



## The Possibility of Producing and Distributing Healthy Cassava Seeds in Cambodia

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**Abstract** This study discussed the possibility of producing and distributing healthy cassava seeds in Cambodia. Since 2015, there has been no official healthy seed certification and distribution system in Cambodia despite the rapid spread of the Sri Lankan Cassava Mosaic Disease in Southeast Asia. To improve cassava production and its sustainability, we conducted interviews using a structured questionnaire in Battambang and Pailin Provinces from April to November 2017 and received responses from 205 cassava producers. The results showed that most producers reused seeds from the previous years' harvest and indicated considerable market interest for healthy cassava seeds in Cambodia. Finally, we found that training and information on healthy seed production combined with stringent pest and disease monitoring efforts are essential. This study suggests that a market-based, healthy cassava seed distribution system can be established in Cambodia.

**Keywords** cassava, seed production and distribution, Cambodia, sustainable, market-based solution

### INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of the largest staple crops in the world and one of the most important cash crops in Cambodia (FAO, 2020; MAFF, 2018). Although there are many uses for cassava starch, from food to cosmetics, its utilization as a source of biofuel has increased its demand in recent years. Cassava propagates from the cuttings of the remaining cassava stems after its tuber is harvested (Tokunaga et al., 2018). Although propagation makes cassava grow faster compared to plant growth from seed germination, once contaminated with a virus or a phytoplasma, this propagation method has a negative impact. It could easily spread diseases like witches' broom (Alvarez et al., 2013) and harmful pests, such as mealybugs, red mites, and scale insects. Furthermore, recently, Sri Lankan Cassava Mosaic Disease (SLCMD), which severely affects cassava and spreads through whitefly and human factors, has spread rapidly in Southeast Asia (Wang et al., 2016; Uke et al., 2018).

In Cambodia, the government-led cassava extension system has been limited (MAFF, 2015; Tokunaga et al., 2018). The Department of Agricultural Extension of the Ministry of Agriculture, Forestry, and Fisheries (MAFF) was established in 1995. However, their activities are limited due to a lack of funding, technical expertise, extension materials; an inadequate production and distribution

system; and human resources to support extension processes. As a result, an official system for producing and distributing cassava seeds has yet to be established.

In Ratanakiri and Battambang Provinces of Cambodia and Dak Lak and Tay Ninh Provinces of Vietnam, cassava seeds are informally distributed and self-regulated, without any active quality certification schemes (Delaquis et al., 2018). Thus, traders play an important role in the long-distance seed movement. The use of farm-saved seed and exchanges among acquaintances within the community are most common. However, given the spread of SLCMD, this informal and self-regulated method of seed distribution has increased the chances of humans spreading the disease.

To remedy this situation and promote the country's economic growth, the Royal Government of Cambodia (RGC) recently announced its "National Policy on Cassava 2020-2025," which declared cassava as one of the potential crops for agro-industrial development in Cambodia (RGC, 2020). Therefore, MAFF and its allied universities are required to "promote and encourage propagation farms and private cassava stem suppliers to sell and distribute healthy and disease-free cassava stems." (RGC, 2020). However, even though this policy is relatively new, there have not been any detailed discussions about the possibility of enabling the production of healthy cassava seeds.

Prior to the current policy discussion, since 2016, we have been conducting a project titled "Development and Dissemination of a Sustainable Production System Based on Invasive Pest Management of Cassava in Vietnam, Cambodia, and Thailand" supported by the Japan Science and Technology Agency and the Japan International Cooperation Agency. The project aims to establish a sustainable production system that utilizes healthy seeds by developing a market-based dissemination model that supports the private sector, producers, and the government, with a management system for invasive cassava diseases and pests. For this project, it was essential first to identify the producers' cassava seed preferences, distribution, propagation methods, and demand for healthy cassava seeds. Our projects contribute to creating a certified production and distribution system for healthy cassava seeds, in line with the one envisioned by the Royal Government of Cambodia.

## **OBJECTIVE**

This study aims to discuss the potential for healthy cassava seed production and distribution in the Cambodian market by characterizing the present status of cassava seeds, including producers' preferences for cassava varieties and their demand for healthy cassava seeds based on a structured questionnaire interview. Finally, the project mentioned above focusing on the production system of healthy seeds was used as a case study.

## **METHODOLOGY**

We interviewed producers about the 2016-2017 cassava production cycle in two Districts of Pailin Province and six Districts of Battambang Province, northwest of Phnom Penh, the capital of Cambodia, from April to November 2017 using a structured questionnaire. The total planted area of 134,385 ha in Battambang is the largest cassava production land area among all Provinces and produces 3,769,266 tons of cassava per year. Pailin Province has the fifth largest cassava planted area of 59,067 ha in Cambodia, producing 1,477,175 tons, the third-largest in terms of quantity (MAFF, 2018).

A stratified random sample based on the cassava planted area was applied to select the respondents. The total respondents included 205 cassava producers: 144 from Battambang Province and 61 from Pailin Province. All the questionnaires were valid. Then, qualitative and quantitative analyses were applied.

## **RESULTS AND DISCUSSION**

Some characteristics of the respondents are profiled below (Table 1). In the survey, only the primary cassava producers in the household were considered, comprising 93% males and 7% females. Their

average age, cassava planting times, and cultivated area was 49 years for males and females, 4.08. and 3.73 ha, respectively. As discussed below, 40% of producers purchased seeds for the 2016-2017 cycle. While currently there is no healthy seed distribution system, approximately 68% of respondents showed a willingness to buy healthy seeds, and 72% showed a willingness to become healthy seed producers.

**Table 1 Descriptive summary of survey respondents**

Variables	Mean	Std. Dev.	Min.	Max.
Gender (1=male, 0=female)	0.93	0.26	0	1
Age (years)	49.00	13.29	21	78
Province (dummy)	0.70	0.46	0	1
Cassava planting times before the 2016-2017 cycle (times)	4.08	3.03	0	16
Total cassava cultivated area (ha)	3.73	4.65	0.09	40
Purchased seeds for the 2016-2017 cycle or not (1=yes, 0=no)	0.40	0.49	0	1
Want to buy healthy seeds (1=yes, 0=no)	0.68	0.47	0	1
Want to be a healthy seed producer (1=yes, 0=no)	0.72	0.45	0	1

(N=205)

First, the survey inquired about the cassava varieties used by the producers (Table 2). While 78.9% of answers included "Unknown" or nicknames in Khmer, such as "Kor Teul" (long neck) and "Masao" (starch), others provided a variety name. Although we cannot confirm the accuracy of the provided variety names, our survey reveals that they mostly use Thai varieties such as Rayong 9, Rayong 90, and Houybong. Based on visual checks done by a descriptor created by our project, the varieties called "Unknown," "Kor Teul," and "Masao" include KU50 and Rayong 7, which are also from Thailand. The name "Masao" implies that producers care about the starch contents of the variety; Masao varieties often have a reputation of containing a high starch content. We find that Cassava producers prefer high starch content varieties. However, they do not have a very strong preference over the specific variety and can accept the variants distributed in the market.

**Table 2 Cassava varieties used by the surveyed producers**

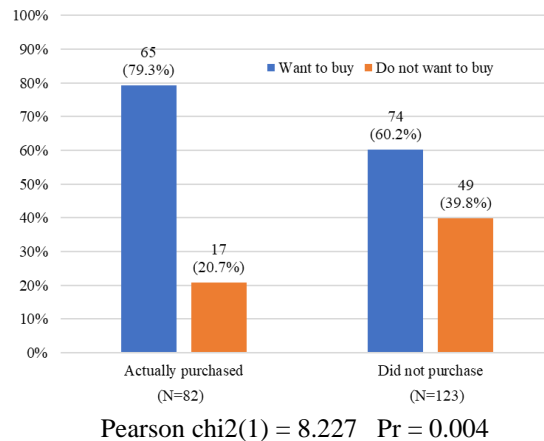
Variety	Unknown		Thai varieties		
	Number of answers	%	Variety	Number of answers	%
Unknown	71	33.3%	Rayong 2	1	0.5%
Kor Teul	61	28.6%	Rayong 3	1	0.5%
Masao	25	11.7%	Rayong 4	2	0.9%
Malay	3	1.4%	Rayong 5	1	0.5%
Meyong	1	0.5%	Rayong 9	9	4.2%
Namdeng	1	0.5%	Rayong 11	1	0.5%
Red Petiole (Kandeng, Kanteng)	6	2.8%	Rayong 90	9	4.2%
			81	6	2.8%
			85	1	0.5%
			89	1	0.5%
			Houybong	13	6.1%

(N=213)

Second, the results showed that 40.0% of those surveyed did not buy cassava seeds because they reused the seeds harvested from their fields in the previous cycle. Further, 76.9% of those who purchased seeds bought them in their neighborhood, while 11.5% bought seeds imported from Thailand, and the remaining 11.5% bought seeds brought by road from Vietnam. This result

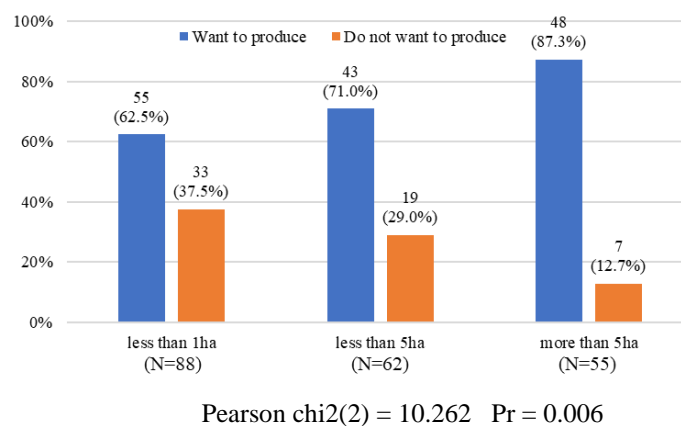
complements the results of the previous study by Delaquis et al. (2018). These results show that seeds can easily be imported and transported across different regions; diseases and pests could easily spread.

Third, we asked producers, "Do you want to purchase healthy seeds if they are available on the market?" To this, 139 (67.8%) producers answered affirmatively, and of those, 48.8% bought seeds in the 2016-2017 cycle. It implies 33.1% (=48.8% x 67.8%) of producers might purchase healthy seeds in the future. Further, the average percentages of producers who want to buy healthy seeds in each "Actually purchased group" and "Not purchased group" are significantly different at  $\chi^2$  statistic of 8.227 (p-value<0.01) (Fig. 1).



**Fig. 1 Producers who want to purchase healthy seeds based on the 2016-2017 purchase record**

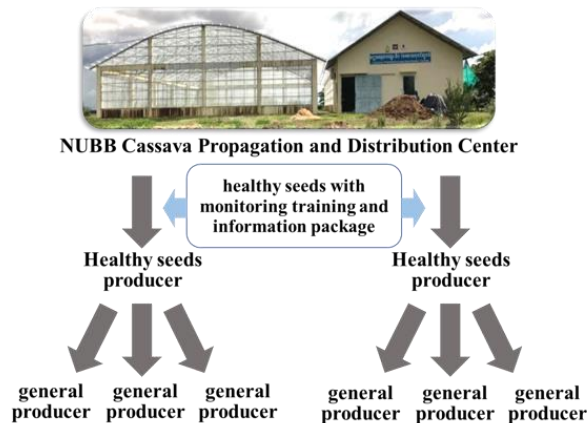
Fourth, 71.7% of producers answered yes to the question, "Do you want to produce healthy seeds as a business?" Furthermore, the producers with a large cassava cultivation area were more interested in healthy seed production than smaller ones (Fig. 2). Additionally, this is statistically significantly different at  $\chi^2$  statistic of 10.262 (p-value<0.01). It implies that the larger the cassava area producers have, the higher the willingness to be healthy cassava producers. Thus, larger land area producers recognize the business opportunities present in the production of healthy seeds.



**Fig. 2 Producers who want to produce healthy seeds by cassava cultivation area**

Thus, we find that producers can accept new varieties, and those who purchased stem seeds for the 2016-2017 cycle are interested in purchasing healthy seeds. Additionally, those with a production area of 1 ha or more are more interested in producing healthy seeds than those with less than 1 ha of cassava production area. These results suggest that there is a potential market for healthy seed cassava in Cambodia. Further, since the existing seed distribution method could spread pests and diseases across Cambodia, establishing a market-based certified healthy seed production system could prevent the spread of pests and diseases like SLCMD.

Based on the results above, our project started a healthy seed production system in Cambodia on a trial basis (Fig. 3). In Cambodia, the National University of Battambang (NUBB) has a Cassava Propagation and Distribution Center. In 2018, the project selected two varieties, KU 50 and Rayong 7, and started producing healthy seeds through careful monitoring and Polymerase Chain Reaction (PCR) testing. Then, the varieties were sold to three producers who wanted to be healthy seed producers in Battambang Province (Producer A: 1,351 healthy seeds), Banteay Meanchey Province (Producer B: 599 healthy seeds and 400 additional healthy seeds in 2019), and the other producer in Banteay Meanchey Province, who stopped production immediately because of weather conditions. We found these producers interested in the project through the survey and personal communications in our pursuit to find healthy seed producers, and we also introduced them to the NUBB. The price is 1\$ per 1 bunch (20 seeds), which was the market cassava price at the time of the study. Two producers in Banteay Meanchey Province were also supported by Deutsche Gesellschaft für Internationale Zusammenarbeit. In 2019, in addition to these three producers, two more producers in Battambang and Oudar Meanchey Provinces and the General Directorate of Agriculture (GDA) field in Battambang Province started to be healthy seed producers. With the prevalence of the spread of SLCMD, gradually more producers became interested in becoming healthy seed producers.



**Fig. 3 The healthy cassava seed distribution system at NUBB**

These producers were trained periodically to monitor cassava fields and could independently execute such monitoring techniques. They also received information packages and training on pests and diseases and how to treat them. The monitoring system recommended by the project is as follows. 1. When the cassava plants start producing leaves, check each border and the middle of the field carefully to find abnormal plants shorter than other plants or those that are yellow. 2. Check the stem from the bottom to the bud and the surface of the leaves to find pests, such as whitefly, mealybug, red mite, and scale insect, diseases such as witches' broom, and SLCMD; and 3. Remove pests by hand, in case there are few. If the pest infestation is severe, use recommended chemicals to control whitefly, a Sri Lankan cassava mosaic virus vector. 4. Finally, and most importantly, remove infected or suspicious SLCMD plants from the field, bury or burn them, and replace them with healthy cuttings.

At the time of harvest, and if the PCR test result of their samples at NUBB is negative, Producer A and Producer B can sell these healthy seeds to the general producers who value such seeds. After multiplying healthy seeds, the producers sold them in 2019 (Producer A: 2,000 stems (1 GDA field)) and 2020 (Producer A: 2,400 stems (1 general producer and 1 GDA field)); Producer B: 1,095 stems (11 general cassava producers)), while other healthy seed producers did not sell because they were under multiplying their stems. Some of these general producers have become interested in producing healthy seeds. They have joined our monitoring training to sell such seeds to other producers as a business.

These findings show that NUBB and healthy seed producers can become sources of trusted cassava seeds for producers in Cambodia. While Cambodia has no official seed distribution system, our system (including NUBB and the cassava producers) can be a pioneer model. However, the

healthy seeds produced in this trial are not free from the risk of disease. Therefore, monitoring is an essential part of healthy seed production. Nevertheless, the results show that a healthy seed production system centered on NUBB with well-trained healthy seed producers can positively affect the cassava sector in Cambodia.

## **CONCLUSION**

The study clarified that cassava producers in Cambodia could accept and produce healthy cassava seeds. Producers care about the starch contents of the variety, though they do not have a very strong preference for the specific variety and can accept variants distributed in the market. Those who purchased seeds in the 2016-2017 cycle are still interested in purchasing healthy seeds. Additionally, those with a cassava production area of 1 ha or more are more interested in producing healthy seeds than those with less than 1 ha. Further, we demonstrated that the pilot project in Battambang Province had created a healthy production system for cassava seeds in Battambang and Banteay Meanchey Provinces, which has seen positive results. We emphasize that monitoring is an integral part of the healthy seeds production system. While SLCMD has been spreading, producers have a high demand for a healthy seed market. Therefore, our market-based production system can contribute toward creating sustainable cassava production to help producers increase their income and improve the country's economic growth while meeting the policy aims of the Royal Government of Cambodia.

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