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Effects of Farmers' Socio-economic Characteristics on Adoption of Push Pull Technology in Western Kenya: Insights from UPSCALE Project

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ABSTRACT

Agricultural technologies are being developed and improved to help in curbing constraints associated with agricultural production and income. Push pull Technology (PPT) is an organic approach in pest management that uses cereal as the main crop and companion crops as Brachiaria.spp and desmodium.spp. UPSCALING the benefits of PPT and its adoption has the potential for intensification of farming systems, addresses food security, livelihoods and climate change resilience in Kenya and beyond while reducing the environmental impact of agricultural practices. The technology significantly reduces Fall Army Worm (FAW), Striga weed and stem borer infestation which is still major menace to cereal yield losses in Kenya. Maize worth USD 1.5b is lost annually due to stem bore in Sub Saharan Africa (SSA). Maize is a staple food in East Africa. PPT enhances quality of grains, retains soil moisture, improves soil fertility and protects the soil from erosion thus has the potential to increase cereal yields by 25 per cent-30 per cent. This study was done in Western Kenya with a focus of determining the effects of farmers' socio economic characteristics on adoption of PPT. Sample size of 304 maize household farmers from five counties with UPSCALE project were proportionately sampled. Questionnaires and key informant interviews (KII) were used for data collection. The findings revealed that Striga weeds, stem borer and fall army worms are still the major menaces. Farmers practiced PPT for various combined reasons which included; to control striga, to increase crop productivity and to control stem borer at 76.70 per cent, 59.09 per cent and 57.39 per cent respectively. The outstanding observation is that only a few farmers (3.41%) practiced PPT as a response to climate change. This could be due to labour intensification of the technology.

Keywords: *Farmer' Socio-Economic Characteristics, Adoption, Push Pull Technology, UPSCALE, Kenya*

INTRODUCTION

Agricultural technologies are being developed and improved to help in curbing constraints associated with agricultural production and income. Adoption of agricultural technologies has the potential to contribute to sustainable farming systems and improves the global market. Kenya's International Centre of Insect Physiology and Ecology *(ICIPE)* and Britain's Rothamsted Research collaborated with partners in Eastern Africa developed the Push-Pull technology (PPT). This is an organic approach in pest management that uses cereal the main crop and companion crops as *Brachiaria spp. and desmodium spp.* (*Amudavi et al.*, 2009; Cook, *et at.* 2007).

According Mwangi and Karuki (2015) to

East African countries often experience major constraints such as food insufficiency, increasing population pressure on resources, declining food production, high incidences of environmental unsustainability, as well as high food prices.

Maize is a staple food in western region of

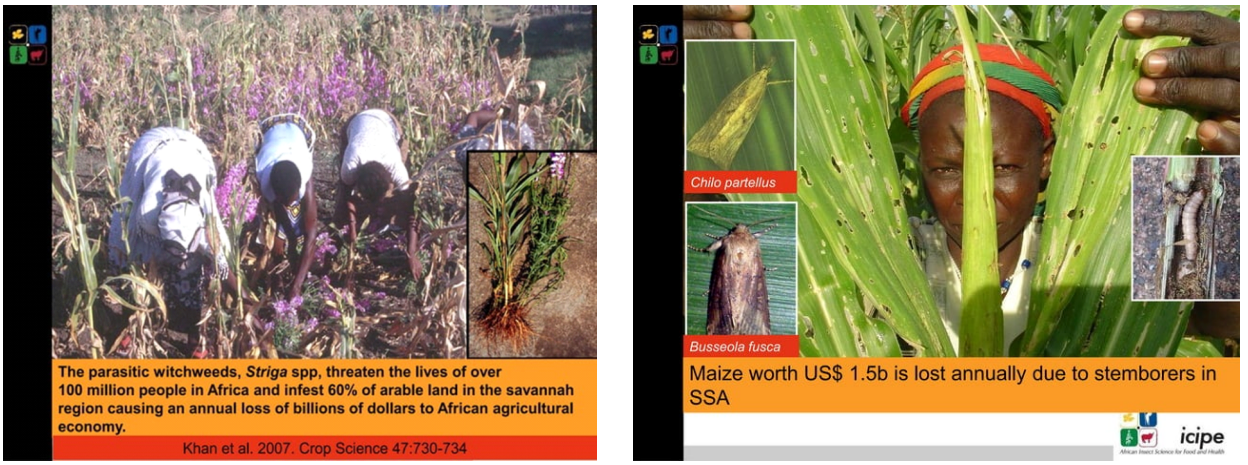

Fig. 1. Maize field infested with Striga and stalk borer (Source: Amudavi, et al., 2009)

PPT is an innovative knowledge-based technology that significantly reduces fall armyworm (FAW), Striga weed and stem borer infestation which is significant to cereal yield losses in western region of the republic of Kenya (Figure 1). PPT enhances quality of grains, retains soil moisture, improves soil fertility and protects the soil from erosion thus it has the potential to increase cereal yields by 25%-30% *(Cheruiyot et al., 2022).*

The technique involves intercropping silver leaf desmodium, a fodder legume, with maize, Napier and Sudan grass (Figure 2) to provide both immediate and long-term benefits. *(Cheruiyot et al., 2022).*

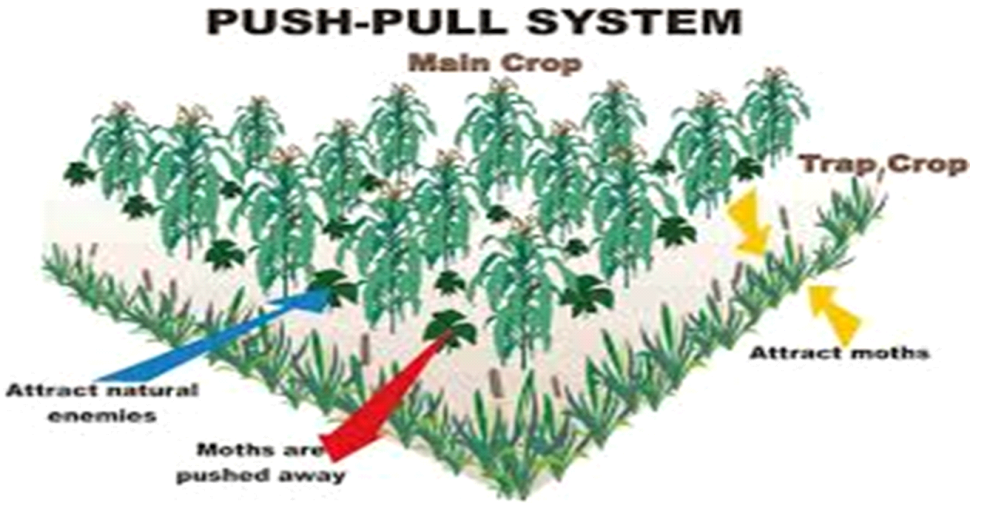

Fig. 2. Push Pull Technology (Source: http:/www.push-pull.net/works.shtml)

PPT has a number of benefits that includes but not limited to stem borer and striga control; increased fodder production; nitrogen fixation and reduced soil erosion; increased forage seed production; increased crop yields; improved dairy production; improved Farm Yard Manure (FYM) production; and increased household income as depicted in Figure 3.

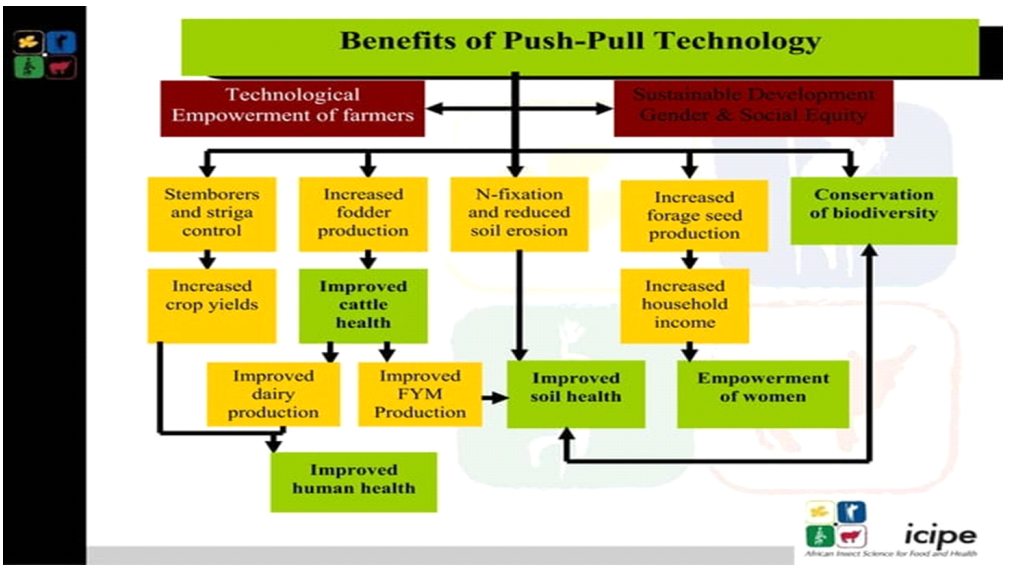

Fig. 3. Benefits of Push Pull Technology

Upscale is a Horizon 2020 (H|2020) project focusing on increasing production efficiency of smallholder farmers in East Africa. The project applies transdisciplinary approaches to research and innovation through Multi-Actor Community (MAC) engagements which is likely to enable smallholder farmers cope with climatic changes while ensuring sustainability and resilience. It is an EU-funded project which aims at scaling up the understanding and applicability of push–pull technology from individual fields, farm, landscape and regional scales; and from cereal to other crops and cultivation systems.

METHODOLOGY

This study was done in Western Region of the Republic of Kenya. The focus of the study was to determine the effect of farmers' socio-economic characteristics on adoption of PPT. Sample size of 304 maize household farmers from counties with UPSCALE project were proportionately sampled namely Kisumu, Homa Bay, Vihiga and Siaya (Table 1). Questionnaires and key informant interviews (KII) were used for data collection (Kothari & Garg 2014).

Table 1
Sample Size Determination

County	Frequency	Percentage (%)
Kisumu	47	15.46
Homa Bay	62	20.39
Vihiga	75	24.67
Siaya	120	39.47
Total	**304**	**100**

This study employed a descriptive and casual research design that allows data collection from individuals from the five counties. This helps to compare relationships between two or more variables among different maize farmers among the UPSCALE project. The research designs were appropriate since the study tends to explore aspects of PPT adoption among smallholder maize farmers as opined by Rodger (1995)

RESULTS AND DISCUSSION

Farmers' Socio-Economic Characteristics Under UPSCALE Project

The results in Table 2 shows socio-economic characteristics of the respondents in the study area.

Table 2
Socio-Economic Characteristics of the Respondents

Gender of respondent	**Frequency**		**Percentage (%)**	
Female	190		62.50	
Male	114		37.50	
Gender of Household head (HH)				
Female	83		27.30	
Male	221		72.70	
Marital status of HHH				
Single (never married)	1		0.33	
Married	222		73.03	
Separated	1		0.33	
Divorced	3		0.99	
Widowed	77		25.33	
Main occupation of HHH				
Agriculture self-employed	239		78.62	
Agriculture wage labour	3		0.99	
Non- Agri self-employed	29		9.54	
Non- Agri wage labour	6		1.97	
Retired/on pension	2		0.66	
Salaried worker	19		6.25	
Remittances	1		0.33	
Sickly/old/not able to work	1		0.33	
Unemployed	4		1.32	
	Mean	min	max	S. Dev.
Household head age (years)	55.82	23	90	12.8974
Academic Years	9.05	0	36	4.2095
Family size (number)	5.92	1	15	2.5486
No. of HH members earning income	1.42	0	9	1.0310
Agricultural Experience (years)	23.19	3	60	12.1106
Total land owned by the household (acres)	2.1625	0	20	2.4271
Total land Rented-in by the household (acres)	1.11	0.125	8	1.1580
Total land Rented-out by the household (acres)	0.97	0.25	2	0.6373

A total of 304 farmers were proportionately sampled and interviewed from Kisumu, Homabay, Vihiga and Siaya Counties at 15.46 per cent, 20.39 per cent, 24.67 per cent and 39.47 per cent, respectively. Individuals within the household who were more informed about the households' farming activities were chosen to be the respondents during the interviews. Out of the sampled respondents, majority (62.50%) were female. This result highlights the increased involvement and gender role of women in the farming sector.

A large proportion of the interviewed households were male headed (72.70), the household heads were mostly within the prime productive age brackets with an average household head being 55.82 years of age and 73.03 per cent of them were married. The household heads were educated as most of them had acquired formal education with an average of 9.05 academic years. The statistics reflect high dependency since the results showed that an average household had 5.92 members of whom an average 1.42 members were in a position of earning income.

A combined 79.61 per cent of the interviewed farmers relied on agriculture as their primary source of income, this was through being

agriculturally self-employed or through agriculture related wage. The sampled farmers were experienced farmers and this is depicted by their average 23.19 years of farming activities. On average the households owned 2.1625 acres of land which is relatively small given the mixed farming nature of the farmers in the study area, to expand on their farm land some rented in land which was averagely an addition of 1.11 acres. Some households other than relying on agricultural production of their land, they earned income from it by renting it out, this was at an average of 0.97 acres of land rented out by a farmer.

Adoption of Push Pull Technology

Table 3 shows results on effects of farmers socio economic characteristics on adoption of push pull technology.

Table 3
Effects of farmers socio economic characteristics on adoption of push pull technology

Variable	Frequency	Percentage
Is your household aware of/ heard about Push-pull technology (PPT)		
Yes	235	77.30
No	69	22.70
How did you first learn about PPT?		
ICIPE staff	175	74.47
Research Centre (trials/demos/field days) KALRO, ICIPE, ISD, ICRAF, GIZ	39	16.60
Government extension	5	2.13
Farmer Coop/Union/group	7	2.98
Farmer field school	5	2.13
NGO/CBO	7	2.98
Fellow farmer	44	18.72
Universities	1	0.43
Social media; YouTube/radio TV etc.	9	3.83
Did the HH use PPT in the past?		
Yes	47	44.76
No	58	55.24
Is your household currently using PPT?		
Yes	130	44.68
No	105	55.32
Have you consistently used PPT?		
Yes	136	76.84
No	41	23.16
Will you continue using PPT in future?		
Yes	128	98.46
No	2	1.54
What are the reasons for using PPT		
Increase crop productivity only	104	59.09
Increase livestock productivity only	38	21.59
To increase livestock fodder	76	43.18
Adopt to changing climate	6	3.41
To improve soil fertility	84	47.73
To control striga	135	76.70
To control stem borer	101	57.39
To control fall armyworm incidences	78	44.32

	Mean	Min.	Max.
For how many years have you known PPT?	8.30	1	27
For how many years have you been using PPT?	8.32	1	25
How many farmers do you know who are using PPT in your village?	5.91	0	100

From the results in table 3, it's worth noting that the farmers' awareness of push-pull technologies in the study region is good, with 77.30 per cent reporting that they were aware or had heard of push-pull technologies while 22.70 per cent were not aware or had never heard of it. The average number of years that the farmers had known PPT and the years they had practiced it were very close as they were 8.30 years and 8.32 years respectively. The highest number of years reported that a farmer had practiced PPT was 25 years.

The farmers' awareness of the PPT was facilitated by a combination of different actors. ICIPE staff were the most influencers on PPT at 74.47 per cent, followed by influence of fellow farmers and Research Centre (trials/demos/field days) at 18.72 per cent and 16.60 per cent respectively. It is worth noting that even though the Universities had an influence in PPT awareness it was the least impactful at 0.43 per cent. From the results it can be noted that farmers were aware of other farmers PPT practices as the reported an average 5.91 neighboring farmers to be practicing it.

As at the time of conducting the study, 44.68 per cent of the farmers were practicing PPT while 55.32 per cent were not practicing PPT. 44.76 per cent of those who were not currently practicing PPT had previously in the past adopted it and later de-adapted it while, 55.24 per cent of those who were not practicing currently had never adopted it even before. Of the farmers who were currently practicing PPT 76.84 per cent had practiced it consistently over the past years. On the future prospect of PPT, 98.46 per cent of those who were currently practicing PPT reported that they will continue practicing it.

CONCLUSION AND RECOMMENDATIONS

The farmers practiced PPT for various combined reasons which included; to control striga, to increase crop productivity only and to control stem borer reported at 76.70 per cent, 59.09 per cent and 57.39 per cent respectively. The outstanding observation is that only a few farmers (3.41%) practiced PPT as a response to climate change. This could have been due labour intensive nature of PPT.

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