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Scaling Up Rootcrops Technology and the Women's Wisdom in the Conservation of Sweetpotato Varieties

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Abstract

Sweetpotato, an important traditional food crop especially for women farmers in semi-subsistence communities recorded nearly a total wipeout in 2014. Its absence on the farmers' table brought out expressions such as '*kakaikawa*' (it is deeply missed) and *kasla met bagas dayta* (likened to rice as a staple), revealing how sweetpotato is woven into the everyday lives of these households. Informed of research results done previously in the same community, the extension phase that aimed at saving this important crop through the introduction of a university package of technologies (PoT) took a non-linear path, which this paper highlights. The participatory extension approach of transferring technology at the community level explored how women took on the task of selecting sweetpotato varieties according to locally defined criteria that imitates the traditional varieties. The wisdom of women in conserving traditionally cultivated sweetpotatoes that were abruptly cut due to Fusarium wilt infestation was again utilized during the adoption phase. The practice of seed keeping or, in this case, cultivating planting materials in 'mother plots' for exchange and propagation in other areas facilitated the technology adoption. Despite some setbacks in the earlier experience of the PoT, sweetpotato growing was assessed to have recovered successfully by 2020 with indicators resting on the availability of the item on the table, during rituals, and as a buffer income source. The area cultivated also increased by 42%. From the narratives of the women partners, the adoption of the tissue-cultured clean planting materials technology went beyond Kibungan, the initial project site.

Introduction

The scaling up of the package of technology (PoT) in Kibungan is in response to the alarming near loss of sweetpotatoes that is not only true for Kibungan but throughout the Cordillera and nearby Nueva Vizcaya (Masangcay, 2017). The delivery of extension services specifically in Kibungan is informed by the results of research and documentation conducted by the Institute of Social Research and Development (ISRD) of Benguet State University (BSU) between 2015 to 2016 that dealt with understanding the implications of the near demise of traditional food crops, specifically

camote or sweetpotato, caused by fungal infection called Fusarium wilt. Before Fusarium wilt was identified as the disease of camote in this area, there were two views expressed as a probable cause for the infestation: one was the folk view that the *peste* was due to *tungro*, a virus that is associated with rice farms, and the other was indirectly associated with climate change. *Tungro* is a generic term used by the locals to refer to any observed discoloration, stunting, and reduced yield of plants, which were also observed in sweetpotatoes.

Barangay Palina is one of the identified main producers of several traditional varieties of sweetpotato tubers in Benguet, the fact that they were able to conserve such varieties. Documentation shows that it was not only an additional source of income but also a staple food for the community members, as well as feed for pigs and their other domestic animals. In a study conducted by Batani et al. (2016) in Barangay Palina on traditional food crops, worldview and climate change scenarios in a semi-subsistence community in the municipality of Kibungan, Benguet, sweetpotato locally known as *tugue*, is said to be an "embodiment of socio-cultural community life." This is aside from its economic value, characterized as: [a] as an item for exchange or barter food; [b] payment in kind –a practice in the community that if a neighbor helps voluntarily on the farm, a can of sweetpotato is given upon harvest; [c] staple food; [d] animal food; [e] source of cash income or *pangsupusop*, buffer food or buffer crop to be sold for use in the kitchen or for children's fees; [f] snack and/or dessert; [g] gift – specifically for visitors and guests of the community; [h] food for feasts or *sida* –solidifying social ties during feasts; and [i] food for infants – sweetpotato is usually the first solid food of infants before rice. Moreover, sweetpotato has a long history of saving lives during the Second World War. As the locals say, "*tugue met di nang salbar en dakami*" (sweetpotatoes saved lives during the war). It is widely grown in the tropics over a wide range of environmental conditions, even in marginal areas.

Panagbitil: Sweetpotato Infection Spells Scarcity

Informants likened the absence of sweetpotatoes to *bitil*, which means a 'period of famine' or food scarcity, reminding them of periods of *bitil* in the past. Whenever *peste* (pestilence) beset the locality, it is said to be temporary as they were able to recover. This time, however, this *bitil* was described as 'different' because its absence has been prolonged, depriving them of an alternate food, and source of income. Specifically for women partners whose primary crop is root crops, they say *makapa-ikawa* (deeply missed) referring to the absence of camote on the table. Still others say "*kasla met bagas dayta*" (that is 'like rice') rice being the staple food starting the post-war years. Its value also rests on its socio-cultural importance: the demise of sweetpotatoes can lead to the disappearance of pig raising which could affect ritual performances. Based on the findings in the earlier research (Batani et al., 2017) conducted earlier, where laboratory tests were done, sweetpotatoes in the community were confirmed to be infected with Fusarium wilt. Ames et al. (1996) described Fusarium wilt (*Fusarium oxysporum* f. sp. *batatas*) as one of the identified major diseases of sweetpotatoes in the tropics. The first indication of this disease is dullness and yellowing of the leaves, followed by wilting and death of the vine – which is how the respondents described the disease. Affected vines show the vascular discoloration typical of this disease. It is a soil-borne fungus specific to sweetpotato and a few of its close relatives, barley and flue-cured tobacco. In the study conducted by the BSU-NPRCRTC specific to the region and Nueva Vizcaya, aside from yellowing of leaves, an interveinal yellowing of the older leaves and necrosis of the stem vascular bundle with brown to purple discoloration were observed (Backian et al., 2020). The fungus can survive in the soil and debris for several years.

The disease led to severe damage to the sweetpotato production in the community as early as 2014. In other areas of the region, it was documented that as early as 2012, there were already reports by NPRCRTC of Fusarium wilt infection (Masangcay & Galian, 2021). This infection, later on, turned the previously sweetpotato-rich community into a community that now depends on the produce of neighboring communities. The loss of sweetpotato became one of the major contributors as to why the community has now shifted to vegetable gardening for cash, which is much more laborious than sweetpotato production. From the 2015 Municipal profile of the municipality of Kibungan, rice, and sweetpotato were the major crops of the municipality whilst vegetables were grown in

Barangays Madaymen and Sagpat back in the early 80s. However, a major shift from sweetpotato and rice production into vegetables was observed particularly in Palina where some of the rice fields were converted into vegetable gardens.

The severity of the disease cannot be underestimated; the fact that the community members suffered from consecutive seasons of damages to their sweetpotato crop. In their own words, "*magmagango, nakupos, nakuyos*" (it wilts, it dries up, and eventually dies), describe the varied experiences felt in the repeated efforts to propagate sweetpotato. Because of this, many of the community members discontinued planting the crop. A considerable group of women, however, was determined to continue planting and had expressed the desire to acquire planting materials from BSU.

In this regard, the goal of this extension project to recover sweetpotato production was conceptualized with the following objectives: [1] to engage sweetpotato growers in the selection of camote varieties using their own criteria, [2] to propagate clean planting materials utilizing the tissue culture technology of the BSU-NPRCRTC, [3] to conduct participatory field trial and reproduction of the clean planting materials, and [4] to facilitate capacity building activities to prepare the community in maximizing the package of technologies. This paper documented this participatory approach, which started from the selection of varieties to the distribution of suitable varieties until its monitoring and evaluation.

Methodology

The package of BSU technologies (PoT) in the form of tissue cultured 'clean planting materials' being propagated by NPRCRTC coupled with a 'biocontrol organism-so called *Trichoderma* to manage Fusarium wilt. The delivery of this technology took a non-linear path, using the participatory approach and iterative consultation that entailed partnership with women farmers. A non-linear approach was employed in the sense that iterative processes allowed for changes in the plan depending on existing conditions, ensuring that the women growers are informed and that they have a say in the whole technology adoption process. For instance, the first batch of planting materials accessed and grown was less successful which gave way for another planning and selection of sweetpotato varieties, even planting sites. This process allowed meaningful participation and ownership over adoption decisions that affect root crops production. The documentation process also took different turns during the process – from an institute-based documentation to a more informal and participatory documentation which was explored in the process and brought about interesting results including women's voices.

Research and Documentation

This project builds on previous research results done between 2015 to 2016 where fieldwork was conducted to explore traditional food systems from an interdisciplinary perspective. Two communities were involved, sitio Legleg and sitio Palina proper. The primary concern then was the drastic loss of sweetpotatoes in several provinces of the region, which was felt strongly in these communities, specifically by women, who traditionally grow these rootcrops. Data gathering consisted of face-to-face interviews, participant observation in certain phases of the agricultural cycle, and informal conversations mostly with women who are particular in growing root and tuber crops. A Global Positioning System (GPS) was also utilized to map areas where sweetpotatoes were grown. Continuing documentation was pursued during the implementation of the 'extension project' which was a response to the drastic loss of sweetpotatoes. The documentation this time was on the progress the women growers were making in terms of yield, observed growth, *Trichoderma* application, and the stories that come with it. Given this scenario, documentation was mainly done by the women partners, where they were given a notebook and were asked to record whatever they observed, planting materials they shared, including sweetpotatoes sold or given as gifts. Stories were captured whenever field visits were conducted including stories behind the progress they were making using their notebooks.

Selection of Community Partners

Building on previous fieldwork and networking with the community, the women partners of the project were identified through consultation and organizing. Women who cultivate sweetpotatoes were already identified during the research phase as they were the ones who expressed the need to revive sweetpotato production. Community members who were willing to propagate

sweetpotatoes volunteered their area (plot or farm) to serve as learning sites and 'mother plots.' The concept of 'mother plots' appropriates the concept of the nursery, but only this time, the respondents' farms serve as open sources of clean planting materials for anyone willing to propagate.

Participatory Varietal Selection

One technology transfer modality is to introduce and distribute tissue-cultured planting material and this was done in Palina in three batches in response to the need to recover and propagate sweetpotato. The tissue-cultured planting materials are 'clean planting materials' propagated from traditional camote varieties. BSU NPRCRTC, as the technology generator, recommends that to fight Fusarium wilt, clean planting materials should come with *Trichoderma*, a biological control agent, and other farming practices that use 'organic' materials. The bundle of introduced technology consisted of 'the planting materials' and *Trichoderma* that will serve to protect the crop from the disease. The research of Galian and Nagpala (2019) also encouraged the use of *Trichoderma koningii* as a sole inoculant in inhibiting Fusarium wilt. Moreover, there is strong evidence of the positive economic returns and adoptability of *Trichoderma* in highland agriculture (Launio et al., 2020). For the first batch, NPRCRTC recommended three varieties namely: *Immitlog, SP30*, and *Taiwan*. Through the participatory approach, it was agreed that the distribution be facilitated by clustering the contiguous areas since the area covered is widely distributed. Women volunteers grouped themselves into clusters for three locations with one representative per cluster in charge of 'planting and propagating' the seedlings. Three (3) women volunteered to take on the job and offered their plots to serve as 'mother plots' as well as learning sites for other community members. The sites are located at Sitios located far apart: Agadangan, Beyeng, Legleg, and Paoay. These 'mother plots' were agreed to be the source of planting materials for the other community members.

Clean planting materials were requested from the NPRCRTC using local varieties selected by the community members. These planting materials were assumed to be clean the fact that it is tissue cultured. The identification of the varieties distributed for propagation was based on the feedback and/or experiences of the community members. The institute through the NPRCRTC continuously distributed different varieties of sweetpotato until the best suitable varieties in the area were already identified. In the parlance of agronomy, this constituted the suitability trial phase. As the process was participatory, the women collectively identified which varieties were to be grown and distributed later.

Monitoring

The distributed planting materials were closely monitored through actual field visits as well as open communication through mobile devices with the women partners. The status of the soil was also monitored through the samples taken from the area and subjected to laboratory tests at the Plant Health Clinic (PHC) of the BSU and NPRCRTC Laboratory.

Trainings and Seminars

Trainings and seminars were conducted based on the needs identified by the community as well as based on the results of the monitoring. The different expertise of the NPRCRTC researchers as well as other agencies such as BPI-DA were tapped. Part of the bundle of technologies was a training series that consisted of three (3) livelihood skills training; and three (3) hands-on training on the production of *Trichoderma,* and soil testing analysis done in different years from 2017 to 2020.

Results and Discussion

Farm and Community Profile

Barangay Palina is the 5th largest among the seven barangays of the Municipality of Kibungan, located in the northern part of the municipality. Farming is still the major source of livelihood in the area. In the past, rice farming was the municipality's main produce with swidden farming coming next, making it semi-subsistence. In 2014, the municipal profile documented vegetable gardening at 20.69% with rice farming registering at 15.4%, while sweetpotato farming was at 22.97%. In an assessment done in 2018, a household survey in Palina revealed that 83% of households are into vegetable gardening while 52% are farming rice and other crops – with sweetpotato as one of these crops (Kibungan LGU, 2018). Palina has always been cited as a place

where sweetpotato is being grown throughout the year such that pig raisers source their camote feeds from Palina. Relatedly, livestock raising is another source of income for community members, especially the camote growers.

The source of labor for farming is the household except when help is needed they would hire additional hands, often during the planting and harvesting periods. Daily paid work, or so-called *por dia*, is usually Php300 for men and Php250 for women. Men have higher wages than women with informants pointing to the 'heavy workload' tasked to men and that 'men are expected to perform other tasks' such as carrying the produce, equipment, and other heavy loads and materials used.

Some traditional practices are still in place such as *alluyon* and *binnadang*, a form of cooperative work (*bayanihan* in Tagalog), particularly during planting and harvesting seasons. *Alluyon* and *binnadang* do not involve cash/money. Labor of the community members who helped will be paid with six bundles of rice (approximately 2.5kg of rice per bundle) or through labor exchange. A can ('Baguio oil') of camote (approximately 12kg to 15kg) can also be exchanged for a day's work.

Rapid Shift to Vegetable Farming

Informants recalled that in the 1970s up to the early 1990s, sweetpotato and rice were the major crops in Sitio Palina proper and the neighboring sitios. Only about five community members were into vegetable farming. At the time, the market of the harvested vegetable crops was in La Trinidad via a footpath as the access road. From the informal discussion with some of the community members, they claimed sweetpotato used to cover the whole mound of Mt. Kil-kili in Barangay Palina. Even the sides of the nearby mountains where the national road was constructed were also planted with sweetpotatoes. Still, according to one of the informants, back then, the farmers would transport a sack of potatoes by foot to Sumil (sawmill), while Ampusungan in Bakun was an alternate route to the nearest market. The other route is the Palina-Poblacion route which was farther (at least when road concreting was not yet constructed) to Palina. The 1990 earthquake that hit the area resulted in the erosion of rice terraces: "*nagday din talon*" (the terraced rice fields were eroded). As their rice farms were irreparable, some community members were forced to shift to vegetable farming, albeit on a limited scale. With *tungro* or Fusarium wilt infestation, it marked the booming of vegetable farming in the area. As shown in Table 1, as of 2018, of the total area of the barangay, 273.73 hectares is devoted to vegetable farming (Office of the Municipal Agriculture [OMAG], 2018) compared to the 51.64 hectares recorded in 2010 (Kibungan LGU, 2010). From the same data, sweetpotato area drastically shrunk to 0.5ha by 2016 and 2017 and even further decreased to 0.4ha by 2018, mainly due to Fusarium wilt. This is a 99.9% decrease from the 2010 data.

In 2018, the road going to Palina proper was fully concreted which made transportation easier, resulting in more aggressive vegetable farming.

In Sitio Legleg of Barangay Palina, the specific sitio where more camote produce is accessed, informants narrate that sweetpotato along with rice used to be the main crops up to the early 2000s. What is visible as vegetable farms nowadays, used to be planted with sweetpotatoes. The introduction of vegetable farming in the community was through a certain vegetable grower named 'Victor' from Beyeng, in a nearby barangay in Bakun, sometime around 1995. Starting around the mid-1990s, Victor hired

Table 1

Land Use in Barangay Palina, Kibungan, Benguet (hectare)

Commodity	Years			
	2010	2016	2017	2018
Rice	601.97	39.48	134.34	135.24
Vegetable	51.64	66.85	329.00	273.73
Sweetpotato	698.16	.50	.50	.40

Source: Office of the Municipal Agriculturist

additional labor from Legleg especially the women hired for *por dia*. With this vegetable farm exposure, they also started rotating vegetables with camote. On the other hand, it was observed by the Legleg research partners that vegetable growing entailed excessive use of the water supply as well as pesticides, which at the time of data gathering, brought some discomforts to these women. Perhaps a more compelling reason for their reservations about vegetable growing is the desire to plant camote again. Interestingly, even with the *tungro* attacking camote, camote and peanut is still being rotated with short growing duration crops such as pechay.

Vegetable gardening seems very attractive to farmers. The cash income that can be realized from vegetable farming and the increasing need for it is a reality. Yet one factor that slowed down the expansion of vegetable gardening in this part of the municipality is the inaccessibility of Legleg. While road concreting finally reached Palina proper, Legleg remained isolated. Because public transportation was not available even until the time of eriting this paper except for private vehicles in the area (there is only a dirt road going to Legleg and is unpassable during the rainy season), farmers would transport their harvests by foot or through a hired *comboy* (baggage carrier) to Sitio Poen, Palina, where there is available transportation going to La Trinidad. Another option is through Beyeng going to La Trinidad but the "*comboy* fee" is much higher, estimated to be at Php5.00 per kg. The limited access to transportation to and from the area is what kept its status as "*agrugrugi*" or 'just starting' as said by the community members in terms of vegetable gardening.

Limited Use of Agrochemical Inputs

Vegetable gardening also means the introduction of various agro-chemical inputs. As mentioned earlier, vegetable farming in Sitio Legleg is still at an early stage, "*agrugrugi*" or remains to be so - thus the usage of agro-chemical inputs is from zero to still minimal amount as claimed by the informants. "*Agusar kami nu kasapulan* (we will use only if needed)." Pepper and sweet peas, for instance, are sprayed once a week, compared to gardeners in Palina Proper and Sitio Poen where farmers apply pesticides twice a week.

An interesting narrative from informants is their emphasis on the use of green and blue-labeled pesticides. Green and blue-labeled pesticides are classified as slightly to moderately toxic. The community members still value the importance of organic and GAP farming: "*Madi met nga maispray an nu pangkakan, maangot jay* chemical (it is not good to be spraying food crops as the chemical odor is strong)." On the other hand, the better road access in these areas is also contributing to higher chances of using agro-chemical inputs.

Protecting the Local Water Source

Water scarcity is experienced especially during summer. The communal watershed is not enough to supply the demand for vegetable farming. Barangay Palina has a policy enforced by the LGU that does not allow gardening during summer with strict monitoring. The officials and some of the community members would go around the community to check the water utilization of the community. A fine will be collected from the community members who will be caught violating the said water utilization schedule and using water hoses not approved by the LGU. Perhaps this is another reason why vegetable farming remained '*agrugrugi*' ('early phase') as locally termed as there is a collective agreement that vegetable growing will be controlled. For some, this policy is very limiting especially so that the neighboring municipality of Bakun is aggressively into cash crop production, which is sometimes a cause of tension.

Decreasing Areas Devoted to Sweetpotatoes

This drastic decline of sweetpotato areas could further be observed by comparing the declared areas that the informants used to plant with their estimated existing sweetpotato areas. Through GPS, a drastic reduction of area and harvests between 2014 to 2016 was noted; by 2016, clean planting materials were provided every year until 2019, hence there were indications of recovery, as shown in Table 2.

As of 2018, 42.5% of the reported 0.4 hectares of sweetpotato areas in Barangay Palina were planted with clean planting materials provided by Benguet State University (Table 3). Only those whose areas were personally visited were included in the figure, hence the area covered with planting materials from BSU may be higher.

Table 2

Sweetpotato Areas Devoted by Farmer Adopters in Barangay Palina , Kibungan, Benguet

Adopter No.	Est. Area Planted with sweetpotato before (m^2)	Volume of Harvest (kgs)	Est. Area Planted (May 2019) (m^2)	Volume of harvest (May 2019) (kgs)
1	10,000	7,500	29	0
2	100	50	19	28
3	600	30	179	5
4	50	100	0	0
5	300	60	231	20
6	20	25	4.2	2
7	100	15	20	0
8	600	90	1,008	164
9	200	50	272	15
10	600	100	78.29	5
11	500	500	20	0
12	100	200	143	10
13	50	20	0	0
14	278	55	4.7	1

Table 3

Estimated Area Planted with Clean Planting Materials from BSU-NPRCRTC

Year	Total area of sweetpotato in Palina (m^2)	Total Area Planted (m^2) with BSU planting material	Percent area planted with BSU planting material
2016	5000	279	5.58
2017	5000	1,007	20.14
2018	4000	1,700	42.5
2019	---	1,988	45.0

Saving and Propagating Local Sweetpotato Varieties

From the interviews, 16 varieties of sweetpotato were already identified wherein 11 of these are local varieties (Table 4). The other five varieties came from other places such as Bakun. However, only six of these 16 varieties are still surviving. As noted by women cultivating sweetpotatoes, these surviving varieties were not intentionally planted as claimed by the informants as these plants 'just grow' around the community. These varieties sprouted on their own when it rained, most probably from the tubers that were not harvested.

Project participants lament the loss of the majority of the old varieties. They cannot help but compare particularly in taste: "*Mas mabukag jay dati ngem dagijay adda tadta nga kamote* (the old varieties are mealy and tastier than the new ones)". However, they acknowledged that the old varieties are more susceptible to pests and diseases, unlike the new ones.

The loss of these old varieties could not solely be attributed to Fusarium wilt but also to some management practices, which significantly contributed to the loss of the old varieties. In the old days, it was said that whenever the community members saw a new variety from

their neighbors or other places, they would ask for planting materials for planting in their fields. This practice continued resulting in the replacement of the old varieties over time. Unknowingly, this exchange of planting materials also facilitated the introduction of diseases. Another traditional practice is that tubers growing from neighboring farms or swidden fields become the source for "*betang*" or stem cuttings, the farmers being unaware that these planting materials might have been infected.

Participatory Varietal Selection to Propagation and Distribution

From the participatory selection of varieties for the propagation of clean planting materials at the NPRCRTC, what followed was the planting on the field. Women who cultivate the sweetpotatoes volunteered to grow the clean planting materials in their plots. The goal was to produce enough planting materials of the different varieties and distribute them to other growers. The distribution of planting materials accessed from the NPRCRTC was in three (3) batches (Table 5).

Table 4

List of Sweetpotato Varieties Being Planted Over Time, Barangay Palina, Kibungan, Benguet

Variety	Source	Tuber Description	Duration	Planted Before	Planted at Present
Manila	Unknown	Pure yellow	April- September (6 mos)	Yes	No
Lapitayan	Local	Red skin, white flesh	April – August (5 mos)	Yes	No
Pitayan	Local	Red skin, white flesh	Dec or April – March or September (4 - 6 mos)	Yes	No
Ulongan	Local	Red skin, white flesh	April – September (6 mos)	Yes	No
Kalbo-oy	Local	Pure white	April – September (6 mos)	Yes	Yes
Gis-ey	Local	Red skin, yellow flesh	April – September (6 mos)	Yes	Yes
Miracle	Lanipew Kibungan	White skin, yellow flesh	April – June (3 mos)	Yes	Yes
Sampido	Unknown (some say from BSU)	Violet skin, white flesh with violet dots	April – September (6 mos or it could take as long as 8 mos to 1 year)	Yes	No
Saku-oyan	Sipetan, Bakun	White skin, yellow flesh	June – September (4 mos)	Yes	Yes
Pintu-ok	Local	Yellowish skin, Yellow flesh	October or November – September (10 mos)	Yes	No
Gay-yading	Local	Pure white	October or November – September (10 mos)	Yes	No
Kapangan	Local	Yellowish skin, white flesh	April - August or September (5 to 6 mos)	Yes	Yes
Violet/Biolet	Local	Pure violet	April – September (6 mos)	Yes	Yes
Baudan	Baudan	Violet skin, white flesh	April – September (6 mos)	Yes	Yes
Kawitan	Local	Red skin, yellow flesh	December or May - march or August (4 mos)	Yes	No
Pattalan	Local	Red skin, white flesh	April – September (6 mos)	Yes	No

During the monitoring activity in early 2017, only Albina, one of the three women partners, successfully propagated the planting materials given to her. She was able to expand her mother plot approximately measured at around 150m² to about 400m² by late 2017.

The other two partners, on the other hand, were not as successful as Albina. Based on the visual observation of the area (approx. 77 square meters) where Elsie, one of the three partners, her sweetpotatoes were severely infected with Fusarium wilt. The area was sprayed with *Trichoderma*, a biological control agent known to suppress the Fusarium wilt, but only once or twice. Based on the result of the soil sample taken from the area, *Fusarium* sp. along with other parasitic nematodes such as *Aphelenchoides, Tylenchus,* and *Helicotylenchus* were also present. These parasitic nematodes feed on root systems causing damage to roots where soil pathogens enter that including *Fusarium* sp. (E. Balinsoy, personal communication, 2017).

Table 5

Distribution of Sweetpotato Planting Materials in Barangay Palina, Kibungan, Benguet

	Date	Varieties	Pieces	Partners-adopters
First Batch	2016	Immitlog	30	3 women
		Taiwan	100	
		SP30	120	
Second Batch	2017	Pakak	300	7 women
		Swerte	300	
		SP30	300	
Third Batch	2019	Haponita	300	21 (20 female, 1 male)
		Swerte	300	
		SP30	300	
		Kalbooy	300	

Second Batch of Planting Materials. Because Albina was the only remaining source of planting materials for the other community members, the team requested another batch of planting materials from the NPRCRTC. However, since the temperature in the barangay varies significantly per sitio, the so-called microclimate variability that occurs in Kibungan, a sort of 'trial and error' was done to screen and identify the most suitable varieties for each area.

Through collective assessment of the performance of the NPRCRTC varieties, the women growers requested three varieties, namely, *SP 30, pakak*, and *swerte,* at 300 pieces each. From the women growers, the *SP 30* was again requested as it was identified as the most resistant among the first batch of sweetpotato varieties that were distributed. This time seven women were identified to take charge of propagating the second batch of planting materials: three (3) women from Legleg, one (1) from Pangpang, two (2) from Poen, and one (1) from Lingey. Only two varieties, *Swerte* and *Pakak*, were given to Sitio Legleg as they already have the *SP30* and it was agreed that the community members from Legleg would source their planting materials from the standing sweetpotato plants of Albina.

During the monitoring activities done in 2018, only the partners in Sitio Legleg and one from Sitio Poen were able to successfully propagate the planting materials provided. Though the other

Figure 1

Second Batch of Distributed Planting Materials in Barangay Palina, Kibungan, Benguet

partners had patches of surviving sweetpotatoes from the planting materials provided to them, these were visibly heavily infected with Fusarium wilt.

Third Batch of Planting Materials. Again, during the second quarter of 2019, the team requested another set of planting materials from the NPRCRTC, namely, *Swerte, Haponita, Kalbooy,* and *SP30*, at 300 pieces for each. This time, more community members were provided with the planting materials but in smaller quantities. About 11 of the community members were provided with 50 stem cuttings or more, while the rest were given 20 stem cuttings each.

Acceptability of Introduced Technologies

The measures of acceptability were mainly qualitative with data coming from the stories of the women partners. The feedback for the sweetpotatoes was summarized in Table 6.

Resistance

At present, three varieties have already been identified to be the most resistant to Fusarium wilt: *SP30, Pakak*, and *Swerte*. However, the level of resistance of the varieties differs according to location. In Sitio Legleg for instance, all three varieties identified are resistant, while only the *Swerte* variety is resistant in other areas.

Table 6

Perceived Characteristics of Tissue Cultured Sweetpotato Planting Materials from BSU by Farmers in Barangay Palina, Kibungan, Benguet

Variety	Taste		Resistance		Other observations	
	Legleg	Other Sitios	Legleg	Other Sitios	Legleg	Other Sitios
Immitlog	Mealy, sweet	--	Not resistant	--	Tubers have deep longitudinal grooves	--
Taiwan	Bland	--	Moderately resistant	--	Long irregular or curved tubers with deep horizontal constrictions	--
SP30	Mealy, sweet	Mealy and sweet	Resistant	First to be attacked	There are still those that are being attacked but at least majority of the plants are surviving	*madi ti bagas na, bako-bako (Tuber is not good, it is crookedly shaped)*
Pakak	Mealy, sweeter	Watery and bland	Resistant	Second to be attacked		--
Swerte	Mealy, less sweet among the three	Mealy and sweet. Most preferred among the three. Softer and sweeter compared to all other varieties.	Resistant	Resistant		--
Haponita	Dry but it is best use in food processing		Moderately resistant	Resistant		
Kalbooy	Watery	Watery	Not resistant	Not resistant		

Furthermore, the *SP30* which is the most resistant in Sitio Legleg has the lowest level of resistance in other areas, followed by the *Pakak* variety.

Unfortunately, the *Immitlog* variety was not recommended as it was the 'first to get attacked' with Fusarium wilt. As for the *Taiwan* variety, farmer Albina observed its susceptibility to Fusarium wilt. Despite this initially observed low resistance, farmer Albina still tried to propagate it, believing that by continuously propagating sweetpotatoes, the Fusarium wilt would 'give up'. "*Ta mauma met ti sakit* (and will eventually disappear)." She also tried adding a few "*betang*" or stem cuttings from the *Taiwan* variety with the other varieties whenever there were community members who would ask for planting materials. She reasoned that it might thrive in other areas. It is interesting to note that women growers hold knowledge of certain pathological characteristics, and that the disease occurs under a variety of environmental conditions.

From the third batch of clean planting materials given, the *Haponita* variety was shown to be moderately resistant to the disease in Legleg while it is resistant in other sitios of Palina. *Haponita* is lauded by women partners as a good ingredient in food processing.

Different varieties are resistant from one sitio to another which can be explained through the different elevations of each area that affects the temperature, weather, and soil. Accordingly, the optimum temperature to achieve the best growth of sweetpotatoes is between 21°C to 29°C. In the barangay profile of Palina in 2018-2020, the average temperature of Palina ranges from a maximum of 24°C to a minimum of 10°C . Sitio Legleg is located at a higher elevation than Sitios Proper, Pangpang, and Poen. Pine and alnus trees surround Legleg which gives it a lower temperature, suitable for *SP30* and *Pakak,* and thrive in cold weather. The other sitios are located in lower elevations and flatter areas with a warmer temperature that makes the *Swerte* variety thrive in the area.

Taste

When it comes to taste, it also varies according to location. The *Swerte* variety is much preferred in Palina Proper and other sitios compared to *SP30*, as Swerte is much sweeter and more "*mabukag*" or mealier. In Sitio Legleg, the varieties P*akak, Swerte, SP30,* and *Immitlog* were described as mealy and sweet while the *Taiwan* variety was described as 'bland.' In addition, the tops of the *Swerte* variety were described as good to be served as a viand, while the tops of the *SP30* and *Pakak* varieties have a bitter taste. However, further observations are needed to confirm the different tastes of the tubers produced by the same sweetpotato varieties planted in different locations.

Other observations were also noted by the women partners such as the physical appearance of the tubers produced by the sweetpotatoes provided. When the *Immitlog* variety was still being planted in Sitio Legleg, it produced tubers with deep longitudinal grooves, while the *Taiwan* variety had long irregular or curved tubers with deep horizontal constrictions. In Palina Proper and other sitios, the *SP30* has curved tubers in contrast to the perfectly shaped tubers (flawless, no constrictions) produced by the same variety in Sitio Legleg.

Farmer Albina reiterated that planting sweetpotato takes *tiempo* and *luta* (timing and soil condition) to have desired results. She further explained that the sweetpotato plants cultivated from January to April bear good tubers compared to those planted from July to December. The tuber produced by *SP30* planted from July to December was described as "*nakusikus ti lames na*" or has long irregular tubers. Later, tubers seemingly adopted as tubers looked more regular.

Another partner, Lilia, added that it might be better not to put any fertilizer on the sweetpotato plants. Instead, she recommended the use of uncleared or newly opened areas, "*baro nga daga*," to plant the clean planting materials.

Wider Adoption: Women Agency in the Exchange of Stem Cuttings

When one introduces a technology through extension, one key indicator of the effectiveness and usefulness of the technology is that it can expand its adoption from the original farmer partners to secondary adopters. It is interesting to note that among women farmers, the seed-keeping and seed-exchange tradition was sustained this time through the sharing of stem cuttings. Sitios Legleg and Palina Proper were identified as most successful in propagating the

NPRCRTC planting materials and the news went around mostly by word-of-mouth and through text messages. Their plots served as the main sources of planting materials for the other community members.

Lilia, Sitio Palina Proper

In Sitio Palina Proper, "Mother" Lilia as she was popularly called is the wife of the *Punong barangay*, and like the other women growers, underwent 'phases' before successfully growing tubers. She tried planting in a fallowed area and later transferred to another location where chayote is also grown. By the time the chayote had spread, her camote also grew and was to become the main source of planting materials in the neighborhood. As her planting site (Figure 2) is near the road, it has become the 'open source' of planting materials for passersby. In this way, Lilia claims that the practice of women sharing seedlings, or in this case planting materials 'from one hand to the next,' was somehow revived. When asked how many had taken planting materials, she said 'Anyone can just cut' and the 'word goes around.' Even with her camote plants serving as sources for stem cuttings, she said that from 2017 to 2019, she was able to harvest around 40 kilograms, all consumed by her household.

Albina, Sitio Paoay

Albina is the most successful in terms of propagation and adoption of the sweetpotato material among all of the women partners. From the 150m² where she planted the first batch of planting materials provided to her, she was able to expand it to 400m² in 2017, 1,140m² in 2018, and 1,800m² in 2019. As of 2020, she currently maintains three areas: a 579m² area just above her house near the footpath, a 177m² area behind her house, and a 252m² area around two hundred meters away from her house. These three areas captured through GPS were the main sources of planting materials for the other community members (Figure 3a & 3b).

Figure 2

Sweetpotato Area of Lilia in Sitio Palina Proper, Palina, Kibungan, Benguet

Figure 3

Existing Sweetpotato Area of Farmer Albina in Sitio Paoay, Palina, Kibungan, Benguet

Among all the partners, she is the only one who maintained a logbook for her sweetpotatoes, enabling her to track her harvest and those whom she provided with stem cuttings. Recording and record keeping constituted also the capacity-building activities. She recorded some of her observations in the same logbook where it registered that neighbors in Palina, as far as Mankayan, Bakun, and Tacadang, Kibungan accessed her stem cuttings (Table 7).

When it comes to harvests, her records showed that she was able to harvest a total of 837.9 kilograms of sweetpotato from her areas from 2017 to 2019; of which 72.91% were sold while the remaining 27.09% were given away, consumed by the household and her domestic animals (Table 8). Some of it was served as snacks for visitors in the community as well as used as payment for transportation whenever she goes to the other sitios in Palina. Of the 72.91% sold harvest, she was able to make approximately Php10,996. It is noted however that the reflected total harvest is only those that she was able to record.

Stories of Dominga and Medina, Sitio Agadangan

Dominga and Medina of Sitio Agadangan accessed their planting materials from Albina's mother plots although they were also provided stem cuttings during the distribution of the 2nd batch of planting materials. As of the 2018 visit, they have an estimated area of 54m² and were able to harvest around 26kg and 29kg respectively. As the area is intended for rice crops, they eventually transferred their sweetpotato plants to an *uma*, with the 3rd batch of planting materials. As of the latest monitoring, Dominga harvested 10kg of tubers from her existing 143m² area which were all consumed by her household. She was also able to share 200 pieces of stem cuttings with a community member from Barangay Tacadang, Kibungan (Figure 4).

Table 7

Estimated Number of Recipients of Stem Cuttings from Albina's Farm, by Year and by Location

Location of Receiver	No. of Receiver	Quantity (pcs)
2017		
Poblacion, Bakun	1	20
Beyeng, Bakun	4	210
Agadangan, Palina	3	60
Paoay, Palina	3	750
Legleg, Palina	1	20
Lengawan, Mankayan	1	150
2018		
Beyeng, Bakun	3	60
Legleg, Palina	2	40
2019		
Poen, Palina	3	280
Tacadang	1	450
Legleg, Palina	5	1595
Palina proper	1	235
Legab, Bakun	1	93
Paoay, Palina	2	340
Budu-an	1	30

Notes:
1. Estimates based on discussions
2. There are community members who took planting materials from her sweetpotato areas that she was not able to document

Table 8

Sweetpotato Harvest of Farmer Albina in Sitio Paoay, Palina, Kibungan, Benguet

Year	Area	Total Harvest (kg)	Total volume sold (kg)	Total volume for others (consumption, given away, used as payment) (kg)	Price range	Total*
2017	400m²	185	185	27	Php20-25	Php3,585
2018	1,140m²	249.9	163.9	86	Php20-25	Php1,806
2019	1,800m²	403	262	141	Php20-25	Php5,605
Total		837.9	610.9	254		Php10,996*

**All the sold sweetpotato where prices were not indicated were multiplied by Php20.00*

Figure 4

Sweetpotato Garden of Dominga from Sitio Agadangan, Barangay Palina, Kibungan

In the meantime, Medina noted that one should continuously plant sweetpotatoes as she believes that if the 'grower does not give up, the crop is also inspired to produce tubers.' This is an interesting view of women growers, treating their root crops as having a 'life' that is also dependent on its growers.

As of the second quarter of 2019, Medina harvested a total of 34kg of sweetpotato, of which 14kg were sold to her neighbors at Php25/kg. The rest were consumed by the household and were given as '*pasalubong*' to her children staying at other places. She was also able to provide 20 pieces of stem cuttings to a community member from Sitio Legleg.

Introduction of the Use of Trichoderma

Along with the distribution of clean planting materials was also the introduction of *Trichoderma*, a biocontrol agent known to suppress Fusarium wilt. The path to the adoption of this technology was not without problems. The first batch of *Trichoderma* was accessed from the Plant Health Clinic of the Benguet State University and was readily distributed but was not applied by the women partners. When asked why, it was mainly attributed to the lack of knowledge of proper usage. A hands-on training was therefore conducted with a pest and disease management awareness seminar. However, the technology was not again used. One of the women who received the product stated that "*inpadas ku nga inusar ngem narigat nga matunaw, pinullatan na jay nozzle ti sprayer* (I tried to use the *Trichoderma* but found out that it was difficult to dissolve in water, clogging the nozzle of the sprayer instead)."

Trichoderma can be used in several ways. One of the most common ways is by dissolving the pure cultured product in 16 liters of water. This method is what was shared with the community of Legleg as it is much more convenient and easier to prepare. The other method is mixing it with chicken manure or compost, which is a bit more laborious (Masangcay, 2017).

In response to the reluctance to use and the expressed need to learn the details of using *Trichoderma,* during the distribution of the last batch of clean planting materials another hands-on skills training on *Trichoderma* utilization was conducted, joined by 42 participants coming from the different sitios of the barangay. More than 95% who attended were women. The training was conducted in partnership with the DA-Bureau of Plant Industry (BPI).

Positive feedback was received after this series of trainings. According to their observations, the planting materials soaked with *Trichoderma* were more resistant than those that were not. This observation is better seen in the area of Lilia in Sitio Pangpang after half of the planting materials she planted were soaked with diluted *Trichoderma*.

This affirms the positive benefits of using *Trichoderma*. In the evaluation on the use of *T. koningii* showed a 10%-50% change in yield on various crops based on farmers interviews and 4%-92% based on field and pot experiments. Morover, the estoimated average incremental benefits of using the technology is Php138,134.00 per hectare per year (Launio et al., 2020).

As seen in Figure 5, those that were soaked with *Trichoderma* are still healthy while those that were not are already turning yellow, indicating the onset of Fusarium wilt.

However, a reluctance to use the product was again noted during one of the monitoring sessions, and this can be attributed to the non-availability of the product in the market.

Though the community members were trained on how to reproduce their own *Trichoderma*, reproducing it is still not so alluring to them especially those who are in vegetable gardening as they consider it as 'laborious.' As one of the informants stated, "*Ti kayat ti tao tadta ket instant* (what people want nowadays is 'instant')."

These constraints noted from the women partners in adopting Trichoderma to suppress Fusarium wilt coincides with the findings of Launio et al. (2020) that limited knowledge about the technology and its limited market outlets are among the constraints in adopting the technology.

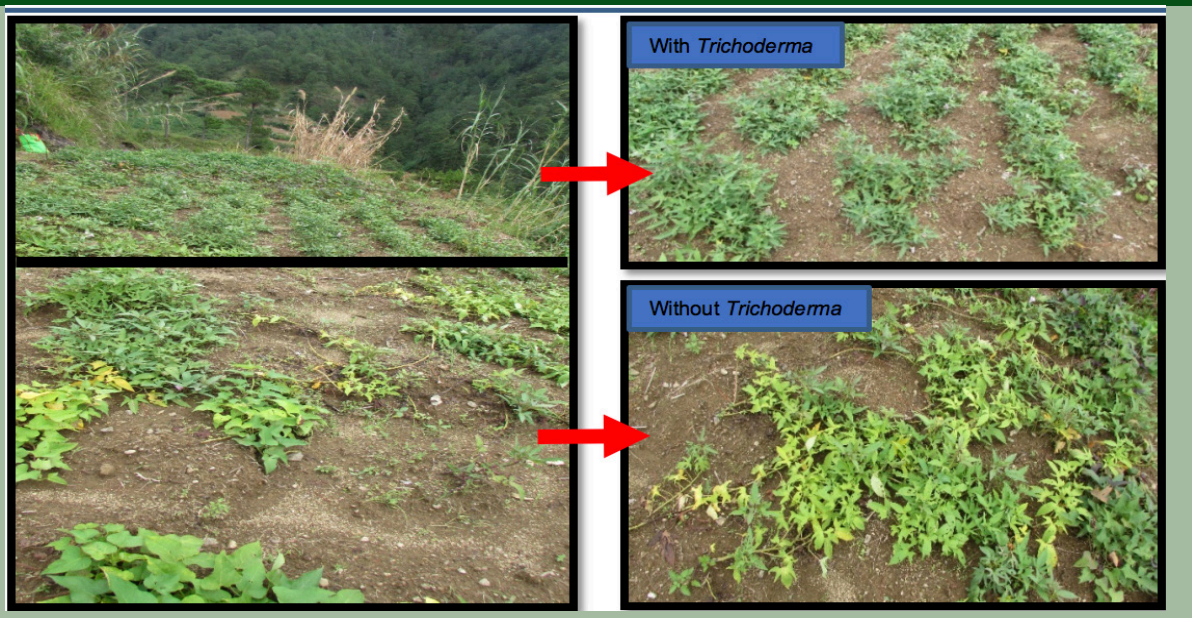
Some camote growers noted that the Fusarium wilt seems to be "disappearing" because of the rain, '*Haan unay ti sakit ti kamote tadta, kasla nga maug-ugasan nu agtodo*" compared to that in the summer season. A consulted plant pathologist said that the slope of the area as well as the temperature could have affected the spread and reproduction of the fungus. Rainfall does help in spreading the fungus in other areas, the cold weather on the other hand helps in controlling it to reproduce.

Conclusions

As the project attempted to fill the need to recover sweetpotato from what is termed by plant pathologists as 'crop damage', the project was also informed by evidence-based research that not only aimed at addressing the disease but also aimed to contextualize the root crop as an embodiment of women's everyday lives, aspirations, and wisdom. Such wisdom proved helpful in the process of understanding and locating as well as motivating women to actively participate in learning and adopting the technologies introduced. As it is, keeping seeds and planting materials in a semi-subsistence community like Palina remains pivotal not only in the stories of the women growers but also in the wider and successful adoption of the technology. In the parlance of evaluation studies, the farmers' characteristics and the characteristics of the technology being introduced appropriated the women cultivators' experiences and openness to learning new knowledge. In the extension experience centered on saving and propagating

Figure 5

Comparison of Sweetpotato Plants With and Without the Trichoderma Application



this root crop, the value of cooperative work as seen in women 'sowing, exchanging and continuous propagation' are also values of collective engagement. With resource limitations on the part of the extension agents, the use of this local wisdom coming from women proved to be efficient and effective in terms of broadening the adoption of the NPRCRTC sweetpotato technology. Unlike the tissue-cultured technology, the *Trichoderma* technology may take time for its adoption in the community.

Recommendation

At present, sweetpotato is identified as a high-value crop next to cassava and has been given preference at the national level because of its industry potential as food, feed flour, vinegar, and coloring for wines and other by-products. This entails wider support from various stakeholders. The varieties *Swerte* and *SP30* can be recommended to other areas in CAR given similar environmental conditions. In addition, integrating S&T in farm management and follow-up trainings on raising *Trichoderma* awareness and utilization should be conducted. Moreover, there should also be continuous technical assistance to the adopters of BSU technologies for sustainability as well as in support of a women-identified crop. For NPRCRTC, continuing upscaling through tissue culture propagation using traditional sweetpotato varieties is recommended.

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