Research article

Experimental Study of Extension Impact on Farmers' KAP towards Sri Lankan Cassava Mosaic Disease Prevention in Cambodia

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Abstract The Sri Lankan Cassava Mosaic Disease (SLCMD) poses a major threat to the cassava industry in Cambodia, as it can decrease cassava yield by up to 80 percent. As SLCMD has no clear prescription, and currently, the only remedy is pulling out and incinerating the infected stems. The government of Cambodia, through the General Directorate of Agriculture (GDA), has moved swiftly to sensitize farmers on the causes, effects, and prevention measures of SLCMD. The GDA has used various media and methods to disseminate knowledge on SLCMD. However, effective information dissemination methods for changing farmers' behaviors in terms of the knowledge, attitudes, and practices (KAP) still remain to be identified. In this study, we investigate the effectiveness of two knowledge dissemination methods, i.e., "single intervention"—distribution of printed educational materials (PEMs) and "multifaceted intervention"—distribution of PEMs combined with workshop training. The study was conducted in Battambang, north-west Cambodia over two periods, from June to October 2019, and from November 2019 to February 2020. In the first period of investigation, 468 farmers were randomly selected to participate in the study. We formulate the contents of the poster and workshop based on the "initial" KAP results where farmers had lower KAP. Then, all 468 farmers were divided randomly into three groups, namely "Control," "Treatment1," and "Treatment2." farmers in "Treatment1" were subjected to "single intervention" and those in "Treatment2" were subjected to "multifaceted intervention," while those in "Control" were subjected to no intervention. In the second period of investigation, the "second" KAP was analyzed to estimate the effectiveness of interventions applied in the first period. The results show that "multifaceted intervention" is the effective method to improve the KAP of farmers in

Cambodia. Our experience of running such farmers' workshops and the materials we developed could be useful to governments, non-governmental organizations, and commercial associations that are keen to mitigate the effects of SLCMD through appropriate interventions.

Keywords field experiment, extension, KAP, SLCMD, RCT

INTRODUCTION

Cassava is the second major income source for Cambodian small-scale farmers after rice. In 2019, the number of small-scale cassava farmers in Cambodia was above 300,000 (Codes et al., 2019). From 2018 to 2019, land area under cassava cultivation increased from 611 thousand hectares to more than 624 thousand hectares (MAFF, 2019). In 2019, Cambodian cassava yield was, on average, approximately 27 tons per hectare. The total harvested area was approximately 504 thousand hectares (FAOSTAT, 2019). The corresponding benefit-cost ratio analysis shows that for every 1 riel invested in cassava farming, a profit of 1.31 riel was realized (Thav, 2017).

However, the increasing number of pests and cassava diseases poses a major threat to the quantity of cassava produce. This may in turn harm local food industries and consequently the national economies in cassava producing countries (Chanda et al., 2016). For example, cassava crops in Africa are being attacked by pests (such as the cassava green mite (CGM), the cassava mealybug, and the variegated grasshopper) and diseases (such as the cassava mosaic disease (CMD), the cassava brown streak disease (CBSD), and the cassava bacterial blight diseases) (Vanessa et al., 2011). In Africa, CMD is the most harmful of the cassava diseases. Data have shown that it can reduce cassava yield by up to 90 percent (Hahn et al., 1980). In Cambodia, the Sri Lankan cassava mosaic disease (SLCMD) is the most harmful. It was first discovered at a commercial farm in Ratanakiri province, Eastern Cambodia in May 2015 (Wang et al., 2016). By 2019, approximately 12 provinces had an outbreak of the SLCMD (MAFF, 2019).

Some of these outbreaks have been attributed to the whitefly and stem transmissions (Vanessa et al., 2011 & Minato et al., 2019). Currently, integrated insect pest and pathogen control methods are hardly used, owing to little sensitization of farmers on their availability and the trivial effort put by manufacturers into the manufacture of needed equipment. Biological methods seem to be the popular insect pest and pathogen control choice among farmers.

Therefore, there is an urgent need for improved uninfected planting tools (Nsiah-Frimpong et al., 2020). To address this situation in Cambodia, many strategies have been employed, including controlling the movement of planting materials, selecting healthy and uninfected seedlings, encouraging farmers to regularly check their fields, mapping the infected and non-infected areas, and improving communication between farmers and local agricultural extension agencies (MAFF, 2017, 2019). In addition, the general directorate of agriculture (GDA) has adequately sensitized farmers on SLCMD via field-day workshops, posters, and information leaflets. Further, the GDA has produced an educational video clip titled "managing the cassava mosaic disease," which can also be found on social media.

To cure infected cassava stems, the National University of Battambang, supported by the Japanese international cooperation agency and the Japan Science and technology agency, has propagated tissue culture of cassava (Tokunaga et al., 2020). Existing studies have recommended workshop training to improve the knowledge, attitudes, and practices (KAP) in managing the pests and diseases of cassava (Chikoti et al., 2016 and Nsiah-Frimpong et al., 2020). Disseminating the relevant knowledge to farmers could be the most splendid strategy for managing SLCMD (Houngue et al., 2018). However, there is no study that can help identify the information that the farmers are lacking. Further, and it has not been determined which of the information dissemination methods is more effective in changing the KAP of farmers. Therefore, in this study, we endeavor to identify the knowledge gaps and investigate the effectiveness of two knowledge dissemination methods, i.e., "single intervention"—distribution of printed educational materials (PEMs) and "multifaceted intervention"—distribution of PEMs combined with workshop training.

OBJECTIVE

The main objective of this study is to evaluate the effectiveness of the current information dissemination methods compiled by the project in order to examine farmers' behavioral change in terms of the KAP towards pest and disease control. We will determine if the information dissemination methods have been effective in discouraging the re-use of contaminated seedlings and suggest policy changes that will help mitigate further damage that may be caused by the SLCMD.

METHODOLOGY

Study Site

Battambang was selected as the study site. Battambang is the largest cassava producing province in northwest Cambodia. The total area under cassava cultivation in Battambang is 112,543 hectares which is ~ 18 % of the total area under cassava cultivation in Cambodia (MAFF, 2019).

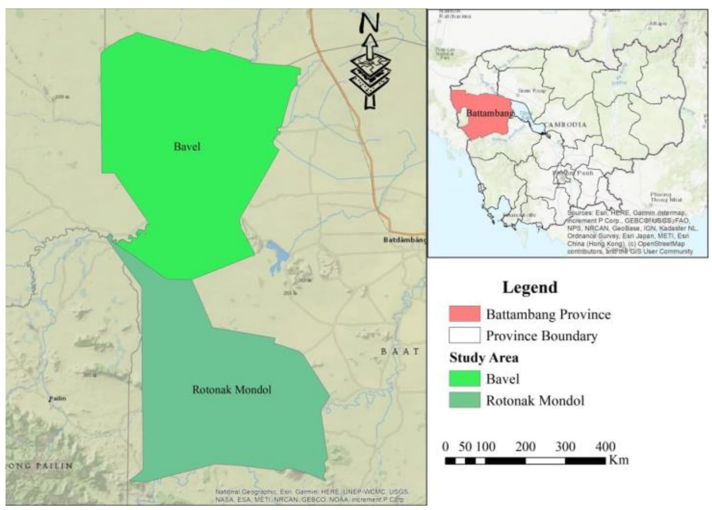

Fig. 1 Study area in Battambang Province, Cambodia

Research Design and Data Collection

The study was conducted over 2 periods—from June to October 2019 and from November 2019 to February 2020 (Fig. 1). In the first period of the investigation, between June and August 2019, 468 farmers were randomly selected to participate in the study. Their "initial" KAP was analyzed, following which all the 468 farmers were divided randomly into 3 equal groups—"Control," "Treatment1," and "Treatment2," using Stata version 16 (a statistic software). Randomization was evenly stratified at the commune level by gender, age, education, and knowledge level. Farmers in "Treatment1" received printed educational materials (PEMs) in the form of posters. Those in "Treatment2" received PEMs in the form of posters and were sensitized in educational workshops. Those in "Control" did not receive any sensitization material. In the second period of investigation, the "second" KAP was analyzed to estimate the effectiveness of interventions applied in the first period.

For this investigation, we received responses from 310 of the 468 research participants. This is because 158 farmers did not cultivate cassava during the second period of investigation.

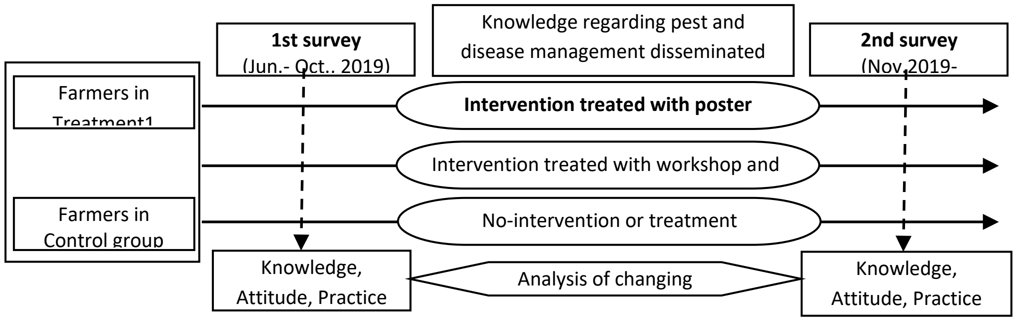

Fig. 2 Randomized Control Trial (RCT) design for Knowledge transfer

Table 1 Results of randomization at the commune[6] level

Groups	Communes			Observations	Percentage (%)
Treatment1	Plov Meas	Sdao	Treng	231	49.35
Treatment2	Ampil 5 Derm	Kdol Tahen	Reaksmey Sangha	157	33.54
Control	Khleang Meas	Onderk Herb		80	17.09

Note: Data summarized by the authors

Intervention Design

Single intervention - Printed educational materials (PEMs)[7]:

The PEMs distributed in the form of posters contained text, photos, illustrations, and spaces adorned in bright colors to attract the attention of readers. The majority of the information contained in the posters was about SLCMD. Specifically, the causes, effects, and prevention measures of SLCMD. Information on the transmission mechanisms of the disease was put in a conspicuous section of the poster. Information on the devastating effects of SLCMD in Cambodia and Africa was shown via images and text. SLCMD prevention and control measures were illustrated by cartoons, which made the poster more accessible. The designers of the posters took great care to make sure that information visualized by photos and cartoons could not be misunderstood or misinterpreted. The posters had a horizontal layout. The size of posters (A3) was carefully decided to enable farmers to easily hang them on walls and/or fold them in half during sessions of group/community information sharing.

Multifaceted intervention:

The multifaceted intervention involved combined use of PEMs distributed in the form of posters (the same as used in the single intervention—PEMs) and a workshop. The workshop was held to improve the knowledge of farmers on pest and disease management. Information disseminated in the workshop was compiled based on pre-identified gaps in the farmers' understanding, awareness, and practices. The gaps were identified in the first survey. Similar to the poster's design process, the workshop content was created by the experts of agronomics from the National University of Battambang. The experts took into account the language, culture, and literacy of the targeted farmers. These farmers; social data were collected during the first period of our investigation. Moreover, the workshops included a Q&A session where misunderstandings of the audience were clarified. The audience was also allowed to share their experiences with SLCMD. We also used the workshops to collect more data on SLCMD by asking the farmers what they deal with in real life.

[7] Printed educational materials in the form of poster will be included in the Annex.

Questionnaire:
The field survey was conducted in Rattanak Mondol, Reaksmey Songha, Plov Meas, Sdao, Treng, Onderk Herb, Ampil 5 Derm, Kdol Tahern, and Kleang Meas communes (Table 1), and 468 samples were collected. There were 5 parts to the questionnaire: the first part was about the correspondents' socio-demographic status; we concentrated on the participants' knowledge, awareness, and practices in the second, third, and fourth parts, respectively; the final part focused on the farmers' understanding of willingness to pay for healthy cassava seedlings.

Data analysis methods:
The data were analyzed using Stata version 16. From the ex-ante data (first survey) and the ex-post data (second survey), we scored the answers as 1 for correct and 0 for incorrect. For questions with multiple answers, if the respondents chose more than one answer, it would automatically be classed as incorrect and scored as 0. To estimate the effects of the two knowledge interventions (PEMs and multifaceted intervention), we used the differences between the treatment groups (Treatment 1 and Treatment 2) in the first and second surveys to compare with the difference in "Control" via t-test.

RESULTS

The paired t-test was conducted to compare the differences between before and after treatments, namely difference-in-difference (DiD) among "Control" to "Treatment 1" and "Treatment 2." The differences in the means were calculated. Both DiD of mean differences of "Treatment1" versus "Control" and that of "Treatment2" versus "Control" showed statistical significance at a p-value of 0.01. Table 2 shows that improved knowledge of whitefly and SLCMD symptoms in "Treatment1" and "Treatment 2" versus "Control" was significantly different at a p-value of 0.01. Likewise, getting to know the name "whitefly" was significantly different at a p-value of 0.01 in "Treatment 2" and a p-value of 0.10 in "Treatment 1." Farmers' knowledge after receiving dissemination from both "single intervention" and "multifaceted intervention" increased at a p-value of 0.01.

Table 2 T-test results of Farmers' Knowledge

Variable	Definition of variable (Correct=1; incorrect=0)	Mean-Diff ($2^{nd} - 1^{st}$)			Coefficient	
		Control group (n=51)	Treatment1 group (n=165)	Treatment2 group (n=94)	Control vs. Treatment1	Control vs. Treatment2
KN_whitefly	Whitefly is an insect pest.	-0.039	0.151	0.351	0.143 ***	0.185 ***
KN_slcmd	Do you know SLCMD?	0.156	0.557	0.861	0.200 ***	0.363 ***
KN_whitename	Name of whitefly	0.140	0.234	0.554	0.068 *	0.226 ***
KN_whiteanswer	Whitefly causing the symptoms	0.039	0.327	0.489	0.304 ***	0.488 ***

**** Significant at 0.01 ** Significant at 0.05 *Significant at 0.1 - Non-significant*

As can be seen from the above table, before the distribution of PEMs and/or workshops, the majority of the respondents were not aware of the precariousness of getting their cassava seedlings from a neighbor or a middleman. Additionally, they were not aware of the benefits of getting their cassava seedlings from a certified healthy seedling distributor (Table 3). It means that farmers continue to face the risk of getting infected stems. On the other hand, when farmers are asked "I can do something to prevent (cassava) plants, Treatment1 seems to have more positive more than the farmers in the Control while farmers in Treatment 2 were not significantly different from that of Control. Moreover, farmers of both Treatment1 and Treatment 2, felt they need more authority advice regarding SLCMD and farmers' attitudes of both groups improved at a p-value of 0.01. Treatment 2 felt the importance of authority advice more than farmers in Treatment 1.

Table 3 T-test results of Farmers' Attitude

Variable	Definition of variable (Strongly diagree=1 to strongly agree=5)	Mean-Diff ($2^{nd} – 1^{st}$)			Coefficient	
		Control group (n=51)	Treatment1 group (n=165)	Treatment2 group (n=94)	Control vs. Treatment1	Control vs. Treatment2
AT_neighbor's stem	Neighbor's stem can reduce the risk of SLCMD.	-0.078	0.090	-0.510		
AT_middle man's stem	Middle man's stem can reduce the risk of SLCMD.	-0.745	-0.915	-0.765		
AT_certified healthy	Certified healthy's stem can reduce the risk of SLCMD.	-0.486	-0.236	-0.567		
AT_I_can_do_s.th	I can do something to prevent plant.	0.529	0.446	0.557	0.503 ***	
AT_authorityadvise	It is important to know SLCMD.	1.000	-0.496	-0.574	0.568 ***	0.891 ***

**** Significant at 0.01 ** Significant at 0.05 *Significant at 0.1 - Non-significant*

Table 4 indicates that the mean of purchasing seedlings for planting from a trusted source increased for both groups. On the other hand, the mean of timely spraying of insecticide to whitefly in neither group was significantly different. Finally, the mean of removing all cassava debris suspected of being SLCMD in Treatment1 versus Control was significantly different at a p-value of 0.1. Also, it was not significant in Treatment 2 versus Control, the direction was not to remove the debris. This might mean that farmers have gotten the wrong impression after receiving the contents in PEMs and workshops and can be a scope for improvement of the contents in the future training.

Table 4 T-test results of Farmers' Practice

Variable	Definition of variable (Never=1, Sometimes=2, Always=3)	Mean-Diff ($2^{nd} – 1^{st}$)			Coefficient	
		Control group (n=51)	Treatment1 group (n=165)	Treatment2 group (n=94)	Control vs. Treatment1	Control vs. Treatment2
PR_trusted sources	Purchasing cassava stem from trusted sources.	0.098	0.418	0.414	0.320 ***	0.317 ***
PR_insecticidewhitefly	Timely treatment of whitely.	-0.294	0.000	-0.308	0.294	-0.014
PR_removed_debris	Removing all cassava debris suspected of being SLCMD	-0.254	-0.727	-0.276	-0.472 *	-0.022

**** Significant at 0.01 ** Significant at 0.05 *Significant at 0.1 - Non-significant*

DISCUSSION

Our results show that the dissemination of information via the multifaceted intervention is the more effective method of increasing farmers' KAP. Previous studies had indicated that the majority of farmers who participated in workshop training became more aware of the cassava virus diseases (Eni et al., 2019). Nishiah-Frimpong et. al. also emphases the importance of training farmers on integrated methods of insect pest and disease control (2020). It is also possible that the workshops increased their outreach by extending the programs to the less literate farmers. In addition, other studies have posited that farmers are more susceptible to consume knowledge when it is disseminated by experts (Houngue et al., 2018).

However, we also found out that neither of the two methods sufficiently improved the attitudes of farmers toward disease preventive measures. When we asked whether they believe "certified healthy stem can reduce the risk of SLCMD," in the attitude question (Table 3), farmers in all groups slightly shifted from disagreeing to agree; however, it was not statistically significant. On the other hand, when we asked their purchasing behavior in the practice question (Table 4), farmers indicated that they would purchase items for the next propagation from trusted sources. It could suggest that the majority of them did not believe that purchasing the seedlings from trusted sources can reduce the risk of SLCMD, and they would still face potential infection after purchasing healthy stems. On the other hand, farmers both in Treatment1 and Treatment2 would purchase stems for next propagation from trusted sources. It indicates that they are more aware of the potential risk of SLCMD even for healthy seedlings, but still purchasing stems from a trusted source is important to reduce the risk of getting stems infected from seedlings. Another reason could come from the fact that although multifaceted intervention enabled farmers to understand the importance of purchasing the seedlings from trusted sources, the majority of them did not believe that purchasing the seedlings from trusted sources can reduce the risk of SLCMD. noticeably, the choice of cassava seedlings for the majority of the farmers depends on their agronomical traits, such as tuber yield, fast harvesting, resilience in the soil, and adaptability to drought (Bentley et al., 2017). Also, the reluctance of farmers to purchase seedlings from trusted sources can be attributed to the farmers realizing that purchasing seedlings from a trusted source cannot by itself reduce the risk of SLCMD transmission unless farmers implement regular monitoring and pest treatment management.

Moreover, the workshop disseminated information on well-known SLCMD symptoms and how to identify uninfected cassava seedlings for the next planting session. Farmers who could not come around to purchasing seedlings from trusted sources were taught how to propagate their own stems as an alternative mitigation measure of reducing the spread of SLCMD (Mulenga et al., 2016). The workshop with the poster group did significantly improve farmers' practices, for example, purchasing cassava seedlings from trusted sources. Our findings are consistent with those of a study conducted in Nigeria (Ebewore and Isiorhovoja, 2019), which acknowledged that training is a major source of information to cassava producers, and without training, only approximately 17.0% of the farmers will (N=569) practice disease management.

Further, the study revealed that although spraying insecticide the whitefly is crucial to curbing the spread of SLCMD, farmers were not spraying the insecticide. The two possible explanations are: (1) farmers have unsuccessfully tried to spray the insect before and had eventually given up; (2) farmers do not have sufficient finances to spray the insect. Previous studies showed that approximately 91.1% (N=90) of farmers were familiar with insect pests and diseases as causes of significant damage to the cassava crop, but they could not distinguish between the treatments of insect pests and diseases (Chikoti et al., 2016). From the results, it became clear the need to emphasize the importance of early treatment of whitefly, as it is the vector of SLCMD spread.

CONCLUSION

The objective of this study was to estimate the effectiveness of knowledge dissemination methods in changing farmers' KAP towards pest and disease management. We sought to determine which method is effective in discouraging the re-use of contaminated seedlings. We also suggest policy changes that might help mitigate further damage due to the SLCMD. In general, we found that dissemination of information via workshop training, combined with the distribution of PEMs is an effective way of improving farmers' KAP and, consequently, prevent the spread of SLCMD. Nonetheless, as effective as workshop training combined with the distribution of PEMs was, this method did not sway farmers' KAP completely. In this regard, we suggest that for future training, trainers should emphasize the importance of early mitigation practices in minimizing yield loss. The emphasis is likely to further improve farmers' KAP. To do so, trainers should inform farmers of the actual yield loss per hectare they are likely to incur and consequent income loss if they neglect the early mitigation. Where possible trainers should give real-life examples that the farmers can relate to. This way, the farmers will see the magnitude of the potential yield and income loss. Nevertheless, our experience of running such farmers' workshops and the materials we developed could be evolved and improved, and they could be useful to governments, non-governmental organizations, and commercial associations that are keen to mitigate the effects of SLCMD through appropriate interventions.

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