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Use of Participatory Video in Enhancing Sorghum Production among Smallholder Sorghum Farmers' in Rachuonyo North Sub-County, Kenya

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Abstract **– Push-pull technology (PPT) is currently and widely promoted amongst smallholder farmers in western Kenya in order to enhance sorghum production. It effectively controls the most critical biotic constraints of stemborers and striga weed affecting cereal production in smallholder farming systems in Africa. Since it is a relatively knowledge intensive technology, accessing information about its efficacy is critical for maximum adoption and continued use. PPT has been disseminated through traditional extension methods which have not proven very successful. Although PPT has been successfully demonstrated to improve livelihoods and welfare of poor farmers, its adoption by, and impact on the majority of the farmers and other end users remains a challenge. This is majorly attributed to ineffective dissemination pathways. Participatory Video (PV) is being promoted as an alternative to such methods to enhance use of PPT to increase sorghum production. This study sought to determine the effectiveness of PV in sharing PPT knowledge to enhance sorghum production among smallholder sorghum farmers in Rachuonyo North. The study utilized a cross-sectional survey research design to collect data from 120 randomly selected smallholder sorghum farmers who were trained through PV, using a semi-structured interview schedule. The data was analyzed using SPSS and presented using frequency tables, percentages, charts, graphs, averages, and Chi-square test. The results indicated that almost all PV trained farmers easily shared out information to fellow farmers. The results also indicated a statistically significant positive relationship between knowledge shared and knowledge use. The study recommends sustainable up-scaling of effective participatory methods and approaches like PV for public extension to reach more farmers beyond the study area, and for other agricultural enterprises. This is significant for policy on dissemination and adoption of agricultural productivity enhancing technologies such as PPT.**

Keywords **– Participatory Video, Push-pull Technology, Sorghum Production, Striga.**

I. Introduction

Food security in Rachuonyo North is linked to attaining sufficient sorghum supply at household level [1]. However, sustainable sorghum production is faced with numerous challenges which have the potential to upset livelihood of many households in the area. Among these challenges, the infestation by cereal stemborers and the parasitic striga weed are very critical [2]. In Kenya, it is estimated that stemborers cause between 20-80% estimated yield losses, while striga causes up to 100% yield losses annually under severer infestation levels [3]. However, Push-pull technology (PPT) developed by the International Centre of Insect Physiology and Ecology (ICIPE) and partners is a novel cropping management strategy which concurrently addresses these biotic constraints and soil fertility resulting in significant yield increases and improving farm productivity in cereal-based farming systems in SSA [4]. This has the implication that the PPT should be effectively disseminated so that farmers may realize optimum sorghum yields.

In spite of the evidence suggesting multiple benefits of PPT, its adoption by smallholder sorghum farmers has remained low. This is evidenced by striga and stemborer infested farms and the low sorghum productivity (< 1 ton/ha) [1]. Low adoption of PPT has been attributed majorly to the ineffective dissemination pathways to enhance access to knowledge and accelerated uptake of the technology. Studies done in western Kenya, specifically [5] and [6] have shown that PPT is relatively knowledge intensive and that accessing information about its efficacy is critical for maximum adoption and continued use. The properties of PPT make it appropriate for delivery by more innovative dissemination pathways to build the capacities of farmers to learn and engage in productive activities [7].

Participatory video (PV) is considered as an empowering extension methodology which offers considerable potential for improving the quality of learning and dissemination of PPT. Reference [8], [9] and [10] ascertain that PV is important for learning and dissemination for it uses among other things the power of images and enables storage and quick retrieval of information, and has emerged as a powerful medium for knowledge sharing in a cost effective format. The empirical evidence from the [5] study concluded that the power of the PV could thus enable extensive and intensive learning of PPT by farmers. However, the studies are not explicit on how PV is effective in enhancing the capacities of farmers to learn and disseminate PPT. PV is being promoted as an alternative to other extension methods in use such as field days, FFS, print materials and others which have not proven very successful. This study therefore endeavored to determine effectiveness of PV in sharing PPT knowledge among smallholder sorghum farmers for enhanced sorghum production in Rachuonyo North.

The study borrowed from the Diffusion of Innovation theory (DoI) [11], and Technology Acceptance Model (TAM) [12]. The DoI emphasizes that innovations communicated through effective pathways results in effective dissemination by tapping into the social networks within community structures [11]. The TAM Model posits that perceived usefulness and perceived ease of use determines an individual's intention to use a system with intention to use serving as a mediator of actual system use. Perceived usefulness is also being seen as being directly impacted by perceived ease of use of the technology. The relevance for this study is that the dissemination of knowledge intensive technology such as PPT can be enhanced to reach many farmers through Participatory Video.

II. Research Methodology

The study was carried out in Rachuonyo North Sub-County, Kenya, where biotic constraints addressed by PPT, namely striga weed, stemborers and poor soil fertility are a major threat to staple food productivity. It is one of the main sorghum growing areas in Nyanza region. Majority are smallholder farmers who are hardest hit by the challenges mentioned and are a representation of farmers in similar regions. The sub-County has two divisions with a population of 162,166 persons, 32,000 households and 26,000 farm families, with an average population of 403 persons per square kilometre. It is a marginal Sub-County with poverty index of 69% [1]. The Sub-County borders Lake Victoria to the north, Rachuonyo South Sub-County to the south, Nyakach Sub-County to the east and Homa Bay Sub-County to the west. The Sub-County ($00^0$17′-$00^0$36′S, 34º26′E) lies at an altitude between 1140m–1580m above sea level, receives bimodal rainfall with annual average of 700-1200 mm per annum, with 40% reliability and temperature range of 28^0C-32^0C. The soil types are black cotton and sandy loam and falls within agro ecological zones (AEZ) LM3 and LM4. Production systems are predominantly crop-livestock, basically staple cereals and indigenous livestock [13].

The research used a cross-sectional survey design that involved a semi-structured interview schedule to collect data. Population under study consisted of 300 smallholder sorghum farmers who learnt PPT through exposure to PV extension methodology in Rachuonyo north sub-County. Farmers were being trained by ICIPE in collaboration with Ministry of Agriculture. Simple random sampling was used in choosing a sample of 120 respondents from a sample frame of 300 PV trained sorghum farmers in Rachuonyo North Sub-County. The type of data collected related to areas of demographic information, type of information shared with fellow farmers, number of farmers shared knowledge with and ease of sharing PPT information using PV.

III. Results and Discussions

Sample's demographic characteristics

The personal variables were relevant to the study since they may have an influence on the respondent's ability to effectively learn, share and use knowledge of PPT in sorghum production. The results on key demographic factors of the respondents are presented in Table 1.

Table 1: Descriptive data for individuals interviewed (n=120)

Variable	Sub-level	Frequency	Percent
Gender	Male	50	42.0
	Female	70	58.0
Age group	21-30yrs	16	13.0
	31-40yrs	35	29.0
	41-50yrs	38	32.0
	>50yrs	31	26.0
Level of Education	None	08	6.7
	Primary	66	55.0
	Secondary	38	31.7
	Tertiary	07	5.8
	Adult class	01	0.8
Marriage	Married	92	76.7
	Widowed	27	22.5
	Single	01	0.8
Farm size (acres)	0.1-1.99	13	10.8
	2.0-3.99	76	63.3
	4.0-6.99	30	25.0
	7.0-10	01	8.0

The respondent's mean age was found to be 43 years with majority (32%) falling in the middle-age group ranging between 41-50 years. This implies that, majority of the farmers are energetic and therefore are able to invest on Push-pull technology for future benefits. More than half (58%) of the respondents were female and 42 percent were male. The higher percentage of women implies that more women are involved in sorghum production and that they were also decision makers in household activities including deciding what food to grow, what agricultural technologies to adopt and how to access the information. However, if sorghum production is to be enhanced, it is thus important to provide both male and female farmers with efficient, effective and appropriate technology, training and information. Most (76.7%) of the respondents were married, 22.5% were widowed and only one respondent (0.8%) was single. Literacy level was moderate, with majority (55%) of the respondents had primary education, while 31% had secondary education, 5.8% had tertiary education, only one female respondent

(0.8%) attended adult literacy class and only eight respondents (6.7%) majority of who were females had no formal education. This implies that since majority of the farmers had education up to primary level, then farmers' ability to obtain, process and analyse information disseminated by PV is enhanced. In a related study by [14]to determine the role of women in diffusion and uptake of PPT in Lambwe, Suba District, it was noted that low levels of literacy and education was a major constraint in receiving and sharing of PPT knowledge among women farmers. To address such constraints and enhance use of PPT, a unique opportunity could be derived through training using PV. The minimum farm size reported was 0.5 acres, while the maximum was 10 acres. Farms in the study area are generally small averaging between 2-3 acres per household for the sample respondents. This suggests that the respondents were smallholders who practice subsistence farming. However, the size of the farm did not affect PPT adoption, suggesting that PPT is mostly scale neutral, and that its adoption may take place regardless of farmer's scale of operation [4]. PPT allows intensive farm utilization. Sorghum and Maize are the major staple cereals grown by all households. Other crops included legumes such as groundnuts, beans, cow peas and green grams); root crops mainly cassava and sweet potatoes and arrow roots. Indigenous livestock species are predominant including local zebus, poultry, goats and sheep.

Sharing PPT Knowledge with other Farmers

The study investigated whether PV trained sorghum farmers had shared out to other farmers the knowledge and information acquired about PPT through exposure to PV in Rachuonyo sub-County and outside. The results are presented in Table 2.

Table 2: Extent of sharing knowledge with other farmers

	Frequency	Percent
Yes	116	96.7
No	4	3.3
Total	120	100.0

The results indicate that majority of the respondents, 116 (96.7%) shared out knowledge freely with fellow farmers who were non-members of their groups. Therefore, knowledge and information shared is expected to positively influence utilization of PPT for striga weed and stemborer control geared towards enhanced sorghum production in the study area. The farmers shared knowledge on push-pull technology on areas they understood and were confident about. They indicated that they shared out information acquired through participatory video trainings. Most farmers were confident they were able to impart the information they had learnt. This finding corroborate with results in a study conducted by [15]and[18], which revealed that the success of PV lies in its effectiveness in learning and dissemination processes of knowledge and skills among rural communities. This implies more farmers acquired knowledge to enhance use of PPT to increase sorghum production.

The main means of interaction with other farmers were through interpersonal networks where farmers exchange information and acquire knowledge. The farmer group team effort was crucial, and community action and social group cohesion were strengthened by the PV process. This was an important aspect in enabling social capital for further knowledge sharing and technology diffusion and subsequent adoption [8]. It was demonstrable among the sorghum farmer groups that PV led to building new and dynamic relationships around a common objective. PV has potential to develop the farmers' own innovative capacity for increased productivity geared towards improved livelihoods. According to [16]-[17], Membership into farmer groups enables individuals to have access to capacity building efforts such as training, and to information pertaining to new agricultural technologies. Farmer-to-farmer extension channel is preferred by all farmer groups. However, PV is proven able to improve information delivery and communication of farmer-to-farmer extension, [18].

The study sought to establish the number of fellow farmers an individual PV trained smallholder sorghum farmer shared knowledge with either within or outside their groups. The farmers were found to have reached different numbers of fellow farmers with information on PPT. Table 3 summarizes the number of farmers shared knowledge with.

Table 3: Distribution of respondents by number of farmers shared knowledge with (n=120)

Number of farmers shared with	Frequency	Percent
None	4	3.3
1-5	70	58.3
6-10	28	23.3
More than 10	18	15.0
Total	120	100.0

The highest number of farmers reached by each farmer who viewed videos ranged between 1-5 (58.3%), while 23.3 percent of farmers reached with information on PPT ranged 6-10 and 15.0 percent were more than 10, whereas only 3.3 percent did not share the information on PPT due to poor health and impaired hearing. Most farmers who viewed videos shared information with averagely five people outside his or her group. PV, therefore, is effective in driving participatory communication which functions as a catalyst for action and as a facilitator of knowledge acquisition and knowledge sharing among people [19] including communication from those on the margins of traditional research-extension processes hence can be used by extension providers and other organizations to deliver services to large numbers of rural people than they could reach before. As observed from the study, PV has snowball effect in the dissemination of PPT which makes it a novel tool in the knowledge management process to further enhance the utilization of knowledge shared by smallholder farmers for increased sorghum yields.

Types of information shared with fellow farmers

The researcher investigated the types of information gained about PPT through exposure to PV are shared with other farmers in Rachuonyo sub-County and outside. These variables are relevant to the study since it may have an influence on the respondent's decision whether to use knowledge of PPT in sorghum production. Farmers are more likely to seek and acquire information from those who are similar to them in various socio-economic respects and from those considered more competent in certain knowledge aspects [20]. Farmers shared the information on PPT on areas they understood and were confident about as indicated in Table 4.

Table 4: Type of information shared

Types of information shared	Frequency	Percent
Benefits of PPT	74	61.7
How PPT works (mechanism)	64	53.3
Establishment/ management of PPT plot	25	20.8
Sourcing of 'push' and 'pull' plants	18	15.0

Table represents multi-responses **(n=120)**

Majority of the PV trained farmers shared information on benefits/importance of PPT (61.7%), mechanism of PPT (53.3%) other information share included establishment of PPT plot (20.8%), and how to source the 'Push' and 'pull' plants (15.0%). These results corroborate those of [3] who reported significant economic gains from the PPT relative to the farmer conventional practices. The Diffusion of innovations theory [11] adopted for this study postulates that technologies are adopted according to the characteristics of the technology such as relative advantage, triability, communicability and perceived complexity. This supports the finding that, PPT's positive spill over effects (unintended benefits) over and above Striga and Stemborer control serves to provide incentives to the farmers for its dissemination and subsequent adoption [14].

Test for knowledge shared and knowledge use

Pearson's Chi-square test was conducted for knowledge shared and knowledge use. The aim is to establish if there is a statistically significant relationship between knowledge shared and knowledge use. Table 5 summarizes the findings.

Table 5: Chi-square test for knowledge shared and knowledge use

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	240.000[a]	4	.000
Likelihood Ratio	172.055	4	.000
Linear-by-Linear Association	119.000	1	.000
N of Valid Cases	120		

significant levels: *** p<1%; chi-square = 240, df=4, p-value = 0.000

The results in Table 5 indicate a statistically significant positive relationship between knowledge shared and knowledge use (chi-square value = 240.0, df =4, p<0.001) at 99 percent confidence implying that the differences between the scores are real differences and not due to chance. With reference to these findings, the null hypothesis 1 (HO_1) which suggested that there was no statistically significant relationship between knowledge shared and knowledge use is rejected. Knowledge level is important in determining knowledge use. The Technology Acceptance Model [12] adopted for this study postulates that technologies are adopted if farmers perceive them to be useful and easy to use. This supports the finding [21] that PPT multiple benefits serve to provide incentives to famers and influence their attitudes positively which determines actual use/adoption. This is reflected in terms of number of farmers reached with PPT through PV and knowledge retention and use within farmer groups.

Ease of sharing PPT information using PV

The analysis of the ease with which farmers shared PPT information through PV in the study area was also investigated. The perceived ease of use determines an individual's intention to use a system or technology with intension to use serving as a mediator of actual system/technology use. Perceived usefulness is also being seen as being directly impacted by perceived ease of use of the technology as already guided by the TAM model [12]. Since the PV had been introduced as alternative to conventional extension methods, it was considered important to establish if ease of use of PV influence knowledge sharing of PPT. To achieve this, the respondents were asked to indicate how easy is it to share information using PV methodology.

The results are presented in Fig 1.

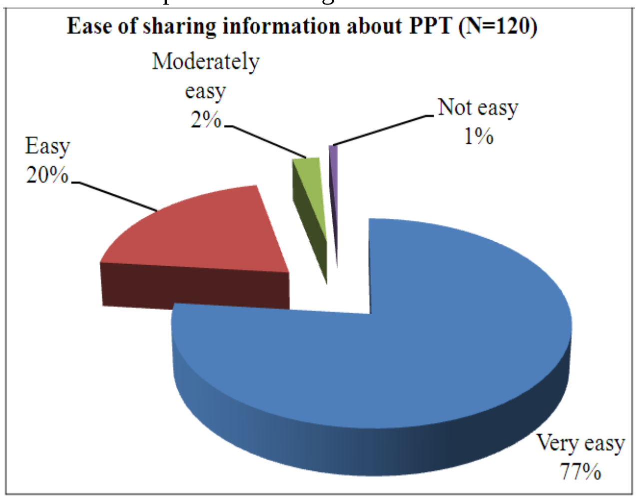

Fig.1. Response of respondents' on ease of sharing information

Findings in Figure 1 indicate that majority of respondents (77%) felt that it was very easy to share PPT information through PV, while 20 percent noted that it was easy, 2 percent felt it was moderately easy and only one person (1%) said it was not easy. The result also confirms the responses recorded under farmers' levels of knowledge on PPT, the benefits of PPT, and on the number of farmers reached respectively. The implication is that respondents were able to acquire knowledge, share and use information about PPT on the basis of relative ease of use of PV as an empowering extension methodology. This supports the finding that video self-training method is innovative and cost-effective method of training many farmers quickly with minimal distortion of facts **[22]**. Results also show there is no difference among male and female in PPT information sharing from use of PV, and that farmers with different levels of education were equally able to share information with fellow farmers who were non group members. Age was not a limiting factor in sharing information, inferring that PV is an effective tool and method in dissemination of knowledge and information.

IV. Conclusion and Recommendation

The study determined effectiveness of Participatory Video in enhancing learning and dissemination of 'push-pull' technology among smallholder sorghum farmers in Rachuonyo North sub-County. The findings show that farmers will readily share out the knowledge and their own findings if they use participatory video. There was significant relationship between knowledge shared and knowledge use. This was attributed to PV's effectiveness in driving participatory communication among farmers. Level of knowledge also influences dissemination in that farmers shared information on PPT on areas they understood and were confident about, which further influenced the use of the technology. Generally, knowledge shared focused on, benefits and mechanism of PPT and establishment and management of PPT plot. Social and economic networks played a significant role in sharing of PPT knowledge among the smallholder farmers. The study also established that personal characteristics had no influence on knowledge sharing. This demonstrates that PV is effective in dissemination of PPT for improved sorghum production.

The implication is that extension agents should consider using PV as an effective dissemination tool for smallholder farmers' sharing of ideas, innovations and information to enhance use/adoption of innovative practices, which is critical to user sustainability. The extension agents and research institutions should consider using effective and participatory methods and approaches like Participatory Video for public extension in order to reach more farmers with improved technologies at specific times. Policy makers in collaboration with researchers and development partners should promote the use of PV among smallholder farmers. This is to enhance effective and interactive learning, dissemination and adoption of productivity-enhancing technologies such as PPT for increased productivity geared towards improved livelihoods, even in environments with limited infrastructure and financial resources.

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