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

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Abstract

Despite "Push pull" technology's (PPT) effectiveness in increasing maize yields by controlling Stem borer and striga weeds, its full benefits are yet to be realized. PPT involves planting Napier grass around maize intercropped with Desmodium. Agro-dealers are often used to spread PPT but knowledge of its effectiveness was inadequate. This study sought to provide the missing information using a cross-sectional research design to collect data from a proportional stratified random sample of 102 agro-dealers in Western Kenya. A valid, closed-ended questionnaire whose 0.85α reliability was above the 0.70 acceptable was used. Data were analysed using Chi-square at 0.05α set a priori. Results: 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 from them; gender, education and years in business did not affect agro-dealers' effectiveness; and those visited most by farmers were more effective in disseminating PPT. Conclusions: Agro-dealers are appropriate for educating males and females and spreading PPT through them enhances adoption. Recommendations: Extension providers should train and involve agro-dealers in disseminating PPT and selling certified seeds.
Key words: *agro-dealers, Desmodium seeds, effectiveness, farmers, maize, Napier grass, push-pull technology, Stem Borer, Striga weeds, Western Kenya.*

Introduction

Cereal farming in Eastern Africa contributes approximately 50% of the Gross Domestic Product (GDP). The Central Bureau of Statistics (2006 & 2007) indicates that cereals, particularly maize and sorghum, are the most important food crops as they contribute, on average, 47.1% of all calories and are grown by 90% of the farmers. However, production of cereals is seriously affected by stem borer *(Busiolla fusca*), the parasitic weed *Striga hermonthica*, unreliable rainfall, soil infertility resulting from soil erosion, pre- and post-harvest losses caused by pests, poor infrastructure that greatly constraints input supply and products' marketing, unreliable markets, and policy bottlenecks (Cook, 2007, ICIPE, 2011, Kegley, 2008, Khan, 2007). *Busiolla fusca* and *Striga hermonthica* cause great harm to maize and sorghum and consequently reduce

their yields by 30-100% on smallholder farms (Khan, Midega, Njuguna, Amudavi, Wanyama & Pickett 2008a). *Striga hermonthica* is a major biotic constraint to cereal production that can be controlled by trap crops (Odhiambo, Vanlauwe, Tabu, Kanampiu, & Khan, 2011). The International Centre of Insect Physiology and Ecology (ICIPE) with its collaborators has developed the "Push Pull" technology (PPT) in which farmers use Napier grass planted in border rows and Desmodium legume (silver leaf and Green leaf Desmodium) intercropped with maize or sorghum to control these pests and improve soil fertility (Khan, Midega, Pittchar, Pickett & Bruce, 2011). The technology is appropriate and economical to the resource-poor smallholder farmers in the region because it is based on locally available plants, no expensive external inputs, and fits well with traditional mixed cropping systems in Africa (International Centre of Insect Physiology and Ecology, 2011).

A number of research projects have found the "Push Pull" technology to be effective (Woodward, 2011). But as with any such project, many useful agricultural research findings fail to reach the intended users due to deficiencies in the delivery systems. It is important therefore to use appropriate extension methods to give farmers relevant agricultural technologies such as PPT as this may enhance their knowledge, skills and overall attitude towards agricultural productivity (Government of Kenya, 2008). Furthermore, knowledge of the adoption process may greatly improve the planning and implementation of successful research and extension programs (Cramb, 2003). In Kenya, agro-dealers play a key role in the cereals' production value chain as well as in agricultural extension. Kenya has a well established network of agro-dealers who link farmers with other stakeholders in the agro-inputs supply chain (AATF, 2008; The Sower, 2008). Agro-dealers provide farmers with farm inputs (seeds, tools, pesticides, and fertilizer), which are critical in raising crop and livestock productivity. Many agro-dealers have a background in research, extension or entrepreneurship and by making quality agricultural information and advice as well as farm inputs readily available to farmers, they accelerate efficiency of the production process (Blackie & Albright, 2005; Rockefeller Foundation, 2006).

The 'Push–Pull' technology (PPT) has been promoted and disseminated through different pathways each of which might have different uptake enhancement capabilities (Murage, Obare, Chianu, Amudavi, Pickett, & Khan, 2011). This study sought to determine agro-dealers' effectiveness in enhancing dissemination and adoption of the "Push Pull" technology, which is used to control *Busiolla fusca* and *Striga hermonthica* with the aim of increasing cereal production among smallholder farmers in Western Kenya. The study's specific objectives were to determine the effectiveness of agro-dealers in disseminating information and adoption of "Push Pull" technology as well as the effectiveness of agro-dealers in stimulating demand for Desmodium seeds among smallholder farmers in Western Kenya. The researchers hypothesized that possession of this missing information would enable extension providers in the Ministry of Agriculture, ICIPE and their development partners to more effectively disseminate information on Desmodium seeds, which would lead to greater adoption of the PPT among smallholder farmers in Western Kenya.

Problem of Research

Scientists continue to develop improved technologies to increase farming efficiency and productivity but the rate of adoption of these technologies is still less than optimal. Consequently, the full benefits of agricultural research are far from being realized. Among the technologies whose full benefits are yet to be realized in Western Kenya is the effective, ICIPE-developed, low-cost and environmentally friendly PPT for controlling *Busiolla fusca* and *Striga hermonthica* (Khan, 2007 & 2008c). Though several investigations had been done in Western Kenya on how PPT was disseminated, adequate information was still lacking on

how it was diffused to smallholder farmers using agro-dealers. Insufficient empirical evidence on the effectiveness of agro-dealers in disseminating the PPT to smallholder farmers limited its full exploitation. This was a primary concern among researchers and extension providers who needed the information to enhance service delivery particularly with respect to input supply.

Research Focus

While selling farm inputs aimed at increasing crop and livestock productivity, agro-dealers advise farmers on how to use them. Their well established network in Kenya links farmers with other stakeholders in the agro-inputs supply chain and the dealers are used by local and multi-national seed, fertilizer, and agro-chemical companies to exhibit and demonstrate new technologies to farmers (Rockefeller Foundation, 2007, The Sower, 2008). At the time of the study, seed outlets in most districts of Western Kenya were few, unevenly distributed and mostly found in big trading centres and because the dealers were concentrated in high production areas or where production of high value crops was practiced, farmers travelled long distances to buy seeds thereby incurring high transaction costs (Gordon, 2000). While local agro-dealers in the area supplied most of the seeds that farmers required, availability of certified Desmodium seeds posed a big challenge because seed companies did not engage in commercial multiplication of Desmodium seeds (Kibaara, 2006). Unavailability of high quality certified Desmodium seeds made it harder for agro-dealers to stock them, which caused scarcity of the seeds and their inaccessibility by farmers. This situation left farmers using Desmodium seeds of unknown quality.

According to DFID (2006), a seed dealer in Kenya required an operation permit of 70,000.00 Kenya Shillings (Ksh 80 = US$ 1.00), which was unaffordable to many smallholder farmers. A favourable policy for seed production, certification, registration, packaging and supply prices would motivate the private sector to invest in the seed supply business. Input suppliers' costs, risks and uncertainty can be reduced by increased demand volumes and transaction sizes, which can be arranged between farm input suppliers and farmer organisations (Blackie & Albright, 2005; Gordon, 2000). The 'Push-Pull' technology developed by ICIPE offers an effective control of *Busiolla fusca* and *Striga hermonthica* and is simple, low-cost and environmentally friendly (Khan, 2007). In this technology, Desmodium is planted between the rows of maize or sorghum to improve soil fertility and stability through nitrogen fixation. Being a low-growing plant it does not interfere with the growth of maize. It also provides a highly nutritious animal feed.

Despite the vegetative propagation of Desmodium seeds being widespread, their shortage limits disseminating of the PPT (ICIPE, 2007). Farmers have difficulties accessing the seeds because agro-dealers who are expected to sell them do not usually deal with some particular legume, tree or shrub seeds (DFID, 2006). Marketers and business managers in general often want to estimate demand for the seeds in order to use the estimates for strategic and tactical planning (Brennan, 2004). Estimates of the potential number of buyers times the average quantity purchased by a buyer times the price gives helps in arriving at the total market potential (Kotler, 2002; Solomon, Marshall & Stuart, 2006). Insufficient demand for Desmodium seeds limits their market size making it smaller than that of food crops and relatively unattractive to Big seed companies, which leaves farmers selling uncertified seeds among themselves (Odame, Musyoka & Kere, 2008). With this problem in mind, Desmodium seed producers should inform potential buyers through radio, print and electronic media as well other communication channels where to get the seeds (Kotler, 2002; Perreault & McCarthy, 2005).

The theoretical framework for this study was based on the diffusion of innovation theory as it demonstrates how a new technological idea, artefact or technique, or use of an old one moves from inception to ultimate use. Diffusion, also defined as aggregate adoption, is the process by

which an innovation is communicated to members of a social system (Arumapperuma, 2008). The willingness and ability of intended users to adopt a new technology depend on their awareness, interest, evaluation and trial of the technology. According to Rogers (1971), research on the effectiveness of communication pathways in the diffusion process was inadequate and although researchers continued to develop new technologies such the PPT to address farmers' needs, improving farmers' adoption rates was still a major challenge. The Diffusion of Innovation Theory provided an instrument for conducting and analyzing empirical data aimed at measuring agro-dealers' effectiveness in disseminating PPT among farmers in Western Kenya.

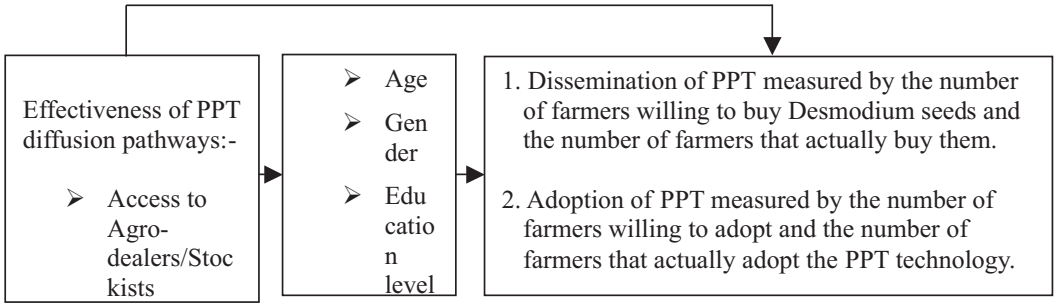

Figure 1: A conceptual framework for measuring the effectiveness of agro-dealers in enhancing dissemination and adoption of "Push-Pull" technology.

Methodology of Research

General Background of Research

The study used a cross-sectional survey design, which is also called cross-sectional analysis, to collect and analyze data. The researchers chose this design for the study because it is faster and less expensive compared to cohort studies and it allows for hypotheses testing while providing self-reported facts on things that are not directly observable such as people's beliefs, feelings, attitudes, opinions and habits (Kendall, 2007, Kombo & Tromp, 2008, Kothari, 2008). Cross-sectional surveys are used in all branches of science. They enable researchers to study and describe a population that is too large to observe directly (Kendall, 2007). Since data is collected from a specific population at one point in time, chances for attrition are minimized. Western Kenya borders Uganda to the west, Tanzania to the south and lies between latitude 1° 8' N and 1° 24' S and between longitude 34° and 35° E (Jaetzold & Schmidt, 1982, 1983).

Sample of Research

The study population comprised local agro-dealers located in districts of Western Kenya in which farmers practised PPT. A district-based proportionate stratified random sampling with consideration for agro-ecological, ethnical and market access diversity was used to select a sample of 102 agro-dealers from a list of 250 that was provided by the local staff of the Ministry of Agriculture prior to the beginning of the study. This sample size was considered adequate, precise and representative enough of the target population because according to the central limit theory, the sampling distribution of the mean tends to be closer to the normal distribution provided that the number of sample items is equal or more that 30 (Frankfort-Nachmais, 1997;

Kathuri & Pals, 1993, Kothari, 2003). The districts from where the sample was drawn included Bungoma South, Teso, Busia, Vihiga, Siaya, Bondo, Butere, Kisii, Kuria, Migori, Rachuonyo and Suba.

Instrument and Procedures

A closed-ended questionnaire, used to collect data from agro-dealers, enhanced consistency of responses across respondents. Content validity was ascertained by a panel of 10 extension professionals drawn from Egerton University and the International Centre of Insect Physiology and Ecology. The Cronbach's alpha coefficient was used to measure the instrument's internal consistency while a pilot test involving 18 agro-dealers from Homabay district showed that the questionnaire's reliability was 0.85α, which was above the 0.70 minimum acceptable for educational research. Prior to field data collection, the researchers sought and obtained a research permit from the National Council of Science and Technology after which they make appointments with the selected respondents and explained to them the purpose of the study before asking them to complete the questionnaire. The responses recorded in the questionnaires were later transferred to an electronic database (SPSS version 11.5 software) for further analysis.

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 obtained from the questionnaires were entered and analysed using the Statistical Package for Social Sciences (SPSS). Descriptive and inferential statistics were used to describe and report information related to the variables of the study. Cross-tabulation was utilised to compare situation of respondents along several variables and to determine the effects of various categorical variables. Study findings were represented in form of discussions, charts and tables. The two null hypotheses of the study were tested using Chi-square at a confidence level of 0.05α.

Results of Research

Over 61% of agro-dealers (Table 1) had operated the farm-input business for 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. Out of the 98% agro-dealers with knowledge of *striga hermonthica*, 50% rated the striga problem as very serious, 37.3% as serious and 11.8% as moderate. Half of female and 50% of male agro-dealers rated the striga problem as very serious (Table 2) while 34.6% female and 38.2% male agro-dealers rated it as serious, 15.4% female and 10.5% male rated the problem as moderately serious; and 85.7% of agro-dealers with primary education, 59.5% with secondary, 40.9% with college and 35.7% university education rated the problem as very serious. Over 87% of agro-dealers that had operated the business for 1-9 years considered the striga problem in their areas as serious compared to 43.3%) of those who had operated the business for 10-19 years, 66.7% of those who had operated for 20-29 years, and 50% of those who had operated the business for over 30 years.

Table 1. Agro-dealers' personal characteristics and rating of the striga problem by length of years in business (N=120).

Agro-dealers characteristics	Percent	Seriousness of the striga problem	Percent
Female	25.5	Agro-dealers with knowledge on striga	98.0
Male	74.5	Considered striga problem as very serious	50.0
Operated business for 01-05 yrs	61.8	Considered striga problem as Serious	37.3
Operated business for 06-10yrs	28.4	Considered striga problem as Moderate	11.8
Operated business for 11-15yrs	3.9	Considered striga problem as Less serious	1.0
Operated business for 16-20yrs	2.9		
Operated business for 21-30yrs	1.0		
Operated business for >30yrs	2.0		
Agro-dealers from whom farmers sought solutions for striga problem			85.3

Source: Survey data (2011)

Table 2. Agro-dealers' characteristics and rating of striga problem by education (N=120).

	Agro-dealers' rating of striga problem in their area			
Agro-dealers characteristics	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
Primary education (n= 7)	85.7	0.0	0.0	14.3
Secondary (n=37)	59.5	27.0	13.5	0.0
College education (n=44)	40.9	47.7	11.4	0.0
University education (n=14)	35.7	50.0	14.3	0.0
Operated as an agro-dealer for 1-9 yrs (n=82)	54.9	32.9	12.2	0.0
Operated as an agro-dealer for 10-19 yrs (n=15)	40.0	3.3	0.0	6.7
Operated as an agro-dealer for 20-29 yr (n=3)	0.0	66.7	33.3	0.0
Operated as an agro-dealer for >30 yrs (n=2)	0.0	50.0	50.0	0.0

Source: Survey data (2011)

Different methods that farmers in agro-dealers' neighborhoods used to control striga weeds (Table 3). Over 54% controlled stiga weeds by uprooting and burning, 28.4% by applying farm yard manure, 2.0% by applying ash, 3.9% by early planting, 22.5% by weeding, 12.7% by using striga-tolerant maize varieties, 18.7% by using PPT, 7.8% by intercropping, 6.9% by crop rotation 2.9% by herbicides and 1.0% by using treated seeds. Though most agro-dealers indicated that striga infestation in their localities was very serious, 4% of them had no idea on how to control it. Out of the 85% agro-dealers from whom farmers sought solutions to the striga problem, 7.8% advised farmers to use chemicals, 4.9% early land preparation, 31.4% PPT, 2.0% certified maize seeds, 23.5% farm yard manure, 20.6% to uproot and burn the weed, 14.7% to use crop rotation, 4.9% to intercrop cereals with legumes, 26.5% to use striga tolerant varieties and 7.8% advised them to use proper weeding. Over 18% of the agro-dealers had heard of PPT for the first time from radio, 12.7% from extension officers, 2.7% from field days,

9.8% from PPT brochures or posters and 5.9% from NGOs or CBOs. Other sources of PPT information included farmer teachers (3.9%), ASK shows (2.9%), Newspapers or magazines (2.0%), neighbours (2.0%), agro-dealers (2.0%), ICIPE on-farm trials (2.0%) and agriculture teachers (1.0%).

Method of striga control	Percent	Solution for the striga problem	Percent
Application of farm yard manure	28.4	Agro-dealers consulted by farmers	85.3
Application of ash	2.0	Agro-dealers advised chemical control	7.8
Early planting	3.9	Advised early land preparation	4.9
Weeding	22.5	Advised use of PPT	31.4
Use of striga-tolerant maize varieties	12.7	Advised use of certified maize seeds	2.0
Use of chemically-treated seeds	1.0	Advised use of farm yard manure application	23.5
Use of PPT	18.6	Advised use of uprooting and burning striga	20.6
Intercropping	7.8	Advised use of crop rotation	14.7
Crop rotation	6.9	Advised intercropping of cereals with legumes	4.9
Herbicides	2.9	Advised use of striga-tolerant varieties	26.5
Uprooting and burning	54.9	Advised use of proper weeding	7.8
Information from radio	18.6	Information from farmers field day	12.7
Information from brochures/posters	9.8	Information from NGO/CBO	5.9
Information from Farmer teachers	3.9	Information from neighbour	2.0
Information from Extension officers	12.7	Information from farm input stockiest	2.0
Information from ASK shows	2.9	Information from ICIPE on-farm trials	2.0
Information from print media	2.0	Information from agriculture teachers	1.0

Source: Survey data (2011)

Table 3. Striga control methods and solutions as suggested by agro-dealers (N=120).

Agro-dealers' effectiveness in disseminating PPT was not related to their understanding of the seriousness of the striga problem in their locality ($p>0.05$). Table 4 shows that 43.1% of those considered most effective, rated the problem as very serious in areas in which they operated compared to 23.7% who considered it serious and 33.3% who considered it moderate. Of those categorized as effective, 60.5% rated the problem in their locality as serious. Agro-dealers' effectiveness in disseminating PPT was not related to their knowledge of PPT's effectiveness to control striga weeds. Nor was it related to their knowledge of Desmodium seed. The Chi square test showed a relationship between agro-dealers' effectiveness in disseminating PPT and the frequency in which farmers visited them in a month looking for information on Desmodium seeds ($\chi^2 = 23.768$, p-value=0.003).

Table 4. Agro-dealers' effectiveness (N=120).

	Percentage effectiveness				
Agro-dealers' characteristics	**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
Operated business for 1-9yrs (n=82)	20.7	45.1	34.1		
Operated business for 10-19yrs (n=15)	20.0	53.3	26.7		
Operated business for 20-29yrs (n=3)	0.0	66.7	33.3		
Operated business for over 30yrs (n=2)	0.0	0.0	100.0		
Total(n=102)	19.6	46.1	34.3	5.192	0.519
Primary education (n=7)	14.3	42.9	42.9		
Secondary education (n=37)	21.6	45.9	32.4		
College education (n=44)	22.7	40.9	36.4		
University education (n=14)	7.1	64.3	28.6		
Total (n=102)	19.6	46.1	34.3	3.159	0.789
Rated problem as very serious (n=51)	21.6	35.3	43.1	9.996	0.125
Rated problem as serious (n=38)	15.8	60.5	23.7		
Rated problem as moderate (n=12)	16.7	50.0	33.3		
Rated problem as less serious (n=1)	100.0	0.0	0.0		
Rating PPT most effective (n=25)	12.0	44.0	44.0	2.805	0.833
Rating PPT effective (n=29)	17.2	51.7	31.0		
Rating PPT moderately effective (n=4)	25.0	50.0	25.0		
Knowledge of Desmodium (n=93)	19.4	44.1	36.6	2.491	0.288
Sought advice once per month (n=14)	21.4	50.0	28.6	23.768	0.003
Sought advice 2-3x per month (n=32)	12.5	53.1	34.4		
Sought advice 4-5x per month (n=13)	7.7	38.5	53.8		
Sought advice >5x per month (n=16)	0.0	37.5	62.5		

Source: Survey data (2011)

Over 91% of the dealers knew about Desmodium (Table 5) and 73.5% had been asked about its seeds by farmers and 13.7% had been asked at least once per month by farmers to provide information on Desmodium seeds. Over 88% of the farmers indicated that they would buy Desmodium seeds if the seeds were available. All agro-dealers had problems estimating demand for Desmodium seeds but 1.9% rated demand for Desmodium seed as very high, 22.5% as high, 32.3% as medium, 33.3% as low, and 8.8% as very low while 0.98% did not know. Over 20% had stocked Desmodium seed in their shops, 84.3% usually attended trainings promotin use of different inputs and over 42% had attended trainings promoting technologies that controled striga while 35.3% had attended trainings promoting PPT.

Table 5. Chi-square test values on agro-dealers knowledge of Desmodium (N=120).

Agro-dealers' knowledge of Desmodium seed	Gender		
	Percent	Chi-square	p-value
Knowledge of Desmodium seed (n=93)	91.6	4.698	0.030
Agro-dealers asked for Desmodium seeds (n=75)	73.5	0.206	0.650
Asked for Desmodium seed once per month (n=14)	13.7	2.449	0.654
Asked for Desmodium seed 2-3x per month (n=32)	31.4		
Asked for Desmodium seed 4-5x per month (n=13)	12.7		
Asked for Desmodium seed 5x per month (n=16)	15.7		
Agro-dealers' perception on whether farmers would buy Desmodium seed if it were available? (n=90)	88.2	0.002	0.967
Rated demand for Desmodium seed as very high (n=2)	1.9	4.300	0.507
Rated demand for Desmodium seed as high (n=23)	22.5		
Rated demand for Desmodium seed as medium (n=33)	32.3		
Rated demand for Desmodium seed as low (n=34)	33.3		
Rated demand for Desmodium seed as very low (n=9)	8.8		
Don't know about demand for Desmodium seed (n=1)	0.98		
Stocked Desmodium seed in their shop (n=21)	20.5	0.578	0.447
Attended training promoting inputs they sold (n=86)	84.3	1.441	0.230
Trained on technologies that control striga (n=43)	42.0	1.856	0.173
Trained on PPT (n=36)	35.3	1.071	0.301

Source: Survey data (2011)

There was no statistical significant difference between gender and agro-dealers' ability to estimate demand for Desmodium seed. Over 88% of agro-dealers indicated that farmers would buy Desmodium seed from them if they sold it. Table 6 shows that all agro-dealers 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. Though over 89% of agro-dealers from Busia, Vihiga, Bondo, Rarieda, Butere, Gucha, Kuria, Migori and Rongo districts, did not have certified Desmodium seed in their shops, they were willing to stock and sell it if it became available. Although 84.3% of agro-dealers usually attended trainings promoting the different inputs that they sold, only 42.2% had attended training promoting technologies that control striga including PPT.

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Table 6. Agro-dealers perceptions on creating demand for Desmodium seeds (N=120).

District of the business	Would farmers buy Desmodium seed if available? (%)	Do you stock Desmodium seed in your shop? (%)	If you don't have Desmodium seed, would you like to stock some?(%)	Are you Usually trained on how to promote your input? (%)	Have you attended training on how to control striga? (%)	Have you ever attended any training on promotion of PPT? (%)
Bungoma	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 (2011)

On how agro-dealers could be made more effective in dissemination PPT and creating demand for Desmodium seed (Table 7), 78.4% of the agro-dealers suggested empowerment through training; 12.7% suggested creating awareness on PPT and Desmodium seeds; 1% suggested creating linkages with seed companies; 36.3% suggested providing posters, brochures and pamphlets; 8.8% suggested reducing Desmodium packages and prices; 11.8% suggested offering credit; 9.8% advertising and promoting PPT through media; 14.7% accessing Desmodium seeds; 7.8% supplying stockists with Desmodium sample seeds; 5.9% publicizing availability of Desmodium seeds; and 9.8% suggested establishing PPT demonstration plots near agro-dealers' stores.

Table 7. Ways of supporting agro-dealers to disseminate PPT (N=120).

Method	Percent
Training	78.4
Creating awareness	12.7
Linking farmers with seed dealers/companies	1.0
Providing poster, brochures and pamphlets	36.3
Reducing Desmodium packages and prices	8.8
Offering credit	11.8

Promoting PPT through media	9.8
Accessing Desmodium seeds	14.7
Supplying Desmodium sample seeds	7.8
Publicising availability of Desmodium seeds	5.9
Establishing demonstration plots near agro-dealers stores	9.8

Source: Survey data (2011)

Discussion

Over 80% of agro-dealers scored highly on nine aspects of effectiveness, which included (1) ability to deliver needed goods and services on time; (2) use of different distribution strategies to reach many farmers; (3) linking farmers to seed companies; (4) ability to explain to farmers how to use seed-based technologies; (5) keeping regular and up to date stock; (6) membership to agro-dealers' networks, partnerships or outreach programs that work with farmers; (7) ability to give credit to farmers; (8) ability to keep records of farmers served; and (9) the ability to keep record of farmers who buy inputs. Agro-dealers' effectiveness in disseminating PPT was not significantly related to their ability to estimate the seriousness of the striga problem in the local farm ($p>0.05$). Neither was their effectiveness significantly related to their understanding of how PPT works or to their knowledge of Desmodium. However, there was a statistically significant relationship between agro-dealers' effectiveness and the frequency in a month in which farmers sought information on Desmodium seeds as indicated by the Chi square test ($p<0.05$). Agro-dealers' effectiveness was not significantly related to their gender, number of years in which they had operated the business or their education level.

However, agro-dealers' gender was significantly related to their knowledge of Desmodium but not significantly related to their perception on whether farmers would buy Desmodium seed if it was made available , being asked for Desmodium seed by farmers or the frequency in a month in which farmers sought information on Desmodium seed. As suggested by Khan (2007), involving agro-dealers in promoting and stocking of Desmodium seed could help meet farmers' demand for the seed and also provide market information on available inputs. In summary, the effectiveness of agro-dealers in disseminating and enhancing adoption of PPT was not affected by gender, education or the number of years in business but agro-dealers effectiveness in enhancing demand for Desmodium seed was affected by one's gender and knowledge of Desmodium. However, it was not affected by the frequency in which farmers sought information on Desmodium seed in a month. Nor was it affected by their perception on whether farmers would buy Desmodium seed if it was made available or whether they were asked for information on Desmodium seed by farmers.

Conclusions

Based on the results of the study, the researchers concluded that agro-dealers were effective in disseminating and enhancing PPT adoption by smallholder farmers in Western Kenya; that the effectiveness of agro-dealers to disseminate information and adoption of PPT was not affected by their gender, education or number of years they had operated as traders. Their effectiveness was not dependent on their knowledge of PPT, knowledge of Desmodium plant or of the seriousness of the striga problem; but depended on the frequency in which farmers asked them for information on Desmodium seed. Creating awareness on PPT and Desmodium seed among farmers encourages them to seek more information from agro-dealers. The researchers further concluded that agro-dealers from whom farmers sought information on PPT and Desmodium seed frequently were

more effective in disseminating it. Marketers should therefore, target agro-dealers who are visited most frequently by many farmers. This study has indicated the important role that agro-dealers play in disseminating PPT, enhancing its adoption and linking farmers to the private sector, seed dealers, extension providers, researchers and other stakeholders. These linkages help farmers to access crucial knowledge, skills, professional advisory services, financial support, credit and useful networks. If properly utilised as dissemination pathways, agro-dealers can enhance adoption by farmers of technologies such as PPT.

Since agro-dealers have been found to be effective in disseminating and enhancing adoption of the push-pull technology by smallholder farmers, they should be taught the correct way to use Desmodium seed and to identify and control the striga weed using the push-pull technology so that they can in turn educate the farmers effectively. Since agro-dealers deal with adult farmers who vary greatly in terms of age, education, experience and socio-economic status, extension providers and their collaborators should train them adequately in adult education principles and in soft skills to improve their competences in public relations as well as oral and written communication. Such training is particularly important for agro-dealers working in areas where stem borer and striga pose a major challenge to agricultural production. Effective training may require a multifaceted approach involving many stakeholders such as universities, banks, Kephis, Agmark, Rockfeller foundation, ICIPE, Western Seed Company, KARI, ACDI and VOCA, among other players along agricultural products and marketing value chain. Through the public-private partnerships, local and national leaders should facilitate timely and widespread availability of affordable and certified Desmodium seed to farmers across the country and should encourage more farmers to use certified Desmodium seed as well the PPT in order to increase productivity of cereals. For future research, the researchers recommend two studies in Western Kenya. The first study should be done to assess the number of smallholder farmers practising and adopting PPT as a result of information disseminated by agro-dealers while the second study should be done to assess the impact of PPT on farmers' standard of living after buying and using Desmodium seed for a period of five years.

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