agents. There was also a negative relationship ($F = 6.27$ $<p.001$) between radio and the highest academic qualification attained; agents with higher academic qualifications use the radio less as a source of pesticide use information.

Table 20: Analysis of Variance between Extension Agents' Use of the Radio and Demographic Variables

Variables	F-value	Signif of F
Age (years):	5.51	.00
Gender:	.79	.37
Schooling:	6.27	.00
Training:	1.57	.21
Position:	1.14	.32
Length of service (years):	6.19	.00

Using Anova, the demographic variables were also assessed against the information sources and channels variables grouped into the following categories: formal and informal, and, rich and lean. Older extension agents use significantly more informal sources and channels of than younger ones ($F = 3.53 < p.02$). Extension supervisors use more lean media sources than their subordinate extension workers ($F = 4.88 < p.003$).

Conclusion: At the .05 level, there are some relationships between use of pesticide information sources and channels and demographic variables. There is a significant relationship between the use of radio as a channel for pesticide information and the age of the extension agent, and, the highest academic qualification attained. Older extension agents use more informal channels than younger agents in the acquisition of pesticide use

information. There are no significant relationships between the use of Agritex officers and publications, sales representatives, newspapers and magazines, farmers, television, and the demographic variables. Extension supervisors have greater access to lean media sources than extension workers.

Comments on Information Sources

Ninety-seven respondents, 46%, wrote comments on information sources. Twenty of the comments alluded to a shortage of print media information sources for pest management. Preferred information channels mentioned were pamphlets, product manuals and posters. There were some comments on the need for training of field staff by both Agritex and pesticide companies. Three respondents raised concern about the sale and/or use of products with no product expiry dates or with expired dates. In one instance, there was a request for all pesticides to have a readable expiry date rather than a code on the product label. One respondent suggested that all pesticide information be provided in the vernacular language. Comments on information sources, edited from the questionnaire are listed in Appendix 5.

Attitudes toward Pesticide Use

The extension agents' attitudes toward aspects of pesticide use was measured using responses to statements in the questionnaire. Responses were assessed using a 5-point Likert scale with the range: strongly disagree (1), disagree (2), undecided (3), agree (4), and, strongly agree (5). Attitudes of extension agents were assessed with respect to the following constructs: Agritex, small-scale farmers, pesticide companies and their representatives, and, pesticide use information and knowledge. Factor analysis was used to determine the attitude statements for each construct (Appendix 6).

Null Hypothesis 3: There are no significant differences in attitudes to pesticide use related to demographic variables.

Extension agent attitudes to Agritex, small-scale farmers, pesticide companies and their representatives, and pesticide use information sources and channels were tested against demographic variables. The demographic variables included were age, gender, highest level of schooling, highest level of agricultural training, position in the organization, length of experience in the organization. Tables 21 to 28 provide summaries and discussions of the mean responses to attitude statements, and the results of Anova tests.

Attitudes toward Agritex

Respondents had moderate to strongly favorable attitudes to Agritex, its officers and their role in pesticide use information management (Table 21). One exception is the nature of the contact between officers and extension workers. Most extension workers disagreed

with the statement that Agritex officers contacted them for pesticide use information, indicating that the flow of information is essentially one-way, from senior to junior members of the organization.

Table 21: Extension Agents' Attitudes toward Agritex

Statement	Mean[a]
Agritex should provide more courses on pesticide use for EWs.	4.52
I contact my superior officer(s) for help with pesticide use problems.	4.23
I contact a SMS for help with pesticide use problems.	4.02
I contact other Agritex officers for pesticide use information.	3.90
My superiors in Agritex should be responsible for obtaining information.	3.65
Agritex officers are an important source of pesticide use information.	3.62
Agritex officers contact me when they need pesticide use information[b].	2.31

[a] - Based on 5-point Likert scale ranging from (1) strongly disagree to (5) strongly agree.

[b] - Excluded from the analysis because inter-item correlations with other variables were <.10.

Differences in Attitudes Toward Agritex

One way analysis of variance (Anova) was used to test for relationships between extension agents' attitudes toward Agritex and demographic characteristics (Table 22).

Table 22: Means, F-values, and Significance of F-values for Extension Agent Attitudes to Agritex Variables

Variables	Mean[a]	F-value	Signif of F
Age (years):			
21-30	3.67	.96	.41
31-40	3.83		
41-50	3.81		
51-60	3.76		
Gender:			
Female	3.87	.70	.40
Male	3.75		
Schooling:			
Grade 7/Standard 6	3.84	.76	.52
Form 2/J.C.	3.76		
Form 4/"O" Level	3.77		
Form 6/"A" Level and above	3.45		
Training:			
Certificate	3.76	.72	.40
Diploma	3.88		
Degree	3.88		
Position:			
Extension worker	3.74	.19	.83
Extension supervisor	3.75		
Extension officer	3.84		
Length of service (years):			
Less than 10	3.73	.47	.62
11-20	3.83		
More than 21	3.78		

[a] - Based on 5-point scale ranging from (1) strongly disagree to (5) strongly agree.
n = 191

At the .05 level, there were no significant differences in attitudes to Agritex variables with respect to age, gender, highest level of schooling and agricultural training, position in Agritex, and years of experience (Table 22).

Attitudes toward Pesticide Companies and Sales Representatives

Pesticide company sales representatives were generally considered as important sources of pesticide use information (Table 23). However sales representatives were more likely to contact extension agents for sales information rather than pesticide use information. The extension agents felt that sales representatives did not provide adequate training on pesticide use for small-scale farmers. They were generally favorable to the statement that pesticide companies should provide courses on pesticide use for extension workers.

Table 23: Extension Agents' Attitudes toward Pesticide Companies and Representatives

Statement	Mean[a]
Pesticide companies should provide courses on pesticide use for EWs.	4.28
Sales reps are an important source of pesticide use information.	4.16
I contact sales reps for pesticide use information.	3.75
Sales reps contact me when they need sales information.	3.33
Sales reps provide information on the products they are selling in my area.	3.13
I consult with sales reps for information on pesticides.	3.07
Sales reps provide farmers with adequate training on pesticide use.	2.38
Sales reps contact me when they need pesticide use information.	1.88

[a] - Based on 5-point Likert scale ranging from (1) strongly disagree to (5) strongly agree.
n = 191

Differences in Attitudes toward Pesticide Companies and Representatives

One way analysis of variance (Anova) was used to test for relationships between extension agents attitudes toward pesticide companies and demographic characteristics.

Table 24: Means, F-values, and Significance of F-values for Extension Agent Attitudes to Pesticide Company and Representative Variables

Variables	Mean	F-value	Signif of F
Age (years):			
21-30	3.21	.16	.92
31-40	3.25		
41-50	3.19		
51-60	3.27		
Gender:			
Female	3.18	.16	.69
Male	3.24		
Schooling:			
Grade 7/Standard 6	3.19	.61	.61
Form 2/J.C.	3.29		
Form 4/"O" Level	3.20		
Form 6/"A" Level and above	3.00		
Training:			
Certificate	3.21	.93	.34
Diploma	3.35		
Degree	3.35		
Position:			
Extension worker	3.21	.36	.70
Extension supervisor	3.25		
Extension officer	3.33		
Length of service (years):			
Less than 10	3.15	1.68	.19
11-20	3.34		
More than 21	3.28		

[a] - Based on 5-point scale ranging from (1) strongly disagree to (5) strongly agree.

At the .05 level, there were no significant differences found in attitudes toward pesticide companies and sales representative variables with respect to the age, gender, highest level of schooling and agricultural training, position and years of service in Agritex of the extension agents.

Attitudes toward Small-scale Farmers

Attitudes of extension agents toward their farmer-clients as sources of pesticide information were generally unfavorable (Table 25). Extension agents did not regard farmers as an important source of information on pesticides and/or pesticide use. In general, extension agents did not contact farmers for pesticide use information and they believed that most of the farmers in their respective work areas did not know how to use pesticides correctly.

Table 25: Extension Agents' Attitudes toward Small-scale Farmers

Statement	Mean
Training of farmers in pesticide use should be my responsibility.	4.09
Sales reps should be responsible for training farmers.	3.33
Farmers should seek pesticide use information from sales reps[a].	2.48
Most of the farmers in my area know how to use pesticides correctly.	2.19
Farmers are a useful source of technical information on pesticides.	1.91
Farmers are an important source of pesticide use information.	1.85
I contact farmers for pesticide use information.	1.82

[a] - Excluded from factor analysis because inter-item correlations with other factor variables were <.10.

Differences in Attitudes toward Small-scale Farmers

One way analysis of variance (Anova) was used to test for relationships between extension agents attitudes toward small-scale farmers and demographic characteristics.

Table 26: Means, F-values, and Significance of F-values for Extension Agent Attitudes to Farmer Variables

Variables	Mean	F-value	Signif of F
Age (years):			
21-30	2.52	1.14	.33
31-40	2.52		
41-50	2.57		
51-60	2.35		
Gender:			
Female	2.31	2.76	.10
Male	2.53		
Schooling:			
Grade 7/Standard 6	2.49	.85	.47
Form 2/J.C.	2.57		
Form 4/"O" Level	2.47		
Form 6/"A" Level and above	2.75		
Training:			
Certificate	2.50	2.51	.12
Diploma	2.71		
Degree	2.71		
Position:			
Extension worker	2.49	1.39	.25
Extension supervisor	2.46		
Extension officer	2.73		
Length of service (years):			
Less than 10	2.51	1.61	.20
11-20	2.60		
More than 21	2.40		

[a] - Based on 5-point Likert scale ranging from (1) strongly disagree to (5) strongly agree.
n = 191

At the .05 level, there were no significant differences in extension agent attitudes toward small-scale farmer variables with respect to age, gender, highest level of schooling and agricultural training, position in Agritex, and years of experience (Table 26).

Attitudes toward Pesticide Use Information and Knowledge

The attitudes of most extension agents are favorable toward the need for understanding the technical aspects of pesticide use. Most of the extension agents responded that they got pesticide use information when they needed it, although they considered the pesticide books and other print materials they have as inadequate (Table 27). On average, they disagreed with the statement that technical information on pesticides is difficult to understand but were generally agreeable to the need for, and importance of, pesticide use information and knowledge in their work activities. Surprisingly, most extension agents were agreeable to the statement that they should be required to pass a test in pesticide use. This indicates that an accreditation system involving formal evaluation of extension workers for competency may be favorable to extension workers.

Table 27: Extension Agents' Attitudes toward Pesticide Use Information and Knowledge

Statement	Mean
Knowledge about pesticide use is important for EWs.	4.74
In my job, it is necessary to know the technical aspects of pesticide use.	4.57
The "Safe Use of Pesticides" course should be obligatory for all EWs.	4.47
In my job, it is necessary to have items of protective clothing.	4.44
All EWs should be required to pass a test in pesticide use.	4.07
I get pesticide use information when I need it.	3.63
I have adequate books and other literature on pesticide use[a].	2.39
Technical information on pesticides is difficult to understand.	1.91

[a] - Excluded from factor analysis because inter-item correlations with other factor variables were <.10.

Differences in Attitudes toward Pesticide Use Information and Knowledge

One way analysis of variance (Anova) was used to test for relationships between extension agents attitudes toward small-scale farmers and demographic characteristics. At the .05 level, there were no significant differences in attitudes toward pesticide use information and knowledge variables with respect to the extension agent's age, gender, highest level of schooling and agricultural training, position and years of experience in Agritex (Table 28).

Table 28: Means, F-values, and Significance of F-values for Extension Agent Attitudes to Information and Knowledge Variables

Variables	Mean	F-value	Signif of F
Age (years):			
21-30	3.83	.67	.57
31-40	3.83		
41-50	3.74		
51-60	3.76		
Gender:			
Female	3.80	.00	.98
Male	3.80		
Schooling:			
Grade 7/Standard 6	3.76	.30	.82
Form 2/J.C.	3.82		
Form 4/"O" Level	3.79		
Form 6/"A" Level and above	3.94		
Training:			
Certificate	3.81	1.40	.24
Diploma	3.68		
Degree	3.68		
Position:			
Extension worker	3.82	1.45	.24
Extension supervisor	3.74		
Extension officer	3.64		
Length of service (years):			
Less than 10	3.85	2.08	.13
11-20	3.75		
More than 21	3.72		

[a] - Based on 5-point Likert scale ranging from (1) strongly disagree to (5) strongly agree.
n = 191

Conclusion: At the .05 level of significance, there is no evidence to reject the null hypothesis. There is no significant difference in extension agent attitudes related to the following variables: age, gender, level of formal training, position and length of service in Agritex.

Technical Support Needs

Technical support needs of field extension agents regarding pesticide use management were assessed from the responses on the questionnaire and interviews with available senior Agritex officers, and managers of pesticide companies. Within the public sector semi-structured interviews were held with the Agritex director, five chief agricultural extension officers, the head of the PPRI, and the pesticide registration officer (PPRI). In the private sector interviews were held with one chief executive officer, and 4 senior managers working for pesticide companies[25].

Small-scale farmers seek the Agritex extension agents for advice on pesticide use. Ninety-eight percent of the extension agents sampled have been asked by farmers for advice on pesticide use. Eighty-one percent of the respondents had conducted at least one short course or training session on pests and pest management for farmers. There is a need for establishing a minimum level of competence in pesticide use for extension agents before they conduct farmer training.

[25]Companies represented were Shell Chemicals, Windmill, Ciba-Geigy and Bayer.

Extension Agent Pre-service Training

Seventy-seven percent of the respondents took a course covering pesticide use while in training. Seventy-eight percent of the respondents with no pre-service training in pesticide use were extension workers (Table 29). Only one female agent had not taken a course in pesticide use while in college.

Table 29: Extension Agent Attendance at Agritex In-service Training Courses

Course	Frequency	%	Rank
Cotton Production (Kadoma)	128	63.4	1
Safe Use of Pesticide	53	26.2	2
Pesticide company courses	34	16.7	3

Availability of books and other literature

About 70% of the respondents indicated that they have inadequate books and other print materials like posters and pamphlets (Table 29). Interviews with some senior Agritex officers revealed that in general, print materials of good quality are expensive for the department to produce, so they rely on those provided by pesticide companies. Some of the materials provided by the companies are not locally relevant or are more applicable to large-scale commercial farming (for example with respect to equipment and the products). Materials provided by companies tend to be related to marketing activities for new products. The pesticide industry association, ACIA, is working toward producing more generic

materials especially for pesticide safety[26]. The PPRI produces a updated list of registered products annually. Copies of the list are provided for the Agritex head office, but circulation is limited. Pesticide companies have supported efforts to produce a comprehensive manual of all registered products and their specific uses. Most extension agents do not have access to this manual.

Table 30: Availability of Books and other Print Materials for Extension Agents

Availability of books	Frequency*	%*
Inadequate	140 (114)	69.3 (72.6)
Neutral	4 (2)	2.0 (1.3)
Adequate	58 (41)	28.7 (26.1)
Total	202 (157)	100 (100)

* Figures in parentheses are for extension workers only

Availability of Protective Clothing

The PPRI provides guidelines for the protective items required for use with specific pesticides. These items are generally expensive for small-scale users, and there are some concerns regarding their suitability in hot environments. Protective clothing regulations are generally not enforced in small-scale farming areas. Agritex extension agents and pesticide company representatives promote safe practices in the use of pesticides. Extension agents therefore require items of protective clothing as teaching aids. About 44.5% of the

[26] Chittenden, Chairperson, ACIA pesticide committee, personal communication, September, 1992.

respondents do not have any items of protective clothing for pesticide use; 79% of this group are extension workers and supervisors (Table 31).

Table 31: Availability of Protective Clothing for Extension Agents

Items	Frequency*	%*
None	54 (47)	31.8 (35.1)
1 or 2 items	39 (31)	22.9 (23.1)
Basic kit	77 (56)	45.3 (41.8)
Total	170 (134)	100 (100)

* - Figures in parentheses are values for extension workers only

** - Basic kit consists of at least protective shoes (gum boots), overalls, gloves and hat specifically designed for pesticide use.

Pesticide Topics for Future Courses

Topics to be addressed in future courses in pesticide use were listed in the questionnaire by 161 (77%) respondents. The topics listed were grouped into three general areas: pesticide safety, calibration and pesticide information. Over half of the respondents requested each of these areas to be included in future in-service training sessions (Table 32).

Table 32: Frequency of Preferred Topics listed by Extension Agents[a]

Topic	Frequency	% of sample
Pesticide safety	116	55.5
Calibration	112	53.6
Pesticide information	107	51.2

[a] - Topics were not mutually exclusive. 99 respondents (47%) listed more than one topic; 75 respondents (36%) listed all three.

Summary of Written Comments

Forty-nine respondents (17%) made comments on the questionnaire and other issues related to pesticide use. Four respondents mentioned the need for action after the collection and analysis of data. Three respondents suggested that protective clothing be supplied to all field staff to support teaching of pesticide safety to small-scale farmers. Three comments asked about the relevance of collecting demographic information. One respondent wrote that they felt the questionnaire was vague. Comments on the questionnaire and other pesticide use issues are listed in Appendix 5.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This final chapter provides a concise reflection of the study, possible interventions and areas in need of more information and knowledge. The chapter summarizes first, the main issues and concepts with respect to the research problem, the methodology used, the underlying assumptions and limitations, and the major findings. The second section relates to general and specific conclusions emanating from the study. From the conclusions, a number of recommendations are provided. The final part is a discussion of areas for further research.

Summary

The Research Problem

The efficient use of technology by small-scale farmers requires support from agricultural service institutions. There is a limited knowledge base on the technology transfer systems of agricultural extension organizations in developing countries. Specifically, little is known about the interaction of the organizational system, in terms of communication and information flows, and, the technical competence of extension agents. External technology like pesticide use is developed and marketed by multinational corporations with minor obligations to neither small-scale users nor the extension system. Typical of large agricultural extension organizations in Sub-Saharan Africa, Agritex is a publicly-funded

bureaucracy with a top-down management style. Only a small portion of the organization's budget is available for extension activities. Agritex faces growing pressure for limited resources. There is need for an empirical examination of the relevance of Agritex's extension programs and the organization's ability to undertake various aspects of extension work adequately. The effectiveness of Agritex's extension programs is dependent on the quality of service provided by its extension staff for specific farmer needs. A number of factors contribute to the extension agents' ability to meet these needs. The study sought to address the issue of extension agent competence, and also the interactions between public and private extension institutions with respect to agricultural technology.

Research Questions

The primary objective of the study was to determine the nature of technical information flows and the technical competencies and needs of selected Agritex field agents regarding the use of pesticides. The secondary purpose was to assess the perceptions of key personnel in Agritex, the pesticide industry and pesticide use organizations regarding the technical support needs of Agritex field extension agents.

The major questions and hypotheses that guided the research process were:

Question 1: What are the technical competencies of Agritex extension agents regarding pesticide use?

(a) There is no difference in extension agents' technical competence related to the formal qualifications attained.

(b) There is no difference in extension agents' technical competence related to the level of in-service training in pesticide use received.

(c) There is no difference in extension agents' technical competence related to the level of on-the-job experience.

(d) There are no differences in extension agents' technical competence related to other demographic characteristics.

Question 2: What sources and channels are used to disseminate technical information related to pesticide use within Agritex?

(a) There is no difference between extension agents' perception of Agritex and pesticide companies as sources of pesticide use information.

(b) There is no difference between extension agents' use of formal and informal channels in the acquisition of pesticide use information.

(c) There is no difference in extension agents' acquisition of pesticide use information related to media richness.

(d) There are no differences in extension agents' use of information sources and channels related to other demographic characteristics.

Question 3: What are the attitudes of Agritex extension agents toward pesticide use?

(a) There are no differences in extension agents' attitudes to pesticide use related to age.

(b) There are no differences in extension agents' attitudes to pesticide use related to gender.

(c) There are no differences in extension agents' attitudes to pesticide use related to formal qualifications.

(d) There are no differences in extension agents' attitudes to pesticide use related to position in Agritex.

(e) There are no differences in extension agents' attitudes to pesticide use related to length of working experience in Agritex.

Question 4: What are the technical support needs of Agritex field extension agents regarding pesticide use management.

(a) There is a need to improve technical support to Agritex field extension agents regarding pesticide management.

(b) Agritex should be responsible for supporting field extension agents in pesticide use management.

(c) Pesticide companies should be responsible for supporting extension agents in pesticide use management.

(d) There is a need for formal communication between field extension agents and the pesticide company technical specialists.

Methodology

The study used a descriptive research design. Primary data was collected from selected Agritex extension agents using a self-administered questionnaire. The instrument, which was developed from the research questions and hypotheses, was tested for validity and reliability before administration. It was also pilot tested on a group of similar respondents.

The questionnaire consisted of four sections: competence in pesticide use, information sources and channels, attitudes to pesticide use, and lastly, demographic characteristics. The questionnaire was administered by the author or the respective Agritex regional agricultural extension officer for the district. The usable sample consisted of 209 respondents from Midlands and Mashonaland Central provinces. Due to problems associated with the drought in the survey area, the sub-sample from Mashonaland Central province was not totally random but consisted of available extension agents in some districts.

Data was analyzed using SPSS PC+ Version 4.0 software. Preliminary data evaluation was conducted to investigate differences between the two sub-sample; no significant differences were found in terms of demographic characteristics and competence scores. The next phase of the analysis consisted of computing descriptive statistics and testing the null hypotheses for each research question. The final part of the analysis involved use of multiple regression to create a model to explain how the identified independent factors influenced extension agent competency in pesticide use.

Assumptions and Limitations of the Study

The main focus of the study was limited to Agritex extension agents in the field division. Primary data was not collected from other extension agents, for example those in the private sector, or from farmers, who are the primary end-users of pesticides. Because of the severity of the drought at the time of data collection, only two of the country's eight provinces were selected for the study. There was selection bias in that the two provinces, Midlands and Mashonaland Central, were relatively less affected by the drought, and, normally have greater agricultural potential. The findings may not be generalizable

nationally, and also may have been influenced by the unusual environmental conditions at the time of survey.

The study was limited to management and use of pesticide information. The findings, conclusions and recommendations are therefore bound to the characteristics of this technology, and may not be applicable to other types of agricultural technology. Direct consideration was not given to the possible negative short and long-term effects of pesticide use among small-scale farmers.

Assessment of the extension agents' technical competence was by proxy, using responses to written questions. There were limitations in using other competence assessment methods, to cross-check the written responses. The underlying assumption was that written responses could provide a reliable measure of competence, and further, that honest responses would be disclosed.

Study Findings

At the .05 level, there were no significant differences found between the two provinces in terms of respondent demographic characteristics and competency scores. There also were no unique characteristics in Mashonaland Central province were the sub-sample was not totally random. Although the analysis was conducted separately for the two provinces, the findings are presented for the total sample except in instances where there were specific differences.

Demographic Characteristics

The total sample size was 209 extension agents from Midlands and Mashonaland Central provinces. Most respondents (81.6%) were extension workers; the rest were extension supervisors and senior supervisors (7.7%), and officers (10.7%). Females made up about 10% of the sample, which is similar to the proportion of females nationally amongst Agritex field extension staff. The average age was 39 years, although average for female agents was 10 years lower. Over half the respondents had ordinary level (11 years of formal school) or more. Four of the officers had university degrees. Thirteen of the respondents, all males, had the lowest academic qualifications (Grade 7 or Standard 6). All respondents had at least 2 years of post-school agricultural training, with the majority (92%) being agricultural certificate holders. The average length of service in Agritex was 13.7 years, with a wide range of 38 years. Forty-six percent of the respondents had worked for less than 10 years in Agritex. There was a high incidence of correlation between the demographic variables. Consequently statistical tests that incorporate the effects of confounding variables were used.

Extension Agent Technical Competence

The operational definition of technical competence was the extension agent's score in three task performance areas in the questionnaire. These task performance areas were pesticide application skills, knowledge of recommended products for specific pests and crops, and, general pest management. Self-assessment was used for measuring the pesticide application skills; 72% of the extension agents considered themselves capable of various

application skills. An average of 60% of the agents provided correct responses to pesticide product knowledge questions; the average for general pest management questions was 64%. About 20% of the extension agents referred to banned or withdrawn pesticide products in some of their responses indicating a general unawareness of the registration status of some pesticides.

Semi-partial multiple regression was used to test for the significance of variables in three general areas: demographic characteristics, training and access to information. At the .05 level the three variable sets were significant.

Using stepwise multiple regression, the following independent variables were identified as influencing the competency score: the extension agent's age, gender, level of in-service training, contact and use of pesticide company sales representatives as information sources. Age was negatively related to the technical competence; younger agents scored significantly higher than older agents. The extension agents' years of employment in Agritex was highly correlated with age and was consequently removed from the regression equation to minimize multicollinearity. Female extension agents had significantly higher scores than males. The level of in-service training, contact and use of sales representatives had positive relationships with the dependent variable. There were no significant relationships between the extension agent's formal qualifications or their rank in Agritex, with technical competence. The independent variables in the regression equation explained about 31% (R^2 = .305) of the variance in extension agents' competency scores.

Information Sources and Channels

Extension agents in the two provinces used a variety of sources for pesticide use information. The main sources listed were Agritex, pesticide company representatives and dealers, printed materials, pesticide-product labels and mass media. Radio and surprisingly television were the most frequently mentioned mass media sources. Both Agritex officers and sales representatives were considered as important sources of pesticide use information, with the latter being perceived as significantly more important than the former.

Formal channels, like Agritex officers and sales personnel, were used more than informal ones like mass media. Media richness, the capacity of an information medium to facilitate communication, had no significant effects on the use of the various information channels tested. About half the extension agents had at least one contact with a pesticide company representative in the preceding year. The frequency of contact was similar to the market shares held by the pesticide companies in the small-scale farmer pesticide market. Agricura, Z.F.C. and Windmill were the most active companies in this sub-market.

There were some relationships between the use of some pesticide information sources and channels, and, demographic characteristics. At the .05 level, there was a significant relationship between the use of radio as a channel for pesticide information and the age of the extension agent, and, the highest academic qualification attained. Older extension agents used more informal channels than younger agents. There were no significant relationships between demographic characteristics and the use of Agritex officers and publications, sales representatives, newspapers and magazines, farmers, television, and, the demographic variables. Extension supervisors had greater access to lean media sources than extension workers.

Extension Agent Attitudes toward Pesticide Use

Respondent attitudes were assessed using a Likert-type scale for responses to various statements related to pesticide use. Extension agent attitudes were generally favorable to Agritex, pesticide companies and representatives, and pesticide use information and knowledge. Extension workers felt that they are not contacted by both Agritex officers and sales representatives for technical information. Attitudes to small-scale farmers, as sources of pesticide use information were generally unfavorable. Most extension agents did not consider small-scale farmers as useful sources of pesticide use information. They felt that most farmers in their respective work areas did not know how to use pesticides correctly. Most extension agents were favorable to having the responsibility for small-scale farmer training in pesticide use. There were no significant differences in attitudes with respect to the following extension agent demographic variables: age, gender, formal training, position and years of service in Agritex.

Extension Agent Technical Support Needs

Most of the extension agents in the two provinces are requested to provide advice on pesticide use by farmers in their respective work areas. The majority have conducted training sessions in pest control for farmers. Extension agents undergo limited pre-service training related to pests and pesticide management. Agritex faces a number of constraints in training extension agents. Less than 4% of the department's budget is allocated for staff training.

While the Training Branch offers a variety of in-service courses, only one relates specifically to pesticide use. There is very little formal training provided for Agritex extension agents by the pesticide companies. Specific areas in pesticide use for which the extension agents requested more training or information were pesticide safety, calibration and product information. The amount of print materials and other aids related to pesticide use are limited. Provision of information on pesticide use is neither systematic nor comprehensive. Most extension agents do not have a readily available source of technical information. While the registration system specifies the items of protective clothing for use with various pesticide products, field extension agents usually do not have access to most items of the required protective clothing.

Pesticide companies are more active in the large scale commercial sector than in communal and resettlement areas. Within the small-scale sector, most of the company representatives in contact with extension agents are salespersons. Contact between company representatives and extension agents is usually informal and related to marketing activities. In principle, companies are supportive of increased training of Agritex agents. Financial considerations in this sub-market limit the extension activities of marketing companies. Pesticide companies and other private organizations are unlikely to make long-term commitments for training Agritex extension agents.

Questionnaire Comments

A number of respondents raised concerns about the limited availability of pesticide information in print form. There were also concerns about the possible sale of expired products by marketers in the small-scale farming sector. Some extension agents suggested

the greater use of the vernacular language for pesticide information, and, specifically product labels. There was a request for the supply of protective clothing for all extension workers.

Conclusions and Implications

The study conclusions are based on both primary and secondary data sources. The former were collected through a descriptive survey of extension agents, while the latter included the literature review, interviews with expert sources, and, the author's observations. The conclusions are divided into four sections: Agritex, PPRI, Pesticide companies, and, farmers.

Agritex

There is wide variance in technical competence of Agritex extension agents in Midlands and Mashonaland Central provinces with respect to pesticide use. Extension agent technical competency is influenced by demographic characteristics, training and access to technical information. To improve the technical competence of its field extension agents, Agritex needs to develop more specific policies in all three areas.

The age and gender of extension agents are key demographic characteristics explaining the variation in technical competence. Older agents are less technically competent than their younger counterparts. Female agents are more competent than males. The proportion of female extension agents in Agritex is still very low. The limited evidence from this study indicates that the policy of recruiting female students into agricultural

colleges and subsequently into Agritex, has had positive effects and should be increased to reduce the disparities in gender representation in the organization.

Extension agents' technical competency with respect to pesticide use, is not related to formal academic and agricultural qualifications. Due to the tremendous increase in school enrolment since 1980, the demand for places at agricultural colleges and consequently Agritex, is likely to remain high. As the major employer of agricultural college graduates, Agritex should have greater input in the programs offered at these institutions. Increasing the entry level academic qualifications for the agricultural certificate institutions may be shortsighted since there seem to be no major differences in extension worker technical competence related to formal qualifications. Increasing the entry-level academic qualifications for extension workers may also disadvantage students from the relatively less-endowed rural schools, despite their greater familiarity with small-scale agriculture.

In-service training is positively related to extension agent competence. There is a need for regular, systematic evaluation of Agritex training policies and the specific courses that the extension agents attend. Though Agritex in-service training will not correct for gaps in basic extension agent training, opportunities should be provided for outstanding extension workers to pursue formal training. The limited career opportunities for lower-level extension staff can only serve to further increase frustration and de-motivation given the arduous nature of rural field work and the generally poor conditions of the public service.

Extension agents use a wide variety of sources for obtaining pesticide use information. Agritex, pesticide company sales representatives and printed materials are the three most frequently used sources. The flow of information is essentially one way: from external sources or technical officers in Agritex, to field extension workers. Extension agents perceive sales representatives as more credible sources of pesticide information than Agritex

officers. Mass media sources and farmers are used less frequently. Older extension agents make greater use of the radio for acquiring technical information than younger agents. Formal channels are used more than informal ones in acquisition of information. Media richness had no influence on the use of information sources and channels. There is potential for greater use of mass media for pesticide-use education. Consideration should be given to developing or recruiting mass media professionals to improve the current use of these channels. This could be facilitated by formal cooperation policies between Agritex and the mass media organizations, like the Zimbabwe Broadcasting Corporation.

Extension agents consider the use of pesticide as an important aspect of their jobs. Their attitudes toward Agritex, pesticide companies, and acquiring more knowledge on pesticides are favorable. They have unfavorable attitudes towards small-scale farmers as potential sources of pesticide use information. This result is rather surprising given that some communal farmers in the survey area have been using pesticides for decades, suggesting that they are likely to acquired some expertise through this long experience. There was limited evidence to allow for more specific conclusions on extension agent attitudes to small-scale farmers. Extension agent attitudes to pesticides and their use are not influenced by demographic characteristics. Assessment of specific relationships between Agritex extension agents and small-scale farmers were outside the scope of this study. There is need for empirical evaluation of extension agent attitudes to small-scale farmers to assess whether the unfavorable attitudes of extension agents found in this study are limited to pesticide use or extend to the broader aspect of farmer knowledge. Insights into extension agent-farmer relationships would allow for more enlightened policies aimed at increasing the mutual benefits from extension agent-farmer interactions.

Technical support, both from within and outside the organization, available to Agritex field extension agents for pesticide management is generally inadequate and irregular. The quality of farmer training by extension agents is affected by shortages of teaching aids including protective clothing and printed materials like books, pamphlets and posters. Extension agents indicated a need for more regular and comprehensive training in pesticide use especially in the areas of application skills, safety and product information. Agritex has limited capacity for correcting knowledge gaps due to inadequate pre-service training. In this respect there is a need to incorporate pest management courses in the curriculum of agricultural training institutions.

The resource limitations facing Agritex require a critical evaluation of the role of public agencies in the provision of extension services. The key policy issue is whether public or private sector organizations should be responsible for providing pesticide use technical support. In the more commercially oriented communal areas like Gokwe, there may be opportunities for formal involvement of pesticide companies in providing technical support, with Agritex playing a monitoring role.

Pesticide Use Regulations

The pesticide registration system in Zimbabwe is generally sound and comparable to systems in more developed countries. There are however some inadequacies which are partly due to the opening up of the country's economy and limited resources within the registration agencies.

Specific concerns relate to the importation of pesticides by individuals and non-traditional organizations, which will entail greater scrutiny by the registration agencies. The

criteria used for screening applicants for pesticide registration has to include the capacity to handle the potentially dangerous side effects of pesticides, over and above product efficacy. With more liberal economic policies, there is growing interest in direct importation of pesticides by commodity groups and individual farmers. These groups are likely to be less knowledgeable and/or concerned about the potential hazards of pesticides.

Monitoring of field activities related to pesticide use is generally informal and has traditionally been based on the goodwill of pesticide companies and other NGOs. The ability of the registration agencies to conduct post-registration activities is imperative. For example, some of the extension agents sampled for this study claimed that expired pesticides are sometimes sold in the small-scale sub-market. The public regulatory agencies, like the Hazardous Substances Board, the Drug Control Council and the Plant Protection Research Institute, have limited capability for field monitoring and enforcement. However there is still a need for these public agencies to act as neutral evaluators of issues like product quality in the market, compliance with regulations like labelling, and, training programs specific to various categories of pesticides. With increasing numbers of marketing organizations, products and applicators, the need for more stringent regulations is critical.

The linkages between these regulatory agencies and Agritex are minimal. Agritex has little involvement in the registration, regulation or monitoring of pesticide use. There is generally no formal communication between field extension agents and the PPRI for example, except with respect to reporting the occurrence of large scale pest outbreaks.

Pesticide Companies

There is negligible contact between pesticide company technical specialists and Agritex extension agents; there is relatively more contact between company sales representatives and extension agents. Contact between sales representatives and extension agents is usually based on informal relationships in the field. Extension agents expressed interest in interacting with pesticide company representatives for technical aspects of pesticide management.

Recommendations

Given the resource constraints facing Agritex, it is unlikely that the organization will be able to increase the number of extension programs/activities it is involved in. There is a need for Agritex to reassess its role in the agricultural system given that it is not feasible to provide adequate support for all communal area farmers. At the policy level, the decision-makers in the organization need to address the key question of whether or not Agritex should be actively involved in the pest management system. The recommendations for Agritex are provided on the assumption that it will remain as the main supporting organization for advising small-scale farmers on pesticide use management.

To accommodate the perspectives, interests and needs of the diverse organizations and personnel involved in pesticide management and use, the recommendation section is divided into the three main categories of pesticide use information users: Agritex, the monitoring and regulatory agencies, and pesticide companies. Within each section, the recommendations are divided into general and specific categories. This structuring is meant

more for placing the issues into context, rather than to portray pesticide use information management as consisting of sets of self-contained entities. These user-categories are all part of a dynamic system in which each unit affects the total performance of the whole.

Effective use of agricultural technology requires knowledge on the part of users and advisers. Increased use of agricultural inputs also entails a greater demand for more, and specialized technical services. Small-scale farmers are likely to make more cost-effective use of pesticides if the knowledge levels of the extension agents advising them increases. The philosophical orientation of Agritex's extension system needs to emphasize knowledge and its acquisition, rather than the traditional notion of viewing extension agents as message carriers. Agritex will benefit from investing in the technical knowledge of its field staff. Extension agents will benefit if Agritex is a more active participant in the pesticide management system. This would not only improve the awareness and knowledge of senior Agritex staff of the relative sophistication and intricacies of the pesticide industry but also bring to the fore, problems associated with pesticide use amongst small-scale users. Benefits from investing in technical knowledge will be realized if the organization promotes an atmosphere for professional activities and behaviors.

Agritex

To enhance the technical know-how of extension agents, Agritex needs to develop closer links with the agricultural training institutions. Agritex needs to focus on increasing the awareness of the trainers in these institutions of the skills required of potential Agritex extension agents. Specifically, the curriculum used by training institutions should put more emphasis on agricultural pests and pest management. This is a necessary requirement given

the need to address the environmental aspects of small-scale agriculture and the limited capability of Agritex to correct for knowledge gaps in pre-service basic training. Because of the positive relationship between in-service training and technical competence, training in pesticide use should be obligatory for all extension agents who are directly involved in advising and training farmers. Specifically, the Agritex course on the safe use of pesticides should be mandatory for all field extension staff.

Agritex should also facilitate training and informal linkages between its extension agents and other organizations. For example, extension agents benefit from the training provided by other institutions like the Cotton Training Centre at Kadoma.

The following concerns need to be addressed in the short term:

1. The provision of safety clothing for demonstration/teaching purposes by extension agents. Small-scale farmers' awareness of the safety measures required when using pesticides will be enhanced by regular reinforcement by extension agents. Given that some extension agents are involved in farming activities, their credibility with respect to pesticide safety concerns will be at stake if they do not practice the recommended safety practices.

2. The production of a basic manual or pamphlets on pests and pesticide management. Such a manual would provide technical and other information on the pesticides used by small-scale farmers, their uses and safety information. It would also help in alleviating some of the confusion that arises from the use of different trade names for similar products. The English language skills of some Agritex extension agents are limited and efforts to use more vernacular language in technical literature should be increased.

3. The introduction of an accreditation scheme for Agritex extension agents directly involved in farmer training. This could take the form of a basic test on pesticide management which every extension agent has to pass within a given period after joining the department. Agritex could invite other organizations like the pesticide companies and the FAO in designing and implementing such a scheme.

4. Agritex should increase the use of multi-media strategies in information dissemination. There is potential for increased use of mass media channels. For example, over half of the extension agents in Mashonaland Central and the Midlands province have access to a radio and about 20% to a television set. Use of these two channels for information targeted at field staff has not been fully exploited. More systematic use would allow the organization to increase efficiency in providing general interest and awareness information to field staff.

Monitoring and Regulatory Agencies

Evidence from secondary data sources indicates the need for the monitoring and regulatory agencies to review policies related to pesticide use. More stringent regulations are required to reduce the likelihood of registering products from organizations with inadequate capacity to handle the potential side-effects of pesticide manufacturing and marketing.

For the small-scale farming sector, there is need for introducing additional requirements for pesticide products with potential use in this sub-market. Such regulations could include requesting that applicants for product registration, in conjunction with Agritex field staff, conduct demonstration trials in communal areas.

The regulatory agencies should make use of more information channels to announce the withdrawal or restricted use of specific pesticides. Agritex field staff are generally uninformed of the status of pesticide products. Greater use of mass media channels and involvement of Agritex technical specialists would facilitate both extension agent and farmer awareness.

Pesticide Companies

Linkages between Agritex and pesticide companies for technical information are weak. Agritex extension agents make limited use of the technical know-how within the pesticide companies. Pesticide companies should play a greater role in training extension agent in pesticide use, since Agritex has limited capacity to increase expenditure on staff training from budgetary sources. Given that it may be uneconomic for pesticide companies to conduct such training in communal areas, an alternative could be formal participation of private sector specialists in Agritex training sessions.

Pesticide companies perhaps through their association, ACIA, should consider the standardization of some pesticide product names. A number of generic compounds are marketed using different trade names causing some confusion amongst extension agents, and most likely small-scale farmers.

Pesticide companies should provide greater support for pesticide information dissemination activities through increased use of mass media. Specific areas include more use of printed materials, radio and television targeted specifically for the small-scale farming sector.

Areas for Further Study

It is generally acknowledged that use of pesticides does not lead to sustainable pest management in agriculture. A number of alternatives, like integrated pest management (IPM) have been advocated. While the technical merits of such alternatives are fairly well documented, there is a paucity of studies looking at the social aspects of alternatives to pesticide use especially for small-scale agriculture.

There are a limited number of studies on the effectiveness of Agritex extension programs and activities. Longitudinal studies on the effects of various interventions and causal modelling would strengthen the knowledge base on Agritex and other public extension systems. Such studies could be incorporated into the ongoing activities of the monitoring and evaluation section within Agritex. More empirical evidence is needed on the competencies of extension agents in the use of other types of agricultural technology. There is a need for studies on the technical and professional competencies of Agritex from the farmers' perspective and also the relationships between competencies and motivation/job satisfaction.

The private sector is playing an increasingly important in agricultural research and extension in developing countries. There are a variety of private extension organizations and systems working in Zimbabwe's agricultural sector. These include the traditional non-governmental organizations, commodity groups and private voluntary organizations. There have been few independent studies evaluating the extension and other activities of these organizations. Potential areas for investigation are the management and communication patterns in private extension organizations, comparative analysis of extension systems and alternate mechanisms for linking extension institutions.

APPENDICES

APPENDIX 1

A) Agritex: Research Approval Letter

B) Letters to Chief Agricultural Officers

Verbatim Copy of Original

All correspondence to be addressed to the Director

MINISTRY OF LANDS, AGRICULTURE AND RURAL RESETTLEMENT
Department of Agricultural Technical and Extension Services
P.O.Box 8117, Causeway, Harare, Zimbabwe.
Tel:707311 or 794601

REF: B/115/1

9 July 1992

Raymond T. Kujeke
Department of Agricultural and Extension Education
Michigan State University
410 Agriculture Hall
East Lansing MI 48824-1039
Michigan
USA

Ph.D RESEARCH PROPOSAL ON AGRICULTURAL EXTENSION

Reference is made to your request regarding the above subject. In principle the department of Agritex is supportive of your endevours. You will have access to our publications and documents that relate to your research proposal. However, in view of the limited resources thr department cannot afford to:

(a) Provide transport and accommodation during you field work.

(b) Assign staff to physically assist you in conducting your questionnaires.

You will have to sign an agreement with the department, when you come in August, to commit you to provide us with all the research data and results.

(signed)
J.M. MAKADHO
DIRECTOR OF AGRITEX

Verbatim Copy of Original

All correspondence to be addressed to the Director

MINISTRY OF LANDS, AGRICULTURE AND RURAL RESETTLEMENT
Department of Agricultural Technical and Extension Services
P.O.Box 8117, Causeway, Harare, Zimbabwe.
Tel:707311 or 794601

REF: D/107/1

14 September 1992
Chief Agricultural Extension Officer
Midlands Province
Mashonaland Central Province

RESEARCH PROGRAMME ON PESTICIDE USAGE: MR R. KUJEKE

This serves to introduce Mr Kujeke who is carrying (out) a study of Pesticide Usage in Communal Areas. Mr Kujeke is a Zimbabwean affiliated with Michigan State University.

Could you please assist Mr Kujeke by providing any information pertaining to his study. He would also (like to) administer a questionnaire among Agritex Officers. Please assist in selecting the districts and officers to be interviewed.

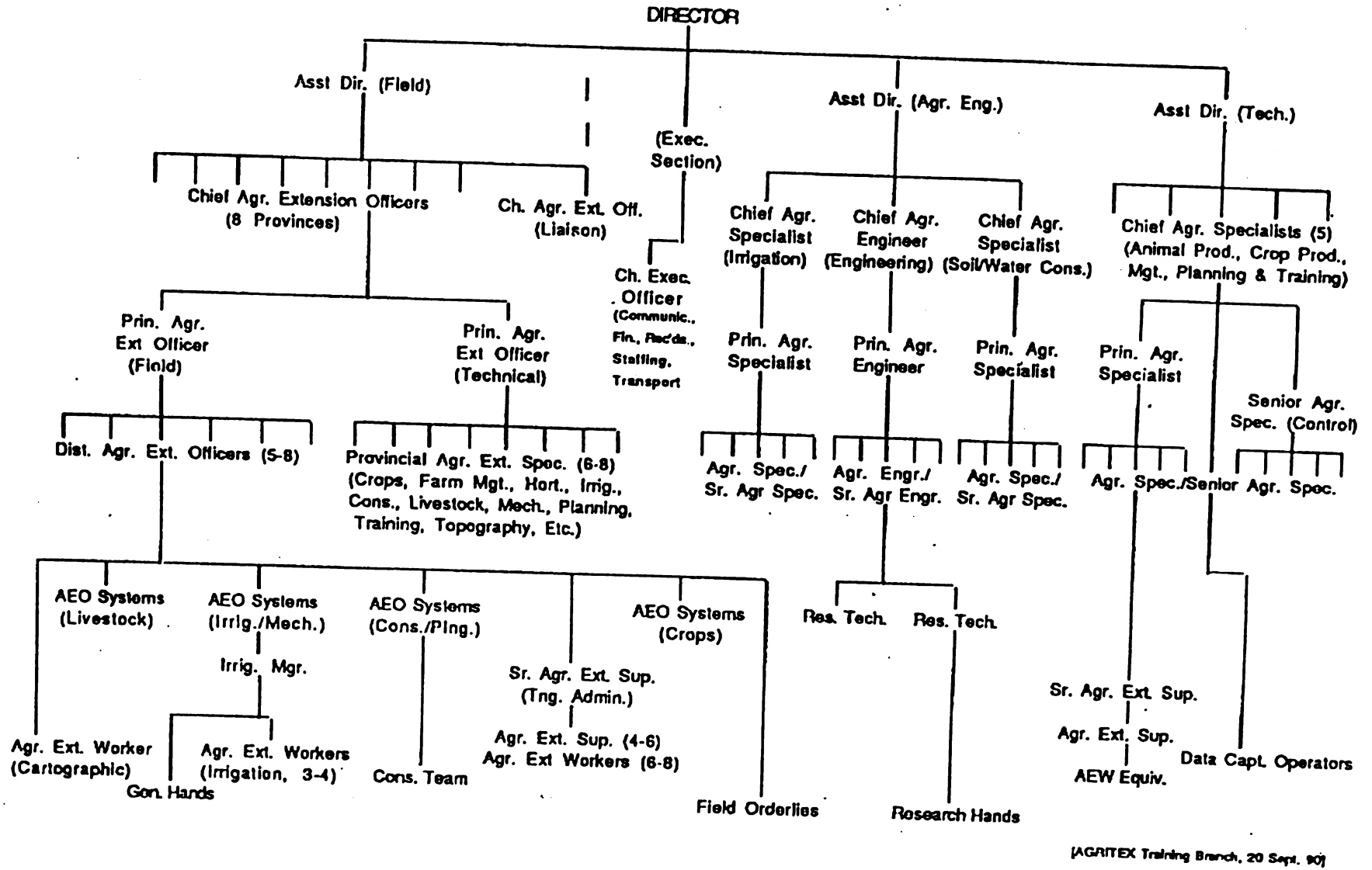
(signed)
J.M. MAKADHO
DIRECTOR OF AGRITEX

APPENDIX 2

A) Agritex Organizational Chart

B) Agritex Field Staff by Gender

AGRITEX SCHEMATIC ORGANIZATIONAL CHART - Ministry of Lands, Agriculture and Rural Resettlement



[AGRITEX Training Branch, 20 Sept. 90]

APPENDIX 2
BREAKDOWN OF TECHNICAL AND EXTENSION STAFF IN AGRITEX[a]

Position	Total Posts	Filled Posts	% Female
Director	1	1	-
Assistant Directors	3	2	-
Chief Agricultural Extension Officer	9	9	-
Chief Agricultural Specialist	8	5	-
Principal Agricultural Extension Officer	16	15	-
Principal Agricultural Specialist	7	5	40
Assistant Chief Engineer	1	0	-
District Agricultural Extension Officer	49	45	2.2
Agricultural Extension Specialist	163	148	18.9
Agricultural Extension Officer	238	227	12.3
Agricultural Engineering	10	6	-
Principal Technician	1	0	-
Technician	21	19	-
Publications Officer	3	2	50
Senior Agricultural Extension Supervisor	57	46	-
Agricultural Extension Supervisor	267	229	-
Agricultural Extension Worker	1690	1633	11.5
TOTALS	2544	2394	10.3

[a] - Compiled by M. Chimbira, Agricultural Extension Specialist, August, 1992.

APPENDIX 3

UCRIHS Approval Letter

MICHIGAN STATE UNIVERSITY

OFFICE OF VICE PRESIDENT FOR RESEARCH
AND DEAN OF THE GRADUATE SCHOOL

EAST LANSING • MICHIGAN • 48824-1046

August 10, 1992

Raymond Kujeke
410 Agriculture Hall

RE: TECHNICAL INFORMATION FLOWS AND TECHNICAL COMPETENCIES OF AGRITEX EXTENSION AGENTS IN ZIMBABWE, IRB #92-402

Dear Mr. Kujeke:

The above project is exempt from full UCRIHS review. The proposed research protocol has been reviewed by a member of the UCRIHS committee. The rights and welfare of human subjects appear to be protected and you have approval to conduct the research.

You are reminded that UCRIHS approval is valid for one calendar year. If you plan to continue this project beyond one year, please make provisions for obtaining appropriate UCRIHS approval one month prior to August 5, 1993.

Any changes in procedures involving human subjects must be reviewed by UCRIHS prior to initiation of the change. UCRIHS must also be notified promptly of any problems (unexpected side effects, complaints, etc.) involving human subjects during the course of the work.

Thank you for bringing this project to my attention. If I can be of any future help, please do not hesitate to let me know.

Sincerely,

David E. Wright, Ph.D., Chair
University Committee on Research Involving
Human Subjects (UCRIHS)

DEW/pjm

cc: Dr. Frank Bobbitt

APPENDIX 4

Cover Letter and Questionnaire

AGRITEX SURVEY OF PESTICIDE USE INFORMATION

QUESTIONNAIRE

SECTIONS

1. **Cover Letter and Instructions**
2. **Information Sources and Channels**
3. **Pesticide Use**
4. **Attitudes To Pesticide Use**
5. **Demographics**

SECTION 1: COVER LETTER AND INSTRUCTIONS

Background

The use of pesticides in agriculture continues to increase especially in communal and resettlement areas. To improve Agritex's ability to provide service to farmers, it is necessary that information on the current state of education and advisory services regarding pesticide use be available. Your responses to the issues raised in this questionnaire are therefore important in assessing Agritex's ability to serve farmers in the safe and effective use of pesticides.

This questionnaire is part of a survey to determine the technical support/advisory needs of Agritex staff regarding pesticide use among small-scale and communal farmers. The questionnaire will take about one hour to complete. Your selection was by chance and you are free to refuse participation in this study. Completion and return of this questionnaire is an indication of your agreement to participate. All answers will be kept strictly anonymous and you do not have to write your name.

If you have any questions regarding this questionnaire and/or the survey please contact:

Raymond Kujeke Pesticide Survey P.O. Box 553 Harare Phone: 65601 (Harare)	OR	The Director AGRITEX P.O. Box 8117 Causeway Phone: 707311 (Harare)

A summary of the results of this survey will be available at your provincial office or at the head office.

Directions

Answer each question or statement as accurately as you can. Most of the questions can be answered by circling the item that best describes your opinion or situation. Other questions require a cross (X) to be placed next to the most appropriate response(s). Space is provided for you to make comments at the end of each section. Try to answer all questions. Examples of how to answer specific types of questions are shown below:

Example 1

No Yes 1. I organize field days in my area.

* Circling Yes indicates that you organize field days.

Example 2

Please comment on the value of field days.

Example 3

The possible responses are:

SD - Strongly disagree
D - Disagree
? - Undecided
A - Agree
SA - Strongly agree

SD D ? A SA 2. Rainfall is important for agricultural production in my area.

* Circling SA indicates that you strongly agree that rainfall is important for agricultural production in your area.

Example 4:

3. How old are you? _____

The answer indicates that you are 41 years old.

Feel free to ask if you do not understand any of the questions or statements.

SECTION 2: INFORMATION SOURCES AND CHANNELS

Circle the most appropriate response

No Yes 1. Have farmers ever asked you to provide advice on the use of a pesticide?

2. List, in order, the 3 most important sources of pesticide information to you.

1._____

2._____

3._____

3. Which of the following sources do you use for obtaining information on pesticide use?

Put a cross (X) next to all appropriate responses.

	Agritex Publications
	Agritex Officers
	Sales Representatives
	Newspapers and Magazines
	Farmers
	Radio
	Television
	Others (specify)

No Yes 4. Have you taken the cotton training course at the Cotton Training Centre in Kadoma?

5. If your answer is Yes, what year did you last take this course? 19__.

No Yes 6. Have you attended the Agritex "Safe use of Pesticides" course?

7. If you answered Yes, what year did you last take this course? 19__.

No Yes 8. Have you attended a course(s) on pesticide use conducted by a pesticide company.

9. If you answered Yes, which company(s) conducted the course?

_____

_____

_____

No Yes 10. Did you take a course covering pesticides when you were in college?

No Yes 11. Have you conducted a course on the use of pesticides for farmers?

No Yes 12. In the last year, where you ever in contact with a representative of an agricultural chemical company?

13. If your answer to question 9 is Yes, please list the name(s) of the company(s), whose representatives you have been in contact with during the last year:

_____

_____

_____

For the following set of questions, indicate your level of agreement by circling the most appropriate response.

Response	Key
Strongly Disagree	SD
Disagree	D
Undecided	?
Agree	A
Strongly Agree	SA

SD D ? A SA 14. Agritex officers are an important source of pesticide use information.

SD D ? A SA 15. I contact other Agritex officers for pesticide use information.

SD D ? A SA 16. Representatives of pesticide companies are an important source of pesticide use information.

SD D ? A SA 17. I can contact a representative(s) of a pesticide company for pesticide information.

SD D ? A SA 18. Farmers are an important source of pesticide use information.

SD D ? A SA 19. I contact farmers for pesticide use information.

SD D ? A SA 20. I get pesticide use information when I need it.

SD D ? A SA 21. Agritex officers contact me when they need pesticide use information.

SD D ? A SA 22. Representatives of pesticide companies contact me when they need pesticide use information.

SD D ? A SA 23. Representatives of pesticide companies contact me when they need sales information.

SD D ? A SA 24. I contact my superior officer(s) when I need help with a pesticide-related problem.

SD D ? A SA 25. I contact a subject matter specialist when I need help with a pesticide-related problem.

SD D ? A SA 26. I have adequate books and other literature on pesticide use.

27. Write down any comments you have about the sources of information for pesticides available to you in the space below:

SECTION 3: PESTICIDE USE

Circle the most appropriate response.

No Yes 1. Have you ever applied an insecticide?

No Yes 2. Have you ever applied a herbicide?

No Yes 3. Annual weeds produce seeds in the second year of growth.

No Yes 4. Dimethoate (Rogor) is more toxic than Gramoxone (paraquat)

No Yes 5. The inert ingredient is the component that controls the target pest.

No Yes 6. Pesticides with a green label are the most dangerous.

No Yes 7. Perennials are plants that live for two years.

No Yes 8. I can calibrate a ULV (ultra low volume) sprayer.

No Yes 9. I can calibrate a knapsack sprayer.

No Yes 10. I can calibrate a tractor-mounted sprayer.

No Yes 11. I find it difficult to calculate the right amounts of chemical and water to mix.

For the following list of pest problems, write down the name of one pesticide you would recommend to a farmer. Write "DK" if you do not have an answer:

12. Red bollworm on cotton_____

13. Aphids (inda) on cotton _____

14. Nutgrass (cyperus) in cotton_____

15. Broadleaf weeds in maize_____

16. Stalkborer (Rukonye) in maize_____

17. Rodents (mbeva, makonzo) in stored maize_____

18. Red spider mites in tomatoes_____

19. In the space below, write down any items of protective clothing that you own:

SECTION 4: ATTITUDES TO PESTICIDE USE

Please indicate your level of agreement with the following statements. Circle the most appropriate response.

Response	Key
Strongly Disagree	SD
Disagree	D
Undecided	?
Agree	A
Strongly Agree	SA

SD D ? A SA 1. Knowledge about pesticide use is important for extension workers.

SD D ? A SA 2. Agritex should provide more courses in pesticide use for extension workers.

SD D ? A SA 3. Agricultural chemical companies should provide courses on pesticide use for extension workers.

SD D ? A SA 4. In my job, it is necessary for me to know about the technical aspects of pesticide use.

SD D ? A SA 5. All extension workers should be required to pass a test in pesticide use.

SD D ? A SA 6. The Agritex "Safe use of pesticides" course should be obligatory (required) for all extension workers.

SD D ? A SA 7. Most of the farmers in my area know how to use pesticides correctly.

SD D ? A SA 8. Training of farmers in the use of pesticides should be my responsibility.

SD D ? A SA 9. The representatives of pesticide companies should be responsible for training farmers in pesticides.

SD D ? A SA 10. The representatives of pesticide companies provide farmers adequate training on pesticide use.

SD D ? A SA 11. The representatives of pesticide companies provide me with information on the pesticides they are selling in my area.

SD D ? A SA 12. I normally consult with the pesticide company representative for information on pesticides.

SD D ? A SA 13. My superiors in Agritex should be responsible for obtaining information on pesticides.

SD D ? A SA 14. Technical information on pesticides is difficult for me to understand.

SD D ? A SA 15. Farmers should seek the information they need on pesticides from the company representative(s).

SD D ? A SA 16. Farmers are a useful source of technical information on pesticide use.

SD D ? A SA 17. In my job, it is necessary to have items of protective clothing.

18. List down topics which you would like to be covered in future courses on pesticides.

_____

_____

_____

_____

SECTION 5: DEMOGRAPHIC INFORMATION

1. How old are you? ____

2. What is your sex?

Male __
Female__

3. What is the highest academic qualification you attained?

Put a cross (X) next to the box for the appropriate response.

Grade 7/Standard 6	
Form 2/J.C.	
Form 4/O Level	
Form 6/A Level	
Degree(B.Sc,M.Sc.)	

4. What is the highest agricultural qualification you attained?

Certificate (e.g.Esigodini,Mlezu)	
Diploma(e.g.Gwebi,Chibero)	
Degree (B.Sc.,M.Sc)	
Other (Specify)	

5. What is your position in Agritex? _____

6. How long have you been working in Agritex? ____ years

7. Use the space below to write any comments, ideas or questions you have regarding this questionnaire or pesticide use in general.

APPENDIX 5

COMMENTS ON INFORMATION SOURCES, THE QUESTIONNAIRE AND PESTICIDE USE

APPENDIX 5

COMMENTS ON INFORMATION SOURCES

I don't have enough sources except officers and specialists especially those in the horticulture section. I need pictures, samples of pesticides and books on pesticides.

The books I have are not enough and some have old information.

Most pesticides should bear information in the vernacular language.

I get information from subject matter specialists when I need it and also from reps who come on request.

The department provides a bit of information on the use of pesticides and the horticultural specialist looks for the latest information for me.

Encourage farmers to use protective clothing whenever they use pesticides.

I need a lot of information concerning pesticides. Some of the pesticides do not work if they are not used correctly.

Sales reps are only interested in sales. At times they are not interested in explaining the dangers of pesticides.

Companies are no longer as generous as in the past in terms of making materials available. They are most interested in talking to groups who will eventually purchase inputs.

Pesticides are very effective.

Agritex and sales reps are important information sources.

I have the Agritex "Safe Use of Pesticides" booklet.

I have got nothing to do with pesticides as far as my work is concerned.

I need sales reps to hold demonstration meetings in my area to reinforce the use of fertilizers.

Companies should provide booklets annually to Agritex so that Agritex can provide assistance to farmers faster.

Sources are limited. I would be grateful if sales reps provide me information rather than ask me for customers.

Some companies do not put an expiry date on their labels instead they put a code that is not understood.

Not enough literature for my work. Little availability of pesticide representative. No resources for farmer training.

If there are proper directions of use then it is easy to handle a pesticide by following these directions.

New chemicals appear quickly on the market before we get information or publications from the dept; also the old ones disappear fast from the market.

When I need information I personally contact Agricura, Farmers Co-op and any related companies to get the information I need.

Sources are not readily available. There is no revision of materials to accommodate changes in names and to record new products.

Sales rep information concerning farmers confuse farmers with trade names.

Some of the pesticides have no expiry date.

Sources of information are usually unreliable especially sales reps because they do not tell the truth. Information should be provided in publications.

I receive very little information on pesticides. I need posters but these are unavailable.

I need books on pesticides.

Booklets are not enough to give out to the users, therefore supply should be increased.
I need more books and literature about pesticides.

Do not have enough sources for pesticides therefore it is difficult to conduct a course for farmers. More books on this subject should be produced and given to each staff members.

Most of the information is kept at district office under lock and key to the expense of district staff.

Reps are mostly interested in their sales rather than teaching and educating farmers about the dangers and effects of their products. Literature on safety to farmers is poor and very alarming.

Information is not readily available.

Need more books or pamphlets on pesticide use and the sales reps to visit our areas every year and attend our field days.

I have never heard Agritex officers conducting a course on safe use of pesticides. Most of my information is from fellow extension workers, sales reps, magazines and publications.

I always listen to the weekly radio programs. Magazines like Umlimmi which I receive every month at times contain topics on new pesticides use, especially new chemicals.

Agricura booklets should be given to all staff. If all companies would improve on the booklets this would help. Books are essential at all levels

Agritex officers are found wanting. The subject matter specialists are found doing some other business instead of teaching staff hence we resort to sales reps who are always available and helpful.

Agritex officers should train extension workers on the use of pesticides, and charts should be provided.

Agritex should get a lot of information on pesticides from those companies which manufacture pesticides.

It is important for reps to come to "grassroots" farmers to train and demonstrate the uses and dangers of pesticides.

Sources of information are inadequate.

Agritex officers provide information for pesticides.

Agritex officers are best sources but they wait for me to ask for information instead of providing courses. Agritex publications are good but unavailable. Newspapers and magazines are expensive.

Some of the information is out of date; the names of some chemicals have changed and others are no longer in production. Information on latest chemicals on the market is scanty.

Pesticide companies rarely visit important field days to educate farmers on pesticide safety.

Some of the pesticides are outdated and others are no longer available on local markets.

Courses on pesticide dangers must be organized and attended regularly.

Agritex crops branch should constantly review and update field officers on pesticides on the market. Books and other literature should be more readily available for use as reference material.

Reps and Agritex officers are hard to come by as sources of information due to their location in relation to where I am. Mileage constraints account for the communication short fall.

I get information about pesticides from Agritex publications as well as pamphlets from commercial companies.

I have a handout on safe use of pesticides given to me by the (Agritex) Training branch.

Sources of pesticide information are inadequate.

Companies should give handouts and manuals on pesticides.

Publications on pesticides should be made available to farmers.

Information should be given to farmers in time; up to date information should be supplied to Agritex.

The other sources of information for pesticides are courses held at provincial level with the specialists.

Would welcome periodic handouts on use and calibration of pesticides or an update since there may be new (products) being put on the market.

There are limited sources of information for pesticides. Research, Agritex and companies should arrange courses and seminars, and handouts should be provided to the staff in the area.

Labels on bottles and packs.

I subscribe for other magazines nationally and internationally e.g. Minnet magazine which I get monthly.

I get most information from (the) Kadoma Training Centre Handbook and from manufacturer's recommendation leaflets. This is mostly for cotton. For other crops I get handouts from subject matter specialists.

I get information from the Cotton Training Centre Handbook and from subject matter specialists when they produce handouts. Sometimes we have courses and specialists help with information.

I need more information on pesticides.

If we could have books and pamphlets for use un the field.

I have books from companies which help, and some teaching from the radio.

The sources are very minimal.

I am not fully equipped with adequate sources of information and I think this is true for most staff at my level.

The Agritex staff should know about the technical aspects of pesticides.

Companies should arrange courses and provide handouts for all staff

Most correct information is obtainable from company handouts and research handbooks.

I usually rely on the Agritex "Safe use of Pesticides" handbook when I prepare a lesson on safe use of pesticides.

Use only Agritex Handouts. No other serious information from elsewhere.

I cannot get enough information for my requirements.

Sources of information are not readily available because officers have never been in my area for almost two years.

Some publications should be made available to farmers.

Sales reps appear to be too busy to talk to farmers. Some chemicals are too dangerous to be sold to anybody who wishes to buy.

Books and handouts are not up to date.

Some books and charts do not have up to date information.

Companies supply information on pesticides to me when I need it.

Information is readily available from reps as well as pamphlets accompanying the particular pesticide.

Company publications are the most reliable source of information on pesticide use.

I have a few Agritex publications on pesticide use. Specialists are very far away to give required information in good time. A handbook is required to provide detailed information for the extension worker.

More literature must be made available to ground staff. Posters hanging in towns shows information wrongly placed. Reps should improve their degree of liaison with ground staff.

I get information from Kadoma Training Center and Horticultural courses held at Senga.

In most cases I use Agritex staff. This information is generally not adequate. There is a need to seriously look into this issue to reduce danger caused to human life.

Main source of information is through Agritex training branch. It is always technically written.

Source of information is through Agritex Training branch.

Pesticides are good because they help destroy all pests.

Pesticide companies must come down to farmer's groups and demonstrate the uses of these pesticides and their effectiveness at appropriate times.

Companies should assist in providing extra information.

I depend on personal notes and books for information; nothing has so far been provided by the department with the exception of magazines and "News and views".

Information is not readily available. I have to make a good effort to make things right. I feel if I get books and pamphlets on pesticide information it would become easy.

I get information about pesticides from books, sales reps and subject matter specialists.

Agritex has inadequate information about pesticides, and the information is kept in offices when staff have very little time to get to the office.

Sources are limited to some extent.

I have enough information on pesticides but would like new information on the dangers of different pesticides.

Information on pesticide safety is very useful for every user.

COMMENTS ON THE QUESTIONNAIRE AND PESTICIDE USE

Its a good questionnaire and I hope courses are going to be conducted concerning this topic.

I hope you are going to use the information.

Protective clothing should be provided for training in the field. Sales reps must not be interested in sales only but should explain things like expiry date.

Private companies could do more in terms of distribution of pesticide materials. Stage courses in the field. Carry out demonstrations.

Why are you asking about age and gender?

I don't know what is behind this questionnaire, otherwise the questions are educative.

I do not need much information on chemicals since I am a soil and water conservation officer.

Lack of liaison with companies hinders farmers from buying the right chemicals. Farmers need external education on how to use chemicals. Extension workers should be provided protective clothing and new product lists.

Trial/demonstrations should be done in communal areas to help demonstrations. Companies should provide information on pesticides to Agritex staff.

Information on pesticide toxicity should be clearly written rather than putting labels with colors.

Sales reps should have more contact with extension workers.

Companies should replace expired products with new ones. Companies should supply protective clothing.

Can pesticide information be given to our offices so that we can obtain this information from them.

This questionnaire is very important. If there could be feedback on what is contained in it and the responses given.

Companies should avoid changing product names for goodness sake!

The survey is very important and needs further explanation.

The questionnaire is comprehensive and relevant to my area of work.

Very useful.

Farmers should also visit the Cotton Training Center.

Extension workers should be supplied with protective clothing.

Questionnaire is very appropriate.

I wish there could be a course run by Agritex officers on the use of pesticides.

Reps should hold refresher courses for extension staff on pesticides and their uses, dangers and avoidance of pollution.

More field visits to farmers are called for to reinforce awareness on pesticide dangers.

Companies should train farmers. Some farmers want information direct from the companies. Companies should explain the dangers of pesticides e.g. reusing pesticide containers.

I need to be supplied with up to date information on pests and pesticides which are a major problem in Zimbabwe.

Agritex should supply recommendations on different crops for each extension worker.

Why asking about our academic qualifications yet they are not considered in Agritex.

From our response you will identify training needs. Courses thereafter will be more than welcome considering the increasing impact in vegetable and fruit tree growing.

What is the relationship of my age and sex with the information on pesticide use?

The questionnaire is very useful. I wish the people responsible would put more information on the use of pesticides.

Responsible people should give us full training on pesticides.

A good start to mass production.

This exercise should be compulsory for all extension agents. Courses should be provided at district, provincial or national levels. If there are no funds available then substitute by handouts.

Officer should take action by organizing courses where there is inadequate information.

Our teaching on effective clothing is not effective because do not have the clothing. Very few farmers respond to the use of protective clothing.

Farmers are confused when one pesticide is given different trade names.

A full course on the use of pesticides should be conducted and flip-charts supplied.

Reps should meet with Agritex training specialists at provincial level, and then organize training of extension workers who will then train farmers.

Labels on containers are not specific.

Courses on pesticide uses should be conducted to all Agritex staff as they are in daily contact with the users.

Courses on pesticide and herbicide usage are needed for extension staff.

Grassroots staff should be provided with adequate books and literature concerning the use of pesticides.

All staff should be given adequate handouts.

The questionnaire is very vague.

We teach farmers about protective clothing yet we do have any which does not enhance our teaching.

It is necessary for farmers to have handbooks in the vernacular.

APPENDIX 6

FACTOR ANALYSIS OF ATTITUDE VARIABLES

APPENDIX 6

FACTOR ANALYSIS OF ATTITUDE VARIABLES

Principal component solutions for Agritex extension agents' attitudes towards pesticide use

Each attitude variable was measured on a five-point Likert scale varying from 1 (strongly disagree) to 5 (strongly agree). Undecided (3) responses were omitted from the analysis.

1. ATTITUDES TOWARD AGRITEX

Variables	Factor loading	Communalities (h^2)	Eigen value	Variation
Agritex officers are an important source of pesticide use information.	.663	.515	2.063	29.5%
I contact other Agritex officers for pesticide use information.	.664	.588		
Agritex officers contact me when they need pesticide use information[a].	-	-		
I contact my superior officer(s) for help with pesticide use problems.	.765	.588		
I contact a SMS for help with pesticide use problems.	.531	.300		
Agritex should provide more courses on pesticide use for EWs.	.267	.538		
My superiors in Agritex should be responsible for obtaining information.	.492	.498		

[a] Excluded from the analysis because inter-item correlations with other variables were <.10.

2. ATTITUDES TOWARD PESTICIDE COMPANIES AND REPRESENTATIVES

Variables	Factor loading	Communalities (h^2)	Eigen value	Variation
Sales reps are an important source of pesticide use information.	.358	.237	2.116	26.5%
I contact sales reps for pesticide use information.	.605	.484		
Sales reps contact me when they need pesticide use information.	.189	.478		
Sales reps contact me when they need sales information.	.453	.274		
Pesticide companies should provide courses on pesticide use for EWs.	.231	.488		
Sales reps provide information on the products they are selling in my area.	.718	.526		
Sales reps provide farmers with adequate training on pesticide use.	.567	.343		
I consult with sales reps for information on pesticides.	.700	.503		

All variables were included in the analysis

3. ATTITUDES TOWARD SMALL-SCALE FARMERS

Variables	Factor loadings	Communalities (h^2)	Eigen value	Variation
Farmers are an important source of pesticide use information.	.722	.646	1.675	23.9
I contact farmers for pesticide use information.	.638	.421		
Most of the farmers in my area know how to use pesticides correctly.	.151	.370		
Farmers should seek pesticide use information from sales reps[a].	-	-		
Training of farmers in pesticide use should be my responsibility.	.144	.654		
Sales reps should be responsible for training farmers.	.158	.662		
Farmers are a useful source of technical information on pesticides.	.765	.597		

[a] - Excluded from factor analysis because inter-item correlations with other factor variables were <.10.

4. ATTITUDES TOWARD PESTICIDE USE INFORMATION AND KNOWLEDGE

Variables	Factor loadings	Communalities (h^2)	Eigen value	Variation
I get pesticide use information when I need it.	.160	.561	2.467	30.8%
I have adequate books and other literature on pesticide use[a].	-	-		
Technical information on pesticides is difficult to understand.	.365	.145		
Knowledge about pesticide use is important for EWs.	.724	.525		
In my job, it is necessary to know the technical aspects of pesticide use.	.755	.583		
All EWs should be required to pass a test in pesticide use.	.660	.436		
The "Safe Use of Pesticides" course should be obligatory for all EWs.	.707	.499		
In my job, it is necessary to have items of protective clothing.	.523	.303		

[a] - Excluded from factor analysis because inter-item correlations with other factor variables were <.10.

BIBLIOGRAPHY

BIBLIOGRAPHY

Abelson, R. & Levi, A. (1985). "Decision making and decision theory." In Lindley, G. & Aronson, E. (eds), Handbook of Social Psychology, vol.1 pp.231-310. New York: Random House.

Agritex (1983). Wedza Project Evaluation Reports #1-6. Socio-economic Research Section. Agritex/CILCA. Harare: Agritex.

Agritex (1985). Wedza Project Evaluation Reports #9 & 10. Monitoring and Evaluation Section, Agritex/CILCA. Harare: Agritex.

Agritex (1985a). The Safe Use of Pesticides. Agritex Training Branch. Harare: Agritex.

Agritex (1991). Agritex Annual Report: Field Division. Ministry of Lands, Agriculture & Rural Resettlement. Harare: Agritex.

Agritex (1992). Training and Visit Project of Midlands: Shurugwi and Chiwundura. Unpublished End of Project Report, Monitoring and Evaluation Section, Agritex. Harare: Agritex.

Allcock, S. & Leece, V. (1980). Handbook of Registered Pesticides (Excluding Herbicides) in Zimbabwe. Plant Protection Research Institute. Department of Research and Specialist Services (DR&SS). Harare: DR&SS.

Alreck, P. & Settle, R. (1985). The Survey Research Handbook. Illinois: Irwin.

American Psychological Association (1991). Publication Manual of the American Psychological Association. (3rd edition). Washington, DC: APA.

Argyris, C. (1964). Integrating the Individual and the Organization. New York: New York.

Arnon, I. (1989). The Structure of National Agricultural Extension Services. In Agricultural Research and Technology Transfer. New York: Elsevier Applied Science.

Ary, D., Jacobs, L. & Razavieh, A. (1990). Introduction to Research in Education. Chicago: Holt, Rinehart & Winston Inc.

Ashworth, V. (1990). Agricultural Technology and The Communal Farm Sector. Background paper, Zimbabwe Agriculture Sector Memorandum, December, 1990. Washington, DC: The World Bank.

Axinn, G. (1988). Guide on Alternative Extension Approaches. Rome:FAO.

Ayewon, M. (1983). The Professional Competencies Needed by Agricultural Extension Agents in Bendel State of Nigeria. Unpublished doctoral dissertation, Pennsylvania State University, Pennsylvania.

Babbie, E. (1989). The Practice of Social Research (5th ed.). Wadsworth Publishing Company: California: Belmont.

Billing, K. J. (1985). Zimbabwe and the CGIAR Centers: A Study of their Collaboration in Agricultural Research. CGIAR Study Paper #6. Washington, DC: The World Bank.

Bindlish, V. & Evenson, R. (1993). Evaluation of the Performance of T&V Extension in Kenya. Agriculture and Rural Development Series #7. Washington, D.C.: The World Bank.

Borg, W. R. & Gall, M. D. (1983). Educational Research: An Introduction. New York: Longman

Bower, G. & Hilgard, E. (1981). Theories of Learning (5th ed.). New Jersey: Englewood Cliffs.

Bratton, M. (1992). Corporatism or Neopatrimonialism? The Merger of Farmer Unions in Zimbabwe. Paper prepared for the Annual Meeting of the African Studies Association, Seattle, November 20-23, 1992.

Bratton, M. (1986). Farmer Organizations and Food Production in Zimbabwe. World Development Report, 14(3), 367-384.

Brooks, L. R. (1982). Assessing Florida's County Extension Agents' Perception of In-service Training Needs. Unpublished doctoral dissertation, Maryland University, Maryland.

Byerlee, D. & Polanco, E. (1986). Farmer's Stepwise Adoption of Technological Packages: Evidence from the Mexican Altipano. American Journal of Agricultural Economics, 68(3).

Central Statistical Office (1985). Statistical Yearbook of Zimbabwe 1985. Harare: Central Statistical Office (CSO).

Chipika, S. (1990). Agricultural Technology in Zimbabwe - the smallholder's choice. Appropriate Technology, 17(1), 22-25.

Cleaver, K. (1992). Making Agricultural Extension Work in Africa. In Russell, N. & Dowswell, C. (eds) Policy Options for Agricultural Development in Sub-Saharan Africa. Mexico: CASIN/SAA/Global 2000.

Colley, A. (1989). Acquisition and Performance of Cognitive Skills. New York: Willey.

Contado, T.E. (1990). Agricultural Extension Approaches: What FAO's Case Studies Reveal. In Global Consultation on Agricultural Extension Report. Rome, Italy 4-8 December, 1989. Rome: FAO.

Cooperative Extension Service (1991). Commercial & Private Applicator Core Manual. Extension Bulletin E-2195, CES, MSU. East Lansing: Michigan State University.

Cornelissen, W. J. (1991). Agricultural Services Project: Extension Component. Unpublished Supplemental Report on Cost recovery & Private sector involvement in Agricultural Extension, Netherlands Economic Institute, Rotterdam.

Craig, J. (1990). Comparative African Experiences in Implementing Educational Policies. World Bank Discussion Papers: African Technical Department Series (83). Washington, DC: The World Bank.

Daily Gazette (1992, December 10). Population increases. p.2.

Dandhanin, M. (1984). An Analysis of Organizational Structure, Role Perceptions, and Inter-role Relationships Affecting the Functioning and Effectiveness of the Agricultural Education System in Thailand. Unpublished doctoral dissertation, Cornell University, Ithaca, New York.

Daniels, T. D. & Spiker, B. K. (1987). Organizational Communication. Iowa: Wm. C. Brown Publishers.

Dearing, J. (1993). Rethinking Technology Transfer. International Journal of Technology Management, Special Issue on 'Industry-University-Government Cooperation. 8(5-8).

Dengu, E. (1988). Research and Extension linkages: An extension perspective of consolidating the COFRE Model. Review of World Bank Supported Research and Extension Projects. Incomplete citation in Hakutangwi (1990).

Easter, G. W. (1985). Assessment of Professional Competencies Needed by Extension Agents in Developing Countries: Case Study in Swaziland. Unpublished doctoral dissertation, Pennsylvania State University, Pennsylvania.

Eicher, C. K. (1986). Strategies for combating hunger and poverty in Africa. In Berg R.J.& J.S.Whitaker (eds) Strategies for African Development. University of California Press.

EPA (1988). The Federal Insecticide, Fungicide and Rodenticide Act as Amended. Office of Pesticide Programs, US Environmental Protection Agency. Washington, DC: US EPA.

Eponou, T. (1990). Informal Linkage Mechanisms and Technology Transfer: The PACO Project in Cote d'Ivoire. Linkages discussion paper (5e). The Hague: ISNAR.

FAO (1989). Guidelines for legislation on the control of pesticides. Rome: FAO.

FAO (1990). Global Consultation on Agricultural Extension Report. Rome, Italy 4-8 December, 1989. Prepared by the Agricultural Education and Extension Service (ESHE) with the editorial assistance of Burton E. Swanson. Rome: FAO.

FAO (1990a). International Code of Conduct on the Distribution and Use of Pesticides, (Amended version). Rome: FAO.

FAO (1991). Sub-Regional Workshop on Pesticide Management for SADCC Member States Report. Harare, Zimbabwe 20-27 May, 1991. FAO, Regional Office for Africa, Accra, Ghana. Rome: FAO.

Feder, G., Just, R. & Zilberman, D. (1985). Adoption of Agricultural Innovations in Developing Countries: A Survey. Economic Development and Cultural Change, 33(2), 255-298.

Financial Gazette (1992, October 8). Agrochemicals safe use campaign launched.

Feder, G. & Slade, R. (1985). The Role of Public Policy in the Diffusion of Improved Agricultural Technology. American Journal of Agricultural Economics, 67(2), 423-428.

Freire, P. (1982). Education for Critical Consciousness. New York: Continuum.

Friedkin, N. E. (1982). Information Flow Through Strong and Weak Ties in Intraorganizational Social Networks. Social Networks, 3, 1982.

Gannon, M. J. (1987). Organizational Behavior: A Managerial and Organizational Perspective. Boston: Little, Brown & Company.

Gill, D. S. (1989). Returns to Expenditure on Agricultural Extension Services: Evidence from Literature. Staff Paper 89-19, Department of Rural Economy, University of Alberta.

Govereh, J. M. (1990). Constraints to Increasing Crop Productivity in Marginal Rainfall Areas of Zimbabwe: Impact and Extent of Technology Adoption. Unpublished master's thesis, University of Zimbabwe.

Griffith, W. (1984). Learning Theory. In Blackburn, D. (ed) Extension Handbook. Guelph, Ontario: University of Guelph.

Gwekwerere, B. (1991). Mobile Training Unit Evaluation: Reaction Level. Paper presented at the Agritex Training Branch Conference, November, 1991, Harare, Zimbabwe.

Hakutangwi, M. (1990). Training Strategies for Effective Operations in Agritex Review and Overview: Impressions. Paper presented at the Agritex Technical Workshop, University of Zimbabwe, February 19-22, 1990.

Hakutangwi, M. B. K. (1992). Training Policy (draft). Agritex, Ministry of Lands, Agriculture and Water Development. Harare: Agritex.

Hamilton, C. & Parker, C. (1990). Communicating for Results: A guide for business and the professions. Belmont, California: Wadsworth.

Hanneman, W. & Farnsworth, R. (1981). The Role of Risk Preferences and Perceptions in the Adoption of Integrated Pest Management. Dept. of Agriculture and Resource Economics Working Paper. University of California, Berkeley.

Hayward, J. W. (1987). Technical Communication and Logistic Support to Field Extension Workers in Zimbabwe. In Expert Consultation on Improving Agricultural Extension to increase Food Production in Africa. FAO Conference, 6-10 October, 1986, Arusha, Tanzania. Rome: FAO.

Hill, W. (1977). Learning: A Survey of Psychological Interpretations. New York: Thomas Cromwell.

Hoeng, K. L. (1989). Sources of Rice Crop Protection Information. In Harris, K. M. & Scott, P. R. (eds), Crop Protection Information: An International Perspective. Proceedings of the International Crop Protection Workshop, 1989. Oxon: CAB.

Howell, J. (1985). Government Services and Small Farmers. Development Policy Review, 3, 89-102.

Hunting, G., Zymelman, M. & Godfrey, M. (1986). Evaluating Vocational Training Programs: A Practical Guide. Washington, DC: The World Bank.

Igodan, C., Gwary, M. & Ekpere, J. (1990). Critical Skills and Competency Needs of Extension Workers: Evidence from Nigeria. Journal of Extension Systems, 6(1).

Institute of Development Studies (1991). Interactions for Local Innovation. In Chambers, R. Pacey, A. & Thrupp, L. (eds) Farmer First: Farmer Innovations and Agricultural Research. London: Intermediate Technology Publications.

Kerlinger, F. & Pedhazur, E. (1982). Multiple Regression in Behavioral Research: Explanation & Prediction Chicago: Holt, Rinehart & Winston, Inc.

Kesseba, A. (1989). Technology Systems for Small Farmers: Issues and Options. Boulder, Colorado: Westview.

Klemp, G. (1979). Identifying, Measuring and Integrating Competence. In Pottinger, P. & Goldsmith, J. (eds) New Directions for Experiential Learning, 3, 41-52.

Knowles, M. (1973). The Adult Learner: A Neglected Species. Houston, Texas: Gulf.

Kujeke, R. (1988). The Behavior of Tsetse Fly to an Ox treated with Alphacypermethrin. Unpublished product development paper, Shell Developments Zimbabwe.

Lakoh, A. K. (1988). Extension Agents' Job Design, Satisfaction and Performance Model: determining interfaces. National Bank News Review, 4(10).

Lee, B. & Ong, S (1983). Problems Associated with Pesticide Use in Malaysia. Proceedings of an International Symposium on Pesticide use in Developing Countries. Tropical Agricultural Research Center, Ibaraki, Japan.

Lele, U. (1975). The Design of Rural Development: Lessons From Africa. Baltimore: Johns Hopkins University Press.

Lindley, W. & Gonzalez, I. (1983). Building Curricula for Extension Agents. In Training for Agriculture and Rural Development. FAO Economic and Social Development Series (31). Rome: FAO.

Maalouf, W., Contado, T. & Adhikarya, R. (1991). Extension Coverage and Resource Problems: The Need for Public-Private Cooperation. In Rivera, W. & Gustafson, D. (eds), Agricultural Extension: Worldwide Institutional Evolution & Forces For Change. New York: Elsevier.

Mahajan, V. & Peterson, R. (1985). Models for Innovation Diffusion. Quantitative Applications in the Social Sciences Series (48). California: Sage.

Malik, W. (1988). An Analysis of the Agricultural Knowledge System in Pakistan. Unpublished doctoral dissertation, Cornell University, Ithaca, New York.

McCaslin, N. & Najjingo-Kasujja, M. (1991). An Examination of Perceived Professional Competencies Needed by Ugandan Extension Personnel. Proceedings of AIAEE Conference, March 1991, St Louis, Missouri.

McDonald, R. (1985). Factor Analysis and Related Methods. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Merrill-Sands, D. & Kaimowitz, D. (1990). The Technology Triangle: Linking farmers, technology transfer agents and agricultural researchers. The Hague: ISNAR.

Moris, J. (1991). Extension Alternatives in Tropical Africa, Agricultural Administration Unit, Occasional Paper (7). Boulder, Colorado: Westview.

Moyo, S. & Page, H. (1992). A Review of the Class and Gender Basis of Agricultural Extension Services in Zimbabwe's Communal Areas. Discussion Paper (16), Zimbabwe Institute of Development Studies. Harare: ZIDS.

Muir, K. (in press). Overview of Zimbabwe's Agriculture. In Rukuni, M. & Eicher, C. K. (eds), Beneath the Surface: Zimbabwe's Agricultural Revolution. Harare: University of Zimbabwe Press.

Mullins, L. (1985). Management and organizational behavior. London: Pitman.

Mutimba, J. (1980). Understanding the Instructions on Labels of Agricultural Chemicals. The Zimbabwe Science News, 4 (6), 139-141.

Mutuma, P., Moyo, S. & Magonya, S. (1987). An Evaluation of Agricultural Extension Services Support to Women Farmers in Zimbabwe with special reference to Makonde District. Zimbabwe Institute of Development Studies Report (12). Harare: ZIDS.

Ndimande, B. N. (1988). The Role of Extension for the Development of Communal Farming in Zimbabwe. In FAO/SIDA Seminar on Increased food Production through Low-cost Food Technology. Harare, Zimbabwe, 2-17 March 1987. Rome: FAO.

Ongondo, W. N. (1984). The Professional Competencies needed by Intermediate Agricultural Extension Personnel in the Kenyan Agricultural Extension Service. Unpublished doctoral dissertation, Pennsylvania State University, Pennsylvania.

Orie, G. (1982). Perception of Agricultural Problems in Kenya by Policymakers, Supervisors and Field Personnel: Implications for Planned Change. Unpublished doctoral dissertation, Virginia Polytechnic Institute & State University, Virginia.

Pazvakavambwa, S.(in press). Agricultural Extension. In Rukuni, M. & Eicher, C. K. (eds), Beneath the Surface: Zimbabwe's Agricultural Revolution. University of Zimbabwe Press.

Pigg, K., Busch, L. & Lacy, W. (1980). Learning Styles in Education: A Study of County Extension Agents. Adult Education, 30(4), 233-244.

Pingali, P. & Carlson, G. (1985). Human Capital, Adjustment in Subjective Probabilities and the Demand for Pest Controls. American Journal of Agricultural Economics, 67(4).

Pottinger, P. (1979). Competence Assessment: Comments on Current Practices. In Pottinger, P. & Goldsmith, J. (eds) New Directions for Measuring Competence, 3, 1979.

Pray, C. & Echeverria, R. (1990). Private Sector Agricultural Research & Technology Transfer Links in Developing Countries. In Kaimowitz, D.(ed), Making the Link: Agricultural Research & Technology in Developing Countries. The Hague: ISNAR.

Putter, C. A. & Van der Graaff, N. A. (1989). Information Needs in Plant Protection. In Harris, K. M. & Scott, P. R. (eds), Crop Protection Information: An International Perspective. Proceedings of the International Crop Protection Information Workshop, 1989. Oxon: CAB.

Rasmussen, K. R. & Rubert, S. C. (1990). Historical Dictionary of Zimbabwe. African Historical Dictionaries #46. New Jersey: Scarecrow Press.

Roberts, N. (ed) (1989). Agricultural Extension in Africa World Bank Symposium. Washington, DC: The World Bank.

Rogers, E. M. (1976). Where are we in understanding the Diffusion of Innovations?. In Schramm, W. & Lerner, D. (eds), Communication and Change in the Developing Countries: Ten Years After, University of Hawaii, Honolulu: East-West Center Press.

Rogers, E. M. (1983). Diffusion of Innovations. New York: The Free Press.

Rogers, E. M. & Bhowmik, D. K. (1970). Homophily-Heterophily: Relational Concepts for Communication Research. Public Opinion Quarterly, 34(4), 523-538.

Roling, N. (1989). Why Farmers Matter: The Role of User Participation in Technology Development and Delivery. The Hague: ISNAR.

Rukuni, M. (in press). The Prime Movers of Agricultural Development. In Rukuni, M. & Eicher, C. K. (eds). Beneath the Surface: Zimbabwe's Agricultural Revolution. Harare: University of Zimbabwe Press.

Rukuni, M., & Eicher, C. K. (in press). Implications for Zimbabwe's Agricultural Revolution for Southern Africa. In Rukuni, M. & Eicher, C. K. (eds), Beneath the Surface: Zimbabwe's Agricultural Revolution. Harare: University of Zimbabwe Press.

Schwartz, L. (1991). Extension in Africa: An Institutional Analysis. Unpublished MSc Plan B Paper, Department of Agricultural Economics, Michigan State University.

Shapiro, K. & Muller, J. (1977). Sources of Technical Efficiency: The Roles of Modernization and Information. In Economic Development and Cultural Change, 25(2), 293-309.

Shopo, T. (1985). The Political Economy of Hunger in Zimbabwe. ZIDS Working Paper. Harare: Zimbabwe Institute of Development Studies.

Schermerhorn, J., Hunt, J.,& Osborn, R. (1988). Managing Organizational Behavior. New York: John Wiley & Sons.

Staw, B. M. (1984). Organizational Behavior: A Review and Reformulation of the Field's Outcome Variables. Annual Review of Psychology, 35, 627-666.

Strube, G. (1987). Answering Survey Questions: The Role of Memory. In Hippler, H., Schwarz, N. & Sudman, S. (eds), Social Information Processing and Survey Methodology. New York: Springer-Verlag.

Sunga, I., Chabayanzara, E., Moyo, S., Mpande, R., Mutuma, P. & Page, H. (1990). Farm Extension Baseline Survey Results. Dept. of Agriculture and Rural Development Studies, Zimbabwe Institute of Development Studies. Harare: ZIDS.

Tchouamo, I. R. (1987). Perceptions by Farmers Extension Agents and Researchers of Linkages among and between Organizations Involved in the Dissemination of Agricultural Innovations in Cameroon. Unpublished doctoral dissertation, Michigan State University, East Lansing, Michigan.

Thomas, J., Ladewig, H. & McIntosh, W. (1990). The Adoption of Integrated Pest Management Practices Among Texas Cotton Growers. Rural Sociology, 55(3), 395-410.

Trevino, L., Daft, R. & Lengel, R. (1990). Understanding Managers' Media Choices: A Symbolic Interactionist Perspective. In Fulk, J. & Steinfeld, J. (eds), Organizations and Communication Technology. California: Newbury Park.

UNDP (1991). Agricultural Extension: Program Advisory Note. Technical Advisory Division, Bureau for Program Policy & Evaluation. New York: UNDP.

Waldman, D. A. & Spangler, W. D. (1989). Putting Together the Pieces: A Closer Look at the Determinants of Job Performance. Human Performance, 2(1), 29-59.

Walter, G. & Marks, S. (1981). Experiential Learning and Change: Theory, Design and Practice. Toronto: John Wiley & Sons.

Wete, F. (1991). New Technology for Transferring Agricultural Information. In Rivera, W. & Gustafson, D. (eds), Agricultural Extension: Worldwide Institutional Evolution & Forces for Change. New York: Elsevier.

Williams, F.,& Gibson, D. (1990). Technology Transfer: A Communication Perspective. Newbury Park, California: Sage.

World Bank. (1983). Zimbabwe: National Agricultural Extension and Research Project: Staff appraisal report No. 4305-Zim. Washington, DC: The World Bank.

World Bank. (1990). Zimbabwe Agriculture Sector Memorandum. Agriculture Division, Southern Africa Department. Washington, DC: The World Bank.

World Bank. (1990). World Bank Tables 1989-90. Washington, DC: John Hopkins University Press.

World Bank. (1992). African Development Indicators. UNDP. Washington, DC: The World Bank.

World Resources Institute (1985). Down to Business: Multinational Corporations, the Environment & Development. Washington, DC: Charles S. Pearson.

Zimbabwe Government (1986). First National Development Plan 1985-1990, vol.1. Harare: Government Printer.

Zimbabwe Government (1991). Zimbabwe: A Framework for Economic Reform (1991-95). January 18, 1991. Harare: Government Printer.

Zuidema, L. (1989). Performance Assessment Factors for Agricultural Researchers. In Abe, L. & Marcotte, P. (eds), Proceedings of the SACCAR/ISNAR Regional Workshop on Human Resource Management in National Agricultural Research Systems. The Hague: ISNAR.