THE EFFECTIVENESS OF AGRICULTURAL SHOWS AND AGRO-DEALERS IN ENHANCING DISSEMINATION AND ADOPTION OF THE "PUSH PULL" TECHNOLOGY AMONG SMALLHOLDER FARMERS IN WESTERN KENYA

STEPHEN WAMBUGU MAINA

A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Master of Science Degree in Agricultural Extension of Egerton University

EGERTON UNIVERSITY

AUGUST 2010

DECLARATION AND RECOMMENDATION

DECLARATION

I hereby declare that this thesis is my original work and has not been presented for the award of a degree or diploma in this or any other University.

Signature ……. Date ……

Stephen W. Maina

EM12/1726/06

RECOMMENDATION

The research thesis has been submitted with our approval as university supervisors.

1. Signed …….. Date ……..

   Prof. John G. Mwangi Department of Agricultural Education and Extension

2. Signed …….. Date ……

   Dr. David M. Amudavi Department of Agricultural Education and Extension

COPY RIGHT

DEDICATION

Dedicated to my dear wife Imelda, my daughter Rita, and to my sons, Mark and Emmanuel.

ACKNOWLEDGEMENT

I would like to pass my sincere gratitude to ICIPE through Dr. Zeyaur R. Khan for awarding me the research funds and allowing me to use its facilities at Thomas Odhiambo Campus (TOC) at Mbita-Suba district. This enabled me to undertake the research for this thesis.

First and foremost, I want to specifically acknowledge the guidance of my two supervisors, Professor John G. Mwangi and Dr. David M. Amudavi and their families for their support, guidance, friendship and time. Professor Mwangi and Dr Amudavi were a consistent source of encouragement and support throughout this research. Both of them were the driving force behind this work. I am once again very grateful to them for their encouragement, suggestions, comments, editing and valuable advice. I have been very privileged to have such a supportive, encouraging and generous team of supervisors.

Special acknowledgements also go to my colleagues, the lecturers at the Department of Agricultural Education and Extension, the Faculty of Education and Community Studies of Egerton University and everybody else who provided comments and assisted me in this study.

ABSTRACT

Despite "Push Pull" Technology's (PPT) effectiveness to increase maize yields by controlling Stemborer and striga weeds, its full benefits are yet to be realized. The PPT involves planting Napier grass around maize and intercropping with Desmodium. Agricultural shows and agro-dealers are often used to spread PPT but knowledge of their effectiveness was inadequate. This study sought to determine how they enhanced PPT dissemination and used a cross-sectional research design to collect data from a proportional stratified random sample of 800 farmers and 102 agro-dealers in Western Kenya. A closed-ended questionnaire whose reliability of 0.85α was above the 0.70 threshold for acceptable reliability and whose validity were ascertained by a panel of extension experts was used in data collection. Data were analysed using Chi-square at 0.05α confidence level set *a priori*. Results indicated that unlike gender, age and education affected agricultural shows' effectiveness to disseminate PPT; type of packaging influenced farmers' intention to buy Desmodium seeds; agro-dealers' effectiveness in communicating PPT was independent of their knowledge of it, Desmodium plant or seriousness of the striga problem but depended on frequency at which farmers sought advice; gender, education and years in business did not affect agro-dealers' effectiveness; awareness on PPT and Desmodium seeds encouraged farmers to seek more information; and agro-dealers visited most by farmers were more effective in disseminating PPT. The study concluded that use of agricultural shows and agro-dealers in communicating PPT enhanced its adoption and that agricultural shows were appropriate for educating males and females. The study recommends that extension providers should know what farmers require and provide it on request through agricultural shows; should train and involve agro-dealers in PPT dissemination, selling certified seeds and making agricultural shows accessible, affordable and more responsive to farmers' needs.

TABLE OF CONTENTS

DECLARATION AND RECOMMENDATION ii
COPY RIGHT iii
DEDICATION iv
ACKNOWLEDGEMENT v
ABSTRACT vi
TABLE OF CONTENTS vii
LIST OF TABLES x
LIST OF FIGURES xi
LIST OF PLATES xii
LIST OF ABBREVIATIONS AND ACRONYMS xiii

CHAPTER ONE 1
INTRODUCTION 1
1.1. Background of the Study 1
1.2. Statement of the Problem 5
1.3. Purpose of the Study 6
1.4. Objectives of the Study 6
1.5. Hypotheses of the Study 7
1.6. Significance of the Study 7
1.7. Assumption of the Study 7
1.8. Limitations and Scope of the Study 8
1.9. Definitions of Terms 9

CHAPTER TWO 10
LITERATURE REVIEW 10
2.1. Introduction 10
2.2. Commercial Extension 10
2.3. Communication 12
2.4 Agricultural Shows, Exhibitions and Fairs as Medium to Disseminate Information 15
2.5 Agricultural Shows in Kenya 15

2.6 Farm Input Stockists 16
2.7. Cereal Production 19
2.8. "Push–Pull" Technology 20
2.9. Desmodium Seeds 23
2.10. Theoretical Framework 29
2.11. Conceptual Framework 31

CHAPTER THREE 33
RESEARCH METHODOLOGY 33
3.1. Introduction 33
3.2. Research Design 33
3.3. Study Location 33
3.4. Target Population of Study 34
3.5. Sampling Procedure and Sample Size 34
3.6. Instrumentation 37
3.7. Data Collection Procedure 38
3.8. Data Analysis 39

CHAPTER FOUR 44
RESULTS AND DISCUSSION 44
4.1 Introduction 44
4.2 Effectiveness of Agricultural Shows in Disseminating Information 44
4.3. Effectiveness of Stockists in Disseminating Information and Adoption of PPT 62
4.4. Effect of Agricultural Shows in Stimulating Desmodium Seed Demand 72
4.5. Effect of Stockists in Stimulating the Demand for Desmodium Seeds 76

CHAPTER FIVE **93**
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 93
5.1. Introduction 93
5.2. Summary 93
5.3. Conclusions 95

5.4. Recommendations 96
5.5. Recommendations for Further Research 97

REFERENCES 98

APPENDICES 107
APPENDIX A: Questionnaire for Individuals Visiting "Push Pull" Technology (PPT) Demonstration Plot at the Agricultural Showground 107
APPENDIX B: A Survey Questionnaire of Farm Input Stockists and Their Potential Role in Dissemination of "Push Pull" Technology in Western Kenya 109
APPENDIX C: A List of Individuals Used to Validate the Research Instruments 113
APPENDIX D: Map Showing Western Kenya 114
ANNEX: Research Permit 123

LIST OF TABLES

Table 1: Distribution of Farmers Interviewed at Kisumu Agricultural Show, 2008 36
Table 2: Sample Size Distribution of Stockists Interviewed in the Study 37
Table 3: Summary of Data Analysis 43
Table 4: Socio-economic Characteristics of Farmers That Attended Kisumu Show 46
Table 5: Farmers Characteristics at Kisumu Show in the Year 2008 49
Table 6: Knowledge on "Push Pull" Technology 51
Table 7: Sources Where Farmers had Seen PPT Before Coming to the Kisumu Show 55
Table 8: Name of the Show Where Farmers had Received Information on PPT 56
Table 9: Reasons Given by Practicing and new Farmers' for Adopting PPT 57
Table 10: Farmers Understanding of How PPT Plot is Planted 58
Table 11: Farmers' Characteristics and Agricultural Shows Effectiveness 61
Table 12: Social Characteristics of the Stockists From Various Districts 63
Table 13: Personal Characteristics of the Stockists and Their Rating of Striga Problem 64
Table 14: Cross Tabulation of Gender and Some Aspects of Striga 65
Table 15: Personal Characteristics and Stockists Rating of Striga in their Areas 66
Table 16: Striga Control Methods and Solutions as Suggested by the Stockists 67
Table 17: First Source of Information About "Push Pull" Technology 67
Table 18: Stockists Effectiveness Against Personal Characteristics 70
Table 19: The Intention of Farmers to buy Desmodium Seeds 73
Table 20: Frequency and Percentages of Farmers' Demand of Desmodium Seeds 73
Table 21: Preferences for Adopting PPT by Farmers 76
Table 22: Relationship of Knowledge, Stocking of Desmodium and Gender 85
Table 23: Stockist's PerceptionS on Creating Desmodium Seeds Demand 78
Table 24: Improving Desmodium Seed Demand 79
Table 25: Training of Stockists and the Organisers.....80
Table 26: Extension Materials with Stockists 81
Table 27: Suggested Ways of Supporting Stockists to Disseminate PPT 82

LIST OF FIGURES

Figure 1: The diffusion process 30
Figure 2: A conceptual framework for measuring the effectiveness of pathways in enhancing dissemination and adoption of "Push Pull" technology. 32
Figure 3: Scale depicting levels of effectiveness of agricultural shows in disseminating information. 40
Figure 4: Scale depicting levels of effectiveness of stockists in disseminating information and creating demand. 41
Figure 5: Period when the farmer heard of PPT before coming to Kisumu show. 53
Figure 6: Farmers' first source of information about "Push Pull" technology. 54
Figure 7: Farmers opinion on effectiveness of Agricultural shows in dessiminating information 2008. 59
Figure 8: Sources where stockists had seen a "Push Pull" technology field. 68
Figure 9: Levels of stockists' effectiveness. 69
Figure 10: Uses of Desmodium identified by stockists 82

LIST OF PLATES

Plate 1: “Push Pull” demonstration and a group of farmers visiting the demonstration plot. 1
Plate 2: A parasitic Striga Weed attached to the host maize plant.....1
Plate 3: A typical “Push Pull” technology layout showing maize intercrop. 21
Plate 4: A “Push Pull” technology plot at Kisumu show, 2008.....1
Plate 5: Adult stemborer moths being attracted to Napier grass 22
Plate 6: Feeding marks of stembores larva on maize and Napier grass. 1
Plate 7: Illustration of the “Push Pull” concept 23

LIST OF ABBREVIATIONS AND ACRONYMS

AATF	African Agricultural Technology Foundation
AEZ	Agro-Ecological Zone
ASK	Agricultural Society of Kenya
ATC	Agricultural Training Centres
CIAT	International Center for Tropical Agriculture
CNFA	Citizens Network for Foreign Affairs
DFID	Department for International Development
EAAHS	East African Agricultural and Horticultural Society
EAFF	East African Farmers' Federation
EIARD	European Initiative for Agricultural Research for Development
FAO	Food and Agriculture Organization of the United Nations
GNP	Gross National Product
GOK	Government of Kenya
ICIPE	International Centre of Insect Physiology and Ecology
KEFRI	Kenya Forestry Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
LH	Lower Highlands
LM	Lower Midlands
MOALFD	Ministry of Agriculture, Livestock, Marketing and Fisheries Development
NALEP	National Agriculture and Livestock Extension Programme
PPT	"Push Pull" Technology
SCODP	Sustainable Community Development Programme
TA	Tropical Alpine
UM	Upper Midlands

CHAPTER ONE
INTRODUCTION

1.1. Background of the Study

In Eastern Africa, cereal farming contributes about 50 percent of the gross domestic product. Millions of rural people in Eastern Africa depend on maize and sorghum for food security and cash incomes (Amudavi et al., 2007). According to the Central Bureau of Statistics (2006; 2007), cereals form the most important food group in Kenya contributing on average 47.1 percent of all caloric supply and grown by 90 percent of the farming households. Despite this, production of these cops is seriously affected by constraints including stemborers, the parasitic weed *Striga hermonthica*, unreliable rainfall, land degradation due to soil erosion, pre- and post-harvest pest infestation, pre- and post-harvest losses, poor infrastructure and marketing, and policy bottlenecks (Cook, 2007; GOK, 2007; GTZ Sustainet, 2006; ICIPE, 2005; Kegley, 2008; Khan, 2007).

Stemborer *(Busiolla fusca*) and striga weeds *(Striga hermonthica)* are the two most destructive pests of cereal crops that greatly reduce yields of maize and sorghum by 30-100 percent on smallholder farms (Khan, Midega, Njuguna, Amudavi, Wanyama, & Pickett 2008a). Stemborers lead to yield losses of 30-40 percent, while striga infestation causes a loss of 30-50 percent to Africa's agricultural economy (Amudavi, Khan & Pickett, 2007). Chemical control of stemborers and striga weeds is very expensive for resource poor farmers besides being potentially harmful to the environment (Khan et al., 2005, 2007).

In mitigation, the International Centre of Insect Physiology and Ecology (ICIPE) and its collaborators have developed the "Push Pull" technology (PPT) for the control of these pests and also to improve soil fertility (Amudavi et al., 2009a). Despite the effectiveness of the PPT to increase maize yields by an average of 25% in areas where only stemborers are present, and by more than 80% where both stemborers and striga are problems, the gains and sustainability of this technology are hampered by lack of Desmodium seeds (Khan, 2007).

The key challenge in most successful innovations, according to The World Bank (2008), has not been to create new innovations but rather to use existing ones to deal with specific problems.

Utilizing appropriate extension methods in reaching small-scale farmers with relevant agricultural technologies in order to improve their knowledge, skills and overall attitude towards agricultural productivity, is important (Government of Kenya, 2008). This is because many promising research findings have not reached the producers due to deficiencies of delivery systems. An understanding of the processes leading to the adoption of new technologies by smallholders has been important to the planning and implementation of successful research and extension programs (Cramb, 2003).

In Kenya, extension services are provided by both private and commercial extension initiatives (Muyanga & Jayne, 2006). Commercial extension initiatives involve conveying information about agriculture and demonstrating technologies that a company promotes such as hybrid seeds. It may be either part of the sales technology of input supply firms or a specialized consultancy service demanded by an agricultural producer (MOALFD, 2007). The Kenyan government laments the slow adoption of modern technologies. According to the Government of Kenya (2005; 2008), the flow of knowledge and innovations plays a critical role in development. The information constraint in input purchase is partly an information flow constraint (Gine, 2005; Gordon, 2000).

The Central Bureau of Statistics (2004) noted that information access is essential in increasing people's knowledge and awareness of what is taking place around them, which may eventually affect their perceptions and behaviour. According to Citizens Network for Foreign Affairs (2005, 2007), the public extension service is overstretched. It is hard for smallholder farmers to access information about new technologies and to enjoy the benefits of inputs. With increased competition in the seed, agrochemical and dairy industry, firms (i.e., the private sector) have begun giving extension advice to farmers through stockists, demonstrations and field days (Muyanga & Jayne, 2006).

It is increasingly realized that the generation, diffusion and application of new knowledge often takes place more efficiently through the private sector because of profit maximization. In agriculture, a significant part of the technology package that farmers use is designed by and supplied through private businesses (e.g., fertilizers, machinery, pesticides, and seeds). With

increasing commercialization, the role of the private sector as technology supplier is growing. Though according to the Word Bank (2008), the private sector involvement is important, the challenge is how to orient the private sector toward effective rural development. Rivera and Cary (1999) noted that when extension is delivered privately, it represents a commercial decision. The private sector engages in collaboration if there is a profit to be made (Word Bank, 2008).

The rationale for private sector provision of agricultural extension services is generally based on an expectation of increased efficiency. Since most commercial extension providers are mainly interested in dealing with farmers that show demand for services and goods, this suggests the need for private systems to operate in areas where there are sufficient incentives to do so (Rivera & Cary, 1999). According to CNFA (2007), strategies are required to strengthen the private sector especially in input distribution system and to deepen its rural penetration by building the bridge between urban input supply companies and rural distributors located in farming communities. Farmers and retailers need information on input quality, particularly on seed viability.

Kenya has a fairly developed network of agro-input dealers (stockists) with over 3,000 rural stockists serving farmers across the country. These retail outlets are often seen as a credible source of agricultural information, especially regarding use of farm inputs (The African Agricultural Technology Foundation, 2008). Private companies, in combination with rural retail distributors (Agro-dealers), offer farmers learning resources in terms of pamphlets, brochures, magazines and posters (CNFA, 2007; Wulff, Bodker, & Jan, 2006). The companies include this cost of promotion in their margins, so there is no cash cost to the farmer or the agro-dealer (stockist), a fact that substantially increases farmers' interest in the activity (CNFA, 2007). Seeing and discussing a product or technology directly with a company representative and the local stockist gives farmers confidence to experiment with a new seed-based technology and experience the benefits while boosting demand and sales for the stockists (thus increasing enterprise viability) (CNFA, 2005; Wulff et al., 2006).

Innovations in branding and use of mass media are a hallmark in product promotion. Most firms sponsor farming programs on vernacular radios, place commercial spots in the electronic media,

produce brochures and technical handbooks and are actively involved in the training of stockists and farmers (Odame, Musyoka, & Kere, 2008). Notably, many smallholder farmers visit stockists to buy and enquire about new farm input products and information related to agriculture. In most cases, all farm inputs used by smallholder farmers on their farms are accessed through these stockists. The African Agricultural Technology Foundation (AATF) recognises the stockists' crucial role of informing and educating farmers (AATF, 2008). In Western Kenya, stockists are located in most towns and local markets making them accessible to many farmers. Studies to determine the effectiveness of agricultural shows and agro-dealers/stockists in enhancing uptake of PPT among smallholder farmers of Western Kenya have not been conducted. Hence, assessing the effectiveness of these pathways in "Push-Push" technology transfer is important if there has to be sustainability in the use of these pathways.

Agricultural Society of Kenya (ASK) shows and other exhibitions give an opportunity to farmers, investors, the business fraternity and service providers to show their products and services. The shows provide a forum for the exchange of agricultural and agribusiness ideas as well as an opportunity to show new farming technologies as they emerge. In Western Kenya, ASK shows are organised each year in Kisii, Kisumu, Kakamega, Migori, Kitale and Eldoret (ASK, 2009). In this study we assessed the effectiveness of Kisumu agricultural show and farm input stockists in enhancing dissemination and adoption of "Push–Pull" technology among smallholder farmers and demonstrated the potential of using these pathways for disseminating agricultural information.

A lot of research has been done on the development of the "Push-Pull" technology at the research station and on the farmers' farms (Khan, 2008c). These studies have explored the effectiveness of the PPT in controlling Striga and stemborers. Several initiatives have also been made to address the dissemination channels and uptake of this technology. However, studies that determine the effectiveness of communication pathways from the perspective of information dissemination are rare. Also, the effectiveness of agricultural shows and agro-dealers as pathways of communicating innovation on PPT has not been examined among smallholder farmers in Western Kenya.

1.2. Statement of the Problem

Although agricultural scientists continue to develop technologies that address farmers' constraints to farm production, the challenge that remains is how to ensure a high rate of their adoption by the farmers. The full benefits of agricultural research are not likely to be realized until the research results are appropriately communicated to farmers and eventually adapted. One such research output that is being promoted to farmers in Western Kenya is the "Push Pull" technology (PPT). This is a technology for controlling agricultural pests such as stemborers and striga weeds by using repellent and trap plants (Khan et al., 2007). It involves intercropping maize with the legume Desmodium (*Desmodium uncinatum)* while Napier grass (*Pennisetum purpureum*) is planted around the maize crop. Despite the multifunctional properties of the PPT including control of stemborers and striga weed, its widespread adoption is yet to be realised.

Khan et al. (2008a) noted that policy makers and development practitioners needed to invest in a range of extension programmes that promoted wide farmer coverage. How to diffuse new innovations has become a question that is important (World Bank, 2008). Given that people vary in the way they communicate or receive information, the United Republic of Tanzania (2005) noted that it is instructive that different dissemination channels be used to communicate and promote innovations. According to the International Potato Center (2008), inconsistent attention to dissemination pathways and scarce information limits the development and diffusion of innovations. This is where the concept of agricultural shows and agro-dealers becomes important as adoption pathways by which extension agents are disseminating the PPT to farmers.

Even though there has been a number of studies investigating how PPT is disseminated, relatively little attention has been paid to understanding how PPT can diffuse using agricultural shows and agro-dealers/stockists (Arumapperuma, 2008). Insufficient empirical evidence on the effectiveness of agricultural shows and stockists as diffusion pathways by which a beneficial technology like PPT reaches many farmers, limits its full exploitation. The question of demonstrating the effectiveness of these two dissemination pathways in PPT uptake is a primary concern to the continued efforts of its extension outreach (International Center for Tropical Agriculture, 2009).

Effective agricultural shows and stockists may improve crop yields, reduce costs of information search, and increase adaptation of proven technologies in smallholder farming systems in Kenya. These pathways are also hoped to stimulate demand for Desmodium seed by farmers as a result of information disseminated to them on PPT. Estimating demand is an important concern of marketers, and business managers in general, because such estimates are an integral requirement for both strategic and tactical planning decisions (Brennan, 2004). Creating and sustaining demand for Desmodium seed enhanced participation by the private sector in seed provision hence augmenting efforts of technology transfer. The possible outcomes of this study were therefore, insights on how to increase uptake of PPT and how to create demand for Desmodium seeds among smallholder farmers in Western Kenya.

1.3. Purpose of the Study

The purpose of this study was to determine the effectiveness of agricultural shows and agro-dealers in enhancing dissemination and adoption of "Push Pull" technology that helps to control stemborer and striga pests, leading to increased cereal production among smallholder farmers in Western Kenya.

1.4. Objectives of the Study

To determine the effectiveness of:-

a) Agricultural shows in disseminating information and adoption on "Push Pull" technology among smallholder farmers in Western Kenya.
b) Agro-dealers/stockists in disseminating information and adoption on "Push Pull" technology among smallholder farmers in Western Kenya.
c) Agricultural shows in stimulating demand for Desmodium seeds among smallholder farmers in Western Kenya.
d) Agro-dealers/stockist in stimulating demand for Desmodium seeds among smallholder farmers in Western Kenya.

1.5. Hypotheses of the Study

The following hypotheses were derived from objectives a, b, c and d respectively.

HO_1 Participating in agricultural shows has no statistically significant effect in disseminating information and adoption of "Push Pull" technology among smallholder farmers in Western Kenya.

H_{O2} Access to farm input Stockists have no statistically significant effect in disseminating information and adoption of PPT among smallholder farmers in Western Kenya.

HO_3 Agricultural shows have no statistically significant effect in enhancing demand for Desmodium seeds among smallholder farmers in Western Kenya.

HO_4 Access to farm input Stockists have no statistically significant effect in enhancing demand for Desmodium seeds among smallholder farmers in Western Kenya.

1.6. Significance of the Study

The main focus of agricultural shows is to educate farmers and empower them to become more effective in managing their crops, livestock, fish ponds and other sources of livelihoods. Knowing the extent to which agricultural shows are effective in achieving this objective is desirable and this study was designed to provide that information. The study has provided useful information on how to disseminate the PPT to farm operators through the shows and the significance of the role played by agro-dealers in disseminating PPT. Ministry of Agriculture officials as well as ICIPE and its partners are likely to find information obtained from this study useful in their efforts to involve agro-dealers and agricultural shows to disseminate information on Desmodium seeds that would lead to many smallholder farmers adopting the PPT. The study findings and discussions are likely to prove useful for policy makers, stockists, academics, researchers; NGOs in Kenya and other countries in sub Saharan Africa dealing with agricultural extension and dissemination of information.

1.7. Assumption of the Study

The expansion of the "Push Pull" technology could be predicted from information disseminated on PPT and Desmodium seeds demand.

1.8. Limitations and Scope of the Study

The study was confined to dissemination of information and demand of Desmodium seeds as some of the limiting factors to the spread of “Push Pull” technology and how this can be enhanced, through agricultural shows and seed agro-dealers/stockists. This study was limited to stockists located in the districts where “Push Pull” technology was being disseminated and practised in Western Kenya and Kisumu ASK show held between July and August 2008.

1.9. Definitions of Terms

Agricultural show: Refers to an exhibition or a display (Hanks, 1979). In this study, shows were agricultural exhibitions organized by the Agricultural Society of Kenya that served as avenues of demonstrating and disseminating agricultural information to farmers/show goers/attendants.

Agro-dealers/ stockists: This referred to dealers who undertake to maintain stocks of a specified product at or above a certain minimum in return for favorable buying terms granted by the manufacturer of the product (Hanks, 1979). In this study, agro-dealers/ stockists had shops located in the local markets and acted as outlets and selling avenues of agricultural farm inputs.

Demand: This refers to the amount of a commodity that consumers are willing and able to purchase at a specified price (Hanks, 1979). Schiller (2005) defined demand as the ability and willingness to buy specific quantities of a good at alternative prices in a given time period, ceteris paribus. In this study demand, meant the amount of kilograms of Desmodium seeds bought per given time as a result of information disseminated.

Effectiveness: Effectiveness is a measure of the ability of a program, project or task to produce a specific desired effect or result that can be qualitatively measured (Hanks, 1979). It is also a measure of the quality of attainment in meeting objectives

Pathway: Refers to a route or way of access to; a way of reaching or achieving something (Collins, 2003). This study adopted the same definition.

"Push Pull" technology: It is a technology for controlling agricultural pests such as stemborers and striga weeds by using repellent and trap plants. It involves planting Napier grass around the perimeter of maize intercropped with Desmodium (Khan et al., 2005).

Western Kenya: This referred to areas bordering Uganda to the west and Tanzania to the south and comprises of Nyanza and Western Provinces. The region lies between latitude 1° 8' N and 1° 24' S and between longitude 34° and 35° E (Amadalo, Jama, Niang, Noordin, Nyasimi, Place, Franzel & Beniest, 2003; Jaetzold & Schmidt, 1982, 1983).

CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction

Chapter two undertakes a literature review and is divided into the following headings: Commercial extension, communication, mass communication, communication channels for agricultural technology, effectiveness of disseminating information, exhibitions, agricultural shows and fairs as medium to disseminate information in agriculture, agricultural shows in Kenya, farm input stockists, cereal production, "Push-Pull" technology, Desmodium seeds, strengthening the Desmodium seeds industry in Kenya. The measures of Desmodium seeds market demand, practical methods of estimating current market demand for Desmodium seeds, estimating future demand for Desmodium seeds, farmers' purchase intentions for Desmodium seeds, sales and promotion of Desmodium seeds as a means of communication, theoretical framework and conceptual framework.

2.2. Commercial Extension

Agricultural extension is a series of embedded communicative interventions that are meant, among others, to develop and/or induce innovations which supposedly assist farmers, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living and lifting social and educational standards. According to Khan et al., (2008a), extension education builds the human capital of farmers by exposing them to information that increases production, incomes and reduce uncertainty about the expected outcomes of the technology.

Commercial extension is a rather recent phenomenon in Kenya but typical of either industrialized forms of agriculture or the most modern sector of an otherwise traditional agriculture (Nagel, 1999). It may be either part of the sales technology of input supply firms or a specialized consultancy service demanded by an agricultural producer (MOALFD, 2007). First, the clients of commercial extension will always be profit oriented. Their objective is the optimal utilization of purchased inputs or contracted expertise (Kremer & Zwane, 2004). Secondly, private firms provide services in accordance with their specialized incentives and farmers respond in terms of what they see as most beneficial to them (Schwartz, 1994). As a result, the

emergence of commercial extension has influenced the debate on who should bear the costs of extension. In the case of commercial input suppliers, the solution is very simple: the costs of extension are included in the product price, as are the costs for research or advertisement (Nagel, 1999). It is obvious that the private sector will be active only in case of reasonable returns, and they will not be concerned with public interest issues. Therefore, because of the selective participation of the private sector, the provision of public good types of information will have to remain a public sector responsibility (Wulff, Bodker, & Jan, 2006).

The private-sector and/or public-private arrangements can play an increasing role in research and extension. The relationships between the public and private sectors in service provision can take different forms, such as: - (1) full transfer of responsibility (pure privatization of public-sector organizations); (2) contractual relationships (e.g. outsourcing of services); and (3) public-private partnerships that underwrite a common goal and share resources (Wennink & Heemskerk, 2006). Ordinarily, private extension activities provide specialised information not available through public extension (MOALFD, 2007).

Motivation for private extension occurs when profit can be directly or indirectly generated through extension activities (Schwartz, 1994; Wulff, Bodker, & Jan, 2006). In most countries, private sector companies are already important contributors to technology transfer and the advancement of agricultural development through, mainly, contract arrangements with farmers (Blackie & Albright, 2005; Nagel, 1999).

The rationale for private sector provision of agricultural extension services is generally based on an expectation of increased efficiency with the operation of private markets and with the resulting efficiencies contributing to the growth of a country's GNP. The private sector is considered to be more efficient at delivery of services, thereby lowering government expenditures and enhancing quality of services (Rivera & Cary, 1999). The government of Kenya recognizes the participation of the private sector in enhancing economic growth and is keen in promoting and facilitating the sector to serve as the driver for economic development (GOK, 2006; Republic of Kenya, 2008). This linkage with private sector can help small farmers improve incomes and livelihoods through access to training and information on new

technologies, credit and inputs. In Kenya, stockists offer after sales services to farmers which include advice on input usage, credit, drug and chemical application. Thus, agro dealers or stockists are major players in agricultural extension in rural Africa.

2.3. Communication

Rural farmers are ready for information but the common problem is non-availability and or lack of access to information sources (Onuekwusi & Gideon 2007). Farmers require constant flow of information on the latest technologies (GOK, 2005). Effective sharing of information is critical because it increases interaction and understanding among people. Communication can be defined simply as the process by which individuals share information, ideas and attitudes (Fruehling & Lacombe, 2000). Given that people vary in the way they communicate, different communication channels are used (United Republic of Tanzania, 2005). Communication channels refer to the ways in which we use the senses of light, sound, and touch to communicate messages (Wilson & Wilson, 1998). Robbin and Sanghi (2005) defined it as the medium through which the message travels.

Communication channels are of two types, personal and non-personal. Personal communication channels involve two or more persons communicating directly with each other face to face, person to audience, over the phone, through e-mail et cetera (Lesikar & Flatley, 2005). Face-to-face communication according to Gurak and Lannon (2007) is arguably the richest form, because you can give and receive information using body languages, vocal reflection, eye contact, and other physical features.

Personal communication channels derive their effectiveness through the opportunities for individualizing the presentation and feedback (Kotler, 2002). It provides maximum amount of information to be transmitted during a communication episode (Robbin & Sanghi, 2005). It includes the grass root field work of extension agents, friends and/or relations, demonstrations, songs, drama sessions, farm walk, study tours, agricultural shows, exhibitions, training sessions, meeting/consultations, market days, traditional/cultural gathering or ceremonies, etc. Personal communication is often more effective in providing feedback than mass communication (Gurak & Lannon, 2007).

Non personal communication channels include media, atmosphere and events. Media consists of print media (newspapers, magazines, and direct mails), broadcast media (radio, television), electric media, and display media (Kotler, 2002). Mass communication differs with interpersonal communication in that its messages must be moved over greater distances. Early research showed that the combination of mass media and interpersonal communication channels is the most effective way of reaching people and informing them about innovations as they play complementary rather than competing roles in dissemination of innovations (Arumapperuma, 2008). Such complementary may also be important in the case of agricultural shows and stockists.

2.3.1. Mass Communication

According to the Central Bureau of Statistics (2004), exposure to media is positively associated with education attainment. The mass media used to send messages over great distances includes books, pamphlets, magazines, newspapers, direct–mail circulars, newsletters, radio, compact disks, audiotapes, television, motion pictures, videotapes and computer networks (Wilson & Wilson, 1998). According to Rogers (1995), the mass media include broadcast (radio and television), print (newspapers, magazines, and extension brochures), and other approaches, such as poster campaigns, films, and theatre shows which enable a source to reach a large audience. Mass media is relatively more important than personal communication at “knowledge function”.

The mass media channels provide an easy, accessible and cheap means of communicating information to end-users and soliciting feedback. They provide important mechanisms for interaction and forum for exchange of ideas (United Republic of Tanzania, 2005). The key purpose here is creating knowledge and spreading information leading to changes in weakly held attitudes environment. The mass media is effective in the face of resistance or apathy on the part of the target audience. Therefore, the formation and change of strongly held attitudes is best accomplished through mass media communication (Rogers, 1995). This study may make a useful contribution since it attempts to address some issues not addressed in the past, especially the issue of disseminating innovations through communication channel combining the mass media and interpersonal components. Agricultural shows and stockists could play an important role in development by conveying useful information and changing farmers’ attitudes.

2.3.2. Communication Channels for Agricultural Technology

Although research has led to development of various technologies to solve problems of pests in smallholder farming systems, agricultural production has continued to decline because many of the technologies have not been effectively disseminated to majority of the farmers and hence remain largely unknown except in a few pilot areas. The European Initiative for Agricultural Research for Development (EIARD) (2008) laments the lack of research results uptake by the end users. Questions arise about what communication methods, pathways and media, extension practitioners use to disseminate research findings? How effective are they? What communication methods and media do farmers and other clients receive or prefer in receiving information on improved technologies, and how are researchers capable of communicating and promoting uptake of their research results remain a big challenge. According to CIAT (2009), specific attention should be given to appropriate communication channels.

2.3.3. Effectiveness of Disseminating Information

Overall, increased dissemination of information makes it possible for organizations to connect with the public and enable consumers to find new innovations (Wright, 2008). A variety of channels for disseminating information exists. Mass media constitute the main vehicle for wide and rapid transmission of information. However, for effectiveness of the mass media in agricultural information transfer, factors such as the target audience, their needs and interest, format in which information is desired, in what order of time, their beliefs and culture, which method of the presentation will serve them best and justification of information should be taken into consideration (Arumapperuma, 2008; Onuekwusi & Gideon, 2007).

According to Max Lock Centre (1998), information is disseminated most effectively if (1) the recipients know what kind of information they want; (2) the information provider is able to understand the recipients request; (3) the information provider has or can easily get the information requested; (4) the information provider is able to assess in what format the recipients can receive the information and is able to repackage the information in this format; (5) there are good communications links between provider and receiver; (6) the information provided is clear, understood and accurate; (7) the recipient can, if necessary, interpret the information to solve their particular problem or meet a particular need (8) the recipient does not receive conflicting information from different sources; and (9) sufficient resources are available to enable the information transfer to take place. For information dissemination to work well, all of the above conditions must apply (Max Lock Centre**,** 1998).

The mechanisms and media used to disseminate research findings include publication in local and international journals, stakeholder meetings, farmers' trainings, extension messages and mass media. The commonly used communication media in the dissemination of research findings in Kenya include leaflets, brochures, pamphlets, posters, agricultural shows, farmer exchange visits, field days, video shows, demonstrations, technical reports, newsletters, publications, radio and the Internet (Wilson, 1998). Effectiveness of communication media as perceived by farmers can be assessed in terms of their attraction, comprehension, acceptability, self-involvement and persuasion (Bertrand, 1978; Lutkamu et al., 2005; Rajabu, 1986).

2.4. Agricultural Shows, Exhibitions and Fairs as Medium to Disseminate Information in Agriculture

An agricultural show is a public event showcasing the equipment, animals, sports and recreation associated with agriculture and animal husbandry. The largest comprise a livestock show, trade fair, competitions, and entertainment. A fair is a gathering of people to display or trade produce or other goods, to parade or display animals and often to enjoy associated carnival or funfair entertainment. Activities at fairs vary widely. Some are important showcases for businessmen in agricultural, pastoral or horticultural districts because they present opportunities to display and demonstrate the latest machinery on the market (Wikipedia, 2008).

A trade fair or show is an exhibition organized so that exhibitors in a specific industry can showcase and demonstrate their latest products, service, study activities of rivals and examine recent trends and opportunities. Exhibitions can be a useful medium to disseminate information. Exhibitions and shows are a useful way to gather information and make contacts (Max Lock Centre**,** 1998). An exhibition provides an excellent platform for stakeholders to meet, exchange ideas and create new business opportunities, with the objective of unlocking exhibitor's economic potential and global competitiveness (GTZ Sustainet, 2006; Phiri & Themba, 2007).

2.5. Agricultural Shows in Kenya

Agricultural shows in Kenya are normally planned and organized by the Agricultural Society of Kenya (ASK). The ASK was founded in December 1901 under the name East African Agricultural and Horticultural Society (EAAHS). The central objective of this society was to promote agricultural development based on European settlement model. The ASK's objective is

to promote agriculture in Kenya through hosting of agricultural shows in fifteen different ecological zones (ASK, 2009). These shows provide a forum for the exchange of agricultural and agribusiness ideas and an opportunity to show case new farming technologies as they emerge.

The ASK shows and trade fairs give opportunity to farmers, investors, the business fraternity and service providers to show case their products and services. People come to these fora to exchange experiences, learn new techniques, and develop trade and business linkages in order to exploit the potential in productivity and agribusiness (ASK, 2009). In Western Kenya, the ASK organizes agricultural shows annually in the urban areas of Kisumu, Migori, Kakamega, Kitale, and Kisii. Potential exhibitors are usually businesses dealing in farm inputs and equipments, pesticides and animal drugs, among others. Plate 1 shows a group of farmers and visitors visiting the PPT demonstration plot at Kisumu showground in 2008.

Plate 1: A group of farmers and visitors visiting the PPT demonstration plot at Kisumu showground in 2008;
Source: Survey data (Pictures) - Kisumu show, 2008

In Kenya, the agro-dealers have become the most important extension nodes for the rural poor. Agro-input dealers or stockists are the retail distributors of agricultural inputs such as seeds, tools, pesticides, and fertilizer (AATF, 2008). According to The Sower (2008), provision of farm inputs is critical. This is because increased use of purchased key farm inputs is an important first step towards increasing crop yield. Inputs may be available in the trading centres but the centres

are many kilometres away from the farmers' fields and would necessitate incurring extra transport costs (EAFF, 2006). Also, the cost of key farm inputs such as certified seeds is high and beyond the reach of many smallholder farmers (GOK, 2008). On mitigation, farmers rely on information available from many channels or sources including farm input retail outlets (where they exist).

Kotler (2002) notes that distribution channels are the series of marketing entities through which goods and services pass on their way from producers to end users. Kenya has a fairly large network of input dealers in all categories from importers to wholesalers and to stockists. Stockists are an important link in agro-inputs supply chain playing the role of retail distributors. They buy inputs from appointed dealers who receive their supplies from the seed companies (AATF, 2008). Several local and multi-national seed, fertilizer, and agro-chemical companies now conduct demonstrations of new technologies with the agro-dealers in rural areas (Rockefeller Foundation, 2007). Most of the input shops in the rural areas are concentrated in high production areas or where production of high value crops is practiced. However, the network is not evenly distributed in all parts of the country. Being a private sector initiative, the businessmen establish input outlets only where there is demand (EAFF, 2006).

The development of rural stockists (agro-dealers) is critical for accelerating the access of the rural poor to quality agricultural inputs in Africa (Rockefeller Foundation, 2006). Besides stockists being the interface between supply and demand, they also make products available and close to farmers (critical, as some farmers have to walk 30-40 km to obtain farm inputs where no stockist network exists) (Blackie & Albright, 2005; CNFA, 2007). Stockists also play an important role in stimulating demand through the provision of information and advice to farmers (Gordon, 2000; Poulton, et al., 2005; Wulff et al., 2006). This is because some stockists are sometimes managed by persons with a background in research or extension and have moved into business because they have an entrepreneurial streak.

Success in agricultural production is embodied in planting seed. Ordinarily, seed needs to be readily available for purchase close to the farm. Whilst local stockists in Western Kenya can supply any seed that local farmers are likely to require, some of the most promising seed

varieties (e.g., Desmodium seed) have not yet reached the stage of commercial multiplication by seed companies (Kibaara, 2006). For the benefits of improved yields to reach resource-constrained smallholder farmers, the farmers must have access to affordable seed of high quality (Wulff et al., 2006). Remarkably, stockists also become a source of input credit to farmers whom they know (Poulton et al., 2005).

In Western Kenya, GIS-based rural input access maps have been developed, which now make it possible to determine the distances farmers in various locations have to travel to purchase inputs (Rockefeller Foundation, 2006). In many parts of Western Kenya, seed outlets are few and restricted to big trading centres requiring most farmers to travel long distances to buy seed thus incurring high transaction costs in locating the stockists (Gordon, 2000). Farm input supply systems also face other difficulties associated with quality assurance, promotion, and dissemination of information that can stimulate farmers' demand (Poulton, et al., 2005). The nature of seeds makes it difficult for farmers to gauge their quality at purchase, and they therefore need assurance of the genuine quality of their purchases (Wulff et al., 2006).

Kenya, like most countries, has varietal registration and certification regulations designed to protect farmers against purchase of poor quality seed. The high cost and delays in getting seed approvals, together with the small size of seed markets in most African countries, presents a serious disincentive on private sector seed supplies (Blackie & Albright, 2005; Poulton et al., 2005). Favourable policies for seed production, seed certification and registration, packaging and supply prices of seed need to be in place for the private sector to invest in this business (Gordon, 2000; Poulton et al., 2005). Apparently, trading in small quantities, to dispersed markets, with irregular, seasonal demand, contributes to high transaction costs. Moreover, high transaction costs incurred by the trader translate into higher retail prices (Gordon, 2000).

Willingness to purchase inputs is also affected by risk and uncertainty. Usually, arrangements between farm input suppliers and farmer organisations can help to increase the volume of demand and transaction sizes, while reducing uncertainty which can reduce input suppliers' costs and risks (Blackie & Albright, 2005; Gordon, 2000). Since stockists provide a good contact with smallholder farmers, the extent of alternative, small-scale extension delivery through these

stockists in the uptake of “Push Pull” technology is important. Measures to explore how quick information about Desmodium seeds spread through stockists and the possibility of stockists stimulating farmers demand by giving information on agriculture extension has to be established.

2.7. Cereal Production

In Eastern Africa, cereal farming contributes about 50% of the gross domestic product. Millions of rural people in Eastern Africa depend on maize and sorghum for food security and cash incomes (Amudavi et al., 2007). According to Central Bureau of Statistics (2006; 2007), cereals form the most important food group in Kenya contributing an average of 47.1 percent of all caloric supply and grown by 90 percent of the farming households. Despite this, production of these cops is seriously affected by constraints such as stemborers, the parasitic weed *Striga hermonthica*, unreliable rainfall, land degradation due to soil erosion, pre- and post-harvest pest infestation, pre- and post-harvest losses, poor infrastructure and marketing, and policy bottlenecks (Cook, 2007; GTZ Sustainet, 2006; ICIPE, 2005; Kegley, 2008; Khan, 2007). In Kenya, decline in yields has been affected by declining land sizes, soil erosion, and subsequent loss of soil nutrients due to poor farming practices (GOK, 2007).

Production of maize, sorghum and millet in Western Kenya is constrained by stemborers, the parasitic striga weed and poor soil fertility (Amudavi, et al., 2007; ICIPE, 2007; Khan et al., 2007). Stemborers and the parasitic striga weed are also two major biotic constraints to increased cereal production in Eastern and Southern Africa (ICIPE, 2005; Khan et al., 2006). Parasitic weeds (shown in Plate 2) in the genus Striga threaten the lives of over 100 million people in Africa and infest 40% of arable land in the savanna region, causing an annual loss of US$ 7 to 13 billion (Cook, 2007; ICIPE, 2005; Kalule, Khan, Bigirwa, Alupo, Okanya, Pickett & Wadhams, 2006). Around the Lake Victoria basin, striga infestation is quite severe and 30 to 100% loss in maize yield is caused by *Striga hermonthica* (ICIPE, 2005; Kalule, 2006, Khan et al., 2007)

Plate 2: A parasitic striga weed attached to the host maize plant
Source: Khan et al. (2005).A primer on planting and managing "Push Pull" fields for stemborer and striga control in maize - A step-by step guide for farmers. Nairobi, ICIPE.

Striga infestation is associated with increased cropping intensity and declining soil fertility (Khan et al, 2007; 2006). Infestations by weeds of Striga spp. have resulted in the abandonment of much arable land in Africa (ICIPE, 2005). The problem is more widespread and serious in areas where both soil fertility and rainfall are low (ICIPE, 2005; Khan et al., 2006). Striga infestation continues to extend to new areas. Another 40% of arable land may become infested in the next 10 years (ICIPE, 2005). Recommended control methods to reduce striga infestation include heavy application of nitrogen fertilizer, crop rotation, use of trap crops and chemical stimulants to abort seed germination, hoeing and hand pulling, herbicide application and the use of resistant or tolerant crop varieties (GTZ Sustainet, 2006; ICIPE, 2005; Kalule, 2006).

2.8. 'Push–Pull' Technology

The International Centre of Insect Physiology and Ecology (ICIPE) has developed an effective, low-cost and environmentally friendly technology, known as 'Push-Pull' (Plate 3) for control of stemborers and suppression of striga weeds in maize (Amudavi et al., 2008a; Khan, 2007; Khan et al., 2005, 2007). It is a simple cropping technology, whereby farmers use Napier grass planted in border rows and Desmodium legume (silver leaf and Green leaf Desmodium) as intercrop (Cook, 2007; ICIPE, 2007; Khan, 2007; Khan et al., 2008a; Khan et al., 2007; Khan et al., 2005). Plate 4 shows a typical "Push-Pull" technology layout showing maize intercropped with

Desmodium and planted around with a parameter of Napier grass at Kisumu show PPT demonstration plot.

Plate 3: A typical “Push Pull” technology layout showing maize intercropped with Desmodium and a parameter of Napier grass
Source: Khan et al. (2005). A primer on planting and managing “Push Pull” fields for stemborer and striga control in maize - A step-by step guide for farmers. Nairobi, ICIPE.

.

Plate 4: A “Push-Pull” technology plot at Kisumu show, 2008
Source: Survey data (pictures) - Kisumu show, 2008

The approach relies on a carefully selected combination of companion crops planted around and among maize or sorghum plants. Both domestic and wild grasses can help to protect the crops by attracting and trapping the stemborers. The grasses are planted in the border around the maize and sorghum fields where invading adult moths become attracted to chemicals emitted by the grasses themselves. These grasses provide the "Pull" in the “Push-Pull” technology (PPT) (Cook,

2007). They also serve as a haven for the stemborers' natural enemies. Good trap crops include well-known grasses such as Napier grass and Sudan grass (Cook, 2007; Khan, 2007; Khan et al., 2005). More stemborer moths are attracted to Napier grass as compared to maize as shown in Plate 5.

Plate 5: Adult stemborer moths being attracted to Napier grass (left) as compared to maize (right)
Source: Khan et al. (2005), A primer on planting and managing "Push Pull" fields for stemborer and striga control in maize - A step-by step guide for farmers. Nairobi, ICIPE

Napier grass has a particular way of defending itself against the pest onslaught. Once attacked by a borer larva, it secrets sticky substance that physically traps the pest and effectively limits its damage (Plate 6).

Plate 6: Feeding marks of stembores larva on maize and Napier grass.
Source: Khan et al. (2005), A primer on planting and managing 'Push-Pull' fields for stemborer and striga control in maize - A step-by step guide for farmers.

The natural enemies lurking among the grasses go into action and dispatch the borers in maize, sorghum or grass hosts' plants. The "Push" in the intercropping scheme is provided by the plants that emit chemicals (kairomones), which repel stemborer moths and drive them away from the main crop of maize or sorghum (Cook, 2007; ICIPE, 2007) as shown in Plate 7. The best plants discovered so far with the repellent properties are members of leguminous genus *Desmodium spp*. Desmodium is planted in between the rows of maize or sorghum. Being low-growing plant it does not interfere with the crops' growth and furthermore has the advantage of maintaining soil stability and improving soil fertility through nitrogen fixation. It also serves as a highly nutritious animal feed and effectively suppresses striga.

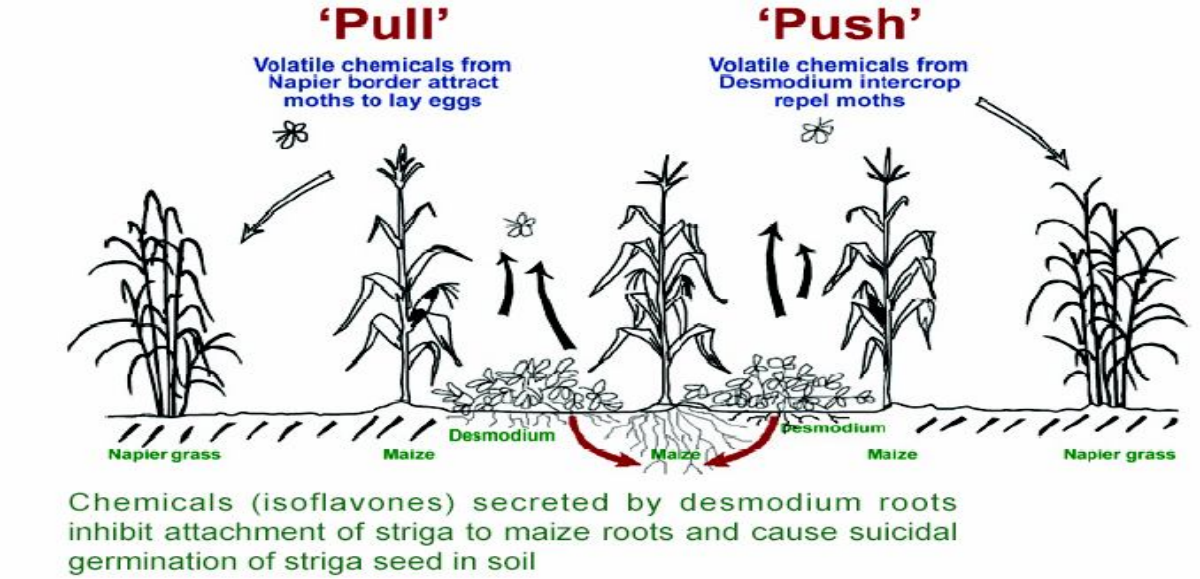


Plate 7: Illustration of the "Push Pull" concept

Source: Khan et al. (2005). A primer on planting and managing "Push Pull" fields for stemborer and striga control in maize-A step-by step guide for farmers. Nairobi, ICIPE.

2.9. Desmodium Seeds

Despite the fact that vegetative propagation of Desmodium has become a common way of interplanting this legume, an important limiting factor for disseminating the "Push-Pull" technology system is often the shortage of Desmodium seeds (ICIPE, 2007). Seeds are most critical and basic input for agricultural output. Given the significance of seed production and the need to maintain a reliable supply of good quality seed and ensure its wide distribution, smallholder farmers who want to buy seed have trouble accessing it directly (DFID, 2006). Although technology and methods for the production of seed and development of local markets

are now being developed in collaboration with local seed companies, availability of seeds remains a bottleneck (ICIPE, 2007). According to ICIPE external research and development review (ICIPE, 2007), lack of Desmodium seed is a major cause of the limited spread of the "Push-Pull" technology. The problem is that under current phytosanitary laws in Kenya, seed dealers need to be licensed to undertake this activity. In Kenya, the permit costs Ksh 70,000 (US$ 875), which inhibits seed dealers and stockists from getting involved in seed marketing (DFID, 2006).

2.9.1. Strengthening the Desmodium Seeds Industry in Kenya

Smallholder farmers who want to buy seed have trouble accessing it directly because the input stockists to whom they would normally go for inputs, do not usually deal with some particular legumes, tree or shrub seed (DFID, 2006). Local stockists sell agricultural seed which they get from seed companies; but the market for Desmodium seed is so much smaller than for food crops that the big seed companies do not find the Desmodium market lucrative (DFID, 2006). Although according to Odame, Musyoka, and Kere (2008), farmers sell some seed amongst themselves, the seed does not move far and is not sold by stockists (DFID, 2006).

2.9.2. The Measures of Desmodium Seeds Market Demand

Understanding and estimating demand is extremely important for marketers (Solomon, Marshall & Stuart, 2006). According to Perreault and McCarthy (2005), demand is an expression of consumers' buying intentions, of a willingness to buy, not a statement of actual purchases. They noted that a convenient summary of buying intentions is the demand curve, a graphic illustration of the demand schedule. Schiller (2005) and Parkin (2005), also defined demand as the ability and willingness to buy specific quantities of a good at alternative prices in a given time period, *ceteris paribus*. There are two types of demand: market demand and company demand. Market demand is determined by the number of potential buyers and their respective tastes, income, other goods and expectations. The market demand represents the combined demands of all markets participants (Perreault & McCarthy, 2005). To estimate current demand, companies attempt to determine total market potential, area market potential, industrial sales, and market share (Kotler, 2002). Marketers talk about potential markets, available markets, served markets and penetrated markets. A market is a set of all actual and potential buyers of a market offer. The marketers' first step in evaluating marketing opportunities is to estimate total market demand.

Market demand for a product is the total volume that would be bought by defined customers in a defined geographical area in a defined time period in a defined marketing environment under a defined marketing program. Company demand on the other hand is the company's estimated share of market demand at alternative level of company marketing effort in a given time period. The company's share of market demand depends on how its products, services, prices, communications, and so on are perceived relative to the competitors (Perreault & McCarthy, 2005).

2.9.3. Practical Methods of Estimating Current Market Demand for Desmodium Seed

Market executives want to estimate total market potential, area market potential, and total industry sales and market sales. Total market potential is the maximum amount of sales that might be available to all the firms in an industry during a given period under a given level of industry marketing effort and given environmental conditions. A common way of estimating total market potential is by estimating the potential number of buyers times the average quantity purchased by a buyer times the price (Kotler, 2002; Solomon, Marshall & Stuart, 2006). For example, if 1000 people buy Desmodium each year, and the average Desmodium seed buyer buys 4 kilograms a year, and the average price of a kilogram of Desmodium seed is Ksh 1000, then the total market potential for Desmodium seed is 4 million kilograms (1000 x 4 kg x 1000 Ksh/kg) (Kotler, 2002). The most difficult component to estimate is the number of buyers in the specific product or market. One can always start with the total population in an area. The next group is to eliminate the group that obviously would not buy the product. A variation on this method is the chain-ratio method. It involves multiplying a base number by adjusting percentages (Kotler, 2002).

2.9.4. Estimating Future Demand for Desmodium Seeds

To estimate future demands companies' survey buyers' intentions, solicit their sales force's input, gather expert opinions or engage in marketing testing (Kotler, 2002). All forecasts are built on one of three information bases: what people say, what people do, or what people have done. What people say involves surveying the opinions of buyers or those close to them, such as sales people or outside experts. It encompasses three stages: survey of buyers' intentions, composites of sales force opinions, and expert opinion (Kotler, 2002). Building a forecast on

what people do involves putting the product into a test market to measure buyers' response. What people have done involves analysing records of past buying behaviour or using time series analysis or statistical demand analysis (Kotler, 2002). Forecasting is the art of anticipating what buyers are likely to do under a given set of conditions. By asking questions like 'do you intend to buy Desmodium seeds within the next one year?' you can make a purchase probability scale. The various surveys also inquire into consumer's present and future personal finances and their expectations about the economy (Kotler, 2002).

Estimating demand is an important concern of marketers, and business managers in general, because such estimates are an integral requirement for both strategic and tactical planning decisions (Brennan, 2004). One approach that has shown promising results involves the use of the Juster Purchase Probability Scale, an 11-point scale that has verbal (e.g., "almost sure"), numerical (e.g., "9") and probability (e.g., "9 in 10") descriptors (Brennan, 2004). This scale has been shown to consistently outperform other types of scale, and has been applied to a wide range of applications, such as estimating both purchase rates and purchase levels, estimating relative market share, assessing advertising copy effectiveness, predicting voting behaviour, and constructing demand curves (Brennan, 2004).

2.9.5. Farmers' Purchase Intentions for Desmodium Seeds

Marketers of consumer goods and services have an understandably strong interest to predict the purchase behaviour of customers. In turn, these predictions contribute to market forecasts (Tirtiroglu & Elbeck, 2008). In its simplest form, predicting purchases rests on the stage preceding actual purchase, and is referred to as "intentions to purchase". Purchase intentions can help predict subsequent purchase. Information about purchase intention is drawn from a purchase intent scale or an 11-point purchase which are designed to elicit a response to the question how likely an item will be purchased within a specific time period (Tirtiroglu & Elbeck, 2008).

2.9.6. Price of Desmodium Seeds

Prices are a key positioning factor and must be decided in relation to the target market. Retailers must pay attention to pricing tactics (Kotler, 2002). Price indicates value, helps position a product in the market place, and is the means for earning a fair return on investment (Solomon et

al., 2006). If a price is too high, the product won't sell well, and if the price is too low, the firm may loose money even if the product sells well. Price skimming involves charging a high introductory price and then usually, lowering the price as the product moves through its life cycle. Skimming is useful when you don't know the shape of the demand curve. It is sometimes safe to start with a high price that consumers can refuse and then reduce it if necessary. However, firms should not try to maximise profits by using a skimming policy on new products that have important social consequences, for example, a technique that increases crop yield. Many of those who need the product may not have the money to buy it. Low prices do attract customers (Perreault & McCarthy, 2005). Therefore marketers often use introductory prices dealing- temporary price cuts- to speed new products into a market and get customers to try them. The plan here is to raise prices as soon as the introductory offer is over. Free delivery may be offered to some customers as an aid to closing the sale.

Discounts can be useful in marketing strategy planning. Quantity discounts are discounts offered to encourage customers to buy in large amounts. A sale price is a temporary discount from the list price. Sale price discounts encourage immediate buying. Allowance like discounts, are given to final customers, consumers, or channel members for doing something or accepting less of something. Advertising allowances are price reductions given to firms in the channel to encourage them to advertise or otherwise promote the supplier's product locally (Perreault & McCarthy, 2005). For example a company like Western seed might give an allowance (3% of sales) to its retailers. They in turn are expected to spend the allowance on local advertising. Stocking allowances are given to a middleman to get shelf space for a product. For example, a producer may offer a retailer cash or free merchandise to stock a new product item.

Stocking allowances are used mainly to get supermarket chains to handle new products (Perreault & McCarthy, 2005). Supermarkets are more willing to give space to a new product if the supplier will offset their handling costs and risks .e.g. 13-18 % of sales price. Push money (or prize money) allowance are given to retailers salesclerks for aggressively selling certain items. Push money allowances are used for new items, slower moving items or higher-margin items. Many producers and retailers offer discounts or free items through coupons distributed in packages, mailings, print advertisements, or at the store. By presenting a coupon to a retailer, the

consumer is given a discount off list price. Some firms offer rebates (i.e., refunds paid to consumers after a purchase to promote sales). Free delivery may be offered to some customers as an aid to closing the sale (Perreault & McCarthy, 2005).

2.9.7. Sales Promotion for Desmodium Seeds

Promotion is an attempt by marketers to inform, persuade, or remind consumers and industrial users to engage in the exchange process (Gitman & McDaniel, 2006; Kotler, 2002). Sales promotion consists of marketing activities that stimulate consumers to buy. Some marketing communication campaigns may be specifically aimed at ensuring and increasing consumers' comprehension of the advantages to be derived from the product and how it may benefit them in particular (Blois, 2000). These activities include coupons and samples, displays, shows and exhibitions, demonstrations, and other selling efforts (Solomon, Marshall & Stuart, 2006). Integrated marketing communication is the careful coordination of all promotional messages for a product or a service to ensure consistency of the messages at every contact point where a company meets the consumer (Gitman & McDaniel, 2006).

Sales promotions are marketing events or sales effort that stimulate buying of a good (Belch & Belch, 2004). Consumer sale promotion is targeted to the ultimate consumer market. Trade sales promotion is directed to members of the marketing channels, such as wholesalers and retailers. Cent- off, coupons, free samples, or an eye- catching display in a store will often entice shoppers to try a different brand. Sales promotion offers many opportunities for entrepreneurs (Perreault & McCarthy, 2005; Odame, Musyoka, & Kere, 2008). Marketers and entrepreneurs design contests and sweepstakes, fabric displays, manufacture premiums, and delivery free samples among other things to promote their products and to build demand (DFID, 2005; Gitman & McDaniel, 2006). Packaging is also an important way to promote sales and protect the product (FIPS-Africa, 2005). A package should be easy to store, ship and stack on a shelf. Packaging in a different language may be required (Gitman & McDaniel, 2006).

2.9.8. Promotion of Desmodium Seeds as a Means of Communication

Desmodium seed producers must not only offer good seeds at reasonable prices but also inform potential customers about the seeds and where they can buy them (Perreault & McCarthy, 2005).

Marketing strategies should state what should be communicated to the target market and how. Innovations in branding and use of mass media are a hallmark in product promotion (Odame et al., 2008). The overall promotion objectives are informing, persuading and reminding. What we know about the communication process and how individuals and groups adopt new products is important in planning promotion blends for Desmodium seeds (Belch & Belch, 2004). Retailers use a wide range of promotion tools to generate traffic and purchase (Kerin et al., 2003).

Seed merchants sponsor farming programs on vernacular radios, place commercial spots in the electronic media, produce brochures and technical handbooks and are actively involved in the training of stockists and farmers (Odame et al., 2008). They also place advertisements, run special sales, issue money saving coupons, and run frequent shopper reward programs, in store food sampling, and coupons in shelves or at check out points. Each farm input retailer must use promotion tools that support and reinforce its image positioning (Kotler, 2002).

2.10. Theoretical Framework

The research theoretical framework for this study was based on the diffusion of innovation theory. The relevance of the theory for this research is the manner in which a new technological idea, artefact or technique, or a new use of an old one, moves from the level of creation to level of use. Diffusion is the process by which an innovation is communicated to members of a social system (Arumapperuma, 2008). The members' willingness and ability to adopt an innovation depend on their awareness, interest, evaluation and trial of the technology. According to Rogers (1995), modelling the spread of innovations through society takes the form of an "S" curve with early adopters selecting the technologies first, followed by the majority, until the technologies are common in the society (Figure 1).

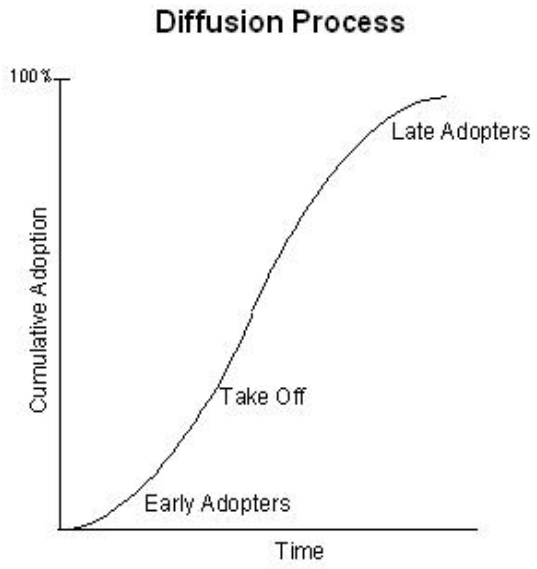


Figure 1: The diffusion process
Source: Rogers, 1995

The theory underscores the importance of pluralistic communication pathways, through which knowledge and information are disseminated bringing about behavioural change. According to Diffusion of Innovation Theory, technological innovation is communicated through particular channels, over time, among the members of a social system (Hubbard & Sandmann**,** 2007). Arumapperuma (2008) noted that in the diffusion process, research organizations select the most appropriate channel to maximise the number of farmers who will adopt the new technology within a particular time period.

Marketers also recognize the differences in individual readiness to try new products, the effect of personal influence, differing rates of adoption and differences in organisations' readiness to try new products. Diffusion describes how the use of a product spreads throughout a population (Solomon et al., 2006). According to Kotler (2002), the diffusion process is the process by which customers learn about new products, try them, and adopt or reject them. This adoption process is however influenced by many factors, including willingness to try new products, personal influences, and the characteristics of the new product or innovation. According to Clarke (1999) and Rogers (1995), the stages through which a potential user passes through in adopting a technological innovation are knowledge, persuasion, decision, implementation and confirmation.

An innovating firm should research the demographic, psychographic, and media characteristics of innovators and early adopters and communicate to them (Kotler, 2002). The communicator must select efficient communication channels to carry the message. Rogers (1971) theorised that little research had focused on effectiveness of communication pathways in the diffusion process. Although researchers continue to develop new technologies, such as the "Push Pull" technology, that address farmers' needs, they face the challenge of low adoption rates by farmers.

The communication process encompasses various components of a channel that interact with one another such as attraction, comprehension, acceptability, self-involvement and persuasion as measures of effectiveness of communication (Bertrand, 1978). It is assumed that the communication channel with a high communication scores on attraction, comprehension, acceptability, self-involvement and persuasion is likely to be effective (Lutkamu et al., 2005; Rajabu, 1986; Wilson, 1998).

Agricultural shows and input stockists provide a combination of mass media and interpersonal communication channels which can be used effectively to reach people with new ideas and persuading them to utilise these innovations (Arumapperuma, 2008). The Diffusion of Innovation Theory gives an analytical instrument for conducting an empirical research in the field and can provide a framework for measuring the effectiveness of agricultural shows and stockists in disseminating information on PPT among smallholder farmers in Western Kenya.

2.11. Conceptual Framework

The conceptual framework used in this study was based on the diffusion of innovation theory. The independent variables in this study were two namely, farmers' participation in agricultural shows and farmers' access to farm input stockists considered relevant to diffusion of PPT. The dependent variables in this study were the dissemination of PPT and adoption of PPT among smallholder farmers. The effectiveness in disseminating information on PPT were measured by scoring levels of agreement on several aspects of PPT demonstrated at the agricultural show and aspects of services by stockists respectively on a Likert-type rating scale of strongly agree, agree, undecided, disagree and strongly disagree as indicated in annex A and annex B. The indicator measurements for the dissemination and adoption of PPT among smallholder farmers were: - (1) Number of farmers who bought Desmodium seed, (2) Number of farmers willing to buy

Desmodium seed, (3) Number of farmers adopting PPT, and (4) Number of farmers willing to adopt PPT. These variables were treated separately. Age, gender, and education level served as moderator variables. A closed-ended questionnaire was used to determine the extent to which the objectives of the study were achieved. Figure 2 outlined the conceptual framework for measuring the effectiveness of the two pathways in enhancing dissemination and adoption of "Push-Pull" technology.

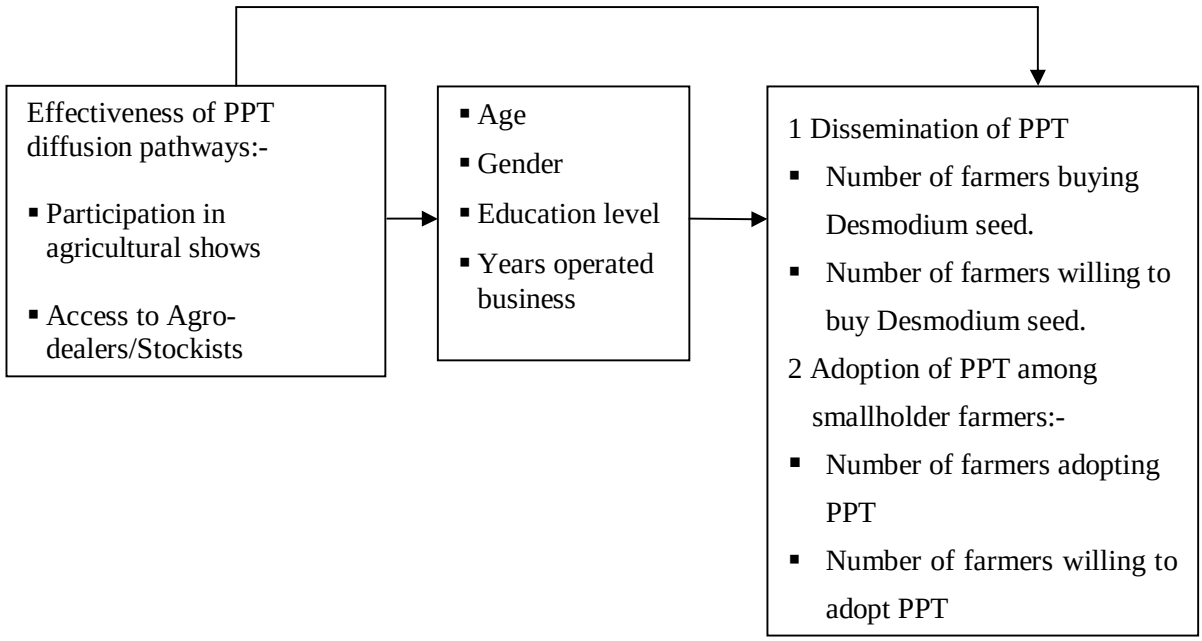


Figure 2: A conceptual framework for measuring the effectiveness of pathways in enhancing dissemination and adoption of "Push-Pull" technology.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1. Introduction

This chapter is organised under the following headings: Research design, study location, population of the study, sampling procedure and sample size, instrumentation, data collection tools, validity, reliability, data collection procedures and data analysis.

3.2. Research Design

This study uses a cross-sectional survey design to determine the effectiveness of agricultural shows and agro-dealers in dissemination of "Push-Pull" technology. According to Mugenda (2008), one benefit of cross sectional studies is that they are considered to be good at generating hypotheses which can then be tested. The cross-sectional survey research also makes it possible to study things that are not directly observable such as people's attitude and beliefs and to describe a population too large to observe directly (Kendall, 2007). Since data is collected from a specific population at one point in time, chances for attrition are reduced to a minimum. To overcome the methodological limitations of a cross sectional survey design, statistical analysis such as cross tabulation, bivariate percentage, was used (Frankfort-Nachmais, 1997).

3.3. Study Location

The study location for the agricultural shows was Kisumu ASK show organized in Western Kenya during the period July to August 2008. The study location for stockists was the areas in some selected districts of Western Kenya where "Push-Pull" technology is being practised. Western Kenya is the region bordering Uganda to the west and Tanzania to the south. It lies between latitude 1° 8' N and 1° 24' S and between longitude 34° and 35° E as shown in appendix D (GOK, 2007; Jaetzold & Schmidt, 1982, 1983). The elevation ranged from 1000 to 1600 m. It occupied an area of 20,719 km², which consists of very gently undulating landscapes with slopes between 2 and 8%. Poorly drained land makes up about 30% of the total area. Western Kenya, the home of over 8 million people, was one of Kenya's most densely populated regions. Population densities ranged from 500 to 1200 people per km², with the highest densities in Vihiga district of Western Province. Farm sizes are small, ranging from 0.2 to 2.5 ha, and the

mean household size is about 7 people (Amadalo et al., 2003). The agro-ecological zones (AEZs) found in Western Kenya are the lower midlands (LM), the upper midlands (UM), the lower highlands (LH), and the tropical alpine (TA) (Jaetzold & Schmidt, 1982, 1983). The study area was selected for several reasons. First, these areas have high infestation of Striga and stemborers. Moreover, cereals are the main staple food in those regions. Hence, it was assumed that the area could qualify to be representative of the cereal producing regions of the country. Second, the area is easily accessible for a field research, as it has all weather road access. In addition, it was possible to get the support of the local agricultural office and ICIPE field staffs to get into contact with stockists. Their support facilitated the field research process.

3.4. Target Population of Study

The population of study comprised of farmers that visited the Ministry of Agriculture PPT demonstration plot at the Kisumu showground in 2008 and local agro-dealers/stockists located in areas of the districts where PPT was practised in Western Kenya. The target population consisted of farmers attending the PPT demonstration plot at Kisumu ASK show in 2008 and farm input stockists. A total of 800 farmers and 102 stockists were targeted.

3.5. Sampling Procedure and Sample Size

The study was conducted in Western Kenya at Kisumu agricultural show and in areas of the districts where PPT was disseminated and practiced. The whole population of about 800 individuals that visited the Ministry of Agriculture PPT demonstration plot at the Kisumu agricultural show were interviewed (Table 1). Since the schedules for agricultural shows were already fixed by ASK, Kisumu agricultural show was selected conveniently. This was because; Kisumu ASK was a national show and was attended by farmers in Western Kenya and from other parts of Kenya. The purpose was to collect data from the show that was attended nationally among Kisii, Kisumu and Migori ASK agricultural shows. A big sample was also required from the population in order to be in agreement with the "Central Limit Theorem". This theorem assures that the sampling distribution of the mean approaches normal distribution as the sample size increases (Kothari, 2003).

Proportionate stratified random sampling method based on districts was used to sample 102 stockists to capture agro-ecological, ethnical, market access diversity (Table 2). The sample size was obtained using the formula:-

$$\frac{Ps}{\sum Ns} x\ n = ns$$

Where ΣNs=Total population of stockists=250

n=Required sample=102

Ps=Population in the stratum (e.g., 20 stockist at Kisii district

ns=Sample size per district $= \frac{102}{250} x\ 20 = 8$ stockists at Kisii

Proportionate stratified random sampling provided greater precision, guarded against an "unrepresentative" sample and was less costly (Kathuri & Pals, 1993; Kothari, 2003). A sample size of 102 was appropriate because it was in agreement with the central limit theory which states that “the sampling distribution of the mean tends closer to the normal distribution, provided the number of sample items is large (i.e., more than 30)” (Frankfort-Nachmais, 1997; Kothari, 2003). Data from stockists were collected from 12 districts of Western and Nyanza provinces namely Bungoma South, Teso, Busia, Vihiga, Siaya, Bondo, Butere, Kisii, Kuria, Migori, Rachuonyo and Suba.

According to Mugenda (2008), and Mugenda & Mugenda (2003), to select a representative sample, a researcher must have a sampling frame. In this study, subjects or cases selected from the sampling frame formed the units of observations (Appendix E). The sampling frame for this study was a list of 250 stockists from sampled districts. A sampling frame of stockists in the selected districts was compiled before the start of the study as indicated in appendix E.

Table 1: Distribution of Farmers Interviewed at Kisumu Agricultural Show, 2008 (N=800)**.**

District of residence	No. interviewed	District of residence	No. interviewed	District of residence	No. interviewed
Rachuonyo	58	Mt Elgon	1	Makueni	2
Kisumu East	154	Lugari	2	Kericho	12
Nyando	126	Masaba	3	Naivasha	1
Kisumu West	63	Buret North	2	Busia	18
Thika	2	Murang'a	1	Emuhaya	4
Hamisi	8	Trans-Nzoia	5	Bungoma	5
Vihiga	20	Nandi North	2	Baringo	5
Suba	13	Trans-mara	6	West Pokot	1
Nairobi	1	Laikipia	6	Kitui	3
Rongo	14	Narok	2	Teso	1
Kakamega	13	Siaya	69	Turkana	1
Kisii	19	Elgeyo Markwert	3	Embu	1
Koibatek	2	Rarieda	16	Nandi South	4
Nandi East	7	Uasin Gishu	9	Molo	1
Nandi Central	2	Nyeri	2	Bomet	1
Kiambu	1	Bondo	25	Sotik	2
Kuria	1	Meru	2	Nyandarua	1
Gucha	6	Homabay	28	Kipkelion	1
Butere Mumias	6	Migori	17	Nyabene	1
Machakos	1	Nyamira	7	Kirinyaga	1
Kibwezi	1	Nakuru	4		

Table 2: Sample Size Distribution of Stockists Interviewed in Twelve Districts in the Study

District	No of Stockist from the sampling frame per district	No. sampled	No. interviewed
Bungoma South	19	8	8
Teso	36	15	11
Busia	28	11	12
Vihiga	38	16	10
Siaya	25	10	10
Bondo	15	6	8
Butere	11	4	6
Kisii	20	8	9
Kuria	14	6	7
Migori	19	8	9
Rachuonyo	14	6	6
Suba	11	4	6
Total	250	102	102

3.6. Instrumentation

A closed-ended questionnaire was used to collect data from the farmers and stockists. A closed-ended questionnaire was chosen because it facilitated consistency of responses across respondents. The items on the questionnaires were developed on the basis of the objectives of the study. The study used two structured questionnaires to collect data. Appendix A shows the questionnaire for farmers that visited the PPT demonstration plot at the agricultural showground while appendix B indicated the questionnaire used to collect data from the stockists. Appendix A was utilized to collect data from farmers attending Kisumu agricultural show. It gave information on how agricultural shows facilitated understanding and uptake of PPT and created demand for Desmodium seeds. The entire questionnaire was pretested with the involvement of 55 respondents. After going through the completed questionnaire, the necessary modifications and adjustments were made. Open ended questions were useful in complementing and enabling in-depth information on opinions and perceptions of participants as articulated in their own words.

The purpose of administering the questionnaire to the stockist (Appendix B) was to find out the extent to which stockists created farmers' demand for Desmodium seeds and hence facilitated dissemination and uptake of the PPT at farm level. The items were adapted for use by ICIPE. These items sought the respondents' views on their knowledge of PPT, Desmodium seeds and opinion on the effectiveness of these two extension pathways. The information on effectiveness was scored on a scale to depict the level of effectiveness of agricultural shows and stockists. The level of effectiveness was determined by a total score for all the aspects considered.

3.6.1. Validity

Content validity was assessed by use of professionals and experts (Mugenda & Mugenda, 2003). The aim was to identify all items that would measure the degree to which the data collected using the instruments, represented a concept under investigation (Mugenda, 2008). The experts from the Department of Agricultural Education and Extension included examiners and supervisors as shown in Appendix C. Criterion related validity was determined by obtaining a validity coefficient. Construct validity was determined by examining the items of the instruments logically to check if the elements represented 'made up' the construct (Kathuri & Pals, 1993).

3.6.2. Reliability

Reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trial (Khothari, 2003). The Cronbach's alpha coefficient was used to measure the instrument's internal consistency. Pre-testing of the questionnaire to the show-goers/respondents was done at Kisumu ASK pre-show days. Pilot testing for Kisumu show was done using 55 show-goers. The pilot testing was to ensure reliability of the instrument and individuals who participated in the pilot test were excluded from the actual data collection.

A pilot testing for stockists was done at Homabay district using 18 stockists who had similar characteristics to the actual sample. The procedures used for pre-testing were identical to those used during the actual data collection as recommended by various researchers including Khothari, 2003; Mugenda, 2008; and Mugenda & Mugenda, 2003. These stockists were also excluded from the study. Results of the pre-tests indicated an alpha reliability coefficient of 0.85; hence an indication that there was consistency among the items in measuring the concept of interest (Frankfort-Nachmais, 1997).

3.7. Data Collection Procedure

Before the actual data collection, a research permit was obtained from the National council of Science and TechnologyMinistry of Education Science and Technology, Nairobi, through the Egerton University Graduate School. The researcher explained to the respondents the purpose of the study before administering the questionnaire. The study population for the shows consisted of farmers attending the PPT demonstration stands at the Kisumu ASK show held in Western Kenya in the year 2008. The researcher administered the farmer questionnaire in annex A to individuals visiting the PPT demonstration plot at the Kisumu agricultural showground.

Desmodium seed was also sold to willing farmers and extension materials such as posters, brochures, pamphlets and magazines issued. The amount of Desmodium seeds bought by each farmer respondent was recorded. Similarly, a closed-ended questionnaire was administered (Annex B) to the sampled stockists to capture effectiveness in disseminating information to farmers. The sampling frame was developed by the researcher from stockists located in the areas of sampled districts where PPT was being disseminated and practised. Effectiveness was then measured in terms of how stockists created farmers' demand for Desmodium seeds and facilitated dissemination and uptake of the PPT. The responses were recorded in the questionnaires and later transferred into an electronic database (SPSS version 11.5 software) for further analysis.

3.8. Data Analysis

The data were checked to ensure correct entry of the responses and summarized and classified according to the hypotheses and objectives of the study. All data derived from the study were coded using open and axial coding. These codes were recorded based on the major themes of the study to form categories. All data obtained from the questionnaires were entered and analysed by computer using SPSS. The variables considered were:

(1) **Gender** (gender); (1=male; 2=female), assumed to either positively or negatively influence a respondent's participation in agricultural shows or dissemination of information by stockists.

(2) **Level of education** in years (educ): Highest level of education attained (1=non-formal; 2=primary; 3=secondary; 4=college; 5=university). The level of education attained by a stockist could either positively or negatively influence opportunities such as access to information, partnerships and networking. Higher levels of education may increase the likelihood of participation in agricultural shows.

(3) **Age of an individual** (age): Age of the respondent was classified on an ordinal scale (1=16-30 years; 2= 31-45 years; 3=46-60 years; 4= 61-75 years and 5=76-90 years) for farmers attending the agricultural show. An individual's age affected the adoption of PPT either positively or negatively.

(4) **Effectiveness of Agricultural Shows:** This was measured by a Likert-type rating scale of strongly agree, agree, undecided, disagree and strongly disagree against some aspects of PPT demonstrated by the show on whether (1) The "Push–Pull" technology (PPT) plot lay-out attracted and held the attention of the farmers, (2) The demonstration facilitated a good understanding of how PPT controlled Striga, (3) The demonstration facilitated a good understanding of how PPT controlled stemborer, (4) Demonstrated how to establish the PPT plot, and (5) Demonstrated the benefits of the PPT.

The indicators of effectiveness were given scores as indicated in appendix A. From these scores, an index was developed by getting the sum of scores exhibited by the respondent. For instance, the lowest score was obtained by a sum of 1+1+1+1+1=5 while the highest score was obtained by summing up 5+5+5+5+5=25. With this basis, a scale ranging from 5 to 25 was arrived at to cater for the respondent's scores. The midpoint of this scale was 15 and this denoted moderate effectiveness of agricultural shows. Considering the scores below and above the midpoint, five levels of effectiveness were defined in this study. Figure 10 depicts levels of effectiveness of agricultural shows in disseminating information and creating demand. These levels were; Not effective for a score of 5-9; Less effective for a score range of 10-14; Moderate for a score of 15; Effective for a score range of 16-20 and finally, Very effective for a score range of 21-25.

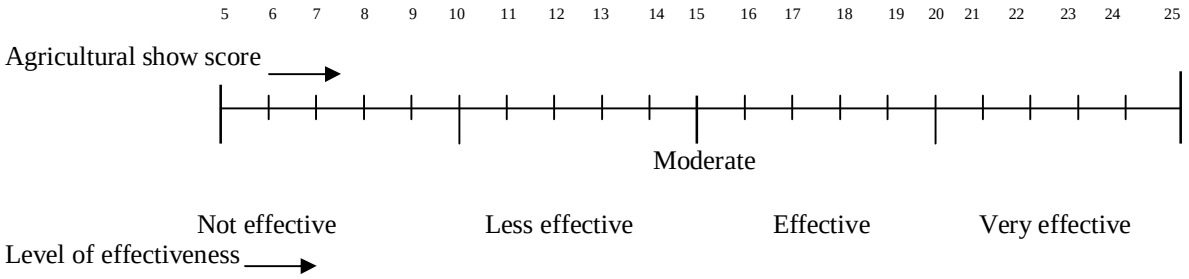


Figure 3: Scale depicting levels of effectiveness of agricultural shows in disseminating information.

Source: developed by the researcher

(5) **Effectiveness of stockists**: The indicator measurements for effectiveness was measured by scoring using some level of agreement on stockist effectiveness on a Likert-type rating scale of strongly agree, agree, undecided, disagree and strongly disagree against some criteria namely, (1)

Ability to deliver needed goods and services timely, (2) Use of different distribution strategies to reach many farmers, (3) linkage to seed companies,(4) Ability to explain to farmers how to use seed-based technologies, (5) Whether regularly keep an up to date stock, (6) Whether a member of networks, partnerships and outreach that work with farmers, (7) Ability to give some credit to farmers, (8) Ability to keep records of farmers served, and (9) Ability to keep record of farmers who buy inputs.

These indicators of effectiveness for stockists were given scores as indicated in Figure 11. From these scores, an index was developed by getting the sum of scores exhibited by the respondent. For instance, the lowest scale was obtained by a sum of 1+1+1+1+1+1+1+1+1=9 while the highest score was obtained by summing up 5+5+5+5+5+5+5+5+5=45 with this basis; a scale ranging from 9 to 45 was arrived at to cater for the respondent's scores. The midpoint of this scale was 27 and this denoted moderate effectiveness of a stockist. Considering the scores below and above the midpoint, five levels of effectiveness were defined in this study for the stockists. These levels were; Not effective for a score of 9-17, Less effective for a score range of 18-26; Moderate for a score of 27; Effective for a score range of 28-36 and finally very effective for a score range of 37-45.

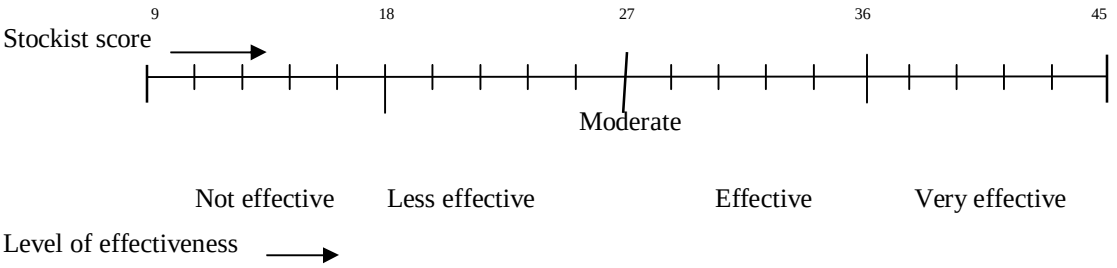


Figure 4: Scale depicting levels of effectiveness of stockists in disseminating information and creating demand.

(6) **Enhancing demand for Desmodium seeds through agricultural show:** The indicator measurements were the number of respondents that bought Desmodium seed, amount of Desmodium seeds bought by farmer, and number of farmers with intention to buy Desmodium seed.

(7) **Stimulating Desmodium seed demand at the showground**: Demand was measured at two levels. By determining the farmer's willingness to purchase Desmodium seed that helped to calculate the market demand, and determining the farmer's intention to purchase Desmodium seed in the future. The market demand for Desmodium seed was calculated by estimating the potential number of buyers times the average quantity purchased by a buyer times the price.

(8) **Stimulating demand for Desmodium seed by the stockist:** The indicator measurements were whether stocking Desmodium seeds, number of stockists asked Desmodium seeds by farmers, quantities of Desmodium seeds sold.

Descriptive and some inferential statistics were carried out. Percentages were used to describe the independent variables. Cross-tabulation were utilised to compare situation of respondents along several variables and to find out the effects of various categorical variables. The findings were represented in form of discussions, charts and tables. The contents in these categories were used to verify data or assumptions obtained from the qualitative analysis or to explain contradictions (Mulugeta, 2008). Effectiveness of agricultural shows and stockists yielded categorical data of most effective, effective, moderate, less effective and not effective that could be analysed using Chi-Square. Chi-square was selected because to establish relationships between variables that were categorical in nature (Mugenda, 2008; Mugenda & Mugenda, 2003).

This study had four hypotheses tested using Chi-square and interpreted at 5% level of significance (α=0.05). To determine the significance of our tests, the probability of the computed Chi-square value was compared with the level of significance set (α=0.05). If the probability of the computed Chi-square value (P value) was more than the level of significance set α =0.05 (P>0.05), we fail to reject the null hypotheses and concluded that the two were not related to each other or vice versa. Tests of hypotheses were carried out to establish whether there was any effect of the independent variables (farmers' participation in agricultural shows and farmers' access to farm input stockists) on the dependent variables (the dissemination of PPT and adoption of PPT). The hypotheses in the study were translated from the objectives i – iv. The statistical package for social science (SPSS version 11.5) was used to compute the data collected. Table 3 gives a summary of how the null hypotheses were tested.

Table 3: Summary of Data Analysis

Hypothesis	Independent variables	Dependent variables	Statistical test
HO_1 Participating in agricultural shows has no statistically significant effect in disseminating information and adoption of PPT among smallholder farmers in Western Kenya.	Participation in Agricultural shows	Disseminating information and adoption of PPT	Chi-square
H_{O2} Access to farm input Stockists have no statistically significant effect in disseminating information and adoption of PPT among smallholder farmers in Western Kenya.	Access to farm input Stockists	Disseminating information and adoption of PPT	Chi-square
HO_3 Agricultural shows have no statistically significant effect in enhancing demand for Desmodium seeds among smallholder farmers in Western Kenya.	Participation in agricultural shows	Effectiveness in enhancing demand for Desmodium seeds among smallholder farmers	Chi-square
HO_4 Access to farm input Stockists have no statistically significant effect in enhancing demand for Desmodium seeds among smallholder farmers in Western Kenya.	Access to farm input Stockists	Effectiveness in enhancing demand for Desmodium seeds among smallholder farmers	Chi-square

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

The purpose of this study was to determine the effectiveness of agricultural shows and agro-dealers in enhancing dissemination of PPT among smallholder farmers in Western Kenya. In this chapter, the research data obtained are presented using descriptive and inferential statistics. The findings are presented in the forms of graphs, tables and their implications discussed. The four hypothesis of the study were tested using Chi-square. The sections in this chapter contain information on effectiveness of agricultural shows in disseminating information and adoption of PPT, effectiveness of stockists in disseminating information and adoption of PPT, effect of agricultural shows in stimulating Desmodium seeds demand and effect of stockists in stimulating the demand for Desmodium seeds.

4.2. Effectiveness of Agricultural Shows in Disseminating Information and Adoption of PPT

The study involved 800 smallholder farmers. The farmers that attended the PPT demonstration plots at the Ministry of Agriculture stand at Kisumu agricultural show in 2008 came from various regions (Table 4). About 19.3% of the smallholder farmers came from Kisumu East district, 15.8% from Nyando, 8.6% Siaya, 7.9% Kisumu West, 7.3% Rachuonyo, 3.5% Homabay, 2.5% Vihiga and 2.4% Kisii, among others. From the results, the gender of farmers' participating at the Kisumu agricultural was not significant to the district of residence (χ^2=54.643, df=62, p-value=0.735).

Overall, Kisumu show was attended by 77.5% male compared to 22.5% female farmers. All participating smallholder farmers from Koibatek, Nandi Central, Kiambu, Kuria, Machakos, Molo, Kibwezi, Murang'a, and Nyamira district among others were males compared to Teso district attended only by female farmers. The highest proportion (50%) of female compared to male attending the show was from Nandi South and Lugari districts followed by Kisii district (female 47.4%; male 52.6%).

The age of farmers attending Kisumu show was categorized into 16-30 years (34.4%), 31-45 years (42.7%), 46-60 years (20.3%), 61-75 years (2.0%) and 76-90 years (0.7%). The mean age of farmers attending Kisumu show was 33 years. The youngest respondent was aged 16 years from Kisumu East while the oldest had 82 years from Busia district with the range of 66 years. Smallholder farmers attending the show from Murang'a, Embu, Sotik, Kipkelion and Kirinyaga district were aged between 46 and 60 years while those from Thika, Kiambu, Machakos, Masaba, Nyeri, Naivasha, West Pokot and Turkana districts were aged between 16 and 30 years. Similarly, all farmers from Nairobi were aged between 76 and 90 years.

Farmers attending the show from Kirinyaga, Murang'a, Nandi North, Teso and Kirinyaga district had university level of education compared to those from Kiambu, Kuria, Machakos, Mt Elgon, Nyeri, Molo and Bomet district that had college level of education. The level of education of the farmers attending the PPT demonstration at the showground was not significant to the farmers' district of residences.

Table 4: Socio-economic Characteristics of Farmers That Attended Kisumu Show in the Year 2008 (N=800)

District of residence		Gender (%)		(%) Age of show attendants in (years)					Level of education (%)				
	%	F	M	16-30	31-45	46-60	61-75	76-90	Non-f	Pri	Sec	Col	Uni
Rachuonyo	7.3	15.5	84.5	38.5	32.7	23.1	5.8	-	5.2	1.7	37.9	32.8	22.4
Kisumu E	19.3	22.1	77.9	36.0	39.6	19.4	4.3	0.7	1.3	20.8	37.7	29.2	10.4
Nyando	15.8	22.2	77.8	29.3	48.3	20.7	0.9	0.9	1.6	16.7	34.1	29.4	18.3
Kisumu W	7.9	25.4	74.6	43.1	36.2	15.5	3.4	1.7	-	11.1	41.3	22.2	23.8
Thika	0.3	-	100.0	100.0	-	-	-	-	-	-	-	50.0	50.0
Hamisi	1.0	12.5	87.5	28.6	57.1	14.3	-	-	-	25.0	37.5	25.0	12.5
Vihiga	2.5	35.0	65.0	11.1	66.7	22.2	-	-	-	5.0	35.0	25.0	35.0
Suba	1.6	38.5	61.5	50.0	25.0	25.0	-	-	-	15.4	38.5	38.5	7.7
Nairobi	0.1	-	100.0	-	-	-	-	100.0	-	100.0	-	-	-
Rongo	1.8	7.1	92.9	25.0	33.3	41.7				7.1	14.3	50.0	28.6
Kakamega	1.6	30.8	69.2	30.0	30.0	40.0	-	-	-	15.4	23.1	23.1	38.5
Kisii	2.4	47.4	52.6	27.8	38.9	33.3	-	-	-	-	31.6	31.6	36.8
Koibatek	0.3	-	100.0	-	-	-	-	-	-	-	-	50.0	50.0
Nandi E	0.9	14.3	85.7	57.1	42.9	-	-	-	-	14.3	42.9	28.6	14.3
Nandi C	0.3	-	100.0	50.0	50.0	-	-	-	-	50.0	50.0	-	-
Kiambu	0.1	-	100.0		100.0	-	-	-	-	-	-	100.0	-
Kuria	0.1	-	100.0	100.0			-	-	-	-		100.0	-
Gucha	0.8	16.7	83.3	33.3	33.3	33.3	-	-	-	-	50.0	50.0	-
Butere	0.8	16.7	83.3	50.0	50.0	-	-	-	-	16.7	33.3	33.3	16.7
Mumias													
Machakos	0.1	-	100.0		100.0	-	-	-	-	-	-	100.0	-
Kibwezi	0.1	-	100.0	-	-	-	-	-	-	-	100.0	-	-
Mt Elgon	0.1	-	100.0	100.0	-	-	-	-	-	-	-	100.0	-

Table 4: Continued

District of residence	%	Gender (%)		(%) Age of show attendants in (years)					Level of education (%)				
		F	M	16-30	31-45	46-60	61-75	76-90	non – f	Pri	Sec	Col	Uni
Lugari	0.3	50.0	50.0	50.0	50.0	-	-	-	-	-	-	50.0	50.0
Masaba	0.4	33.3	66.7	-	100.0	-	-	-	-	-	66.7	33.3	-
Bureti	0.3	-	100.0	50.0	50.0	-	-	-	-	-	-	100.0	-
Murang'a	0.1	-	100.0	-	-	100.0	-	-	-	-	-	-	100.0
Trans-Nzoia	0.6	20.0	80.0	20.0	80.0	-	-	-	-	-	40.0	60.0	-
Nandi N	0.3	-	100.0	50.0-	-	50.0	-	-	-	-	-	-	100.0
Trans-mara	0.8	-	100.0	40.0	60.0	-	-	-	16.7	16.7	50.0	-	16.7
Laikipia	0.8	16.7	83.3	66.7	-	33.3	-	-	-	-	33.3	16.7	50.0
Narok	0.3		100.0	-	50.0	50.0	-	-	-	-	50.0	50.0	-
Siaya	8.6	33.3	66.7	39.7	34.9	25.4	-		1.4	11.6	36.2	33.3	17.4
Elgeyo Markwert	0.4	33.3	66.7	66.7	33.3	-	-	-	-	-	33.3	33.3	33.3
Rarieda	2.0	12.5	87.5	18.8	56.3	25.0	-	-	-	12.5	37.5	12.5	37.5
Uasin Gishu	1.1	22.2	77.8	42.9	57.1	-	-	-	-	11.1	22.2	55.6	11.1
Nyeri	0.3	-	100.0	-	100.0	-	-	-	-	-	-	100.0	-
Bondo	3.1	28.0	72.0	30.4	47.8	21.7	-	-	4.0	4.0	48.0	40.0	4.0
Meru	0.3	-	100.0	50.0	50.0	-	-	-	-	50.0	-	50.0	-
Homabay	3.5	35.7	64.3	13.6	68.2	18.2	-	-	-	14.3	25.0	32.1	25.0
Migori	2.1	11.8	88.2	33.3	50.0	8.3	8.3	-	5.9	11.8	17.6	52.9	11.8
Nyamira	0.9	-	100.0	71.4	28.6	-	-	-	14.3	28.6	14.3	42.9	-
Nakuru	0.5	-	100.0	25.0	-	50.0	25.0	-	-	-	25.0	75.0	-
Makueni	0.3	-	100.0	100.0	-	-	-	-	-	-	-	50.0	50.0
Kericho	1.5	-	100.0	45.5	54.5	-	-	-	-	8.3	33.3	33.3	25.0
Naivasha	0.1	-	100.0	-	100.0	-	-	-	-	-	100.0	-	-
Busia	2.3	27.8	72.2	33.3	44.4	16.7		5.6		11.1	50.0	27.8	11.1

Table 4: Continued

District of residence	%	Gender (%) F	Gender (%) M	(%) Age of show attendants in (years) 16-30	31-45	46-60	61-75	76-90	Level of education (%) Non-f	Pri	Sec	Col	Uni
Emuhaya	0.5	-	100.0	25.0	25.0	50.0	-	-	-	25.0	-	75.0	-
Bungoma	0.6	20.0	80.0	40.0	40.0	20.0	-	-	-	20.0	60.0	20.0	-
Baringo	0.6	40.0	60.0	80.0	-	20.0	-	-	-	-	20.0	40.0	40.0
West Pokot	0.1	-	100.0	-	100.0	-	-	-	-	-	100.0	-	-
Kitui	0.4	-	100.0	33.3	66.7	-	-	-	-	-	33.3	66.7	-
Teso	0.1	100.0	-	100.0	-	-	-	-	-	-	-	-	100.0
Turkana	0.1	-	100.0	-	100.0	-	-	-	-	-	100.0	-	-
Embu	0.1	-	100.0	-	-	100.0	-	-	-	-	100.0	-	-
Nandi S	0.5	50.0	50.0	25.0	75.0	-	-	-	-	25.0	25.0	-	50.0
Molo	0.1	-	100.0	-	100.0	-	-	-	-	-	-	100.0	-
Bomet	0.1	-	100.0	-	100.0	-	-	-	-	-	-	100.0	-
Sotik	0.3	-	100.0	-	-	100.0	-	-	-	-	50.0	50.0	-
Nyandarua	0.1	-	100.0	-	100.0	-	-	-	-	-	100.0	-	-
Kipkelion	0.1	-	100.0	-	-	100.0	-	-	-	100.0	-	-	-
Nyabene	0.1	-	100.0	-	-	-	-	-	-	100.0	-	-	-
Kirinyaga	0.1	-	100.0	-	-	100.0	-	-	-	-	-	-	100.0
Total	100	22.5	77.5	34.4	42.7	20.3	2.0	0.7	1.5	13.0	35.0	31.9	18.3

Key: E-east; W-west; C-central; S-south; N-north; F-female; M-male; Non-f -non formal; Pri-primary; Sec- secondary; Col-college; Uni-university.

Source: Survey data, Kisumu show (2008)

The age category of 31-45 years had the highest respondents (42.7%) on the effectiveness of the agricultural shows (Table 5). The farmers that benefited most from the shows were those that were in age categories of 31-45 years and 46-60 years. The age of the smallholder farmers attending the show was associated to the level of education (χ^2=42.106, df=20, p-value=.003). More than 14% and 21.4% smallholder farmers with non-formal and primary education respectively were in the age category of 61-75 years. Among the show attendants, 38.2% farmers with secondary education were in the age category of 16-30 years compared to 37.2% with college education level in the category of 46-60 years. Equal proportion (20%) farmers with university level were in the age categories of 31-45 years and 46-60 years.

Table 5: Farmers Characteristics at Kisumu Show in the Year 2008 (N=800)

Age categories of show attendants	%	Gender (%)		Highest level of education (%)				
		Female	Male	non-formal	Primary	Secondary	College	University
16-30 yrs (n=246)	34.4	26.4	73.6	0.8	14.6	38.2	31.7	14.2
31-45 yrs (n=306)	42.7	21.2	78.8	0.7	12.7	35.9	30.4	20.3
46-60 yrs (n=145)	20.3	18.6	81.4	3.4	10.3	29.0	37.2	20.0
61-75 yrs (n=14)	20.0	14.3	85.7	14.3	21.4	21.4	28.6	14.3
76-90 yrs (n=5)	0.7	0.0	100.0	0.0	60.0	20.0	20.0	0.0

Source: Survey data, Kisumu show (2008)

All farmers (100%) from Machakos, Murang'a, Nandi South, Molo, and Kirinyaga were part of the 32.9% of the farmers that had heard about PPT before coming to Kisumu show. Only 20.7% of the farmers from Rachuonyo, 28.6% Kisumu East, 41.3% Nyando, 36.5% Kisumu West, 61.5% Suba, 35.7% Rongo, 57.9% Kisii, 16.7% Gucha, 16.7% Butere Mumias, 23.2% Siaya, 37.5% Rarieda, 44.0% Bondo, 42.9% Homabay, 35.3% Migori, 28.6% Nyamira, 44.4% Busia, and 25.0% from Emuhaya district had heard about PPT before coming to Kisumu show (Table 6). Suba district with 38.5%, Kisii (31.6%), Rongo (28.6%), Homabay (28.6%), Kisumu West, (25.4%), Rarieda (25%), Busia (22.2%), Kisumu East (20.8%) and Bondo (20%) had the highest percentage of farmers that had seen PPT before coming to Kisumu from Western Kenya.

Out of 18.6% smallholders farmers who said they had received information on PPT from previous agricultural shows, 13.8% were from Rachuonyo, 24.7% from Kisumu East, Nyando (24.6%), Kisumu West (17.5%), Hamisi (25%), Vihiga (15%), Suba (53.8%), Rongo (28.6%), Kisii (31.6%), Butere Mumias (16.7%), Masaba (33.3%), Siaya (2.9%), Rarieda (25%), Bondo (16%), Homabay (14.3%), Migori (35.3%), Busia (6.7%) and Bungoma (20%). There was no significant relationship between the district of residence and whether the respondent had received information on PPT from previous agricultural shows. Only 3.8% of the farmers in this study indicated that they practiced PPT in their farm. Out of this, 1.7% were from Rachuonyo, 5.8% Kisumu East, 4.0% Nyando, 9.5% Kisumu West, 10.0% Vihiga, 1.4%Siaya, 6.3% Rarieda, 7.1% Homabay, 5.9% Migori, 14.3% Nyamira, and 5.6% from Busia. More than 96% of the small

holder farmers indicated that they would like to plant PPT in their farms. When asked whether the smallholder farmers would like to buy seeds at Kisumu show, 68.0% of them responded in affirmative. All respondents from Kuria and Teso district said that they would like to buy the Desmodium seeds at Kisumu Show. Above 94% smallholder farmers indicated their intention to buy Desmodium seeds in the future.

Table 6: Knowledge on “Push Pull” Technology (N=800)

District of residence	Percent	Had heard about PPT before coming to Kisumu show (%)	Had seen PPT before coming to Kisumu show (%)	Ever received information PPT from previous agricultural shows (%)	Do you practice PPT in your farm (%)	Would you like to plant PPT in your farm (%)	Would you like to buy desmodium seeds now (%)	Intention to buy desmodium seeds in the future (%)
Rachuonyo	7.3	20.7	8.6	13.8	1.7	98.3	51.7	98.3
Kisumu East	19.3	28.6	20.8	24.7	5.8	96.8	48.1	92.2
Nyando	15.8	41.3	18.3	24.6	4.0	98.4	54.0	97.6
Kisumu West	7.9	36.5	25.4	17.5	9.5	95.2	54.0	88.9
Thika	0.3	50.0	-	-	-	50.0	100.0	100.0
Hamisi	1.0	37.5	25.0	25.0	-	100.0	62.5	100.0
Vihiga	2.5	25.0	15.0	15.0	10.0	100.0	50.0	90.0
Suba	1.6	61.5	38.5	53.8	-	92.3	61.5	100.0
Nairobi	0.1	-	-	-	-	100.0	100.0	100.0
Rongo	1.8	35.7	28.6	28.6	-	100.0	78.6	100.0
Kakamega	1.6	46.2	7.7	-	-	100.0	69.2	84.6
Kisii	2.4	57.9	31.6	31.6	-	94.7	52.6	94.7
Koibatek	0.3	50.0	50.0	-	-	100.0	50.0	100.0
Nandi East	0.9	14.3	14.3	-	-	85.7	71.4	100.0
Nandi Central	0.3	-	-	-	-	100.0	-	100.0
Kiambu	0.1	-	-	-	-	100.0	-	100.0
Kuria	0.1	-	-	-	-	100.0	100.0	100.0
Gucha	0.8	16.7	16.7	-	-	100.0	16.7	100.0
Butere Mumias	0.8	16.7	-	16.7	-	100.0	33.3	66.7
Machakos	0.1	100.0	-	-	-	100.0	100.0	100.0
Kibwezi	0.1	-	-	-	-	100.0	-	100.0
Mt Elgon	0.1	-	-	-	-	100.0	-	100.0
Lugari	0.3	-	-	-	-	100.0	50.0	100.0
Masaba	0.4	33.3	-	33.3	-	100.0	33.3	100.0
Buret North	0.3	-	-	-	-	100.0	50.0	100.0
Murang'a	0.1	100.0	-	-	-	100.0	100.0	100.0

Table 6 continued

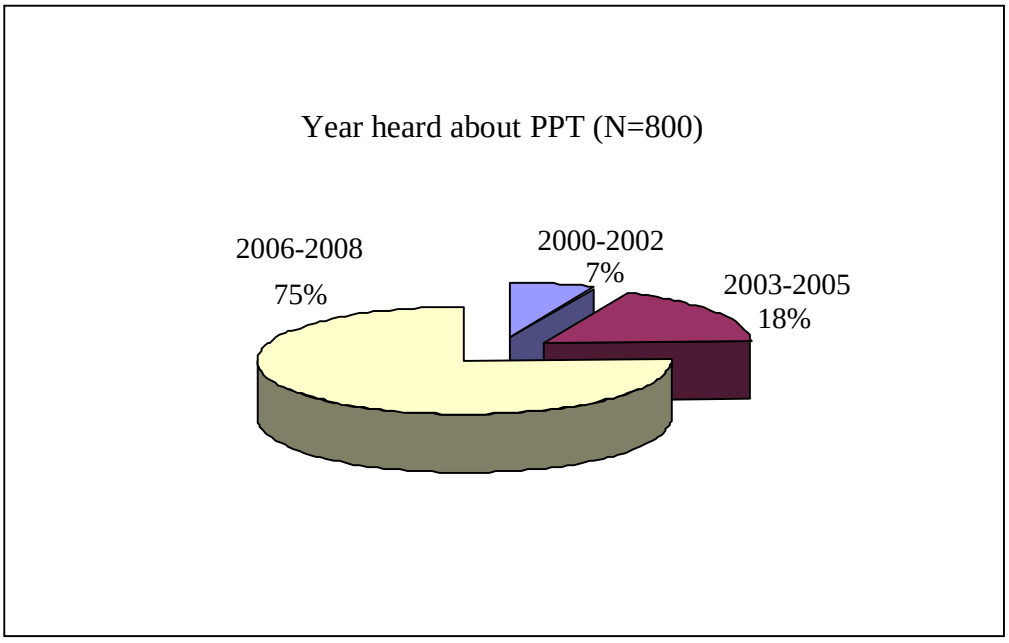
District of residence	Percent	Had heard about PPT before coming to Kisumu show (%)	Had seen PPT before coming to Kisumu show (%)	Ever received information PPT from previous agricultural shows (%)	Do you practice PPT in your farm (%)	Would you like to plant PPT in your farm (%)	Would you like to buy desmodium seeds now (%)	Intention to buy desmodium seeds in future (%)
Trans-Nzoia	0.6	20.0	20.0	20.0	-	100.0	60.0	100.0
Nandi North	0.3	100.0	-	50.0	-	50.0	-	50.0
Trans-mara	0.8	33.3	-	-	-	100.0	33.3	100.0
Laikipia	0.8	50.0	-	33.3	-	100.0	66.7	83.3
Narok	0.3	-	-	-	-	100.0	50.0	100.0
Siaya	8.6	23.2	5.8	2.9	1.4	100.0	55.1	97.1
Elgeyo	0.4	-	-	-	-	100.0	66.7	100.0
Marakwet								
Rarieda	2.0	37.5	25.0	25.0	6.3	93.8	62.5	100.0
Uasin Gishu	1.1	33.3	11.1	33.3	-	100.0	55.6	100.0
Nyeri	0.3	-	-	-	-	100.0	50.0	100.0
Bondo	3.1	44.0	20.0	16.0	-	100.0	68.0	100.0
Meru	0.3	-	-	50.0	-	100.0	100.0	100.0
Homabay	3.5	42.9	28.6	14.3	7.1	85.7	60.7	96.4
Migori	2.1	35.3	17.6	35.3	5.9	94.1	35.3	70.6
Nyamira	0.9	28.6	14.3	-	14.3	85.7	71.4	85.7
Nakuru	0.5	25.0	-	25.0	-	75.0	50.0	75.0
Makueni	0.3	-	-	-	-	100.0	50.0	100.0
Kericho	1.5	50.0	8.3	16.7	-	91.7	50.0	100.0
Naivasha	0.1	-	-	-	-	100.0	-	100.0
Busia	2.3	44.4	22.2	16.7	5.6	100.0	77.8	100.0
Emuhaya	0.5	25.0	-	-	-	100.0	50.0	100.0
Bungoma	0.6	-	-	20.0	-	100.0	20.0	100.0
Baringo	0.6	20.0	-	-	-	100.0	60.0	100.0
West Pokot	0.1	-	-	-	-	100.0	100.0	100.0
Kitui	0.4	33.3	-	33.3	-	100.0	66.7	100.0
Teso	0.1	-	-	-	-	100.0	100.0	100.0
Turkana	0.1	-	-	-	-	100.0	-	100.0

Table 6 continued

District of residence	Percent	Had heard about PPT before coming to Kisumu show (%)	Had seen PPT before coming to Kisumu show (%)	Ever received information PPT from previous agricultural shows (%)	Do you practice PPT in your farm (%)	Would you like to plant PPT in your farm (%)	Would you like to buy desmodium seeds now (%)	Intention to buy desmodium seeds in the future (%)
Embu	0.1	-	-	-	-	-	100.0	100.0
Nandi South	0.5	50.0	-	-	-	100.0	25.0	100.0
Molo	0.1	100.0	-	-	-	100.0	100.0	100.0
Bomet	0.1	-	-	-	-	100.0	100.0	100.0
Sotik	0.3	-	-	-	-	100.0	-	100.0
Nyandarua	0.1	-	-	-	-	100.0	100.0	100.0
Kipkelion	0.1	-	-	-	-	100.0	-	-
Nyabene	0.1	-	-	-	-	100.0	-	-
Kirinyaga	0.1	100.0	100.0	-	-	100.0	-	100.0
Total	100	32.9	16.8	18.6	3.8	96.8	53.9	94.5

Source: Survey data, Kisumu show (2008)

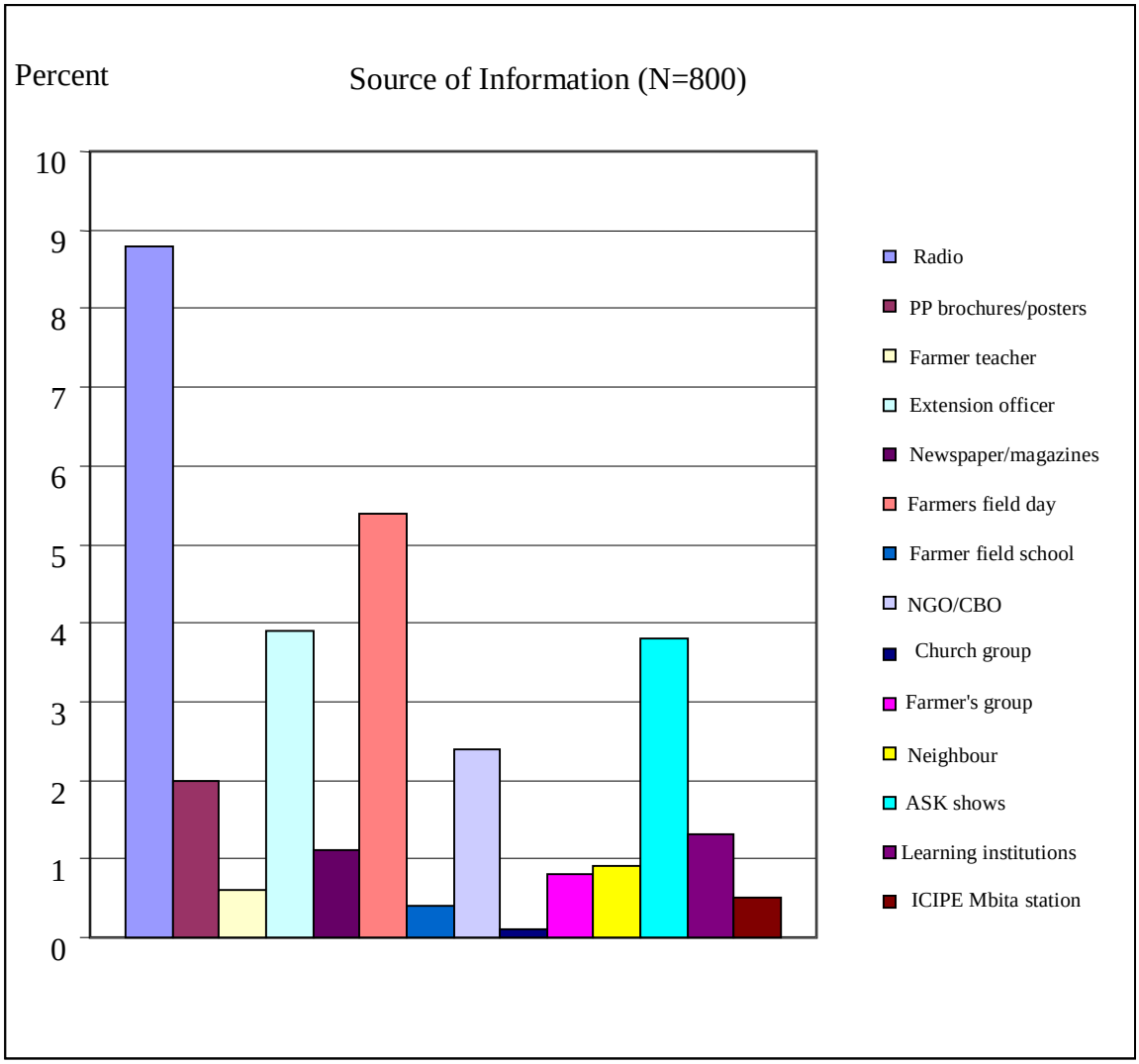
Fig 5 below shows that 75% smallholder farmers indicated that they had heard about "Push Pull" technology for the first time in the period 2006-2008, 18% had heard about PPT in 2003-2005, while 7% had heard it from 2000 to 2002 period.



Source: Survey data, Kisumu show (2008)

Figure 5: Period when the farmer heard of PPT before coming to Kisumu show.

Farmers got extension advice about PPT from various sources. Figure 6 shows that farmers got information about PPT from the radio (8.8%), field days (5.4%), extension officers (3.9%) and ASK (3.8%). Other sources of information were non-governmental organizations (NGOs) (2.4%), PPT print materials (2.0%), learning institutions (1.3%), newspapers (1.1%), fellow farmers (0.9%) and ICIPE Mbita field station (0.5%). The differences were not significant across gender.



Source: Survey data, Kisumu show (2008)

Figure 6: Farmers' first source of information about "Push Pull" technology.

As indicated in Table 7 earlier, only 16.8% farmers had seen a PPT Field before coming to Kisumu show in the year 2008. Out of this, 6.9% had seen the field from previous ASK

agricultural shows, 6.1% field days, 4.9% other farmer's farms, 2.1% ICIPE field station, 1.4% farmer field schools (FFS), and 0.9% farmer teacher's farm.

Table 7: Sources Where Farmers had Seen PPT Before Coming to the Kisumu ASK Show (N=800)

Information Sources	Frequency	Percent
Farmers' field day	49	6.1
Other farmers' farm	39	4.9
Farmer teachers farm	7	0.9
ASK show	55	6.9
Farmers field school	11	1.4
ICIPE station	17	2.1
learning institutions e.g. Maseno A.T.C.	1	0.1
Video/Television	2	0.3
Kitale research station	1	0.1
Total	182	16.8

Source: Survey data, Kisumu show (2008)

Only 21.5% of the female farmers said that they had ever received information about PPT from agricultural show compared to 78.5% male farmers (Table 8). Most female farmers had only visited Kisumu (22.2%) and Kisii (20.0%) agricultural shows compared to male farmers who had visited Kisumu (77.8%), Kisii (80.0%), Kitale (100%), Nakuru (100%), Nairobi (100%), Embu (100%), Kapsabet (100%) and Mombasa (100%) show, respectively. Both male and female farmers can receive information about PPT from Agricultural shows (χ^2=6.130 df=9 P-value=0.727).

Table 8: Name of the Show Where Farmers had Received Information on PPT (N=800)

	Farmers who had ever received information about PPT from agricultural show (%)	
Name of the show where PPT information was received from	Female	Male
Kitale	0	100.0
Kisumu	22.2	77.8
Nakuru	0	100.0
Nairobi	0	100.0
Kisii	20.0	80.0
Embu	0	100.0
Kapsabet	0	100.0
Mombasa	0	100.0
Not indicated the name of the show	50.0	50.0
Total	21.5	78.5

Source: Survey data, Kisumu show (2008)

Results in Table 9 show that the farmers who practiced PPT indicated various reasons for adopting the technology in their farms. About 43% of the farmers said that they used it to control striga, 43% to control stemborers, 37% to increase maize production, 40% to increase fodder for livestock and 47% to improve soil fertility in the fields. Farmers who were not practicing the PPT in their farms previously indicated they were willing to adopt it because of various reasons. About 47.5% of them wanted to plant a PPT plot to control striga, 23% stemborers, 10% improve soil fertility, 24% increase yields and 7% for fodder production. Other reasons mentioned were to experiment (2.4%), to control soil erosion (0.3%), to reduce production costs due to less weeding (6.9%) and to increase moisture retention (0.8%).

Table 9: Reasons Given by Practicing and New Farmers' for Adopting PPT (N=800)

Farmers' reasons for adopting PPT	Percent	Reasons why new farmers want to practice PPT	Percent
Control striga	43	Control striga weeds	47.5
Control stemborers	43	Control stemborers	23.1
Increase maize production	37	Improve soil fertility	10.1
Increase folder for livestock	40	Fodder production	7.0
Improve soil fertility on the field	47	Experiment and for demonstration purposes	2.4
		Control soil erosion	0.3
		Get all the PPT benefits	4.1
		Reduce production costs due to less weeding	6.9
		Generate income	0.9
		Moisture retention	0.8
		Understand how PPT plot is planted after learning	83.3

Source: Survey data, Kisumu show (2008)

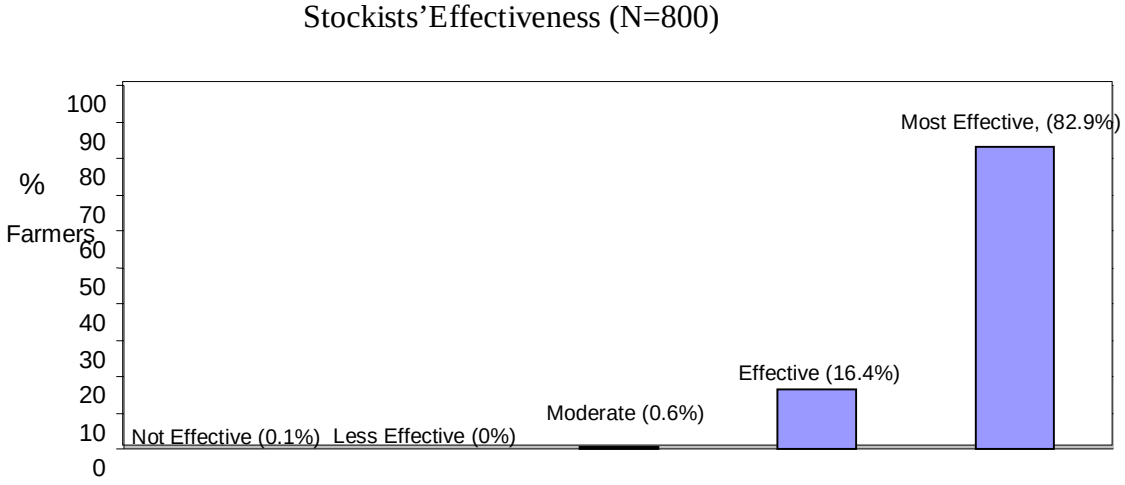
Farmers need to fully understand how a new technology works before they can adopt it in their farms**.** About 83% farmer respondents that visited the PPT demonstration plot at Kisumu showground indicated that they understood well how a PPT plot was established. The study indicated that more female (86.7%) than male (82.3%) farmers fully understood how a PPT plot was established (Table 10). However the statistical difference between genders was insignificant at p-value of 0.37. Most farmers had a good understanding of how PPT plot is planted after learning at the showground regardless of their education status. The results indicated that 66.7% of the farmers with non-formal education, 92.3% primary, 85.7% secondary, 81.6% college, and 76.0% university fully understood how PPT plot was planted after learning at the agricultural show.

Table 10: Farmers Understanding of How PPT Plot is Planted (N=800)

	Understand how PPT plot is planted after learning (%)		
Gender (%)	Yes	No	Somewhat
Female (n=180)	86.7	1.1	12.2
Male (n=620)	82.3	1.3	16.5
Highest level of education (n= %)			
non- formal n=12)	66.7	8.3	25.0
Primary (n=104)	92.3	0.0	7.7
Secondary (n=280)	85.7	0.4	13.9
College (n=255)	81.6	1.6	16.9
University (n=146)	76.0	2.7	21.2

Source: Survey data, Kisumu show (2008)

About 99.3% of the respondents interviewed indicated that the agricultural shows were an effective pathway for disseminating agricultural information (Fig. 7). Approximately, 16.4% and 82.9% of the population in the study rated the agricultural shows as an effective and most effective pathway for disseminating agricultural information, respectively. In Table 11, more female (18.3%) compared to male farmers (15.8 %) considered the agricultural shows as an effective dissemination channel that could be used to introduce new innovations. In contrast, more male (83.5%) compared to female farmers (80.6%) considered that the shows were the most effective channels of disseminating information. Above 82% of all age categories of farmers attending Kisumu show rated the show as most effective regardless of their education levels.



Source: Survey data, Kisumu show (2008)

Figure 7: Farmers' opinions on effectiveness of agricultural shows in disseminating information.

4.2.1 Test of Hypothesis

$H_0$1 Participating in agricultural shows has no statistically significant effect in disseminating information and adoption of "Push Pull" technology among smallholder farmers in Western Kenya.

This hypothesis was tested using Chi-square. The aim was to determine if a relationship existed between the perception that agricultural shows were effective in disseminating information and adoption of PPT on a scale of 4-point Likert type scale with 1= not effective, 2=moderate, 3=effective and 4=most effective against the gender, age and the level of education of the respondents participating in agricultural shows. It was analyzed as shown below.

Gender of the farmers participating in agricultural shows has no statistically significant effect on the agricultural shows in disseminating information and adoption of PPT.

This hypothesis was tested to determine if a relationship existed between the agricultural shows being effective in disseminating information and adoption of PPT against gender of the farmers participating in agricultural shows. The tests as indicated in Table 11 shows χ^2 value of 1.863 and the probability of the computed Chi-square value (P value) as 0.601. Since the probability of the computed Chi-square value is greater than 0.05 the level of significance set α=0.05, we,

therefore, fail to reject the null hypotheses and conclude that there was no statistically significant relationship between effectiveness of the agricultural shows and gender of the farmers.

The age categories of smallholder farmers participating in agricultural shows has no statistically significant relationship with effectiveness of the agricultural shows in disseminating information and adoption of PPT.

This hypothesis was tested to determine if a relationship existed between the agricultural shows' effectiveness in disseminating information and adoption of PPT measured on a 4-point Likert type scale with 1= not effective, 2=moderate, 3=effective and 4=most effective and the age categories of smallholder farmers. The tests as indicated in Table 11 shows χ^2 value of 19.497 and the probability of the computed Chi-square value (P value) as 0.077. Since the probability of the computed Chi-square value is less than the level of significance set α=0.10 ($p<0.10$), we, therefore, reject the null hypothesis and conclude that there was a statistically significant effect between effectiveness of agricultural shows and the age categories of smallholder farmers.

The education level of smallholder farmers participating in agricultural shows had no statistically significant relationship with effectiveness of the agricultural shows in disseminating information and adoption of PPT.

This hypothesis was tested to determine if a relationship existed between the agricultural shows being not effective, moderate, effective and most effective in disseminating information on the level of education. The tests as indicated in Table 11 shows χ^2 value of 22.721 and the probability of the computed Chi-square value (P value) as 0.090. Since the probability of the computed Chi-square value was less than the level of significance set α=0.10 ($p<0.10$), we therefore reject the null hypothesis and the study concluded that there was a statistically significant effect between effectiveness of agricultural shows and education level of farmers.

Table 11: Farmers' Characteristics and Agricultural Shows Effectiveness (N=800)

Gender categories (%)	Agricultural shows effectiveness						
	Count	Not effective	Moderate	Effective	Most effective	Chi-square	P-value
Female	180	0.0	1.1	18.3	80.6		
Male	620	0.2	0.5	15.8	83.5		
Total	800	0.1	0.6	16.4	82.9	1.863	0.601
Age categories of show attendants							
31-45 yrs	306	0.0	0.3	17.0	82.7		
46-60 yrs	145	0.0	0.7	16.6	82.8		
61-75 yrs	14	0.0	7.1	14.3	78.6		
76-90 yrs	5	0.0	0.0	0.0	100.0		
Total	716	0.1	0.4	16.6	82.8	19.497	0.077
Education level (%)							
Non- formal	12	0.0	8.3	25.0	66.7		
Primary	104	0.0	0.0	20.2	79.8		
Secondary	280	0.0	0.7	16.4	82.9		
College	255	0.0	0.0	15.3	84.7		
University	146	0.7	1.4	14.4	83.6	22.721	0.090

Source: Survey data (2008)

4.3. Effectiveness of Stockists in Disseminating Information and Adoption of PPT

This study sought to determine the effectiveness of the stockists in disseminating information and adoption of PPT among smallholder farmers in Western Kenya. The proportion of the sample based on the district where the stockist's business was located were Bungoma South (7.8%), Teso (10.8%), Busia (11.8%), Vihiga (1.0%), Emuhaya (8.8%), Siaya (10.8%), Bondo (5.9%), Rarieda (2.0%), Butere (5.9%), Kisii (6.9%), Gucha (1.0%), Kuria (6.9%), Migori (7.8%), Rongo (2.0%), Rachuonyo (5.9%) and Suba (4.9) (Table 12). The gender for the stockist was categorized as female (25.5%) and male (74.5%).

All the stockists interviewed at Emuhaya (8.8%), Gucha (1.0%) and Kuria (6.9%) were males while those at Vihiga (1.0%) were females. Equal proportions (50%) of males and females stockists managed farm input shops at Rarieda and Rongo districts. About 6.9% of the stockists in this study had attained primary level of education, 36.3% secondary, 43.1% college and 13.7% university level of education. All stockists from Gucha (1.0%) and Rongo districts (2.0%) had attained a secondary level of education, while those at Vihiga (1.0%) had attained college level of education.

Table 12: Social Characteristics of the Stockists From Various Districts (N=120)

District	%	Gender		Highest education level			
	Sample	Female	Male	Primary	Secondary	College	University
Bungoma South	7.8	37.5	62.5	-	37.5	25.0	37.5
Teso	10.8	45.5	54.5	-	63.6	36.4	-
Busia	11.8	25.0	75.0	16.7	50.0	16.7	16.7
Vihiga	1.0	100.0	-	-	-	100.0	-
Emuhaya	8.8	-	100.0	-	11.1	88.9	-
Siaya	10.8	45.5	54.5	18.2	54.5	18.2	9.1
Bondo	5.9	16.7	83.3	16.7	33.3	50.0	-
Rarieda	2.0	50.0	50.0	50.0	50.0	-	-
Butere	5.9	16.7	83.3	-	33.3	33.3	33.3
Kisii	6.9	28.6	71.4	-	42.9	42.9	14.3
Gucha	1.0	-	100.0	-	100.0	-	-
Kuria	6.9	-	100.0	-	-	71.4	28.6
Migori	7.8	12.5	87.5	-	12.5	75.0	12.5
Rongo	2.0	50.0	50.0	-	100.0	-	-
Rachuonyo	5.9	16.7	83.3	-	16.7	50.0	33.3
Suba	4.9	20.0	80.0	20.0	20.0	60.0	-
Total		25.5	74.5	6.9	36.3	43.1	13.7

Source: Survey data (2008)

The level of education influences the stockists to make superior decisions in terms of marketing strategies. Stockists run by members with higher level of education may reflect ability to take risk, expand business, and have linkages. More than 61% of the stockists interviewed indicated they were in farm input business for a period of 1-5 years, 28.4% for 6-10 years, 3.9% for 11-15 years, 2.9% for 16-20 years, 1.0% for 21-30 years and 2.0% for over 30 years as shown in Table13. Out of the 98% farm input stockists with knowledge on striga, 50% rated the striga problem as very serious, 37.3% as serious and 11.8% as moderate.

Table 13: Personal Characteristics of the Stockists and Their Rating of Striga Problem (N=120).

Gender	Percent		Percent
Female	25.5	Stockists with knowledge on striga	98.0
Male	74.5	Stockists rating of striga in their area	
Highest education level		Very serious	50.0
Primary	6.9	Serious	37.3
Secondary	36.3	Moderate	11.8
College	43.1	Less serious	1.0
University	13.7	Stockists asked for solutions for striga problems by farmers	85.3
Years operated stockiest			
1-5 yrs	61.8		
6-10yrs	28.4		
11-15yrs	3.9		
16-20yrs	2.9		
21-30yrs	1.0		
over 30yrs	2.0		

Source: Survey data (2008)

From Table 14, almost equal proportions of female (84.6%) and male stockists (85.5%) were asked to identify the solution for the striga problem by the farmers. However, less proportion of the female (61.5%) compared to male stockists (80.3%) were among the 77 stockists who had heard about PPT. More male (55.3%) than female stockists (34.6%) had seen a PPT field. Almost all the stockists interviewed had knowledge on the striga weed. Most stockists noted that striga infestation was a very serious problem in the areas where they operated. Half of the stockists rated the striga menace as very serious while 38% of them rated it as serious in their locality.

Table 14: Cross Tabulation of Gender and Some Aspects of Striga (N=120).

		Gender (%)	
	Count	female	male
Stockists asked solutions for striga problems	87	84.6	85.5
Stockists that had heard about PPT	77	61.5	80.3
Stockists that had ever seen PPT field	51	34.6	55.3
Stockist rating of striga in their areas			
Very serious	51	50.0	50.0
Serious	38	34.6	38.2
Moderate	12	15.4	10.5
Less serious	1	0.0	1.3

Source: Survey data (2008)

Equal proportions (50%) of female and male stockists rated the striga menace as very serious (Table 15). About 34.6% female and 38.2% male stockists rated the striga menace as serious, while 15.4% female and 10.5% male stockists rated the striga menace as moderately serious. Moreover, 85.7% of the stockists with primary level of education, 59.5% secondary, 40.9% college and 35.7% university education rated the striga menace as very serious. More than 87% of the stockists that had operated between one to nine years indicated that striga was a serious problem in the areas where they operated their business compared to age categories of 10-19 years (43.3%), 20-29 years (66.7%) and category with over 30 years (50%).

Table 15: Personal Characteristics and Stockists Rating of Striga in their Areas (N=120).

	Stockists rating of striga in their area			
Gender	Very serious	Serious	Moderate	Less serious
Female(n= 26)	50.0	34.6	15.4	0.0
Male(n=76)	50.0	38.2	10.5	1.3
Highest education level (%)				
Primary (n= 7)	85.7	0.0	0.0	14.3
Secondary (n=37)	59.5	27.0	13.5	0.0
College (n=44)	40.9	47.7	11.4	0.0
University (n=14)	35.7	50.0	14.3	0.0
Categories of years operated as a stockist				
1-9 yrs (n=82)	54.9	32.9	12.2	0.0
10-19 yrs (n=15)	40.0	3.3	.0	6.7
20-29 yr (n=3)	0.0	66.7	33.3	0.0
over 30 yrs (n=2)	0.0	50.0	50.0	0.0

Source: Survey data (2008)

Farmers in the stockists' neighborhood used several methods to control striga as shown in Table 16. More than 54% of the stockists indicated that farmers in their neighborhood uprooted and burnt striga weed, 28.4% indicated that farmers applied manure, 2.0% applied ash, 3.9% planted early, 22.5% hand weeding, 12.7% used tolerant maize varieties, 18.7% used "Push Pull" technology method, 7.8% intercropped, 6.9% crop rotation 2.9% used herbicides while 1.0% of the stockists indicated that farmers used treated seeds.

Although most stockists noted that striga infestation was very serious in their localities, about 4% could not offer to farmers any solutions for the control of striga weed. Out of the 85% of the stockists asked solutions for solving the striga problem by farmers, 7.8% advised them to use chemicals, 4.9% advised on early land preparation before planting, 31.4% on "Push Pull" technology method, 2.0% on certified maize seeds, 23.5% on manure use, 20.6% on uprooting and burning, 14.7% on crop rotation, 4.9% on intercropping cereals with legumes, 26.5% on striga tolerant varieties and 7.8% on proper weeding.

Table 16: Striga Control Methods and Solutions as Suggested by the Stockists (N=120).

Method of striga control stockists are locality	Percent	Solutions for striga problems	Percent
Apply manure	28.4	Stockists asked solutions for striga problems by farmers?	85.3
Apply ash	2.0	Solutions suggested by stockists to farmers having striga problem	
Early planting	3.9	Chemicals to control striga	7.8
Hand weeding	22.5	Preparing land early before planting	4.9
Use of torelanttolerant maize seeds/striga resistant varieties	12.7	"Push Pull" technology method	31.4
Use of treated seeds	1.0	Certified maize seeds	2.0
"Push Pull" technology method	18.6	Manure	23.5
Intercropping	7.8	Uprooting and burning	20.6
Crop rotation	6.9	Crop rotation	14.7
Herbicides	2.9	Intercropping cereals with legumes	4.9
Uprooting and burning	54.9	Striga tolerant varieties	26.5
		Proper weeding	7.8

Source: Survey data (2008)

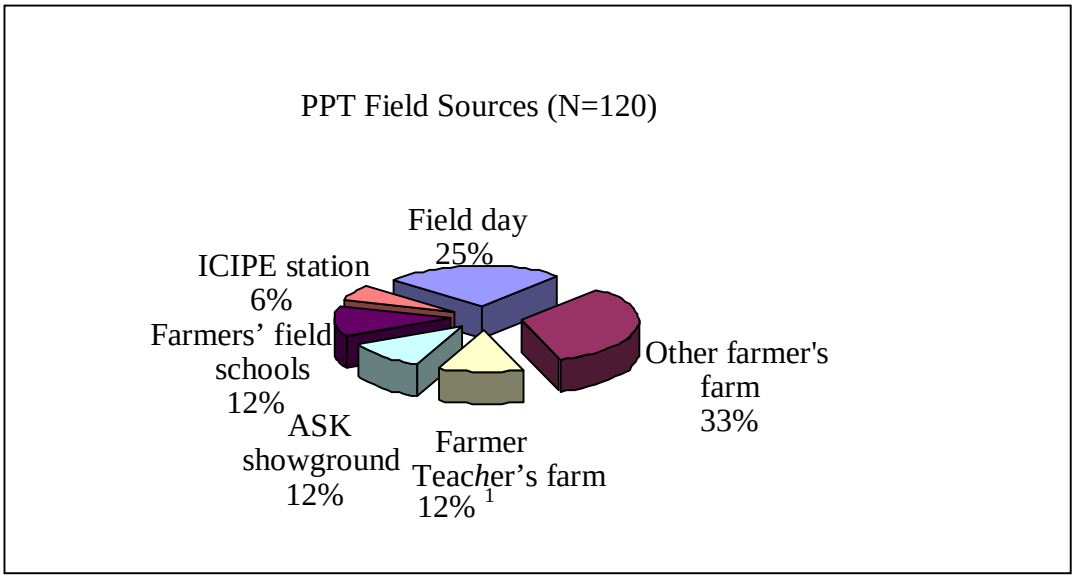
Stockists had heard about PPT for the first time from several sources as shown in Table 17. Above 18% of the stockists had heard about PPT from the radio, 12.7% from extension officers, 2.7% from farmers' field days, 9.8% from "Push Pull" technology brochures/posters and 5.9% from NGOs or CBOs. Other sources included farmer teachers (3.9%); ASK agricultural shows (2.9%), Newspapers or magazines (2.0%), neighbours (2.0%), farm input stockists (2.0%), ICIPE on-farm trials (2.0%) and Agriculture teacher (1.0%).

Table 17: First Source of Information About "Push Pull" Technology (N=120).

Source	Percent	Source	Percent
Radio	18.6	Farmers field day	12.7
PPT brochures/posters	9.8	NGO/CBO	5.9
Farmer teacher	3.9	Neighbour	2.0
Extension officer	12.7	Farm input stockiest	2.0
ASK show	2.9	ICIPE on-farm trials	2.0
Newspaper/magazine	2.0	Agriculture teacher	1.0

Source: Survey data (2008)

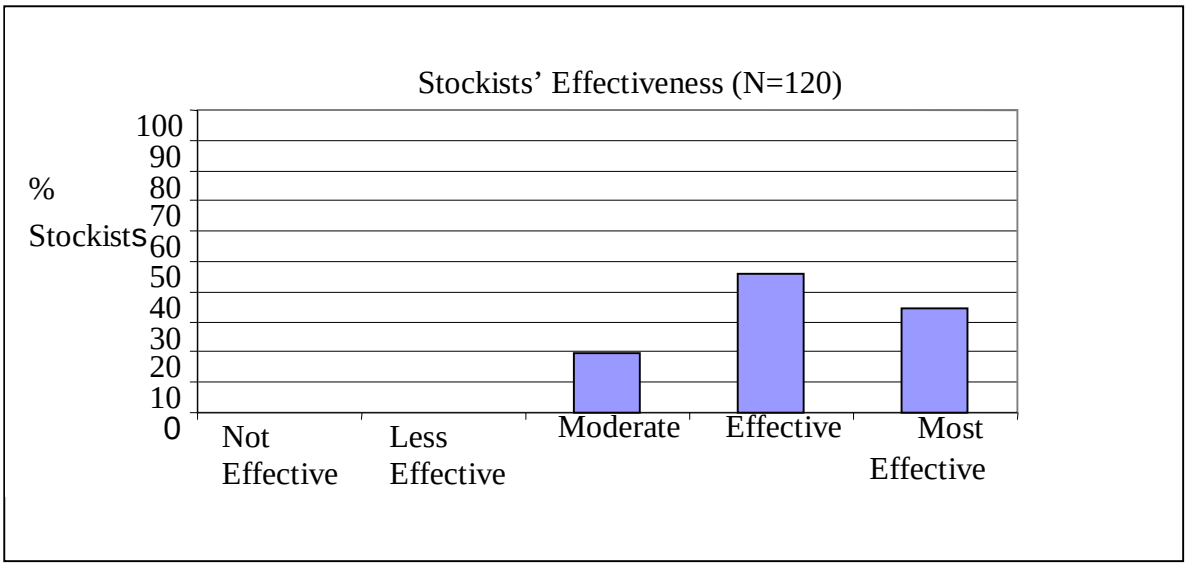
About 25% of the stockists with knowledge on PPT field said that they had seen it from farmers' field days, 33% from other farmers' farm, 12% from farmer teacher's, 12% at ASK show grounds, 12% at farmers' field schools, and 6% at ICIPE station (Figure 8).



[1]Farmer teachers are farmers who have adopted the PPT and have been trained to teach other farmers in farmers' field schools
Source: Survey data (2008)

Figure 8: Sources where stockists had seen a "Push Pull" technology field.

More than 80% of the stockists interviewed scored highly on nine aspects of effectiveness criteria namely, (1) ability to deliver needed goods and services timely, (2) use of different distribution strategies to reach many farmers, (3) linkage to seed companies,(4) ability to explain to farmers how to use seed-based technologies, (5) whether regularly kept an up to date stock, (6) whether a member of networks, partnerships and outreach that works with farmers, (7) ability to give some credit to farmers, (8) ability to keep records of farmers served, and (9) ability to keep record of farmers who buy inputs. These stockists indicated a high level of effectiveness and 45% of them were categorized as being effective, 35% most effective and 20% moderately effective pathway of disseminating information to farmers (Figure 9).



Source: Survey data (2008)

Figure 9: Levels of stockists' effectiveness

The effectiveness of the stockists was not related to their ability to rate the seriousness of striga problem in their locality ($p>0.05$). Table 18 shows that 43.1% of the stockists categorized as most effective, rated striga as a very serious problem in the areas they operated compared to 23.7% who indicated it as serious and 33.3% as moderate. Also, 60.5% of the stockists categorized as effective, rated the striga weed as a serious problem in their locality.

The effectiveness of stockist's to disseminate information was not related to the knowledge they have on the PPT effectiveness to control of striga, or about Desmodium. The Chi square test showed there was a relationship between the stockists effectiveness in disseminating information and the frequency in a month that farmers asked information about Desmodium seeds ($\chi^2 = 23.768$, p-value=0.003).

Table 18: Stockists Effectiveness against Personal Characteristics (N=120)

	Stockist's effectiveness (%)				
Gender (%)	Moderate	Effective	Most effective	Chi-square	P value
Female (n=26)	23.1	38.5	38.5		
Male (n=76)	18.4	48.7	32.9		
Total (n=102)	19.6	46.1	34.3	0.828	0.661
Categories of years operated as a stockiest					
1-9yrs (n=82)	20.7	45.1	34.1		
10-19yrs (n=15)	20.0	53.3	26.7		
20-29yrs (n=3)	0.0	66.7	33.3		
over 30yrs (n=2)	0.0	0.0	100.0		
Total(n=102)	19.6	46.1	34.3	5.192	0.519
Highest education level					
Primary (n=7)	14.3	42.9	42.9		
Secondary (n=37)	21.6	45.9	32.4		
College (n=44)	22.7	40.9	36.4		
University (n=14)	7.1	64.3	28.6		
Total (n=102)	19.6	46.1	34.3	3.159	0.789
Rating of striga in your area (%)					
Very serious (n=51)	21.6	35.3	43.1	9.996	0.125
Serious(n=38)	15.8	60.5	23.7		
Moderate(n=12)	16.7	50.0	33.3		
Less serious (n=1)	100.0	0.0	0.0		
Rating effectiveness of technology in control of striga (%)					
Most effective (n=25)	12.0	44.0	44.0	2.805	0.833
Effective (n=29)	17.2	51.7	31.0		
Moderate (n=4)	25.0	50.0	25.0		
Stockists' knowledge on Desmodium (n=93)	19.4	44.1	36.6	2.491	0.288
Frequency in a month of farmers asking information about Desmodium seeds (%)					
Once (n=14)	21.4	50.0	28.6	23.768	0.003
2-3 times (n=32)	12.5	53.1	34.4		
4-5 times (n=13)	7.7	38.5	53.8		
over 5 times (n=16)	0.0	37.5	62.5		

Source: Survey data (2008)

4.3.1 Test of hypotheses

$H_0$2 Access to farm input stockists have no statistically significant effect in disseminating information and adoption of PPT among smallholder farmers in Western Kenya.

This hypothesis was tested to determine if a relationship existed between the effectiveness of the stockists in disseminating information and adoption of PPT measured on a 4-point Likert type scale with 1= not effective, 2=moderate, 3=effective and 4=most effective against the gender, the number of years the stockists had operated their business and the education level of the stockists.

The gender of the stockists had no statistically significant relationship with effectiveness of the stockists in disseminating information and adoption of PPT.

This hypothesis was tested to determine if a relationship existed between the effectiveness of the stockists in disseminating information and adoption of PPT against the gender of the stockist. The tests as indicated in Table 17 showed χ^2 value of 0.828 and the probability of the computed Chi-square value as 0.661. Since the probability of the computed Chi-square value was more than 0.05 the level of significance set α=0.05, we therefore fail to reject the null hypotheses and concluded that there were no statistically significant relationship between the gender of the stockists and them being effective in disseminating information and adoption of PPT.

The number of years the stockists had operated had no statistically significant relationship with effectiveness of the stockists to disseminate information and adoption of PPT among smallholder farmers in Western Kenya.

This hypothesis was tested to determine if a relationship existed between the effectiveness of the stockists to disseminate information and adoption of PPT against the number of years the stockists had operated their business**.** The tests as indicated in table 17 showed χ^2 value of 5.192 and the probability (p-value) of the computed Chi-square value as 0.519. Since the probability of the computed Chi-square value was more than the level of significance set α=0.05 ($p>0.05$), we therefore fail to reject the null hypotheses and concluded that there was no statistically significant relationship between the number of years the stockists had operated business and their effectiveness to disseminate information and adoption of PPT.

The education level of the stockists had no statistically significant relationship with effectiveness of the stockists to disseminate information and adoption of PPT among smallholder farmers in Western Kenya.

This hypothesis was tested to determine if a relationship existed between the education level of the stockists and effectiveness of the stockists to disseminate information and adoption of PPT. The tests as indicated in table 17 showed χ^2 value of 3.159 and the probability (p-value) of the computed Chi-square value as 0.789. Since the probability of the computed Chi-square value was more than ($p>0.05$) the confidence level $\alpha=0.05$, the null hypotheses was therefore not rejected and the study concluded that there was no statistically significant relationship between the education level of the stockists and effectiveness of the stockists to disseminate information and adoption of PPT.

4.4. Effect of Agricultural Shows in Stimulating Desmodium Seed Demand

In this study, 96.8% of the farmer respondents wanted to plant PPT in their farm while 53.9% farmers wanted to purchase Desmodium seeds at the Kisumu ASK show (Table 19). More than 94% of the farmer respondents indicated their intention to buy Desmodium seeds in the near future. Also, 67.4% farmer respondents bought quantities of Desmodium seeds that ranged from 0-500 grams, 25% from 501-1000 grams, 0.2% from 1001-1500 grams, 4.2% from 1501-2000 grams while 3.2% bought quantities above 2001 grams. Gender was statistically significant to ranges of quantities of Desmodium seeds that farmers bought at the show, indicating that more males than female or vice versa could buy Desmodium seeds of various packages.

Table 19: The Intention of Farmers to buy Desmodium Seeds (N=120).

	Count	Percent
Farmers that would like to plant PPT in their farm	774	96.8
Farmers that would like to buy Desmodium seeds now	431	53.9
Farmers with intention to buy Desmodium seeds in future	756	94.5
Ranges of quantities of Desmodium seed bought at the show		
0-500 gms	291	67.4
501-1000 gms	108	25.0
1001-1500 gms	1	0.2
1501-2000 gms	18	4.2
Above 2001gms	14	3.2

Source: Survey data (2008)

Table 20 indicates that only 3.8% of the farmers practiced PPT in their farms. About 70.3% of farmer respondents said that they would buy Desmodium seeds during the long rains, 23% during short rains of 2008, 1% when they get money and 0.6% by the year 2010. About 1.3% farmers interviewed said that they would not plant PPT in their farm because they lived in town, 0.5% farmers were not sure of how the technology works, while 0.1% and 0.4% farmers came from areas with no striga or stemborers, respectively.

Table 20: Frequency and Percentages of Farmers' Demand of Desmodium Seeds (N=800)

	Percent	Reason why farmers would not plant PPT in their farm	Percent
Do you practice PPT in your farm?	3.8	Lives in town	1.3
Buy in short rains	22.9	Not sure of the technology	0.5
Buy in long rains	70.3	Committed in other activities	0.4
Buy when funds are available	1.0	No striga	0.1
Buy in the year 2010	0.6	No stemborers	0.4

Source: Survey data (2008)

The intention of the farmer respondents to buy Desmodium seeds in the near future was statistically significant with their level of education (Table 21). About 75% of farmers with non-formal education intended to buy Desmodium seeds in the near future, compared to 92.3% with

primary level of education, 95.4% with secondary education, 96.5% with college education and 93.1% with university education. Of the 246 farmer respondents within age category 16-30 years, 94.7% indicated their intention to buy Desmodium seeds in the near future. The age category of 31-45 years that comprised 306 farmers showed that 95.1% of them intended to buy Desmodium seeds in the near future. About 70.3% of these farmers intended to buy Desmodium seeds during the long rains. The farmers indicated their intention to purchase all ranges of quantities of Desmodium seeds from 0-500 grams to above 2000 grams.

4.4.1 Testing of hypotheses

$H_0$3 Agricultural shows have no statistically significant effect in enhancing demand for Desmodium seeds among smallholder farmers in Western Kenya.

This hypothesis was tested to determine if agricultural shows enhanced or created demand for Desmodium seeds, if a relationship existed between education level, age, quantities of Desmodium seeds bought by smallholder farmers participating in Kisumu show, the time farmers indicated to buy Desmodium seeds and their intention to buy Desmodium seeds in the near future.

The education level of smallholder farmers participating in agricultural shows has no statistically significant relationship with the intention to buy Desmodium seeds in the near future.

This hypothesis was tested to determine if a relationship existed between the education level of smallholder farmers participating in agricultural shows and their intention to buy Desmodium seeds in the near future. The tests as indicated in Table 21 showed χ^2 value of 17.025 and the probability (p-value) of the computed Chi-square value as 0.004. Since the probability of the computed Chi-square value was less than the level of significance set $\alpha=0.05$ ($p<0.05$), we reject the null hypotheses and concluded that there was a statistically significant relationship between the education level of smallholder farmers participating in agricultural shows and their intention to buy Desmodium seeds in the near future.

The age categories of smallholder farmers participating in agricultural shows have no statistically significant relationship with the intention to buy Desmodium seeds in the near future.

This hypothesis was tested to determine if a relationship existed between the age categories of smallholder farmers participating in agricultural shows and their intention to buy Desmodium seeds in the near future. The tests as indicated in Table 21 showed χ^2 value of 3.091 and the probability (p-value) of the computed Chi-square value as 0.543. Since the probability of the computed Chi-square value was greater than the level of significance set $\alpha=0.05$ ($p>0.05$), we therefore fail to reject the null hypothesis and conclude that there was no statistically significant relationship between the age categories of farmers participating in agricultural shows and their intention to buy Desmodium seeds in the near future.

The quantities of Desmodium seed bought by smallholder farmers participating in agricultural shows has no statistically significant relationship with the intention to buy Desmodium seeds in the near future.

This hypothesis was tested to determine if a relationship existed between the quantities of Desmodium seed bought by smallholder farmers participating in agricultural shows and their intention to buy Desmodium seeds in the near future. The tests as indicated in Table 21 showed χ^2 value of 1.623 and the probability of the computed Chi-square value (P value) as 0.805. Since the probability of the computed Chi-square value was more than the level of significance set $\alpha=0.05$ ($p>0.05$), we therefore fail to reject the null hypothesis and concluded that there was no statistically significant relationship between the quantities of Desmodium seed bought by smallholder farmers participating in agricultural shows and their intention to buy Desmodium seeds in the near future.

The period to buy Desmodium seed indicated by the smallholder farmers participating in agricultural shows has no statistically significant relationship with the intention to buy Desmodium seeds in the near future.

This hypothesis was tested to determine if a relationship existed between the period indicated to buy Desmodium seed by the smallholder farmers participating in agricultural shows and their future intention to buy Desmodium seeds. The tests as indicated in Table 21 showed ($p<0.05$), the null hypotheses was therefore rejected at $\alpha=0.05$ and the study concluded that the time to buy Desmodium seed indicated by the smallholder farmers participating in agricultural shows has a statistically significant relationship with the intention to buy Desmodium seeds in the near future.

Table 21: Preferences for Adopting PPT by Farmers (N=800)

Farmer's Characteristics	Intention to buy Desmodium seeds in the near future (%)	Chi-square	P-value
Highest level of education (%)			
Non- formal (n=12)	75.0		
Primary (n=104)	92.3		
Secondary (n=280)	95.4		
College (n=255)	96.5		
University (n=146)	93.2	17.025	0.004
Age categories of farmers (%)			
16-30 yrs (n=246)	94.7		
31-45 yrs (n=306)	95.1		
46-60 yrs (n=145)	93.1		
61-75 yrs (n=14)			
76-90 yrs (n=5)	100.0	3.091	0.543
Ranges of quantities of Desmodium seed bought at the show (%)			
0-500 gms (n=291)	97.6		
501-1000 gms (n=108)	99.1		
1001-1500 gms (n=1)	100.0		
1501-2000 gms (n=18)	100.0		
Above 2001 gms (n=14)	100.0	1.623	0.805
Period the farmer intend to buy Desmodium seed			
Buy in short rains (n=182)	99.5	742.519	0.000
Buy in long rains (n=562)	100.0	743.173	0.000
Buy when funds are available (n=8)	100.0	742.511	0.000

Source: Survey data (2008)

4.5. Effect of Stockists in Stimulating the Demand for Desmodium Seeds

The study also sought to determine the effectiveness of stockists in stimulating demand for Desmodium seeds among smallholder farmers in Western Kenya. When the stockists were asked whether farmers would buy the Desmodium seed if it were available, more than 88% of the stockist in this study affirmed (Table 22). All the stockists (100%) interviewed from Bungoma South, Busia, Vihiga, Emuhaya, Bondo, Rarieda, Kisii, Gucha, Migori and Rongo said that farmers would buy the Desmodium seed if it were available. Also, by asking the stockists

whether they stocked Desmodium seeds in their shops, the researcher was able to capture the percentages of stockist already stocking Desmodium seeds from the sampled districts. Overall, about 20.6% of the stockists interviewed sold Desmodium seed in their shops. Out of this, the proportion within districts were Bungoma South (12.5%), Vihiga (100.0%), Emuhaya (66.7%), Siaya (27.3%), Rarieda (50.0%), Butere (33.3%), Rachuonyo (33.3%), Kisii (14.3%), Kuria (14.3%) and Migori (12.5%), among others. More than 89% of the stockists that did not have Desmodium seed in stock were willing to stock it, especially in Busia, Vihiga, Bondo, Rarieda, Butere, Gucha, Kuria, Migori and Rongo districts. Although 84.3% of the stockists indicated they usually attended trainings on promotion of different inputs they sold, only 42.2% and 35.3% attended training on promotion of technology to control striga and training on promotion of "Push-Pull" technology, respectively.

Table 22: Stockist's Perceptions on Creating Desmodium Seeds Demand (N=120)

District of the business	Whether you think farmers would buy the Desmodium seed if it were available? (%)	Whether stock Desmodium seeds in your shop. (%)	If you don't have Desmodium seed in stock, would you like to stock some? (%)	Usually attend any training on promotion of different inputs you sell. (%)	Attended any training on promotion of technology to control striga. (%)	Ever attended any training on promotion of "Push Pull" technology. (%)
Bungoma South	100.0	12.5	87.5	100.0	87.5	37.5
Teso	63.6	9.1	81.8	27.3	9.1	0
Busia	100.0	8.3	100.0	91.7	50.0	41.7
Vihiga	100.0	100.0	100.0	100.0	0	0
Emuhaya	100.0	66.7	66.7	100.0	88.9	88.9
Siaya	81.8	27.3	90.9	81.8	72.7	27.3
Bondo	100.0	0	100.0	100.0	33.3	33.3
Rarieda	100.0	50.0	100.0	100.0	100.0	100.0
Butere	66.7	33.3	100.0	100.0	0	33.3
Kisii	100.0	14.3	85.7	57.1	28.6	42.9
Gucha	100.0	0	100.0	0	0	0
Kuria	71.4	14.3	100.0	100.0	42.9	28.6
Migori	100.0	12.5	100.0	100.0	12.5	12.5
Rongo	100.0	0	100.0	100.0	50.0	100.0
Rachuonyo	83.3	33.3	66.7	100.0	16.7	16.7
Suba	80.0	0	80.0	80.0	20.0	40.0
Total	88.2	20.6	89.2	84.3	42.2	35.3

Source: Survey data (2008)

In this study, 6.9% of the stockists indicated that the demand for Desmodium seeds was high, 6.9% moderate and 4.9% low (Table 23). The stockists that stocked Desmodium seeds in their shop significantly perceived that the farmers would buy the Desmodium seed if it were available. There was a significant relationship between stockists selling Desmodium seeds in their shops and the number of years they had stocked Desmodium seeds, and the Desmodium seeds demand at $p<0.05$. In Table 24, the 20.5% stockists that stocked Desmodium seeds recommended that the

sale could be improved by creating awareness to farmers (70%), by having field days (66.7%), by holding trainings (18.2%), reducing prices for Desmodium seeds (100%) and packaging in small quantities (100%). More than 22% of these stockist thought that farmers would buy the Desmodium seed if it were available.

Table 23: Improving Desmodium Seed Demand (N=120).

No. of years stockists sold Desmodium seeds	Whether stockist sell Desmodium seeds in their shop (%)	Chi-sq	p-value
1 Year	6.9		
2 Years	8.8		
3 Years	1.0		
4 Years	1.0	78.877	0.000
The Desmodium seeds demand according to stockists that sold the seeds			
High (n=7)	6.9		
Moderate (n=7)	6.9		
Low (n=5)	4.9	90.062	0.000
Suggested ways of improving Desmodium sales			
Improve demand by creating awareness to farmers (n=10)	70.0	25.152	0.000
Improve demand by having field days (n=2)	66.7	22.405	0.000
Improve demand by holding trainings (n=11)	18.2	34.823	0.000
Reduce prices for desmodium seeds and pack in small quantities (n=3)	100.0	26.738	0.000
whether you think farmers would buy the desmodium seed if it were available (n=90)	22.2	1.249	0.264

Source: Survey data (2008)

Over 84% of the stockists interviewed said that they attended various trainings, and of these, over 32% were trained on PPT organised by ICIPE and Western Seed Company (Table 24). About 13.7% stockists were trained on the use of chemicals to control striga, 12.7% certified seeds, 6.9% agronomical practices, 6.9% agrovet management, 3.9% maize varieties and 2.0% soil conservation methods. Institutions like ICIPE, organised thirty three trainings, Syngenta held

fifteen trainings, Agmack held ten, Western Seed Ltd held five trainings, Ministry of Agriculture held five, SCODP hosted two, while Farmchem, Kenya Seed company, SCODP, Bayer, KEFRI, Osho and Kephis held one training each, respectively during the period 2002-2008.

Table 24: Training of Stockists and the Organisers (N=120)

Type of training learnt by stockists	No of trainings	Percent	Organisers/trainer and no. of trainings in brackets	Period
Use of chemicals to control striga	14	13.7	Bayer(n=1) Syngenta (n=8) Agmack (2) Farmchem (n=1) Scodp (n=1)	2006-2008
"Push Pull" technology	33	32.3	ICIPE (n=32) Western seed company(n=1)	2002-2008
Certified seeds	13	12.7	Syngenta (n=4) Agmack (n=3) Western seed (n=4) Kenya Seed (n=1) Osho ltd (n=1)	2007-2008
Agronomical practices	7	6.9	Syngenta (n=2) ICIPE (n=1) Agmack (n=2) Kenya Seed (n=2)	2003-2008
Maize varieties	4	3.9	Syngenta (n=1) Ministry of Agriculture (n=1) Kefri (n=1) Scodp (n=1)	2006-2008
Soil conservation methods	2	2.0	Ministry of Agriculture (n=2)	2005-2006
Agrovet management	7	6.9	Agmack(n=5) Kephis (n=2)	2007-2008

Source: Survey data (2008)

Extension print materials on "Push Pull" technology or Desmodium seeds such as posters, brochures, magazines and pamphlets were available to some stockists for display at the shops About 32.4% of the stockist interviewed had brochures in their shops, 2.9% had magazines, 8.8% had posters, and 4.9% had pamphlet (Table 25).

Table 25: Extension Materials with Stockists (N=120).

Types of extension print materials with stockists in their shops	Count	Percent
Brochures	33	32.4
Magazines	3	2.9
Posters	9	8.8
Pamphlet	5	4.9

Source: Survey data (2008)

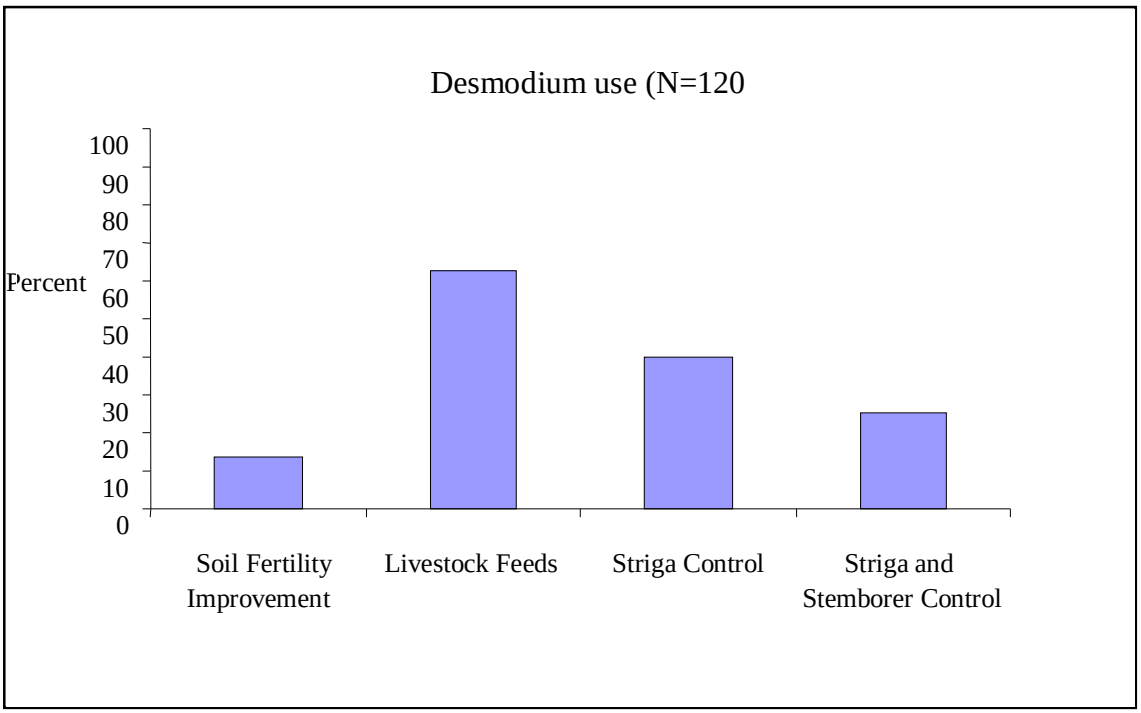
A total of 1,302 kilograms of Desmodium seed was sold by the stockists interviewed. This included 889 kilograms of Desmodium seed sold during the long rains and 413 kilograms during the short rains in 2007-2008. The sampled stockists suggested various ways of making them effective in dissemination and creating demand for Desmodium seeds (Table 26). About 78.4% of the respondent stockists suggested to be empowered through training. Other suggestions were creating awareness on PPT and Desmodium seeds (12.7%); creating linkages with seed dealers/companies (1.0%); providing poster, brochures and pamphlets (36.3%); reducing Desmodium packages and prices (8.8%); offering credit facilities (11.8%); advertising and promoting PPT to farmers through the media (9.8%); accessing Desmodium seeds (14.7%); supplying stockists with Desmodium sample seeds (7.8%); publicizing availability of Desmodium seeds in various stockist stores (5.9%) and establishing PPT demonstration plots near stockists stores (9.8%).

Table 26: Suggested Ways of Supporting Stockists to Disseminate PPT (N=120)

Suggested ways of supporting stockists to create demand for Desmodium seeds.	Percent
By training	78.4
By creating awareness	12.7
Linkage with seed dealers/companies	1.0
Providing poster, brochures, pamphlets etc	36.3
Reduce Desmodium packages and prices	8.8
Offer credit facilities	11.8
Promote PPT to farmers through mass media	9.8
Accessing Desmodium seeds	14.7
Supplying stockists with Desmodium sample seeds	7.8
Publicise availability of Desmodium seeds by stockists to farmers	5.9
Establish demonstration plots near stockists stores	9.8

Source: Survey data (2008)

From Table 27, More than 91% stockists studied knew about Desmodium. Although most of them had knowledge on Desmodium and how it is utilised, only 62.7% knew it as a livestock feed, 40.2% for striga control specifically, 25.5% for the control of striga and stemborer while 13.7% for soil fertility improvement (Figure 10).



Source: Survey data (2008)
Figure 10: Uses of Desmodium identified by stockists.

Overall, 73.5% of the stockists said that they were asked information about Desmodium seeds by farmers. About 13.7% stockists were asked information about Desmodium seeds once in a month by farmers. Another, 31.4% stockists 2-3 times, 12.7% stockists 4-5 times while 15.7% stockists over five times in a month by farmers. More than 88% stockists said that farmers would buy the Desmodium seed if it were available. The entire stockists encountered problems in rating the demand for the Desmodium seed. Only 1.9% stockists rated the demand for Desmodium seed as very high, 22.5% rated the demand as high, 32.3% medium, 33.3% low, 8.8% very low, while 0.98% of the stockists did not know.

Only 21% of the stockists sold Desmodium seeds in their shops, while 84% of them indicated they had attended trainings on promotion of different inputs. Similarly, 42% of the stockists had attended trainings on promotion of technologies to control striga while 35.3% of the stockists had attended trainings specifically on promotion of "Push-Pull" technology. There were no statistically significant gender differences in the stockists' ability to rate the demand for Desmodium seedson whether the stockists stocked Desmodium seeds in their shops, whether stockists usually attended any training on promotion of different inputs they sold, whether they attended any training on promotion of technologies to control striga and whether ever attended any training on promotion of "Push Pull" technology.

4.5.1 Test of hypotheses

$H_0$4 Access to farm input Stockists have no statistically significant effect in enhancing demand for Desmodium seeds among smallholder farmers in Western Kenya.

This hypothesis was tested to determine the extent to which stockists can create farmers' demand for Desmodium seeds, if there was a relationship between the stockist's knowledge about Desmodium, whether the stockist were asked for Desmodium seeds by farmers, the frequency in a month that the farmers asked information about Desmodium seeds, stockist's perception on whether the farmers would buy the Desmodium seed if it were available and gender.

The gender of the stockist had no statistically significant relationship with the stockist's knowledge about Desmodium in enhancing demand for Desmodium seeds.

This hypothesis was tested to determine the relationship between the stockist's knowledge about Desmodium and gender. The tests as indicated in Table 27 showed χ^2 value of 4.698 and the probability (p-value) of the computed Chi-square value as 0.030. Since the probability of the computed Chi-square value was less than the level of significance set $\alpha=0.05$ ($p<0.05$), the null hypotheses was therefore rejected and the study concluded that there was a statistically significant relationship between the stockist's gender and knowledge about Desmodium.

The gender of the stockist had no statistically significant relationship with the stockist being asked for Desmodium seeds by farmers.

This hypothesis was tested to determine if there was a relationship between the gender of the stockist and the stockist being asked for Desmodium seeds by farmers. The tests showed χ^2 value of 0.206 and the probability (p-value) of the computed Chi-square value as 0.650 (Table 27). Since the probability of the computed Chi-square value was more than the level of significance set $\alpha=0.05$ ($p>0.05$), we therefore fail to reject the null hypotheses and concluded that there was no statistically significant effect between the gender of the stockist and the stockist being asked for Desmodium seeds by farmers.

The gender of the stockist had no statistically significant relationship with the frequency in a month that the farmers asked information about Desmodium seeds.

This hypothesis was tested to determine if there was a relationship between the gender of the stockist and the frequency in a month that the farmers asked information about Desmodium seeds. From Table 27, the tests showed χ^2 value of 2.449 and the probability (p-value) of the computed Chi-square value as 0.654. Since the probability of the computed Chi-square value was greater than the level of significance set $\alpha=0.05$ ($p>0.05$), we therefore fail to reject the null hypotheses and concluded that there was no statistically significant relationship between the gender of the stockist and the frequency in a month that the farmers asked information about Desmodium seeds.

The gender of the stockist had no statistically significant relationship with the perception on whether the farmers would buy the Desmodium seed if it were available.

The tests showed χ^2 value of 0.002 and the probability (p-value) of the computed Chi-square

value as 0.967 (Table 27). Since the probability of the computed Chi-square value was less than the level of significance set $\alpha=0.05$ ($p<0.05$), we therefore rejected the null hypotheses and concluded that there was a statistically significant relationship between the gender of the stockist and their perception on whether the farmers would buy the Desmodium seed if it were available.

Table 27: Relationship of Knowledge, Stocking of Desmodium and Gender (N=120)

		Gender	
Knowledge and stocking of Desmodium seeds	Percent	Chi-sq	P-value
Knowledge about Desmodium (n=93)	91.6	4.698	0.030
Stockists asked Desmodium seeds by farmers (n=75)	73.5	0.206	0.650
Frequency in a month the stockists are asked information about Desmodium seeds by farmers			
Once (n=14)	13.7		
2-3 times (n=32)	31.4		
4-5 times (n=13)	12.7		
Over 5 times (n=16)	15.7	2.449	0.654
Stockist perception on whether the farmers would buy the Desmodium seed if it were available? (n=90)	88.2	0.002	0.967
Stockists rating of the demand for Desmodium seed (%)			
Very high (n=2)	1.9		
High (n=23)	22.5		
Medium (n=33)	32.3		
Low (n=34)	33.3		
Very low (n=9)	8.8		
Don't know (n=1)	0.98	4.300	0.507
Whether the stockist stock Desmodium seeds in their shop (n=21)	20.5	0.578	0.447
Usually attend any training on promotion of different inputs you sell? (n=86)	84.3	1.441	0.230
Stockist that attended any training on promotion of technologies to control striga (n=43)	42.0	1.856	0.173
Stockist that attended any training on promotion of "Push Pull" technology (n=36)	35.3	1.071	0.301

Source: Survey data, 2008.

4.6. Discussion of the Results

The mean age of farmers attending Kisumu show was 33 years with a standard error of the mean of 0.559 and standard deviation of 15.821. The youngest respondent was aged 16 years and came from Kisumu East while the eldest had 82 years and came from Busia district with the range of 66 years. The farmer's district of residence, gender, age, and the level of education were some of the factors that differentiated the various categories of farmers attending the Kisumu agricultural show. From the results, the gender of farmers' participating at the Kisumu agricultural was not related to the district of residence. The age of the smallholder farmers attending the agricultural show was related to their level of education.

Above 82% of all age categories of farmers attending Kisumu show rated the show as a very effective channel for disseminating information on PPT regardless of their education levels. This concurs with The Word Bank (2008) view that the distributional effects of innovation process are mediated by institutions such as those related to education, gender, and age. Arumapperuma (2008) also confirms that the end users of most agricultural innovations (i.e., farmers) are varied in terms of education levels, gender and age. There was no statistical significant relationship between the farmers' district of residence and whether they had ever received information about PPT from previous agricultural shows. More than 96% of the respondents indicated that they would like to plant PPT in their farms. When asked whether the smallholder farmers would like to buy seeds at Kisumu show, 68.0% responded positively. Above 94% of the smallholder farmers indicated a strong intention to buy Desmodium seeds in future.

The study results indicated that farmers got information about PPT from the radio, field days, extension officer and ASK among others. The differences were not statistically significant across gender. Only 16.8% farmers had seen a PPT field before coming to Kisumu show in the year 2008. Of these, 6.9% had seen the field from previous ASK agricultural shows. The gender of the farmers who had previously received information about PPT from agricultural shows was not related to name of the show where PPT information was received.

At the PPT demonstration plot at the show ground, more female than male farmers fully understood how a PPT was planted. However, the difference between genders was insignificant.

Most farmers had a good understanding of how PPT plot is planted after learning at the showground. About 99.3% of the farmer respondents indicated that the agricultural shows were an effective pathway for dissemination of agricultural information. The study indicated that there was no statistically significant relationship between effectiveness of the agricultural shows and the gender of the farmers but, significant against the age and education level of farmer respondents. Chou and Chen (2008), noted that better communication channels can facilitate adoption. The agricultural shows as communication channels were effective not only in demonstrating the lay out and potential of the PPT but also how to implement the technology on the farm. The agricultural shows enabled the farmers to have a better understanding of how the PPT works to control striga and stem borer problem. This concurs with Amudavi et al (2008), that, when a new technology is introduced to farmers, its uptake is enhanced if farmers have a better understanding of the problem that the technology addresses and the economic advantages of that technology.

Farmers' interactions with extension methods as expressed by Khan et al (2008a), positively influenced the likelihood of adoption of the PPT. Participating in agricultural shows provided farmers with an opportunity to acquire new skills and knowledge on innovations. Participation by farmers in agricultural shows was mediated by gender. Often, the farmer's capacity to respond to opportunities and to new innovations was influenced by gender based constraints, particularly imbalances in the control over economically productive resources. Moreover, gender in effect, determines access and control over resources (World Bank, 1995). Overall, Kisumu show was attended by more male compared to female farmers.

Female farmers, according to the Government of Kenya (2008), continue to have less access to social services and productive resources than male farmers. According to World Bank (1995), female farmers produce half or more of the food in some parts of the world. Although female farmers are normally the ones who tend the farms in Kenya, they have limited access to agricultural extension advice. This is despite the fact that the burden of poverty falls disproportionately on them. In most , agricultural extension education is provided mainly to male, even where female farmers do much or even most of the farming (GOK, 2007). Any program to improve their efficiency as farmers could have far-reaching consequences.

Consequently, promoting female farmers participation in the agricultural shows and adoption of technologies may require addressing social and economic constraints, time and mobility. Female farmers' capabilities have not been developed to full potential due to limited access to capital, marketing information, education and training (GOK, 2008). There is therefore a need to improve attendance of more female smallholder farmers, especially in the agricultural shows if they are to benefit from new agricultural innovations. Promoting female farmers' participation in agricultural shows may enhance them to benefit from development activities (Mulugeta, 2008; World Bank, 1995).

Education and training are one of the most potent means of empowering farmers. According to Omasa et al., (2007), education and the process of learning are central to a knowledge system. Data from this study revealed that quite a significant proportion of the respondents (98%) were literate and many had post secondary education. Through education, farmers gain knowledge and skills to participate fully in development and to create opportunities to increase their income and productivity and to influence their environment (World Bank, 1995). Farmer education at all levels should aim at improving farmers' skills and productivity. Education has a strong influence on the status of farmers because it is closely related to opportunities such as employment, access to information and networking. Effectiveness of shows varied among farmers depending on their level of education. This is because a farmer needs a good understanding of how the PPT controls striga and stem borer.

High level of formal education influences farmers to make superior decisions in terms of innovations to adopt considering that the productive resources are always scarce. According to Kotler (2002), innovative farmers are likely to be better educated and more efficient, whereas earlier adopters tend to be younger in age, have higher social status, and have a favourable financial position. According to Kornberg & Rekha (2005), education is directly related to the status. A farmer with education enjoys higher status than one without. Education liberates farmers from their traditional roles. Education enables farmers to exercise more power and decision making authority within the social structure (Kornberg & Rekha, 2005).

The packages of Desmodium seed bought at the show was related to the gender of farmers participating at the agricultural show (χ^2=11.331, df=4, p-value=0.023). This concurs with Wider Impact Strategy (2008) that the optimal size for seed packets varies with the intended buyers. Farmers who are not familiar with a new variety are likely to buy a small quantity of seed for trial purposes and because it will be cheaper. It is also a risk management strategy. The risk involved if the variety does not perform well in their cropping situation in a particular season is small. A farmer who has had previous good experience with a particular variety and is ready to invest more in producing it and is likely to buy a larger package (http://www.ecabren.org). The intentions to buy Desmodium seeds in the near future by farmer respondents under the study was statistically significant to the level of education and time the farmer intended to buy Desmodium seed but not related to the age and quantities of Desmodium seed bought at the show.

To determine the effectiveness of the stockists in disseminating information on PPT, several variables were utilised. More than 80% of the stockists respondents scored highly on nine aspects of effectiveness that included the (1) ability to deliver needed goods and services timely, (2) use of different distribution strategies to reach many farmers, (3) linkage to seed companies, (4) ability to explain to farmers how to use seed-based technologies, (5) whether regularly keep an up to date stock, (6) whether a member of networks, partnerships and outreach that works with farmers, (7) ability to give some credit to farmers, (8) ability to keep records of farmers served, and (9) ability to keep record of farmers who buy inputs. These stockists were categorized as being an effective pathway of disseminating information to farmers.

The effectiveness of the stockists to disseminate information on PPT was not statistically significant at $p>0.05$ to their ability to rate the seriousness of striga in their locality. The stockist's effectiveness was not associated to their capability to rate the effectiveness of PPT in control of striga, or on their knowledge about Desmodium. The Chi square test showed that there was a relationship between the stockists effectiveness and the frequency in a month that farmers asked information about Desmodium seeds at $p<0.05$. The study results indicated that the effectiveness of the stockists was not statistically significantly related to the gender, number of years the stockist had operated or their education level.

More than 91% stockists in this study had previous knowledge about Desmodium. Overall, 73.5% stockists were asked about Desmodium seeds by farmers and about 13.7% stockists were asked information about Desmodium seeds once in a month by farmers. More than 88% of the stockists respondents said that farmers would buy the Desmodium seed if it were available. The entire stockists encountered problems in rating the demand for the Desmodium seed. Only 1.9% stockists rated the demand for Desmodium seed as very high, 22.5% stockists high, 32.3% stockists medium, 33.3% stockists low, 8.8% very low while 0.98% stockists did not know. About 20.5% of the stockists respondents indicated that they had stocked Desmodium seeds in their shops, while 84.3% stockists indicated that they usually attended trainings on promotion of different inputs. More than 42% of the stockists respondents indicated that they had attended trainings on promotion of technologies to control striga, while 35.3% stockists had attended trainings, specifically on promotion of PPT.

There were no statistical significant differences among gender and the stockists ability to rate the demand for Desmodium seeds, whether they sold Desmodium seeds in their shops. Others were whether stockists usually attended any training on promotion of different inputs they sold, whether they attended any training on promotion of technologies to control striga, and whether they ever attended any training on promotion of PPT. More than 88% of the stockist respondents indicated that farmers would buy the Desmodium seed if they sold it. All the stockists respondents from Bungoma South, Busia, Vihiga, Emuhaya, Bondo, Rarieda, Kisii, Gucha, Migori and Rongo said that farmers would buy the Desmodium seed if sold at the shops. More than 89% of the stockists respondents said that they were not selling Desmodium seeds but were willing to stock it, especially those from Busia, Vihiga, Bondo, Rarieda, Butere, Gucha, Kuria, Migori and Rongo districts.

Although 84.3% of the stockists respondents indicated that they usually attended trainings on promotion of different inputs they sold, only 42.2% attended training on promotion of technology to control striga including promotion of “Push Pull” technology. In this study, 6.9% of the stockists indicated that the demand for Desmodium seeds was high, 6.9% moderate and 4.9% low. The stockists that sold Desmodium seeds in their shops significantly perceived that farmers would buy the Desmodium seeds if it were available. There was a statistical significant

relationship between stockist selling Desmodium seeds in their shops and the number of years they had stocked Desmodium seeds, and the Desmodium seeds demand at $p<0.05$. This agrees with Kotler (2002) who said that there is no demand for a product which people do not know about. Various approaches can be used to promote PPT. Promotion for Desmodium seeds can be done at many points, which include shopping centres, market places, schools, agricultural fairs and shows, chief's barazas (or community meetings), churches, clinics, hotels, bars, Posho mills and other points where farmers assemble or regularly use. Promotion can be done by researchers, technicians, support staff, extension officers, farmers, retail traders, stockists, wholesalers, NGOs, church officials, seed companies, administrative officers, social workers and other groups interested in community development.

Baraza et al. (2008) noted that stockists sometimes repackaged and sold farm inputs in smaller quantities for farmers to afford. This is also a common practise by many stockists in Western Kenya. According to DFID (2005), the use of mini-packets increased the demand for farm inputs among the smallholder farmers. Most stockists' respondents indicated that farmers would buy the Desmodium seeds if it was available at various packages. The study revealed that very few stockists had on the job training on agronomy, safe use of chemicals, promotion, marketing, enterprenuership among others. Training, according to Odame et al. (2008), build stockists capacity for better service delivery to farmers. Trainers should target stockists to make them more effective in disseminating information and creating demand for Desmodium seeds. The training manual for agricultural farm input retailers would generally include as indicated by Laker-Ojok (2005), record keeping, credit management, inventory control, product handling and storage, safe chemical use, marketing and promotion techniques.

The stockists in this study suggested various ways of making them effective in dissemination and creating demand for Desmodium seeds. About 78.4% of the stockist respondents suggested to be empowered through training. Other suggestions were creating awareness on PPT and Desmodium seeds (12.7%); create linkage with seed dealers/companies (1.0%); providing poster, brochures and pamphlets (36.3%); reduce Desmodium packages and prices (8.8%); offer credit facilities (11.8%); advertise and promote PPT to farmers through media (9.8%); accessing Desmodium seeds (14.7%); supplying stockists with Desmodium sample seeds (7.8%); publicize

availability of Desmodium seeds in various stockist stores (5.9%) and establish PPT demonstration plots near stockists stores (9.8%). Credit guarantees can also be established to encourage existing urban–based, private-sector wholesale distributors to extend credit to rural stockists, thus improving village-level access to agricultural inputs (Laker-Ojok**,** 2005).

This study revealed that the stockist's gender was statistically significant with their knowledge about Desmodium and perceptions on whether the farmers would buy the Desmodium seed if it was available. But it was not statistically significant to the stockist being asked Desmodium seeds by farmers or the frequency in a month that the farmers asked information about Desmodium seeds. As suggested by Amudavi et al. (2008b), involving stockists could help meet the expressed demand for Desmodium seeds and provide information on markets for inputs. The results have demonstrated the stockist's effectiveness in creating farmers' demand for Desmodium seeds and facilitating dissemination and adoption of the "Push Pull" technology.

4.7. Summary of the Results

In summary**, t**he effectiveness of agricultural shows to disseminate information and adoption of PPT to smallholder farmers participating in the shows was affected by age and education level, but not by their gender. Also, the effectiveness of agricultural shows in enhancing demand for Desmodium seeds was affected by the education level of smallholder farmers participating in agricultural shows, their intention and the period the farmer indicated to buy Desmodium seeds in the future. However it was not affected by the age of farmers or quantities of Desmodium seed bought by smallholder farmers participating in agricultural shows.

The effectiveness of the stockists to disseminate information and adoption of "Push-Pull" technology was not affected by gender, education level of the stockists or the number of years the stockist had operated as a trader. However, the effectiveness of farm input stockists to enhance demand for Desmodium seeds was affected by the stockist's gender, knowledge about Desmodium and their perception on whether the farmers would buy the Desmodium seed if it was available. Also, the effectiveness of farm input stockists to enhance demand for Desmodium seeds was not affected by the frequency in a month that the farmers asked information about Desmodium seeds or whether they were either asked for Desmodium seeds by farmers.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

The main objective of this study was to determine the effectiveness of agricultural shows and stockists in enhancing dissemination and adoption of "Push-Pull" technology among smallholder farmers in Western Kenya. This chapter is organised into three sections namely summary, conclusions and recommendations.

5.2. Summary

Despite the multifunctional properties of the PPT including control of stemborers and striga weed, its widespread adoption is yet to be realised. Agricultural shows and agro-dealers/stockists were some of the uptake pathways by which extension efforts were disseminating the PPT to farmers. Insufficient empirical evidence on effectiveness of agricultural shows and stockists as diffusion pathways by which a beneficial technology like PPT reaches many farmers, limited their full exploitation. The question of demonstrating the effectiveness of these two dissemination pathways in PPT adoption was a primary concern to the continued efforts of its extension outreach. The purpose of this study was to determine the effectiveness of agricultural shows and agro-dealers in enhancing dissemination and adoption of the PPT among the smallholder farmers in Western Kenya**.** The overall objective of this survey was to find out how agricultural shows and farm input stockists facilitated understanding, dissemination and adoption of the PPT and created farmers' demand for Desmodium seeds.

The study was guided by four objectives. The first objective was to determine the effectiveness of agricultural shows in disseminating information and adoption of PPT among smallholder farmers in Western Kenya. The study empirically established that the agricultural shows were effective in disseminating information and adoption of PPT to smallholder farmers. The effectiveness of agricultural shows to disseminate information and adoption of PPT was however affected by age and education level, but not by the gender of the smallholder farmers participating in agricultural shows. The study indicated that the show was appropriate for both male and female farmers, but must focus on their ages and education levels. The second

objective was to determine the effectiveness of the stockists in disseminating information and adoption of PPT among smallholder farmers in Western Kenya. The study empirically established that the farm input stockists were effective in disseminating information and adoption of PPT to smallholder farmers. The results indicated that the effectiveness of the stockists to disseminate information and adoption of PPT was not affected by gender, education level of the stockists or the number of years the stockists had operated as traders. The study established that the stockist effectiveness was not dependant on their knowledge of PPT, knowledge of Desmodium plant or knowledge of the seriousness of striga problem; but by the frequency the farmers asked them for new information. The gender, education levels, and the number of years operated as a stockist did not affect the stockist's effectiveness. By creating awareness on PPT and Desmodium seeds, farmers will seek information from the stockists. The study revealed that stockists frequently asked information by farmers were likely to be effective in disseminating information. Marketers can, therefore, target stockists that are frequented by many farmers.

The third objective was to determine the effectiveness of Agricultural shows in stimulating demand for Desmodium seeds among smallholder farmers in Western Kenya. The study empirically established that the agricultural shows were effective in stimulating demand for Desmodium seeds among smallholder farmers. However, the effectiveness of agricultural shows in enhancing demand for Desmodium seeds was affected by the education levels of smallholder farmers participating in agricultural shows, the farmers' intention and the time they would buy Desmodium seeds in the future. Nevertheless, it was not affected by the age of farmers or quantities of Desmodium seed bought by smallholder farmers participating in agricultural shows. The packaging of Desmodium seeds should be responsive to purchasing capabilities of many smallholder farmers. Desmodium seeds can, therefore, be availed in small packages that are cheaper. The intention to buy Desmodium seeds by farmers at the agricultural show was affected by the level of education, age and packaging of Desmodium seeds.

The fourth objective was to determine the effectiveness of Agro-dealers/stockist in stimulating demand for Desmodium seeds among smallholder farmers in Western Kenya. The study, empirically established that the farm input stockists were effective in stimulating demand for Desmodium seeds among smallholder farmers. The study revealed that effectiveness of farm

input stockists in enhancing demand for Desmodium seeds was affected by the stockist's gender, knowledge about Desmodium and their perceptions on whether the farmers would buy the Desmodium seed if it were available. However, it was not affected by the frequency farmers asked information about Desmodium seeds or whether they were asked for Desmodium seeds by farmers at all. Desmodium seeds should be availed to all stockists and replenish/add Desmodium seeds to those stockists already selling the seed. Also, hold training for both male and female stockist on Desmodium seeds and PPT.

5.3. Conclusions

The study has indicated the important role that agricultural shows and farm input stockists played in disseminating information and adoption of PPT or any other agricultural innovations to farmers. The agricultural shows enabled the farmers to learn how a PPT plot was laid out, how the technology worked to control the pests, how to establish the PPT plot and the benefits of the technology. Consequently, many farmers were willing to adopt the PPT and to disseminate it to others. As a result, many farmers demanded and purchased Desmodium seeds. Overall, the agricultural shows provided farmers with exhibitions and demonstrations that were attractive, held farmers' attention, facilitated good understanding of the technologies presented, provided practical skills and outlined the benefits of these technologies to smallholder farmers.

Overall, the agricultural shows and farm input stockists provided to farmers the required linkages to the private sector, seed dealers, extensionists, researchers and the wider society. These linkages were important for accessing crucial resources such as knowledge and skills, professional advisory services, financial support services, credit facilities and networking among others required to change farmers' livelihood. Agricultural shows and farm input stockists if properly utilised as dissemination pathways increased adoption of proven technologies like PPT by many smallholder farmers. The two pathways were important components for reaching out to farmers. The agricultural shows and farm input stockists can therefore be utilised by extensionists and researchers to increase adoption of PPT.

5.4. Recommendations

Based on the findings and conclusions of the study, the researcher made the following recommendations.

5.4.1 The Government of Kenya, Agricultural Society of Kenya, NGOs, CBOs, ICIPE, extensionists, researchers, marketers, and stakeholders hosting agricultural shows must (1) know the kind of information farmers want or request; (2) have or can easily avail the information requested; (3) assess what format the farmers can receive information and repackage this information; (4) provide personal communication links between provider and receivers; (5) provide clear, easily understood, and accurate information; (6) provide information that farmers can interpret to solve their particular problem or meet a particular need; (7) make sure the farmers do not receive conflicting information from different sources and, (8) sufficient resources are available to enable the information transfer to take place.

5.4.2 It is important that appropriate intervention measures are undertaken to educate farm input stockists and involve them in dissemination information to farmers. This would require a multifaceted approach involving all stakeholders like Kephis, Agmark, Rockefeller foundation, ICIPE, Western Seed Company, KARI, and ACDI VOCA among others in the production value chain.

5.4.3 All stockists selling farm inputs in striga infested areas should be trained on PPT and Desmodium seeds by ICIPE, Western Seed Company, KARI, and Ministry of Agriculture or by any other stakeholder. Also, stockists visited by many farmers can be targeted by these stakeholders to disseminate information on PPT and be provided with Desmodium seeds packed in all sizes to sell to farmers.

5.4.4 Given that agricultural shows promoted and prepared many farmers to plant and manage PPT plot, ensuring availability and access to Desmodium seeds is necessary in all parts of Kenya. Therefore, seed companies, researchers and the government should facilitate Desmodium seed certification to enable seed dealers and stockists invest in seed marketing.

5.4.5 There is need for exhibitors, extensionists, researchers, government of Kenya and

Agricultural Society of Kenya to spearhead necessary mechanisms to strengthen agricultural shows to make them accessible, affordable and responsive to the farmers needs.

5.4.6 Desmodium seed dealers like Western seed company, Kenya seed, KARI and others can also organise sales promotion campaigns for Desmodium seeds through coupons, free seed samples, or an eye-catching display, brochures, pamphlets and magazines put in the stores to entice farmers to practice PPT in striga infested areas.

5.5. Recommendations for Further Research

5.5.1 A study to assess the number of smallholder farmers practising and adopting PPT as a result of information disseminated from previous ASK agricultural shows and farm input stockists should be done by ICIPE and partners in Western Kenya.

5.5.2 A study should be done by ICIPE and partners in Western Kenya to assess the impact of PPT on farmers' standard of living after buying Desmodium seed from agricultural show and stockists in the last five years.

5.5.3 This study on agricultural shows should be replicated by ICIPE at other ASK shows in Kitale, Kakamega, Kisii and Migori where striga infestation is also dominant.

REFERENCES

African Agricultural Technology Foundation (AATF) (2008). Strides in Striga management. Retrieved on March, 7, 2009, from http://www.Strides-issue-2-march 08.pdf

Agricultural Research and Extension Network. (2005). *Newsletter No. 52 July 2005.*

Agricultural Society of Kenya. (2009). *Historical perspective*. Retrieved on September 9, 2009, from http://www.ask.co.ke/.

Amadalo, B., Jama, B., Niang, A., Noordin, Q., Nyasimi, M., Place, F., Franzel, S. & Beniest, J. (2003). *Improved fallows for Western Kenya: An extension guideline. Nairobi:* World Agroforestry Centre (ICRAF). Retrieved November 15, 2007, from http://www.worldagroforestrycentre.org/eca/downloads.

Amudavi, D., Khan, Z. & Pickett, J. (2007). Enhancing the "Push Pull" strategy. *LEISA Magazine* 23.

Amudavi D.M., Khan, Z.R., Wanyama, J.M., Midega, C. A. O., Pittchar, J., Hassanali, A. & Pickett, J.A. (2009a). Assessment of technical efficiency of farmers' teachers in the uptake and dissemination of Push–Pull technology in Western Kenya. *Crop Protection*, 28, 987-996

Amudavi D.M., Khan Z.R., Wanyama J.M., Midega, C. A. O., Pittchar, J., Hassanali, A. & Pickett, J.A. (2009b). Evaluation of farmers' field days as dissemination tool for Push–Pull technology in Western Kenya. *Crop Protection* 28, 225–235.

Arumapperuma, S. (2008). *The role of information technology in disseminating innovations in agribusiness: A comparative study of Australia and Sri Lanka.* Melbourne. Centre for Strategic Economic Studies. Victoria University.

Baraza, D. S., Wasike, G., & Thandi, G. (2008*). Kenya food security steering group 2008 long rains assessment report Mount Elgon distric*t 18th to 22nd July 2008.

Belch, G. E. & Belch, M. A. (2004). *Advertising and promotion. An integrated market communications perspective.* Sixth edition. USA. MC Graw-Hill

Bertrand, J. T. (1978). *Communications pretesting*. Chicago, U.S.A. The Community and Family Study Centre.

Blackie, M. & Albright, K. (2005). *A lesson learning study of the Farm Inputs Promotion Projects (FIPS) in Kenya,* (*Special emphasis on public-private partnerships for input provision and possibilities for regional upscaling*). Nairobi, FIPS.

Blois, K. (2000). *The Oxford textbook of marketing*. New York. Oxford University Press.

Brennan, M. (2004) *The Juster Purchase Probability Scale: A Bibliography. Marketing Bulletin Bibliography*. Retrieved November 25, 2007, from http://marketing-bulletin.massey.ac.nz/V15/MB_V15_B1_Brennan.pdf.

Central Bureau of Statistics. (2004). *Kenya demographic and health survey 2003*. Maryland. Calverton.

Central Bureau of Statistics. (2006). *National food balance sheets 2000-2006*. Ministry of Planning and National Development. Nairobi, Government Printer.

Central Bureau of Statistics. (2007). *Basic report. Kenya integrated household budget survey-2005/2006*. Revised edition. Ministry of Planning and National Development. Nairobi, Government Printer.

Chou, P. & Chen, H. (2008). *Engagement in online collaborative learning. A case study using a web 2.0 tool. MERLOT journal online learning and teaching.vol 4. 2008.* Retrieved on March, 7, 2009, from http://www.chou-1208.pdf

Citizens Network for Foreign Affairs (CNFA). (2005). *Kenya: stimulating smallholders' demand for productivity-enhancing inputs.* Washington, USA. Retrieved on November 15, 2007, from http:www.cnfa.org/page.cfm?pageID=121.

Citizens Network for Foreign Affairs. (2007). *Kenya: stimulating smallholders' demand for productivity-enhancing inputs.* Washington, USA. Retrieved on November 9, 2007, from http:www.cnfa.org/page.cfm?pageID=122.

Clarke, R. (1999). *A primer in diffusion of innovations theory*. Retieved November 15, 2007, from http://www.anu.edu.au/people/Roger.Clarke/SOS/InnDiff.html.

Collins, H. (2003). *Collins English Dictionary – Complete and Unabridged*. HarperCollins Publishers. Retrieved on May 25, 2010 from http://www.thefreedictionary.com/pathway

Cook, M. S., Khan, Z. R. & Pickett, A. J. (2007) The use of "Push Pull" strategies in integrated pest management. *Annual Review of Entomology,* 52, 375-400.

Cramb, R.A. (2003). Processes Affecting the Successful Adoption of New Technologies by Smallholders. *In:* Hacker, B. (ed). *Working with Farmers: The Key to the Adoption of Forage Technologies,* pp.11-22. ACIAR Proceedings No. 95. Canberra: Australian Centre for International Agricultural Research.

Department for International Development (DFID). (2006).*Fodder shrub seed production and marketing in Kenya: matching demand to supply***.** Retrieved on November 1, 2008 from www.worldagroforestry.org/downloads/publications/PDFs/pp06104.pdf

Department for International Development (DFID). (2005). *Project Record. Improved access to appropriate farm inputs for integrated maize crop management by small-scale farmers in Embu and Kirinyaga Districts, Kenya.* Retrieved on March 7, 2009 from http://www.research4development.info/SearchResearchDatabase.asp?ProjectID=3621

East African Farmers Federation (EAFF). (2006). *Eastern Africa situation analysis on government srategies for agricultural development and input/output markets for Tanzania, Kenya, Uganda and Rwanda*. Retrieved on November 1, 2008 from http://www.affu.org/downloads/

European Initiative for Agricultural Research for Development (EIARD). (2008). *EIARD Strategy 2009 – 2013.*

Farm Inputs Promotion Projects (FIPS)-Africa. (2005). *A promotion method to develop markets for improved seed and fertiliser to alleviate hunger and poverty of small scale farmers in Kenya*. [Westernmavunopromotionmethod.pdf].

Frankfort-Nachmias, C., & Nachmias, D. (1997). *Research method in social sciences*. 5th ed. London. Anorld.

Fruehling, T. R. & Lacombe, M. J. (2000). *Communication for results*. Delhi-India, AITBS

Gine, X. (2005). Drumnet case study. The World Bank. Retrieved November 9, 2007, from http://www.wordbank.org/DEC/Resources/Drumnetcasestudy.pdf

Gitman, J. L. & McDaniel, C. (2006). *The future of business. The essentials*. USA. Thomson.

Gordon, A. (2000). *Policy Series 7. Improving smallholder access to purchased inputs in Sub-Saharan Africa. Natural Resources Institute.* University of Greenwich. Retrieved November 9, 2007, from http://www.nri.org

Government of Kenya (GOK). (2005). *Millenium development goals in Kenya. A needs assessment and costing report*. Nairobi, Government Printer.

Government of Kenya (GOK). (2006). *Annual progress report 2004-2005. Economic Recovery Strategy. Monitoring and Evaluation Directorate*. Nairobi, Government Printer.

Government of Kenya (GOK). (2007). *Basic report of fourth participatory poverty assessment. Kenya*. Ministry of Planning and National Development. Government Printer.

Government of Kenya (GOK). (2008). *Millennium development goals status report for Kenya-2007.* Nairobi. Ministry of state for planning, National development and vision 2030.

Government of the Republic of Kenya. (2008). *First medium term plan, 2008-2012. Kenya vision 2030. A globally competitive and prosperous Kenya.* Nairobi. Ministry of state for planning, National development and vision 2030.

GTZ Sustainet. (2006). *Sustainable agriculture: A pathway out of poverty for East Africa's rural poor. Examples from Kenya and Tanzania*.

Gurak, L. J. & Lannon, J.M. (2007). *A concise guide to technical communication*. New York. Pearson.

Hanks, P., Long T.H. & Urdang, L. (1979). *Collins dictionary of the English language*. London & Glasgow. Collins.

Hubbard, W. G. & Sandmann**,** L. R. (2007). Diffusion of innovation. Concepts for improved program evaluation. *Journal of extension vol. 45 No 5*. Availabe at:http://www.joe.org/joe/2007october/a1.shtml

International Centre of Insect Physiology and Ecology (ICIPE). (2005). *ICIPE biannual scientific report 2004-2005. Habitat management strategies for control of stemborers and striga weed in cereal based farming systems in Eastern Africa.* Retrieved August 15, 2007, from http://www.push.pull.net/pdf.

International Centre of Insect Physiology and Ecology (ICIPE). (2007). *Icipe external R & D review 2002-2007*. Nairobi. Icipe Science Press.

International Centre of Insect Physiology and Ecology (ICIPE). (2007). "*Push Pull" technology for the control of stemborers and striga weeds*. Retrieved August 5, 2007 from http://www."Push Pull".net/1aboutus1.htm

International Center for Tropical Agriculture (CIAT). (2009).TSI. *Integrated soil fertility management in Africa (TSBF).* Retrieved on March, 7, 2009, from http://www.CIAT-2009-2011-10.pdf.

Jaetzold, R. & Schmidt, H. (1982). *Farm management hand book* Vol. I. Nairobi. Kenya. Ministry of Agriculture.

Jaetzold, R. & Schmidt, H. (1983). *Farm management hand* book Vol. 2. Nairobi. Kenya. Ministry of Agriculture.

Kalule, T., Khan, Z. R., Bigirwa, G., Alupo, J., Okanya, S., Pickett, J. A. & Wadhams, L. J.

(2006). Farmers' perception of importance, control practices and alternative hosts of maize stem borers in Uganda. *International journal of tropical insect science* vol.26, no. 2, pp. 71-77.

Kathuri, J. N. & Pals, A. D. (1993). *Introduction to educational research*. Njoro. (Kenya). Egerton University

Kegley, C. W. Jr. (2008). *World Politics trends and transformation*. Eleven edition. USA. Thomson Wadsworth.

Kendall, D. (2007). *Sociology in our times. The essentials*. USA. Thomson Wadsworth.

Kerin, R. A., Berkowitz, E. N., Hartley, S.W. & Rudelius, W. (2003). *Marketing*. Seventh Ed. New York. Mc Graw Hill.

Khan, Z. R, Midega A. O., Njuguna, E. M., Amudavi, D. M., Wanyama, J.M. & Pickett, J.A. (2008a). Economic performance of the "Push Pull" technology for stemborer and striga control in smallholder farming systems in Western Kenya. *Crop protection* 27,1084-1097.

Khan, Z. R., Amudavi, D. M., Midega, C. A. O., Wanyama, J. M. & Pickett, J. A. (2008b). Farmers' perception of a "Push Pull" technology for control of cereal stemborers and striga weeds in Kenya. *Crop protection* 27;976-987.

Khan, Z. R., Midega, C. A.O., Amudavi, D. M. Hassanali, A., Pickett, J. A. (2008c). On-farm evaluation of the "Push Pull" technology for the control of maize stemborers and Striga weed in western Kenya. *Field Crops Research,* 106, 224–233.

Khan, Z. R. (2007). *"Push Pull" technology for control of stemborer and striga. A platform technology for improving livelihoods of resource poor farmers*. Retrieved August 5, 2007, from http://www.Push Pull.net/updates.html

Khan, Z. R., Muyekho, F. N., Njuguna, E., Pickett, J. A., Wadhams, L. J., Dibogo, N., Ndiege, A., Genga, G. & Lusweti, C. (2005). A *Primer on planting and managing "Push Pull" fields for stemborer and striga control in maize. A step-by step guide for farmers*. Nairobi. ICIPE Science Press.

Khan, Z. R., Muyekho, F. N., Njuguna, E., Pickett, J. A., Wadhams, L. J., Dibogo, N., Ndiege, A., Genga, G. & Lusweti, C. (2007). *Primer on planting and managing "Push Pull" fields for stemborer and striga control in maize. A step-by Step guide for farmers and extension staff*. Second Edition. Nairobi. ICIPE Science Press.

Khan, Z. R., Pickett, J. A., Wadhams, L. J., Hassanali., A. & Midega, A. O. (2006). Combined control of striga hermonthica and stemborers by maize-Desmodium spp. Intercrops. *Crop Protection*, 25, 989-995.

Kibaara, B. (2006). *Working paper No 20/2006 rural financial services in Kenya: What is working and Why? Egerton University. Tegemeo Institute of Agricultural Policy and Development*. Retrieved November 12, 2007, from http://www.fao/ag/ruralfinconference/docs/

Kothari, C. R. (2003). *Research methodology: Methods and techniques*. New Delhi. India. Wishwa Prakashan.

Kornberg, J. & Rekha, D. (2005). *Women in developing countries. Assessing strategies for empowerment.* New Delhi. Lynne Rienner Publishers.

Kortler, P. (2002). *Marketing management. The millennium edition*. New Delhi. Prentice- Hall

Kremer, M. & Zwane. P. A. (2004). *Encouraging private sector research for tropical agriculture*. World Development vol.33, No. 1

Laker-Ojok, R. (2005). *Struggling to facilitate "win-win" relationships in Uganda's agro-input distribution sector*. Retrieved on November1, 2008 from http://www.seepnetwork.org/files/3129_file_

Lesikar, R. V. & Flatley, M. E. (2005). Basic *communication skills for empowering the internet generation.* Tenth Ed. New York. Graw Hill.

Lipsey, R. G. & Chrystal, K. A. (2004). *Economics. Tenth edition.* New York. Oxford University Press.

Lutkamu, M. H., Shetto, M. C., Mahoo, H. F. & Hatibu, N. (2005). *Natural resources systems programme project report.* Tanzania. NRSP Production System

Max Lock Centre**. (**1998*). Working papers paper 4. Informing the urban poor? An assessment of information and dissemination media for informing urban development.* http://www.wmin.ac.uk/builtenv/maxlock/WP4.HTM

Ministry of Agriculture, Ministry of Livestock, Marketing and Fisheries Development. (2007). *National agricultural sector extension policy implementation framework* .Nairobi.

Mulugeta, E. (2008). Crossing the hurdle: survival strategies of poor women in Addis Ababa. *African social science research review.* Vol. XXIV 28. OSSREA

Mugenda, M. O. & Mugenda, G. A. (2003). *Research methods. Quantitative and qualitative*

approaches. Nairobi. Kenya

Mugenda, G. A. (2008). *Social science research*. Nairobi. ARTS press.

Muyanga, M. & Jayne, T. S. (2006). *Agricultural extension in Kenya: Practice and policy lessons*. Nairobi. Kenya. Tegemeo Institute. Retrieved September 12, 2007, from http://www.tegemeo.org/documents/work/tegemeo_workingpaper_26.pdf

Nagel, U. J. (1999). *Alternative approaches to organizing extension*. In Swanson, B. E., Bentz, R. P., & Sonfranko, A. J. (Eds), Improving agricultural extension. A reference manual (Chapter 2). Rome, Italy. FAO. Retrieved August 5, 2007, from http://www.fao.org/docrep/W5830E/w5830e00.htm#Contents

Odame, H., Musyoka, P. & Kere, J. (2008). *How national public policies encourage or impede agribusiness innovation: cases of maize, tomato and dairy in Kenya. Draft report*. Retrieved on November 1, 2008 from http://www.info.worldbank.org/etools/docs/library/243548/KYAgribusinessReport.pdf

Omasa, M., McCormic, D. & Alila, P.O. (2007). *Business Systems: An overview chapter 1 in Business in Kenya Institutions and interactions*. Kenya. University of Nairobi press.

Onuekwusi & Gideon, C. (2007). *Agricultural development in Imo State, Nigeria*. Medwell Journals. Research Journal of Applied Sciences 2 (2): 141 -145, http://www.medwelljournals.com/fulltext/rjas/2007/141-145.pdf

Parkin, M. (2005). *Macroeconomics*. seventh ed. USA. Pearson.

Perreault Jr, W. D. & McCarthy, E. J. (2005). *Basic marketing. A global- managerial approach.* USA. McGraw-Hill.

Phiri, M. G. & Themba, P. (2007). *Survey of private sector and other non-state actors: Angola, Mozambique, Namibia And Tanzania*. http://www.satradehub.org/assets/files

Poulton, C., Dorward, A. & Kydd, J. (2005). *The future of small scale farms: New directions for services, institutions and intermediation*. United Kingdom. Centre for Development and Poverty Reduction. Retrieved October 4, 2007, from http://www.ifpri.org/events/seminars/2005/smallfarms/sfproc/SO6_Poulton.pdf

Rajabu, A.R.M.S. (1986). *Communication practice in development*. Kenya. UNICEF.

Republic of Kenya. (2008). *Information communication technology sector* report Nairobi.

Rivera, W. M. & Cary, J. W. (1999). *Privatizing agricultural extension.* In Swanson, B. E., Bentz, R. P., & Sonfranko, A. J. (Eds), Improving agricultural extension. A reference

manual (Chap 22). Rome, Italy. FAO. Retrieved August 5, 2007, from http://www.fao.org/docrep/W5830E/w5830e00.htm#Contents

Robbin, S. & Sanghi, S. (2005). *Organizational behaviour*. Eleventh ed. USA. Pearson.

Rockefeller Foundation. (2007). *Developing rural agricultural input supply systems for farmers in Africa. In fertilizer toolkit: promoting efficient and sustainable fertilizer use in Africa*. Retrieved on November 2, 2008 from http://www.worldbank.org/html/extdr/fertilizeruse/bpractices/RockefellerAgroDealerSupport.htm

Rockefeller Foundation. (2006). *Developing rural agricultural input supply systems for farmers in Africa. Fertilizer toolkit: Promoting efficient and sustainable fertilizer use in Africa.* Retrieved on November 2, 2008 from http://www.worldbank.org/html.../documentspdf/RockefellerAgroDealerSupport.pdf

Rogers, E. M. (1995). *Diffusion of innovations*. Retrieved November 5, 2007, from http://www.stanford.edu/class/symbosys205 Downloaded 05/11/2007

Rogers, E. M. (1971). *Communication of innovations*. A cross-cultural approach. New York. The Free press.

Schiller, R. B. (2005). *Essentials of economics*. Fifth edition. USA. MC Graw-Hill

Schwartz, L. A. (1994). *The role of the private sector in agricultural extension: Economic and Case studies*. Retrieved November 5, 2007, from http://www.rimisp.org/agren03/documents/agren48.pdf.

Solomon, M. R, Marshall, G.W. & Stuart, E.W. (2006). *Marketing. Real people, real choices, Fourth Ed.* New Jersey. Pearson.

Sub-Saharan Africa Challenge Program. (2008). Retrieved on November 1, 2008 from http://www.asareca.org/pdf/KivuPlsVrpt_en7.pdf.

The International Potato Center, (2008). Medium-Term Plan 2009-2011. Retrieved on March, 7, 2009, from http://www.MTP-2009-2011.pdf.

The Sower. (2008). *Saving the cereals sub sector. Newsletter vol..1 Issue 9*. A publication of the Cereals Growers Association.

The World Bank. (1995). *Advancing gender equality from concept to action*. Washington, DC. World Bank.

The World Bank. (2008). *Agricultural innovation systems: from diagnostics toward operational*

practices, Agriculture & Rural Development Department. Washington. Retrieved on March 23, 2008 from http://www.ARDDiscussionpaper38.pdf

Tirtiroglu, E. & Elbeck, M. (2008). *Qualifying purchase intentions using queueing theory***.** journal of applied quantitative methods Vol.3 no.2. Retrieved on November 28, 2008 from http://www.jaqm.ro/issues/volume-3,issue-2/pdfs/tirtiroglu_elbeck.pdf

United Republic of Tanzania. (2005). *Communication stategy for the national strategy for growth and reduction of poverty Vice President office*. Retrieved on March, 7, 2009, from http://www.commstrat.pdf

Wennink, B. & Heemskerk, W. (eds.) (2006). *Farmers' organizations and agricultural innovation. Case studies from Benin, Rwanda and Tanzania*. Royal Tropical Institute. Amsterdam, The Netherlands

Wider impact strategy. (2008). *Impact strategy for bean in Africa. Part 1: Creating impact***.** Retrieved on November 1, 2008 from http://www.ecabren.org/pdfs/impact_strategy.PDF

Wilson, J. R. (1998). *Mass media / Mass culture*. USA. MC Graw-Hill.

Wilson, J. R. & Wilson, S. L. R. (1998). *Mass media / Mass culture*. An introduction. Fourth edition. USA. MC Graw-Hill.

Wikipedia, the free encyclopedia. (undated). *Agricultural show.* Retrieved 2 November, 2008 from http://en.wikipedia.org/wiki/Agricultural_show

Wright, T. R. (2008). *Environmental science towards a sustainable future*. Tenth edition, America . Pearson.

Wulff, E., Bodker, L. & Jan, T. (2006). *Seed sector country profile. Kenya Danish Seed Health Centres for Developing Countries.* Denmark. University of Copenhagen.

APPENDICES

APPENDIX A: Questionnaire for Individuals Visiting "Push Pull" Technology (PPT) Demonstration Plot at the Agricultural Showground

The purpose of this survey is to find out how agricultural shows facilitate understanding and uptake of "Push Pull" technology and create demand for Desmodium seeds.

Name of the Show _____ Date _____

1. Name of the participant _____Mobile telephone no.(s)_____
2. Farmer's area of residence: (a) District_____ (b) Division_____
   (c) Location_____ (d) Village_____
3. Gender: 1. Female [ ] 2. Male [ ] Age of farmer: ___
4. What is your highest level of education? (**Please tick only one**)

   [ ] Non-formal [ ] Primary [ ] Secondary [ ] College [ ] University [ ] Others (specify)___
5. Have you heard about "Push Pull" technology before coming to this show? [ ] Yes [ ] No

   If **Yes**, when did you hear about it? 1. Year _____

   From what source did you first hear about "Push Pull" technology (PPT)? (**Tick only one**)

   [ ] Radio [ ] Newspaper/magazine [ ] Church group
   [ ] "Push Pull" brochure/posters [ ] Farmers field day [ ] Farmer's group
   [ ] Farmer teacher [ ] Farmer Field school [ ] Neighbour
   [ ] Extension officer [ ] NGO/CBO [ ] Other source (Please specify) ____
6. Have you ever received information on PPT from an agricultural show? [ ] Yes [ ] no

   If Yes, from which show? _____ Which year? _____
7. Have you seen a "Push Pull" field before coming here? [ ] Yes [ ] No

   If Yes, where? (Tick as many sources as possible)

   [ ] Farmers field day [ ] Farmer teacher's farm [ ] Farmer Field school
   [ ] Other farmer's farm . [ ] ASK showground [ ] ICIPE station .
   [ ] Never seen one . [ ] Other source **(Please specify**)_____.
8. Do you practice "Push Pull" in your farm? [ ] Yes [ ] No (**If Yes, go to 9. If No skip to 11)**
9. When did you start using "Push Pull" in your farm**? 1. Year _____ 2. Season _____**
10. Why did you adopt "Push Pull" on your farm? (**Tick as applicable then skip to 12***)*

    1 [ ] Control stemborers 2 [ ] Control Striga weeds
    3 [ ] Increase maize production 4. [ ] Increase fodder for my livestock
    5 [ ] Improve soil fertility on my field 6 [ ] Other reasons (**specify**) _____

11. Would you like to plant "Push Pull" in your farm? [ ] Yes [ ] No

    If **Yes,** why? _____

    If **No,** why not _____

12. Would you like to buy Desmodium seeds now? [ ] Yes [ ] No

    If **Yes**, how much? _____ grams _____kg.

13. Do you intend to buy Desmodium in the near future? [ ] Yes [ ] No

    If **Yes**, in what period from now? 1. [ ] During short rains of 2008 2. [ ] During long rains of 2009 3. [ ] Others (specify)_____

14. Have you understood well how a "Push Pull" plot is planted? [ ] Yes [ ] Somewhat [ ] No

    If **Somewhat or No**, what should be done to improve PPT demonstrations? (**Tick as appropriate**)

    [ ] Provide more literature materials [ ] Show video of PPT establishment [ ] ICIPE field advice [ ] Ministry of Agric. Extension advice [ ] Others (Please specify)_____

15. Please circle the rating on the scale that corresponds to your true opinion on the effectiveness of agricultural shows on the aspects of PPT shown in the table.

	Level of agreement on Show's Effectiveness				
Aspects of PPT Demonstrated by the show	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
The Push–Pull technology (PPT) plot lay-out can attract and hold the attention of the farmers	1	2	3	4	5
The demonstration facilitates a good understanding of how PPT controls Striga	1	2	3	4	5
The demonstration facilitates a good understanding of how PPT controls Stemborer	1	2	3	4	5
Demonstrated how to establish the PPT plot	1	2	3	4	5
Demonstrated the benefits of the PPT	1	2	3	4	5

END: Thank you for the time you have taken to answer these questions.

APPENDIX B: A Survey Questionnaire of Farm Input Stockists and Their Potential Role in Dissemination of "Push Pull" Technology in Western Kenya

"Push Pull" technology is a seed-based technology. The purpose of this survey is to find out the extent to which stockists can create farmers' demand for Desmodium seeds and hence facilitate dissemination and uptake of the "Push Pull" technology.

1. Name of stockist: _____
2. Name of the Shop: _____
3. Area of the business: (a) District_____ (b) Division_____
   (c) Location_____ (d) Village_____
4. Gender of the respondent: 1. [ ] Female 2. [ ] Male
5. What is the highest level of education you have attained? (**Tick only one**)

   1. [ ] Non-formal 2. [ ] Primary 3. [ ] Secondary

   4. [ ] College 5. [ ] University 6. [ ] Others
6. How long have you been operating as a stockist? _____Years
7. Do you know a weed called Striga? [ ] Yes [ ] No (**If No, skip to question 12)**
8. If yes, (a) how would you in general rate the seriousness of Striga weed in your area? Use scale of: 5=Very Serious, 4=Serious, 3 = Moderate, 2= Less Serious and 1= Not serious (**Please tick in the space provided)**

   1. [ ] Very Serious 2. [ ] Serious 3. [ ] Moderate 4. [ ] less Serious 5. [ ] Not serious
9. How do people control Striga in your area? (**List methods mentioned).**

   _____

   _____
10. Do farmers ask you for the solution(s) for striga problem? [ ] Yes [ ] No
11. If Yes, What solutions do you suggest? (List them)

    _____
    _____
    _____
    _____
12. Have you heard about "Push Pull" technology to control striga weed and stemborer?

    [ ] Yes [ ] No (**If No, skip to question 15)**

13. If **Yes**, when did you hear about it? 1. Year _____

From what source did you **first hear** about "Push Pull" technology (PPT)? (**Tick only one**)

[ ] Radio [ ] Newspaper/magazine [ ] Church group
[ ] "Push Pull" brochure/posters [ ] Farmers field day [ ] Farmer's group
[ ] Farmer teacher [ ] Farmer Field school [ ] Neighbour
[ ] Extension officer [ ] NGO/CBO [ ] Farm input stockist
[ ] ASK Shows [ ] Other source (**Please specify**)

14. Have you ever **seen** a "Push Pull" technology field? [ ] Yes [ ] No (**If No, skip to question 16)**

If Yes, where? (**Tick as many sources as appropriate**)

[ ] Farmers field day [ ] Farmer teacher's farm [ ] Farmer Field school
[ ] Other farmer's farm . [ ] ASK showground [ ] ICIPE station
[ ] Other source **(Please specify**) _____

15. How do you rate effectiveness of "Push Pull" technology in the control of striga? Use scale: 5= Most effective, 4=Effective, 3= Moderate, 2=Less effective and 1=Not effective (**Tick one)**

1. [ ] Most effective 2. [ ] Effective 3. [ ] Moderate 4. [ ] Less effective 5. [ ] Not ffective

16. Do you know about Desmodium? [ ] Yes [ ] No

17. What is Desmodium used for? _____

18. Have any farmers asked for Desmodium seed from you? [ ] Yes [ ] No (**If No, skip to question 20)**

19. If Yes, how often in a month do they ask for information about Desmodium seeds? (**tick once**)

1. [ ] Once 2. [ ] 2-3 times 3. [ ] 4-5 times 4. [ ] Over 5 times

20. Do you think the farmers would buy the Desmodium seed if it were available? [ ] Yes [ ] No

21. How would you rate the demand for the Desmodium seed? (**Tick once)**

[ ] Very High [ ] High [ ] Medium [ ] Low [ ] Very low

22. Do you stock Desmodium seeds in your shop? [ ] Yes [ ] No (**If No, skip to question 25)**

If Yes, for how long have you been stocking it? 1. No of years: _____

23. If you stock Desmodium seed, what has been the demand? (**Tick once)**

[ ] High [ ] Moderate [ ] Low [ ]

24. If the sale was low, how would you like to improve it?

_____

25. If you don't have Desmodium seed in stock, would you like to stock it? [ ] Yes [ ] No **(Skip to question 29)**

26. Do you usually attend any training on promotion of different inputs you sell? [ ] Yes [ ] No

27. Have you ever attended any training on promotion of technologies to control Striga?

    [ ] Yes [ ] No

28. What technologies did you learn about? List them

    _____

    _____

    _____

29. Who organized the training? _____

Technology	Organized by	Year
_____	_____	_____
_____	_____	_____
_____	_____	_____

30. Have you ever attended any training on promotion of "Push Pull" technology (PPT)?

    [ ] Yes [ ] No

31. Please circle the rating on the scale that corresponds to your true opinion on the effectiveness of stockist on the aspects shown in the table.

	Level of agreement on Stockit's Effectiveness				
Aspects of services by stockist	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I am able to deliver needed goods and services timely	1	2	3	4	5
I use different distribution strategies to reach many farmers	1	2	3	4	5
I am well linked to seed companies	1	2	3	4	5
I am fully trained to explain to farmers how to use seed-based technologies	1	2	3	4	5
I regularly keep an upto date stock	1	2	3	4	5
I am a member of networks, partnerships and outreach that work with farmers	1	2	3	4	5
I give some credit to farmers	1	2	3	4	5
I keep records of farmers I serve	1	2	3	4	5
I can keep record of farmers who buy inputs from me	1	2	3	4	5

32. Which of the following "Push Pull" technology extension materials do you have in your shop? (**Please tick appropriately)**.

    [ ] Brochures [ ] Magazines [ ] Posters [ ] Pamphlets [ ] None [ ] Others (**specify**) ___

33. How much Desmodium seed did you sell last year? (**For those stockists who had the seed in stock**)

    During the short rains: _____ During the long rains: _____

34. In what ways should stockists be supported to get the "Push Pull" technology to many farmers in your area?

    _____

    _____

    _____

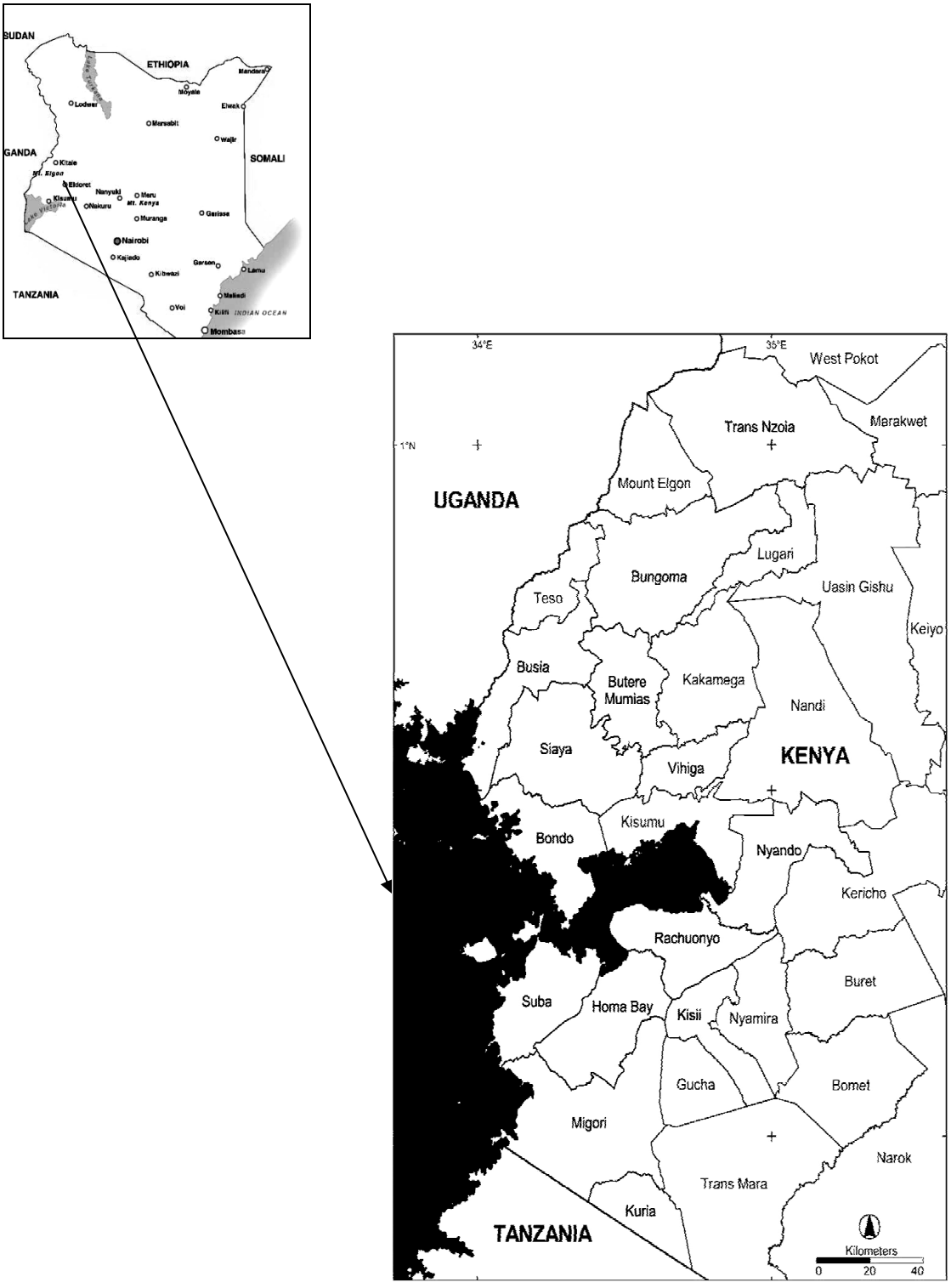
    _____

END: Thank you for the time you have taken to answer these questions.

APPENDIX C: A List of Individuals Used to Validate the Research Instruments

1. Dr Khan, Z. ICIPE –Mbita
2. Dr Amudavi, D. M. Egerton University
3. Prof. Mwangi, J. G. Egerton University
4. Jimmy Pittchar ICIPE –Mbita
5. Atambo, S. M. Colleague
6. Mbeche, I. ICIPE –Mbita
7. Dr Munyua, C. N. Egerton University
8. Matilda, A. O. ICIPE –Mbita
9. Wanyama, J. M. ICIPE –Mbita
10. Olondo, P. ICIPE –Mbita

APPENDIX D: Map Showing Western Kenya



Source: Amudavi, 2008.

APPENDIX E: Sampling Frame of Farm Input Stockists in Western Kenya

	Sampled stockist	Business Name	Trading centre	District
1	√	Adungosi farm input	Adungosi	Teso
2	√	Adungosi good hope	Adungosi	Teso
3		Akukuranut	Adungosi	Teso
4		Cardet	Adungosi	Teso
5		Exodus Mini Hardware	Adungosi	Teso
6	√	Amagoro agrovet	Amagoro	Teso
7		Amagoro Enterprise	Amagoro	Teso
8	√	Koteko Enterprise	Amagoro	Teso
9		Phan Chem Gen Shop	Amagoro	Teso
10	√	Bora Angaleu	Amagoro	Teso
11	√	Amukura Merchandise	Amukura	Teso
12		Elseyoi Epoot E nterprises	Amukura	Teso
13		Ongaroi Investment	Amukura	Teso
14		Angurai Umoja Shop	Angurai	Teso
15	√	Maendeleo Gen. Shop	Angurai	Teso
16	√	Kocholia Agro Vet	Kocholia	Teso
17		Malaba Down Town Agro-vet	Kocholia	Teso
18		Selle Gen. Store	Kocholia	Teso
19		Amukura pharmacy	Malaba	Teso
20		Apolot Uplands Pharmacy	Malaba	Teso
21		Frarims Supermarket	Malaba	Teso
22		Joseph Kimani Wangongi	Malaba	Teso
23		Lizmatt Supermarket	Malaba	Teso
24	√	Malaba Agrovet	Malaba	Teso
25		Mamais Self Selection Shop	Malaba	Teso
26		Mwenda Pole Gen Shop	Malaba	Teso
27		Neema Traders	Malaba	Teso
28		Popular Supermarket	Malaba	Teso
29		Rose General Traders	Malaba	Teso
30		Shree Sikotar	Malaba	Teso
31		Ushika Farmers Shop	Malaba	Teso

32		Western End Supermarket	Malaba	Teso
33	√	Simon Ekeya's	Amukura	Teso
34	√	Adungosi SCODIP	Chakol	Teso
35		Amukura M. P. stores	Amkura	Teso
36		Mam Agrovet	Amagoro	Teso
37		Busia Farmers Agro Vet	Busia	Busia
38	√	Giathi Vet Enterprises	Busia	Busia
39		Mundika Agrovet	Mundika	Busia
40	√	Wakulima market	Bumala mkt	Busia
41	√	Western Agrovet	Korinda	Busia
42	√	Mkulima Duka	Matayos	Busia
43	√	Matayos agrovet	Matayos	Busia
44	√	Matayos Multipurpose	Matayos	Busia
45		Wakulima Agrovet	Bumala	Busia
46		Mareba Agrovet	Bumala	Busia
47		Butula Agrovet	Butula	Busia
48		Butula Farmers Coop	Bumuyi	Busia
49		Murumba Agrovet	Murumba	Busia
50		Oden Agrovet	Nambale	Busia
51		Scorvian Agrovet	Nambale	Busia
52		Sinan Agrovet	Nambale	Busia
53		Mkulima Agrovet	Busia	Busia
54		Mareba M Traders	Busia	Busia
55		Multivier Agro Supplies	Busia	Busia
56	√	Farmers Corner	Butula	Busia
57	√	St. James Agrovet	Matayos	Busia
58	√	Bumala Agrovet	Butula	Busia
59	√	Mundika Farmers Centre	Matayos	Busia
60	√	Border vet	Busia	Busia
61	√	SCODIP	Busia	Busia
62		Evaline stores	Busia	Busia
63		Mareba Multipurpose traders	Busia	Busia
64		Agrovet Boarder vet	Busia	Busia
65		Kilingili Agrochemicals	Kilingili	Vihiga

66		Mkulima Agrovet	Gisambai	Vihiga
67		Jolly Enterprise	Gisambai	Vihiga
68		Faulu Agrovet	Majengo	Vihiga
69		Biyehu Agrovet	Luanda	Vihiga
70		Sabatia Agrovet	Sabatia	Vihiga
71		Beta Farmcare	Chavakali	Vihiga
72		Egale Agrovet	Lusiola mkt	Vihiga
73		Ushindi Agrovet	Chavakali	Vihiga
74		Elshadai Traders	Kima	Vihiga
75		Bei Bora Farm Store	Kima	Vihiga
76		Mkulima Agrochem	Kilingili	Vihiga
77		Magada Farm Inputs	Magada	Vihiga
78		Farmers Pride Agrovet	Luanda	Vihiga
79	√	Kabura Agrovet	Luanda	Vihiga
80		Ronald Animal Feeds	Luanda	Vihiga
81		Rama Wholesalers	Luanda	Vihiga
82	√	ECPK Agrovet	Luanda	Vihiga
83	√	Jumbo Agrovet	Luanda	Vihiga
84	√	Elmart Agrovet	Luanda	Vihiga
85	√	Luanda Agrovet	Luanda	Vihiga
86		Esibuye SCODP	Esibuye	Vihiga
87	√	Tarun Agrovet	Majengo	Vihiga
88	√	Farmers Pride Agrovet	Majengo	Vihiga
89		Mbale Farm input Store	Mbale	Vihiga
90	√	New Popular Agrovet	Mbale	Vihiga
91	√	Jumbo agrovet	Chavakali	Vihiga
92	√	Kamro agrovet	Luanda	Vihiga
93		Luanda Chemist	Luanda	Vihiga
94		Sedan Wholesalers	Luanda	Vihiga
95		Luhadada Stores	Majengo	Vihiga
96		Chama Agrovet	Mbale	Vihiga
97		Mungoma chemists	Mbale	Vihiga
98		Newcastle Agrovet	Majengo	Vihiga
99		Down Town Chemists	Mbale	Vihiga

100		Mbale farm inputs Shop	Mbale	Vihiga
101		Frida enterprises	Chavakali	Vihiga
102		Wakulima agrovet	Mayanja	Bungoma
103		Bila Farmers	Mayanja	Bungoma
104	√	Regina Stores	Mayanja	Bungoma
105		Mayanja General store	Mayanja	Bungoma
106		Sio General Store	Bungoma	Bungoma
107		Bungoma Merchandise	Bungoma	Bungoma
108		Jebi Agrovet	Bungoma	Bungoma
109	√	Luna Agrovet	Bungoma	Bungoma
110	√	Bungoma chemist	Bungoma	Bungoma
111	√	KFA	Bungoma	Bungoma
112		Upendo Agrovet	Bungoma	Bungoma
113		Beraked Farm Agrovet	Bungoma	Bungoma
114		Junction Agrovet	Bungoma	Bungoma
115		Mona Animal Feeds	Bukembe	Bungoma
116		Khetia Drapers	Bungoma	Bungoma
117	√	Hilson Farmers store	Kanduyi	Bungoma
118	√	Namunai Farmers Choice	Kanduyi	Bungoma
119	√	Wonderland Distributor	Bungoma	Bungoma
120	√	Farmers Centre	Kanduyi	Bungoma
121	√	Buchero Enterprises	Khwisero	Butere
122		Bahati General Stores	Khwisero	Butere
123	√	Khwisero Agrovet Supplies	Khwisero	Butere
124		Fegra General shop	Muluanda	Butere
125	√	Kumi Kumi General Stores	Khwisero	Butere
126	√	Mwangaza Enterprises	Khwisero	Butere
127		ROP Agrovet	Khwisero	Butere
128	√	Luma agrovet	Khwisero	Butere
129	√	Mkulima agrovet	Khwisero	Butere
130		New Bridge Agrovet	Khumusalaba	Butere
131		Baraka Ani-vet Farm	Matungu	Butere
132		Bondo Farmers Centre	Bondo	Bondo
133	√	Rads Agrovet	Bondo	Bondo

134		SCODP Madiany	Madiany	Bondo
135	√	Lucky vet services	Ndori	Bondo
136	√	Bondo Agrovet	Bondo	Bondo
137		SCODP Ndori	Ndori	Bondo
138	√	Majafdame Agrovet	Bondo town	Bondo
139		Farmcare Centre	Nginya	Bondo
140		Pathways Agrovet	Bondo	Bondo
141	√	Lake belt agrochemicals	Maranda	Bondo
142		Kamito SCODP	Rarieda	Bondo
143	√	Zilmark agrovet	Maranda	Bondo
144	√	Hagonglo agrovet	Ramba	Rarieda
145	√	Bondo farmers agrovet	maranda	Bondo
146		Ngiya Agrovet	Nginya	Siaya
147	√	Kayombi Dosila Stockist	Ugunya	Siaya
148		Nyamulu G. stores	Ngiya	Siaya
149	√	Believe farm stores	Siaya	Siaya
150		SCODP Siaya	Siaya	Siaya
151		Jaro farmers	Siaya	Siaya
152	√	SCODIP Wagai	Siaya	Siaya
153		Emco farm stores	Siaya	Siaya
154	√	Farmers centre	Yala	Siaya
155		Pacho agrovet	Akala	Siaya
156		SCODP Sigomre	Sigomere	Siaya
157		SCODP Ukwala	Ukwala	Siaya
158	√	Farmchoice	Yala	Siaya
159	√	Maliwaswa	Ukwala	Siaya
160		Ugunja farmers store	Ugunja	Siaya
161		Hodari Agrovet	Ugunja	Siaya
162		Yala agrochemicals	Yala	Siaya
163	√	Selibo Enterprises	Karemo	Siaya
164	√	Avepo Enterprises	Karemo	Siaya
165	√	Yala farmlands	Yala	Siaya
166		Dora agrovet	Sega	Siaya
167		SCODP Sega	Sega	Siaya

168	√	Oasis Agrovet	Yala	Siaya
169		Kanyumba SCODP	Ukwala	Siaya
170		Jaramogi Agrovet	Yala	Siaya
171		Kachapa agrovet	Kadongo	Rachuonyo
172		Senata farmers store	Senta junction	Rachuonyo
173	√	Elmart agrovet	Oyugis	Rachuonyo
174	√	Animal draft power program	Oyugis	Rachuonyo
175	√	Nyahera farmers point	Oyugis	Rachuonyo
176	√	Jireh agrovet	Oyugis	Rachuonyo
177		Khafi stores	Kadongo	Rachuonyo
178		Ramba general stores	Ramba market	Rachuonyo
179		Kadongo SCODP	Musambi	Rachuonyo
180	√	Ombura agrovet	Oyugis	Rachuonyo
181		Oyugis integrated project	Oyugis	Rachuonyo
182		Hill agrovet	Oyugis	Rachuonyo
183	√	KFA	Oyugis	Rachuonyo
184		Joy farm input	Pala	Rachuonyo
185		Bestnine supermarket	Kisii	Kisii
186		Stans agrovet	Kisii	Kisii
187		KFA	Kisii	Kisii
188	√	Josemo distributors	Kisii	Kisii
189		Dakianga stores	Kisii	Kisii
190		Dakima stores	Suneka	Kisii
191	√	Mid-town Agrovet	Suneka	Kisii
192		Lastonya stores	Suneka	Kisii
193	√	Mwangaza general store	Suneka	Kisii
194		Sunday night stores	Suneka	Kisii
195		Gesongo agrovet	Suneka	Kisii
196	√	Kerina general stores	Suneka	Kisii
197		Misababi farmers centre	Suneka	Kisii
198	√	Nyachenge	Nyamarambe	Kisii
199	√	Summer/legal osmock	Suneka	Kisii
200		Suneka agrovet	Suneka	Kisii
201	√	Umoja Enterprise	Suneka	Kisii

202		Omonchari farmers choice	Suneka	Kisii
203	√	Getenge General store	Suneka	Kisii
204		Suneka hardware	Suneka	Kisii
205		Kamro agrovet	Migori	Migori
206	√	Longo Agrovet	Suba West	Migori
207		Ngombe agrovet	Migori	Migori
208		Farmers Ageovet center	Sori	Migori
209		Misiwi agrovet	Sori	Migori
210		Migar general stores	Suna	Migori
211	√	Jumbo agrovet	Migori	Migori
212		Kenold agrovet	Ogwedhi	Migori
213	√	Hippo Agrovet	Suba West	Migori
214		Cekefe agrovet	Onger	Migori
215		Ombeka enterprises	Migori	Migori
216		Jack & J agrovet	Onger	Migori
217	√	Maafa agrovet	suna	Migori
218		Lengo agrovet	suna	Migori
219	√	Uriri farmers agrovet shop	Uriri	Rongo
220	√	Kajulu Junction Agrovet	Uriri	Rongo
221	√	Ndati/Tembo stores	suna	Migori
222	√	Maota agro vet shop	suna	Migori
223	√	Jean agencies	suna	Migori
224		Farmers investment	suna	Migori
225		Kubao agrovet	Masaba	Kuria
226	√	Mwananchi Agrovet	Kehancha	Kuria
227	√	Farm Agrovet	Kehancha	Kuria
228		Motherland stores	Kebaroti	Kuria
229		Muungano agrovet	Mabera	Kuria
230		View point	Kegonga	Kuria
231	√	B. Kegera & family agrovet	mabera	Kuria
232	√	Kiboi general stores	Isebania	Kuria
233		Mabera agency	Mabera	Kuria
234		New marko stores	Gwitembe	Kuria
235	√	Tanken Agrovet	Kehancha	Kuria

236	√	Joma agrovet	Isebania	Kuria
237		Tembo agrovet	Mabera	Kuria
238	√	Janam agrovet	Isebania	Kuria
239		Ukulima self help group	Mbita	Suba
240		BUSGA	Ogongo	Suba
241		ADPP Sindo	Sindo	Suba
242	√	Neem shop	Mbita	Suba
243	√	Ogongo farm input shop	Ogongo	Suba
244	√	Lambwe seed growers agency	Ogongo	Suba
245	√	Onungo agrovet	Ogongo	Suba
246	√	Reja Reja Agrovet	Ogongo	Suba
247		Pacho Agrovet	Magunga	Suba
248		Magera Agrovet	Sindo	Suba
250	√	Stella agrovet	Mbita	Suba

Key: √ refers to sampled stockists