



International Center for Tropical Agriculture

# Cassava and Sweet Potato Cropping Practices and Farmer Communication Networks in Quảng Bình Province, Vietnam

Identifying gaps between existing RTCs farming practices and 'best CSA practices' and characterizing extension communication systems to support Cassava/RTCs Livelihoods in Quảng Bình Province, Vietnam

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## ABSTRACT

Root and tuber crops (RTC), especially cassava and sweet potatoes, have historically played important roles in the livelihood of small farmers in Quảng Bình Province, Vietnam. This agricultural-based province was chosen as a site for the FOODSTART+ project in Vietnam, which aims to introduce RTC innovations that will enhance the food resilience among poor households in upland and coastal communities of the Asia-Pacific. The objective of the project aligns with IFAD's investment project in the region, the Sustainable Rural Development for the Poor (SRDP), to make an "investment in climate smart, socially equitable and profitable rural development models that promote pro-poor linkages, value chains and enhanced rural business competitiveness". This research paper is a continuation of a 2016 scoping study that collected information about RTC production and value chains, RTCs in diets, key stakeholders and problems and opportunities in regards to RTC in the region.

This study evaluates the gaps between current practices and climate smart cropping practices in cassava and sweet potato farming in Quảng Thạch and Cao Quảng communes, as well as evaluates farmers' communication networks in regards to their knowledge about cassava and sweet potatoes. We interviewed 43 key informants and stakeholders in six villages (3 per commune) as well as areas outside the communes. We found that farmers growing RTCs in Quảng Thạch commune are well integrated in local and regional (processing) markets whereas farmers in Cao Quảng commune have little access to profitable markets for cassava and have quality issues that preclude their entrance into local sweet potato markets. In both communes, we found the gaps in practice and climate-smart cassava farming to be: the efficient use of fertilizer, plant spacing, and erosion control and pest management. For sweet potato cropping, in Cao Quảng there is a significant lack of pest and disease management strategies while Quảng Thạch farmers have low pest and disease pressure and are not in need of prevention strategies. Most farmers' knowledge about RTC cropping is learned through interpersonal communication with family and neighbors. Knowledge about market-related information (new products, varieties, prices) is often communicated through stakeholders outside the village, including fertilizer salesman, cassava traders and commune agricultural officers.

## 1. INTRODUCTION

Climate-smart agriculture (CSA) is an increasingly popular framework to address environmental issues and sustainable intensification in small-holder farming landscapes. The FAO definition of CSA, which will be the definition used in this paper, is farming that fulfills three objectives: 1) sustainably increases agricultural productivity to support equitable income growth, food security and development, 2) adapts and build resilience to climate change at farm to national levels and 3) develops opportunities to reduce GHG emissions (FAO, 2013). There will be necessary compromise between these objectives in different systems but this framework attempts to integrate these three important concepts.

While the framework is fairly comprehensive, difficulties arise in prescribing solutions because interventions must be highly location-specific and knowledge-intensive (FAO, 2013). Within the course of the research undertaken, there was great variation in needs and constraints between villages surveyed that were separated by less than a few kilometers.

In Vietnam the government is aware of the threat of climate change to agriculture and food security. These sectors are the most vulnerable to climate change, due to increases in

temperature and increased rainfall that will lead to more frequent flooding, intensify droughts and aid the spread of plant and pest diseases (Ministry Natural Resources & Environment, 2007; IPONRE, 2009). Warmer temperatures will likely move planting boundaries higher, which will negatively affect smallholders with land constraints (IPONRE, 2009). Knowing these threats, the government has goals to reduce greenhouse gas emissions in the agriculture and forestry sector while continuing the raise yield productivity. Some of the strategies proposed to increase agricultural development while reducing GHG emissions include applying sustainable agriculture techniques that reduce instances of crop residue burning, improvement of manure management and irrigation-drainage management in rice fields and strengthening the capacity of agricultural research institutions (IPONRE, 2009). Many of the government's proposed options for climate change adaptation in agriculture align with the CSA framework: planned use of irrigation water, development of varieties that can survive harsher environmental conditions and developing appropriate farming techniques (IPONRE, 2009).

In regions vulnerable to the negative effects of climate change, root and tubers are seen as climate-resilient crops that could ensure greater food security for smallholder farmers. Cassava (*Manihot esculenta*) is the world's sixth most important food crop and is tolerant of environmental stress and drought (El-Sharkawy, 2003). Also, cassava is becoming a globalized commodity as demand grows in Asia for dried cassava and starch for livestock feed and industrial uses (FAO, 2013). Sweet potatoes are also (*Ipomoea batatas*) becoming more popular in processed foods, and for their role in combating Vitamin A deficiency and diversifying diets in developing countries (Scott et al., 2000).

Since climate-smart agriculture is a relatively new framework for agricultural development, there is not a large literature about CSA for root and tuber crops in Vietnam, but much information does exist concerning sustainable intensification or sustainable cropping systems. Some of the studies involving root and tubers have been conducted by the Northern Mountainous Agriculture and Forestry Institute (NOMAFSI), the Food and Agriculture Organization (FAO), Agricultural Research for Development (CIRAD), The International Center for Tropical Agriculture (CIAT) The National Institute for Soils and Fertilizer in Vietnam, and many other Vietnamese research organizations and universities.

CIRAD researchers have done farmer trials for minimum tillage rice-potato cropping in Vietnam, as well as direct-seeding mulch-based cassava systems (DMC) in Cambodia. No tillage planting of potatoes combined with rice straw mulch led to high yields and lower pest incidence in Thai Binh Province (Dung et al. 2012). In Kampong Cham Province, Cambodia, yields increased over three years (2009-2011) with DMC practices compared to conventional practices and farmers improved their overall crop management. The study did find that variable biophysical conditions lead to a high standard deviation and over 40% of farmers abandoned DMC each season because of the increased risk of investment (Chabierski et al., 2012).

The FAO and NOMAFSI reviewed sustainable land management practices on sloping lands in Northern Vietnam, particularly mini-terracing, legume crop rotation and reduced tillage (Arslan, 2010). The report offers recommendations on successfully intercropping cassava with peanuts and beans, as well as the use of grass hedgerows to control erosion in Yen Bia province (Arslan, 2010). Phien & Tam (2000) studied the effects of hedgerows on cassava-peanut systems and concluded that hedgerows reduced soil erosion while maintaining cassava and peanut yields (see chart below). As part of CGAIR's climate smart village project, CIAT is assessing

conservation ag practices in Vietnam’s climate-smart villages, including grass strips in cassava systems. In 2004, CIAT researcher Reinhardt Howeler published two papers recommending sustainable cassava production practices that included applying additional potassium to fields and alley cropping with grass hedgerows to reduce runoff and erosion. In 2013, the FAO released “Save and Grow: Cassava; A guide to sustainable production intensification” that called for a “greening” of Green Revolution practices for cassava (Howeler et al., 2013). Their recommendation pulls heavily from CIAT cassava research and recommendations on reducing soil erosion and improving farmer income with strategies like intercropping, hedgerows or efficient fertilizer management (Howeler et al., 2013). In 2014, CIAT published a sustainable management guide to cassava production in Asia based on more than twenty years of field trials. (Howeler & Maung Aye, 2014).

Table 5. Effect of alley cropping using vetiver grass as hedgerow in combination with application of fertilizer and intercropping cassava with peanut to soil conservation and crop yield (average data of two years: 1997-1998)

| Treatment                                | Soil loss<br>(t/ha/yr) | Crop yield<br>(t/ha/yr) |        | Economic analysis<br>(mill.VN dong) |       |            | % of farmers<br>choosing the<br>technology |
|--|------------------------|-------------------------|--------|-------------------------------------|-------|------------|--|
|  |                        | Cassava                 | Peanut | Output                              | Input | Net return |  |
| 1. Cassava (C), no fert.<br>no hedgerow  | 4.5                    | 10.8                    | -      | 8.2                                 | 5.7   | 2.5        | 3  |
| 2. C+Peanut (P)+NPK<br>no hedgerow       | 1.8                    | 14.9                    | 0.74   | 11.2                                | 6.6   | 4.6        | 10   |
| 3. C+P+NPK+hedge<br>( <i>Tephrosia</i> ) | 0.3                    | 14.2                    | 0.62   | 10.2                                | 6.6   | 3.6        | 55   |
| 4. C+P+NPK+hedge<br>( <i>pineapple</i> ) | 0.1                    | 14.5                    | 0.59   | 10.3                                | 6.6   | 3.7        | 47   |
| 5. C+P+NPK+hedge<br>(vetiver grass)      | 0.0                    | 14.9                    | 0.68   | 10.9                                | 6.6   | 4.3        | 58   |

#### *Phien & Tam (2000) results*

For improved sweet potato cropping, the International Potato Center (CIP) published a manual in 2013 outlining recommended sweet potato production and management strategies (Stathers et al., 2013). Much of the current international research on sweet potatoes focuses on the crop’s use for improved livestock feed (Dom et al. 2017 & Sheikha & Ray, 2017). Other important components of sweet potato production are the crop’s role in diet diversification and nutrition as well as its potential resilience to the effects of climate change (Scott et al., 2000). Most sweet potato research is focused on Sub-Saharan Africa, where interest in promoting the tuber to improve farming livelihood has been growing in the last decade (Stathers et al., 2013).

The FOODSTART+ project, under which this research was undertaken, is an initiative to enhance the contribution of root and tuber crops to food security, nutrition and income in the Asia-Pacific region. These crops are widely grown and traditionally consumed by households and are becoming an increasingly important crop for processed food uses (Barlis, 2013). Within Vietnam, cassava and sweet potato may be better adapted than other crops to withstand climate shocks and provide a source of food and income during those shocks (Scott et al., 2000).

## Purpose

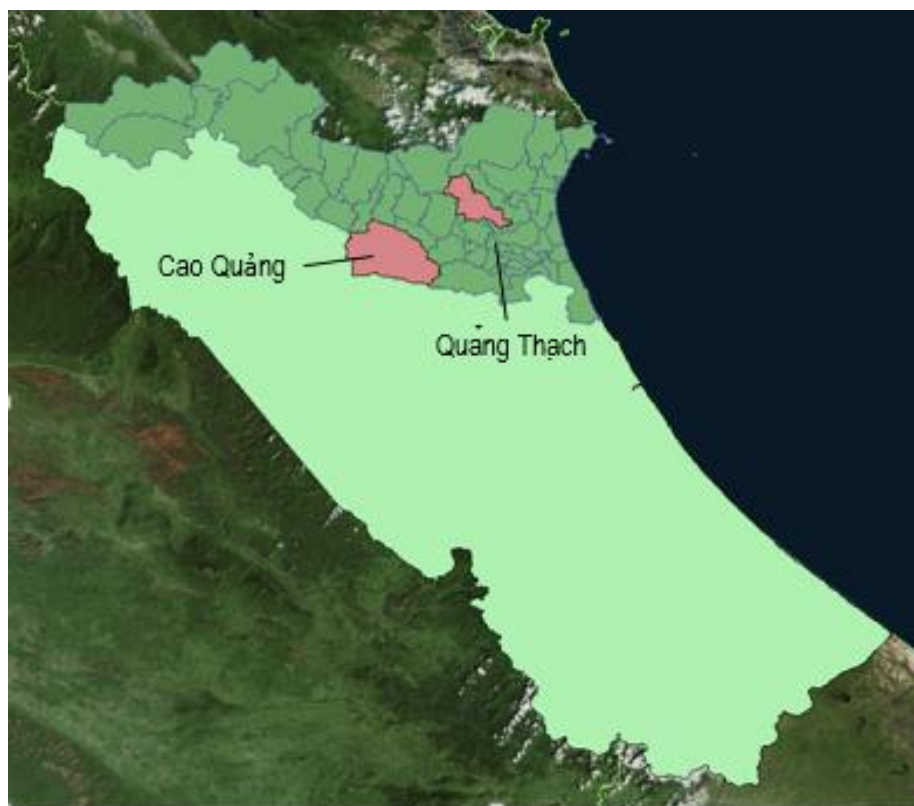
The objectives of this research is to identify potential gaps in farmer knowledge about climate-smart practices for cassava production and to characterize the networks of farmer communication and knowledge-sharing within a village as well as at the commune-level. An initial FOODSTART + scoping study was undertaken in Quảng Bình and Ha Tinh Provinces between October 2015 and January 2016, and the following research is a more detailed evaluation of the RTC systems in two communes in Quảng Bình Province.

Objective 1: Identify gaps in farmer knowledge and practice and climate-smart agriculture practices for cassava and sweet potatoes.

Objective 2: Identify how farmer communities get information about agricultural practices, markets, climate information, etc. relevant to cassava and sweet potato production.

## Description of the Research Area

The FOODSTART+ project in Vietnam will take place in Quảng Bình province, a province on the North Central Coast with a predominately agricultural economy. It is bordered by the South China Sea to the East, Laos to the West, Quảng Trị Province to the South and Ha Tinh Province to the North. Đồng Hới is the coastal capital with about 160,000 residents. Research activities were conducted in Quảng Thạch and Cao Quảng communes, about 60-75 km NE of Đồng Hới. The closest major town to the communes is Ba Đồn, 43 km N of Đồng Hới.



*Quảng Thạch and Cao Quảng communes in Quảng Bình province*



Quảng Thạch is an 8-village commune in Quảng Trạch District, 17 km NW of Ba Đồn Town. The villages are fairly homogenous in their crop production and economic activity. Village 3, 5 and 8 were selected for research activities per recommendation by the commune leadership. These villages are accessible along a paved road that ends at Village 8, which will be connected to a multi-lane paved highway currently under construction (leading to Laos according to villagers). The villages surveyed have level, low-lying croplands used primarily for growing rice and sloping lands where houses and other crop fields are located (varying proportions in each village).

Cao Quảng commune is in Tuyên Hóa District and is accessible by one paved road that parallels the Song Nan River, 33 km from Ba Đồn. Of the commune's 5 villages, 3 villages were selected by the commune leadership for surveying: Vĩnh Xuân, Phú Xuân and Cao Cảnh. The Song Nan River separates Vĩnh Xuân and Phú Xuân from the other villages and the administrative headquarters of the commune (see appendix for Cao Quảng map). Both villages are accessible by foot and motorbike by bridge, while vehicles must use a dirt access road that crosses the river at a low point. The car crossing is inaccessible during the rainy season when the Song Nan is too high to cross.



*View of Song Nan River from foot/motorbike bridge to Vĩnh Xuân village*

## 2. METHODS

The qualitative methods used for data collection were farmer focus groups and semi-structured personal interviews. All interviews and focus groups were recorded, transcribed and then evaluated by the translator for completion or errors.

Farmer focus groups were conducted in the six villages (Table 1). The communes were chosen by SRDP and the villages were chosen by commune leadership after meetings to discuss the objectives of the project. The focus groups were divided into male and female groups of five

participants each (variations listed below) and lasted for about one hour. After the focus groups were completed, interviews with farmers, commune agricultural staff, input salesman, cassava traders and other individuals began.

| Location    | Focus groups | # Participants |
|-------------|--------------|----------------|
| Quảng Thạch |              |                |
| Village 3   | Male         | 6              |
|             | Female       | 5              |
| Village 5   | Mixed        | 10 (5 M, 5 F)  |
| Village 8   | Male         | 5              |
|             | Female       | 6              |
| Cao Quảng   |              |                |
| Cao Cảnh    | Mixed 1      | 5              |
|             | Mixed 2      | 5              |
| Phú Xuân    | Mixed        | 9 (5 M, 4 F)   |
| Vĩnh Xuân   | Male         | 5              |
|             | Female       | 5              |

*Table 1*

Five farmers per village were interviewed. Of the 15 farmers in Cao Quảng interviewed, 8 were female and of the 15 farmers in Quảng Thạch interviewed, 7 were female. In each commune, at least one cassava trader, two fertilizer salesmen and the commune agricultural officer were interviewed (see Table 2). In both communes, some input suppliers or cassava traders lived outside the targeted villages, but were within the commune and geographically close to at least one target village.

There were three interviews outside of communes: representatives of Long Giang and Song Dinh starch-processing factories in Bồ Trạch district and one well-known farmer in Quảng Lư commune, about 6 km from Quảng Thạch and connected to it by a paved road.

The farmer in Quảng Lư was referenced by traders and farmers in Quảng Thạch commune as the first person to bring the newest Sản cao sản cassava variety to the area. He had the highest level of education (college) among all farmers interviewed and a cassava cropping area dramatically above the average (25 hectares). The size of his farm and his strong ties to nearby starch factories provides an interesting contrast to the average farmer sampled.

The personal interviews were coded and analyzed for themes that included: cropping practices, sources of cropping information, extension, yields, crop problems, market problems, etc. We performed a gender analysis to identify any differences between female and male farmers' experience and information sources.



**Table 2**

| Occupation    | Location    | # interviewed |
|---------------|-------------|---------------|
| Extension     | Cao Quảng   | 1             |
|               | Quảng Thạch | 1             |
| Traders       | Cao Quảng   | 1             |
|               | Quảng Thạch | 4             |
| Input seller  | Cao Quảng   | 3             |
|               | Quảng Thạch | 2             |
| Factory staff | Long Giang  | 1             |
|               | Song Dinh   | 1             |
| Farmers       |             |               |
| Cao Quảng     | Cao Cảnh    | 5             |
|               | Vĩnh Xuân   | 5             |
|               | Phú Xuân    | 5             |
| Quảng Thạch   | Village 3   | 5             |
|               | Village 5   | 5             |
|               | Village 8   | 5             |
| Quảng Lưu     |             | 1             |

For each component of the cropping practice, farmers were asked if, how and why they perform specific activities. We also asked farmers where they get information that influences their farming, including weather forecasts, crop prices and emerging pest and disease problems. Individuals were also asked to describe how their farming practices and cropland has changed over time and what improvements they would like to implement in their cropping systems.

Non-farmer interviews emphasized questions that helped characterize the interactions between farmers and the other stakeholders, the dissemination of information and what influenced choices about setting prices or offering certain supplemental products. Agricultural officer interviews included questions about crop trainings, recommended practices and methods of farmer outreach. The starch factory representatives were questioned about relationships between factories and farmers, perceived farmer challenges and desired farmer improvements.

### **3. RESULTS: Cassava**

#### **Cropping Practices & Markets**

Cassava cropping practices are similar in both communes, with slight differences in practices between communes or commune villages. Across all farmers, the average area of cassava grown is less than one fifth of a hectare (0.17 ha). A majority of the farmers surveyed grow cassava for animal feed. Of the 16 farmers interviewed in Cao Quảng, 3 farmers were growing cassava to sell. Some farmers sold cassava in previous years but a lack of traders and low farm gate prices caused many farmers to feed their crop to livestock. In Quảng Thạch, 12 of the 17 farmers were growing to sell. The few not selling had various reasons to not enter the market – mainly a lack of extra cassava after feeding livestock. Information about the use of cassava and sweet potatoes gathered in village focus group discussions is shown below.

| Focus group | Gender | Cassava end use                 | Cassava harvesting                                    | Sweet potato end use                                  | Sweet potato harvesting |
|-------------|--------|---------------------------------|---|---|-------------------------|
| Cao Quảng   |        |                                 |   |   | Farmer                  |
| Cao Canh 1  | M & F  | 95% animal feed, 5% consumption | Farmers   | UK, no selling  |                         |
| Cao Canh 2  | M & F  | 20% trader, 80% animal feed     | Farmers   | 100% food   |                         |
| Phu Xuan    | M & F  | Animal feed                     | Farmers   | No selling (but available in market from other areas) |                         |
| Vinh Xuan   | F      | Animal feed                     | Farmers   | No selling (quality issues)                           |                         |
| Vinh Xuan   | M      | Animal feed                     | Farmers   | UK  |                         |
| Quảng Thạch |        |                                 |   |   |                         |
| Village 5   | M & F  | 50% food; 50% trader            | 90% trader; 10% farmer                                | 90% local market; 10% animal feed                     |                         |
| Village 8   | F      | 50% trader, 50% animal feed     | Dependent on field size (large- trader, small-farmer) | 60% animal food, 40% consumption and selling          |                         |
| Village 8   | M      | 70% trader; 30% animal feed     | UK  | 80% local market; 20% human consumption               |                         |
| Village 3   | F      | 80% trader                      | 50% farmer; 50% trader                                | 100% animal feed                                      |                         |
| Village 3   | M      | 95% trader; 5% animal feed      | UK  | Consumption, animals, local markets                   |                         |

*Focus group discussion results: Cassava and sweet potato uses*

### Planting Material/Varieties

The cassava variety sold for starch processing in Quảng Thạch is known locally as Sắn cao sản. This variety is almost certainly KM94, and was likely introduced to Quảng Thạch from the starch factories in Bồ Trách. Multiple Quảng Thạch traders and one focus group identified the Quảng Lưu farmer as the person who brought the variety from the factories. Farmers claim they began growing cao sản about 20 years ago, which corresponds with KM94's release in 1995 (Kim et al.).

| Focus Group   | Variety   |
|---------------|---|
| Cao Canh 1    | 90% Sắn cao sản; 10% Sắn Đỏ                     |
| Cao Canh 2    | 80% Sắn cao sản; 20% Sắn lâm trường; 1% Sắn Đỏ  |
| Phu Xuan      | 90% Sắn cao sản; 10% Sắn Đỏ                     |
| Vinh Xuan - F | 50% Sắn cao sản; 50% Sắn lâm trường; >1% Sắn Đỏ |
| Vinh Xuan -M  | 60% Sắn cao sản; 40% Sắn lâm trường             |
| Village 5     | 90% Sắn cao sản; 10% Sắn Tinh                   |
| Village 8 - F | 70% Sắn cao sản; 30% Sắn Tinh                   |
| Village 8 - M | 70% Sắn cao sản; 30% Sắn Tộc                    |
| Village 3 - F | 80% Sắn cao sản; 20% Sắn Tinh                   |
| Village 3 - M | 90% Sắn cao sản; 10% Sắn Tinh                   |

*Focus group discussion results: Cassava varieties grown*

Many farmers in Cao Quảng also grow Sắn cao sản, but 6 farmers grow (only or in addition to cao sản) Sắn lâm trường. Six farmers mentioned this variety by name, including the two farmers who sell to the starch processing factories. The only Cao Quảng trader also grows and sell her Lâm trường. Separate accounts by a focus group, extension officer and farmers described how a local nursery named Lâm trường introduced the variety 10 – 15 years ago and ceased operation a few years later. This variety in Cao Quảng is likely not an alternative name for Sắn cao sản because two farmers grow both types and many farmers mentioned growing only Sắn cao sản. The varietal name of Sắn lâm trường is unknown, as the reported date of release does not coincide with any known variety releases in the area.

In addition to these two varieties, farmers also grow traditional varieties. In Cao Quảng, their “traditional” variety is called Sắn Đỏ and Sắn Nguồn and in Quảng Thạch it is called Sắn Tộc or Sắn Tinh. A few rows of traditional cassava are always planted alongside the KM94 or Lâm trường. Many of these traditional varieties may be H34 or Xuan Vinh Phu, which was popular before 1985 (Kim et al., 2000). The Quảng Lưu farmer said that Sắn Tộc is H34.

### **Field Preparation**

Farmers commonly use buffaloes to till their fields or rent machinery when they can afford the expense. Many farmers do tillage in two parts: 1) initial passes with a buffalo or cow to break up the soil (Bừa) and 2) tillage to kill weeds (Cày). While most who mentioned the two-part system performed the weed-killing tillage second, one female farmer passed to kill weeds first.

Some farmers rent a “scooping machine” [excavator], which they follow with animal tillage. Farmers explained that it is best to use the excavator every couple years to improve soil quality, because they mix the top 50-60 cm of soil. Using an excavator is desirable but many farmers cannot afford the rental price. No one in Cao Quảng has used an excavator, only individuals in Quảng Thạch reported using it: 6 farmers, the agricultural officer and 2 traders.

Most farmers said that erosion occurs in their cassava fields, and more commonly in sloping plots. A common technique used to reduce erosion on sloping land is constructing raised beds that slow the downward flow of the water. Another technique mentioned by many is to dig ditches around the crops to divert water around or between cassava rows.

## Planting

Methods of planting cassava were very similar in both communes but there was no common trend in stake spacing. Farmers cut sections of cassava (stakes) from the green and pliable midsection of the cassava plant and place the stakes in the ground at 30-90° depending on the slope. The stake is placed in the soil so that most of the nodes are underground to stop the stake from drying out. The proportion of the stake above and belowground is often correlated to the temperature and forecast at the time of planting; most of the stake is planted underground in hot weather.

There is significant variability in stake spacing, though most farmers plant their stakes further apart in better soils. Cao Quảng focus groups reported spacing from 33-60 cm apart and 11 Cao Quảng farmers plant between 40-80 cm apart (average of 55cm). Spacing between cassava rows was estimated at 100 cm by three focus groups.

In Quảng Thạch commune, the average spacing between stakes is about 40 cm, with a range of 25-70 cm from 11 farmer reports. Rows of cassava are planted 70-80 cm apart. Male and female focus groups in Vĩnh Xuân had contradictory techniques, women plant stakes closer together in poor soil while males farmers plant farther apart.



*Cassava monocrop*

## Intercropping

All farmers grow cassava in monoculture, except for one who intercroops with beans. Most farmers have tried intercropping beans or corn but found it unsuccessful. They found that the cassava was stunted, or the intercrop was shaded out and did not grow. Some farmers attributed this failure to a lack of water. Many farmers said that their parents used to intercrop but that the practice has fallen out of favor, with some farmers suggesting that the land is not fallowed enough or for as long as it was in past generations.

## Fertilization

Almost all the farmers apply soil amendments twice: before planting and during cropping. After land preparation, fertilizer and manure are placed in holes next to the cassava stake, not spread over the planting area. It is difficult to estimate the use of applied amendments because many farmers do not measure amounts quantitatively, instead using measures like *pinches*, *handfuls* and *cart loads*. Farmers reporting in quantitative measures would estimate “kilograms per sào” (1 sào = 500m<sup>2</sup>). Fertilizer purchased at local stores comes in 25 or 50 kilogram bags.

### *Cao Quảng*

Of the manure usage estimated in kilograms, the average application was 300-500 kg/sào (6-10 t/ha) and the highest application rate was 700-800 kg/sào (10-14 t/ha). Farmers are usually limited by the manure produced from their livestock but two farmers purchase extra manure from a nearby cow farm.

The most common type of fertilizer used is Đầu Trâu (20-20-15). Farmer use estimates ranged from tablespoons per plant to 30-50 kg/sào (0.6-1 t/ha). The second most commonly used amendment is Kali (potassium-based fertilizer). Some farmers add other nitrogen-based (Đạm) or phosphorus-based (Lân) fertilizers. Đầu Trâu is used by 9 of the 16 farmers and the others used a mix of P, K, and N-based amendments. Three farmers do not use any fertilizer (or will use fertilizer left over from other crops). Many farmers cited the high price of fertilizer for their low usage but would like to use more fertilizer.



*Đầu Trâu fertilizer at a local store*

### *Quảng Thạch*

Most farmers in Quảng Thạch report usage in quantitative amounts. Estimates for manure use ranged from 1 kg/plant to 300-1000 kg/sào. The most common chemical fertilizers used are multipurpose mixes (NPK) like NPK Đầu Trâu or NPK Ninh Bình (16-16-8), as well as potassium amendments. Estimated application rates varied from pinches of fertilizer to 1000 kg/ha.

### *Supplemental fertilizer*

Supplemental fertilizer application in Cao Quảng is not widely practiced and highly dependent on weather. Six farmers do not add amendments after planting, 6 farmers use nitrogen-based amendments and 3 farmers use Kali or potassium amendments. Farmers do not add amendments if the day is hot and dry because it will be ineffective or may hurt the plant. All the farmers in Cao Cảnh village use supplemental amendments and use was variable in Phú Xuân and Vĩnh Xuân.

In Quảng Thạch, 5 of the 17 farmers added urea (N) after weeding. The five confirmed users were dispersed through the three villages.

### **Weeding**

All farmers (focus groups and interviews) reported weeding after planting cassava. During interviews farmers reiterated that they do weed, but the timing of weeding often depends on labor availability and can be put off if the family is engaged in other farming activities.

### **Harvesting**

Farmers growing cassava for animal feed harvest at different time intervals than farmers growing for processing. Plants destined for livestock are pulled up a few at a time, as needed, and are left in the ground for up to two years. Some farmers may harvest a large amount at once and then chip and dry the roots for later use as feed.

Farmers selling processing cassava will harvest their field in a day or period of days and then sell the lot by weight. The farmer is incentivized to have the trader collect the cassava immediately after harvesting (and will not harvest for sale without a buyer) because the roots dry out and they will be paid less for the reduced weight if the sale is delayed. Sometimes a trader will pay the farmer for the cassava in his field and then hire laborers to harvest, but this arrangement is less popular because of the yield uncertainty on both sides. Unfortunately, farmers do not have much control over this process. Traders are incentivized to transport the roots to the factory quickly so they do not lose too much revenue from the cassava drying out.

We are unable to estimate the amount of cassava that families consume. Two farmers sell to local markets for consumption and only one farmer explicitly said that her family consumes traditional cassava. Families do consume cassava, but it was difficult to evaluate because the season's cassava had not been harvested during the study period (June-July).

### **Pest Management**

Farmers do not have major pest problems for cassava. Focus groups reported no use of pesticides and only two farmers have ever used pesticides on cassava.

The most common cassava pests are termites (Cao Quảng) and crickets (Quảng Thạch). Termites cause damage to newly planted cassava and when soil is dry. Farmers have few or no strategies to prevent termite damage or to kill them. Some farmers have prevention strategies such as: removing dry plant matter from the soil surface, spreading lime on the soil surface, or packing the soil tightly around the plants. Crickets can be a problem when cassava is 10-20 cm tall, but damage from crickets varies from year to year.



Many farmers also have minimal losses from leaf-eating bugs. Two farmers said they use the pesticide TEREX to kill any bugs eating cassava leaves. TEREX is an organophosphate insecticide manufactured in Vietnam and is considered slightly hazardous (National Profile 2004). It is used to control cockroaches, crickets, silverfish, bedbugs, fleas, cattle grubs, flies, ticks, leafminers and leaf-hoppers (Extoxnet, 1993). Four of the five input suppliers said that farmers do not use pesticides on cassava and that they did not carry any cassava-specific pesticides. One supplier thought he had a cassava specific pesticide, but it was only a fertilizer amendment he prescribed for leaf yellowing (Quảng Thạch).

### **Disease Management**

Farmers did not report any diseases affecting cassava, except some root rot in Cao Quảng. The root rot is characterized by soft, rotted tubers and commonly occurs after flooding events that temporarily submerge crop fields. The Quảng Thạch agricultural officer said that there is also root rot in his commune after flooding, but no one in the three villages surveyed mentioned flood events.

### **Yield**

Farmers growing cassava for animal feed reported yields that were higher than farmers growing cassava to sell. There was a large range of yield estimates for livestock-bound cassava: 350 kg/sào (7 t/ha) to 4000 kg/sào (80 t/ha). The average yield of 13 Quảng Thạch farmers growing to sell was 1.3 tons/sào (25 tons/ha). Only one of the three Cao Quảng farmers engaged in selling cassava estimated yield: 3000 kg/sào (60 t/ha).

### **Cassava: Market Factors**

#### **Labor**

Almost all farmers interviewed do not use hired labor for agriculture because “work is cheap, but if you have to hire its very expensive” (Village 5 farmer). Farmers in Quảng Thạch may hire an excavator operator to dig up a field if they can afford it. Village women often work in groups and rotate through each other’s farms to complete cropping tasks. Also, neighbors will often help to finish farm work if a family hasn’t finished their tasks.

Four farmers hired local labor for land preparation, planting and harvesting. These farmers were financially well-off traders and one well-off farmer (Quảng Lưu farmer).

#### *Gendered Labor*

Men and women have nearly identical cropping knowledge but they do perform different cropping activities. Males perform most of the tillage (especially involving machinery) and collect and carry livestock manure. Females are often in charge of planting, fertilizing and weeding. Though this is the common division of activities, it is not uncommon for men and women to perform the other tasks. Three widowed women farmers interviewed say they rely on children and local family members, but are the main labor source for most activities. Whole families will participate in certain activities if they need to be done quickly, like harvesting. Children’s early experiences helping with cropping activities means both genders are exposed early on to all aspects of crop production and have similar knowledge and skills.

## Traders

Traders are local buyers in the villages who purchase and transport cassava from individual farms to one or two starch-processing factories in neighboring Bồ Trạch district. Four of the five traders interviewed also grow cassava. Some traders have factory contracts that are more desirable than selling cassava non-contractually. Contracts are set on expected collection amounts (500-1000+ tons/season). It is unclear if it is difficult to get a factory contract, as one interviewed trader signed a contract with a factory after seeing a commercial advertising a trader job. Four of the five traders complained about slow payments from factories and multi-day wait times, even if they have a factory contract.

Traders generally offer the same prices for cassava to farmers because of the competition, though there is only one trader purchasing cassava in Cao Quảng commune. A few farmers sell to the factories directly, but others do not have access to transportation to take the cassava to Bồ Trạch or choose to sell to traders for other reasons.

Traders will also change the price they offer farmers based on the starch content of the cassava, although it is not known how rigorously this categorization is applied. Starch content is measured at the factory, so traders are incentivized to bring high-starch cassava in order to maximize their profit. The traders use only visual clues to assess starch content, including color (whiter is higher starch), texture (hardness is higher starch) or knowledge of the plot location (sandy soil better). Since measuring these qualities is not rigorous and is mentioned quite casually by traders, it is unknown how much it affects the farm gate price or the factory price. Sometimes traders do lose money on a sale if they have paid a farmer for an entire field or with the assumption of a higher starch content (or total yield).

## Farm gate prices

Farm-gate prices for cassava have been decreasing in the last few years, mostly to the detriment of farmers. In Quảng Thạch, traders/buyers buy fresh cassava for starch processing at 13,000 VND/10 kg (average). Some farmers report receiving offers as low as 7,000 -10,000 VND, while prices in the past (within last ten years) had been 15,000-17,000 VND/10kg.

Last season, traders purchased cassava for 12,000 VND/10 kg and sold to the factory for 15,000-17,000 VND/10kg, netting a profit of about 3000-5000 VND/10kg. All traders reported that their purchase price is dependent on the prices set by the factories, which often changes throughout the season. Prices at the beginning or end of the season are generally higher while prices midseason are depressed when the majority of the cassava is harvested and transported to the factory. The Cao Quảng trader estimated that transporting 10 tons of fresh cassava to Song Dinh factory cost 2 million VND.

| Trader        | Farm gate price (VND) | Factory price (VND) | Factory used           |
|---------------|-----------------------|---------------------|------------------------|
| Quảng Thạch 1 | uk                    | 17,500-18,500       | Song Dinh              |
| Quảng Thạch 2 | uk                    | uk                  | Song Dinh & Long Giang |
| Quảng Thạch 3 | 11,000                | 17,000              | Song Dinh & Long Giang |
| Quảng Thạch 4 | 12,000                | 16,000 - 17,000     | Song Dinh & Long Giang |
| Cao Quảng 1   | 12,000-15,000         | 15,000-17,000       | Song Dinh              |

## **Factories**

All farmers and traders sell cassava to two starch-processing factories, Long Giang and Song Dinh, located in Bồ Trách district. All traders sold to Song Dinh factory and three of the five also had a contract with Long Giang. The Cao Quảng trader sells to Song Dinh only. Agricultural officers from the factories have not visited either commune in the last 3-5 years, but would previously visit and make recommendations about cassava farming practices. The Quảng Lư farmer was regularly visited by factory staff in the last ten years, but factory staff's last visit to his farm was two years ago.

Each factory has agricultural staff that visit farms and villages where the factory purchases a large amount of cassava. Long Giang Factory has agricultural staff who travel regionally eight months of the year to assist farmers. Song Dinh factory has at least one employee who visits farmers and gives recommendations for cassava. The Director of Song Dinh said that is important to have model farms to encourage good cassava farming, but he did not cite specific cropping problems.

## **Pressure from other crops**

The popularity and abundance of acacia on hilly crop lands has limited the land available for cassava. Acacia is harvested after three to six years and cassava can only be intercropped in the first year. When many farmers began planting acacia, it became harder to grow cassava because of the shade created from neighboring acacia plots. Low-lying areas near the river are used for rice, peanuts and maize only. Farmers are generally not allowed to clear forest to plant crops because the upper hillsides are protected. The particulars of this protection are unclear, and the only details offered were anecdotes about German ownership of the surrounding area for climate change control measures.

Many farmers think cassava is more profitable than acacia because acacia is harvested once whereas cassava is harvested annually, but all farmers grow the same thing and individual farmers will not transition to cassava while others continue to grow acacia, unless there is a profitable market output for cassava and major transition of all farmers.

Farmers in Quảng Thạch do not grow acacia, though most farmers are planting or would like to plant more pepper trees. Pepper trees are intensely managed and generally close to a farmer's house, and do not take up much crop land.

## **4. DISCUSSION: Cassava**

Farmers in Quảng Thạch and Cao Quảng have grown cassava for generations, but there are gaps in knowledge about climate-smart friendly cropping practices. In both communes, the major gaps in practice are 1) cassava stake and row spacing, 2) fertilizer usage and 3) land preparation and erosion control. Other gaps are the lack of information about pest and disease management.

### *Crop spacing*

Cassava stakes are planted too closely, at about 40-55 cm apart, while recommended spacing between plants is about 80 cm to 1 meter (Howeler & Maung Aye, 2014). While plants should be grown closer together in poor soil to maximize yield per area, farmers tend to space stakes widely in poor soils and more closely in fertile soils. The Long Giang factory executive

recognized that stake spacing is too narrow and he recommended a spacing of 80 cm between plants and 100 cm between rows, which is also suggested in the literature (Howeler & Maung Aye, 2014). This crop spacing may have contributed to farmers' lack of success intercropping with cassava. Intercropping cassava with beans and peanuts has raised farmer income in many trials throughout Vietnam (Howeler et al., 2013).



*Closely spaced cassava in field*

#### *Fertilizer use*

Farmers do not apply the optimal mix of fertilizers and generally apply too much phosphorus and too little potassium. Many of the average or wealthier farmers use, or report using, more fertilizer than recommended per land area. But farmers who grow 0.5 ha or more cassava use less fertilizer than farmers growing less than 0.5 ha. This is likely due to inflated use estimates or greater amendment use on smaller plots of land. The application rate of manure and fertilizer on 1 sào (0.05 ha) could not be sustainable scaled up to a one hectare parcel, farmers could not afford the same rate of application for more land. The Quảng Lư farmer uses only 28-35 kg fertilizer/sào on his 25 ha of cassava.

General recommendations for fertilizing (with no soil information) is 80–100 kg/ha of N, 40–50 kg P<sub>2</sub>O<sub>5</sub>, and 100–120 kg/ha of K<sub>2</sub>O, or 600 kg/ha of compound fertilizer (15-15-15 or 15-7-18). Nitrogen and potassium inputs should increase over time and phosphorus applications should be reduced, which farmers do not report doing (Howeler & Maung Aye, 2014). Many farmers use compound fertilizer, commonly Đầu Trâu (20-20-15), or nitrogen and phosphorus-based fertilizers alone. Nitrogen and phosphorus are often over applied and potassium is under-applied. Most supplemental fertilization is nitrogen or potassium, which is recommended for healthy plant development (Howeler & Maung Aye, 2014).

#### *Land preparation*

Some farmers use tillage practices that may increase soil compaction and reduce the long-term health of the soil. Many farmers in the six villages have issues with poor drainage

during the rainy season as well as erosion in sloping crop fields. While it is recommended to use a subsoiler to improve drainage and reduce potential for cassava root rot (Howeler & Maung Aye, 2014), an excavator dramatically alters soil structure and may create a hard pan layer around 50-60 cm below the surface. Farmers who use these machines claim they improve soil quality and report increases of yield after deep tillage events. But in flood areas, they may be reducing water infiltration during the rainy season and causing soil waterlogging, erosion and increasing the potential for root rot disease.

While farmers use ditches to channel water around cassava fields, a more climate-smart strategy would be to use hedgerows or other living barriers to slow water and reduce erosion. Research in Vietnam has shown the effectiveness of grasses and other plants to slow erosion (Howeler & Maung Aye, 2014). The use of pineapples for a hedgerow was observed on one farm, but not a surveyed farm.

#### *Knowledge: Pest and disease management*

Farmers have little knowledge about pests and diseases and how to manage them. They are also unable to differentiate between nutritional deficiencies, diseases and pest issues. Farmers are aware that fertilizer improves plant yields but only one farmer discussed general plant health and using specific fertilizers to improve root or leaf growth, etc. Generally, pests are not considered a major issue, even if farmers reported major yield losses from pests. Farmers seem willing to accept crop losses because they do not have the time, labor, money or interest in reducing damage from pests.

## **5. RESULTS: Sweet Potatoes**

### **Planting Materials/Varieties**

The most common varieties grown are Khoai Đỏ and Khoai Chiêm dâu. These two local varieties were found in Quảng Thạch during the scoping study. Farmers in Quảng Thạch often call their sweet potatoes “củ truyền”, or traditional. Almost all farmers grow a small patch of sweet potatoes near their home for use as planting material. When farmers do not have enough potato shoots for planting they ask other farmers for material.

| Sweet Potato variety *            |   |
|-----------------------------------|---|
| Khoai Chiêm dâu                   | 4 |
| Khoai Đỏ                          | 4 |
| Traditional                       | 3 |
| Unknown                           | 8 |
| *growing within year of interview |   |

### **Field Preparation**

Farmers always till their fields before planting sweet potatoes. They then make raised beds and plant shoots at the top of each bed. Planting on the bed crest makes weeding easier because farmers generally weed based on the length of vines down the sides of the bed. Potatoes are often grown between rice crops and rotated with corns or beans.

### **Planting & Harvesting**

In Quảng Thạch, common planting times are July-August and harvest is September-December. In Cao Quảng, limited data shows main planting in May or September and harvesting in October or December. Outside of these growing periods, sweet potatoes are often grown in household's gardens for use in the household and for later planting material. Crop leaves and

small roots are commonly fed to animals and young leaves and larger roots are eaten by the household.

### **Fertilization**

Farmers often make use of leftover amendments for fertilizing sweet potato. They generally apply less amendment to their sweet potatoes than their cassava: the highest manure application estimate in Cao Quảng was 800 kg/sào with focus groups estimating 300-500 kg applied manure/sào. The most common fertilizer used in the Cao Quảng villages was Kali (P-based) and Đạm (N-based), about 3-10 kg total/sào. In Quảng Thạch, farmers apply between 200-1000 kg/sào manure and from 3-30 kg fertilizer/sào, often urea and/or phosphorus amendments.

Most farmers add supplemental fertilizer one month after planting or after the first weeding. Farmers often use urea or Kali (P-based). Use estimates range from 3-15 kg fertilizer/sào in Cao Quảng to 3-7 kg/sào in Quảng Thạch. Sometimes additional fertilizer use is dependent on what, or if, the farmer has any amendment left from other crops.

### **Weeding**

Farmers weed their sweet potatoes at least once in conjunction with adding supplemental fertilizer. Weeding usually takes place from 20-30 days after initial planting. While some farmers weed an additional time, many are constrained by labor or do not consider it necessary/useful.

### **Pest Management**

Cao Quảng farmers have major sweet potato pest issues while Quảng Thạch farmers do not report any pest issues. Leaf eating (and some root-eating) bugs are the major factor in the drastic decline in potato production in Cao Quảng. Stem borers are a major problem for six farmers, while a variety of other insects cause increasing damage the longer the crop remains unharvested.

Four farmers in Quảng Thạch province use pesticides on their sweet potatoes but other farmers are either unaware of applicable pesticides or were hesitant to spray because of the perceived negative health implications. Farmers use TEREX, the same insecticide used for cassava.

### **Disease Management**

Six farmers in the communes reported that their sweet potatoes have crinkled or yellowed leaves. Other farmers mentioned disease problems but could not describe specific symptoms. Some farmers believe that a combination of poor weather (drought or heavy rain) can increase the effects of disease on their potatoes. Farmers with diseased plants do not do anything to prevent or treat the symptoms and do not know the cause of the crinkling or yellowing.

### **Markets & Prices**

Sweet potatoes are considered an important crop in Quảng Thạch but not in Cao Quảng. Four farmers in Quảng Thạch regularly sell their sweet potatoes at local (commune) markets, while other Quảng Thạch farmers and all Cao Quảng farmers grow for household and livestock



consumption only. Five farmers in Quảng Thạch and 4 farmers in Cao Quảng do not grow any sweet potatoes.

Two focus groups in Quảng Thạch reported that sweet potatoes sell locally for 4,000-6,000 VND/kg and 10,000 VND/kg in the off season. Sweet potatoes are available at Cao Quảng local markets for 10,000-15,000 VND/kg.

## **6. DISCUSSION: Sweet Potatoes**

In Cao Quảng, farmers struggle with pest issues and declining yields attributed to the decline of the sweet potato variety. There is also a perception that roots from the villages are “poor quality” because of pest issues. No farmers sell their potatoes at the local market even though there is a local demand and sweet potatoes sell for good prices. The coupling of a poor-yielding variety, lack of pest management practices and poor public perception disincentives local farmers from changing their sweet potato cropping practices. Also, farmers are not aware of any alternative or “better” management techniques and say there is nothing to be done to improve the system. Even if they were aware of an improved technology, like an appropriate insecticide, farmers may refrain from using it because marketable outputs remain inaccessible as long as the quality stigma persists. Also, it is not known what factor is the main cause of yield declines over time, so insecticides may not increase yields dramatically if the low-yielding variety or other unknowns persist.

The situation in Quảng Thạch is markedly different, farmers can and do sell in local markets and quality problems are not a major issue. Focus groups and individual farmers expressed a desire for improved varieties and effective pesticides but did not suggest that insect damage was significantly effecting yields. As in Cao Quảng, sweet potatoes are seen as a supplement to food and feed, but in this area they are sold when there is “extra” or the price is inflated during the rainy season. Those interviewed did not say they consumed sweet potato leaves, though there is evidence that families in the area do consume them. The harvest and inclusion of leaves in meals is likely routine and done throughout the year, whereas when the entire plant is harvested a majority of the leaves are fed to livestock. Farmers would use more fertilizer on sweet potatoes, but capital and inputs currently go to more profitable crops.

Sweet potatoes are a household garden staple which supplement human and animal diets, but poor tuber quality and yield as well as limited opportunities to sell in local markets. A lack of pest management knowledge also contributes to the reduced quality and yield, although it is not certain that farmers would be willing to invest more in sweet potato cropping given its fairly low value (or no market value in Cao Quảng). This is a research question that needs further study.

## **7. CONCLUSION: Cassava & Sweet Potatoes**

The most significant gap in RTC cropping in Quảng Thạch and Cao Quảng is not information, but access to markets and varieties. Improving market access and farm gate prices could encourage farmers to grow RTC crops and participate in markets. The introduction of improved varieties that grow well in poor soils or are resilient to pest damage (significant for sweet potatoes) would also be beneficial for farmers.

To make RTC cropping more climate smart, farmers could change some of their current practices. In cassava systems, changes could include adjusting fertilizer use, modifying crop spacing, and reducing deep tillage. For sweet potato production, farmers could benefit from

learning preventative pest management strategies (Cao Quảng). Intercropped systems are another option, though farmers' past attempts will likely make them hostile to trying again, and the strategy could be ineffective if crop spacing is not modified (crops closely spaced).

In Cao Quảng, social and structural barriers to adoption of cropping changes and entry into markets could make interventions difficult. Phú Xuân and Vĩnh Xuân villages are difficult to access during flooding which limits the ability of farmers and traders to transport cassava if these events are concurrent. Besides this seasonal barrier, most Cao Quảng farmers do not participate in the cassava processing trade because of low prices, likely driven by the lack of area traders (one) and high transportation cost/distance from factories. Farmers are desirous of much higher prices per kg before they will consider selling to traders. Currently, it is more economical to grow cassava for livestock feed and harvest the crop over a long period of time. For most, cassava is not treated as an income generating crop, so farmers may avoid making changes to their cropping system that would require more labor or inputs. Currently, farmers do not think that any improvements are needed in cassava growing, except that it would benefit from more fertilizer.

Most Quảng Thạch farmers sell cassava to traders who supply starch processing factories in Bồ Trạch. All farmers grow some cassava to feed their own livestock, in addition to cassava they sell. Few farmers expressed interest in expanding their cassava operation as most are eager to plant more pepper trees, which currently bring high profits. As in Cao Quảng, farmers in Quảng Thạch do not think their cropping systems for cassava can be improved, besides increasing fertilizer use.

Sweet potatoes also face different challenges in each commune. Cao Quảng farmers might sell their sweet potatoes at the village markets, but low yields and pest problems leave them with limited marketable product and a stigma for low quality that bars their entry. In Quảng Thạch, some farmers participate in local markets, selling tubers and greens, but most use the crop for consumption or livestock feed. Sweet potatoes have a general reputation as a supplemental crop well suited for plots close to the home or quickly cultivated between rice plantings. Though it sells for fair prices in Quảng Thạch markets, few farmers participate in selling or expressed that they were interested in selling.

## 8. RESULTS: Farmer Communication Networks

Farmers get information related to cassava and sweet potato cropping from a variety of sources, though these sources are consistent across all villages and both communes. Variation in sources occasionally differed with gender and cassava end use. The primary source of a;; information about cassava and sweet potato farming is family members, specifically grandparents and parents. For most cropping practices, farmers and other key informants could not identify a source of the practice, rather it was their knowledge from experience farming alongside their parents. All identified sources of information relevant in cassava and sweet potato cropping systems are listed below.

| Source                                  | Type of Information   |
|---|---|
| Family – parents & grandparents         | All cropping techniques<br>- Land preparation, fertilizer, weeding, pest management, planting |
| Commune agricultural/extension officers | Input use, pesticides   |

|                                     |   |
|-------------------------------------|---|
|                                     | General crop trainings (animals, pepper, acacia)<br>Finding buyers for cassava (CQ) |
| Village farmers (neighbors)         | Varieties<br>Fertilizer, other inputs   |
| Village heads                       | Ordering manure<br>Intermediary to local government                                 |
| Fertilizer salesmen                 | Specific fertilizer information<br>Application techniques                           |
| Cassava processing factories        | Variety information<br>Fertilizer application                                       |
| Television, radio                   | Weather forecasts   |
| Government issued cropping calendar | Planting dates (none for cassava or sweet potato)                                   |
| Crop traders and buyers (cassava)   | Varieties<br>Harvesting techniques<br>Crop prices                                   |

### **Agricultural/Extension officers**

There is one agricultural and zoning officer in each commune who is responsible for holding agricultural trainings, identifying crop diseases and pest problems, and recommending pesticides/herbicides. Their role as an agricultural (ag) officer is the closest equivalent to an extension officer in the area. There has been no training about cassava or sweet potato cropping for many years; recent popular trainings in the communes have focused on pepper (QT) and acacia (CQ) production, which many farmers and the officers described as high value crops.

Since cassava has minimal pest problems and few diseases, ag officers have almost no interactions with farmers concerning cassava or sweet potato production. Farmers with sweet potato pests issues rarely talk to the ag officer, expect a couple who got pesticide recommendations. Ag officers get training topics and materials from the government and can ask permission to hold trainings on topics that farmers' request (though it is unknown how often this occurs).

The Cao Quảng agricultural officer said farmers often contact him to help locate cassava buyers or market outputs, rather than ask questions about cropping issues. The ag officer in Quảng Thạch said that there was a commune training about cassava recently (not known or attended by any Quảng Thạch farmers interviewed) but the material covered was part of a broader training on fertilizer use, not about cassava-specific cropping practices. Both officers said that farmers know how to grow cassava and there are no needed improvements to their cropping.

### **Village heads**

Farmers said they occasionally get information from village heads. The elected village head's role is to engage residents of the village and assemble them for training and events as well as help them with their administrative needs. The men in these leadership positions are seen more as a conduit of information from the commune leadership and ag officer rather than a

source. A few farmers said they might ask the village head questions about cassava or sweet potatoes if they had a pest or disease problem. In at least one village in Cao Quảng, village heads can order manure for farmers. Five of the six village heads are farmers and grew cassava, while the village head of Vĩnh Xuân in Cao Quảng is an electrician with no cassava growing experience.

### **Peers/Neighbor farmers**

Within villages, farmer's cropping practices are very similar because of the regular, close influence of neighbors growing the same crops. Some farmers said they adopted fertilizing techniques or purchased new stakes from other farmers in their village or the greater commune. If one farmer has higher yields, his neighbors are likely to copy his practices and over time the sweet potato and cassava systems are nearly identical. In both communes, female family members participate in work groups that bring them onto each other farms and performing the same practices.

Friends and neighbors do trade stories and advice during these planned events as well as during social gatherings during the evenings, usually in separate female and male groups. Farmers do not try to influence others and do not talk about farming practices unless directly asked (according to some), even about material from trainings they attend. Many farmers said that if a crop does badly, it is their own fault and they do not expect or seek help from neighbors or ag officers as they are highly self-reliant and feel solely responsible for problems.

### **Fertilizer salesman**

Fertilizer salesman occasionally visit the communes and organize trainings that focus on the correct application and use of a specific fertilizer. In 2015-2016, a Đầu Trâu fertilizer representative held a training in Cao Quảng, and taught farmers about the company's recommendations for fertilizer application. Đầu Trâu is now the most popular fertilizer in the commune and almost everyone interviewed claimed it was the most effective. Fertilizer companies will also host trainings for input sellers, though it is unclear how often these occur or who is invited.

### **Factories and field staff officers**

Long Giang and Song Dinh factories are sources of information about cropping practices and varieties. Factories were only sources of information for farmers that have had direct contact with the factory, either from trading directly or visiting specifically for information (two farmers). Farmers who visited the factories to specifically seek out information were all financially well-off (self-identified). Traders selling to either of the factories said that the factories and the farmers living around them (Bố Trạch) were information sources.

According to an executive at Long Giang, farmers ask questions related to cassava selling and prices, and rarely ask about cropping. Long Giang has a university-trained agricultural staff that travel in Quảng Bình province and make cropping recommendations.

A Song Dinh executive said that farmers commonly ask about fertilizers, land preparation and varieties. The factory has two staff members that work as quasi-extension officers within the areas they buy from and they also have 6-7 small model farms in Bố Trạch and Lệ Thủy. He said

that it is imperative for farmers to see demonstration plots or they will not adopt recommended practices.

### **Traders**

Local cassava traders are only source of price information for farmers. Very few farmers reach out to the factories directly to find out the current price. All traders contact one of the two factories to learn the current price, then decide what price to offer farmers based on their transportation costs, labor costs and desired profit margins. Traders also have an important role in bringing new cassava stakes to village farmers, either from the factories or other areas.

### **Television**

All farmers get weather forecasts from television broadcasts. The forecast only covers the day but a weekly forecast is available on the radio. There is also a daily weather broadcast over the speaker system in the early morning in each village. Only one person, the Cao Quảng trader, checks the forecast (10-day) on a smartphone.

### **Cropping calendar**

The commune government prints a yearly calendar with recommended dates for planting different crops. Farmers do use the calendars for reference, but the guide does not include recommendations for sweet potatoes or cassava cropping.

### **Farm groups**

There are many village and commune-wide organizations in which farmers participate: the farmer's union, farmer's group, women's group and veteran's group. It is unclear which groups are village-specific and which are commune-specific. The primary function of these groups is to help farmers acquire loans from AgriBank. The majority of the loans are for purchasing animals, though some use the loans for machinery or expenses. The farmer's union has two to three yearly meetings and the leaders discuss cropping information given to them by the local government. Farmers' meetings focus on particular crops or a farming subject, but never cassava or sweet potatoes.

## **9. DISCUSSION: Farmer Communication Networks**

Farmers' communication and knowledge of cassava and sweet potato are almost exclusively-based on interpersonal communication with family and other village farmers. Farmers keep adults within the village or in nearby fields and a majority of social activities occur in the village (i.e. men and women socializing in separate groups in the evening). There are commune-level communication channels because of the proximity of neighboring villages, participation in civic groups and the commune agricultural officer. Farmers rarely interact with people outside the commune, except when they visit Ba Đồn or other towns, sell directly to factories or have family and other relationships outside of the area. Farmers who went to outside areas like Bo Thach to visit factories or talk to other farmers were often financially comfortable (self-described).

Traders (and farmer-traders) have a much larger interpersonal network due to their work and the relationships they may develop with traders or prominent farmers in other areas. Many of the traders interviewed buy cassava from other districts where they are exposed to "different"

varieties or new information; as well as any information that may pass from the factories when they sell their cassava. Traders may hold some influence over farmers because of their purchasing power and connections to diverse networks.

Though it would seem traders are a potential source of information about cropping, they have historically not had major roles as conduits of information. Since many of the traders also farm cassava and come from agricultural families, they have some homophily with farmers. They may remain an outsider in the community though, due to their elevated wealth and farmer's perception (accurate or not) that they are untrustworthy and offer low prices.

The agricultural officers' small role in RTC information flows is likely due to many factors. Only part of their time is spent doing "extension" work, much of which is prescriptive in nature, like recommending pesticides. They also spend a lot of time setting up farmer trainings, which have not focused on cassava or sweet potatoes in many years. Also, it is the officers' perception (like farmers) that no improvements can be made to these cropping systems on the farm level. Their most useful role to farmers is likely connecting them to cassava traders.

Local groups like the farmer's union, farmer's group or women's group are a major part of the social and economic fabric of villages because of their role as loan brokers, but seem to have little influence in cropping. The positions in the group are held by neighbors and friends, but the usefulness or diffusion of information presented (passed from local government officials like ag officers) is unknown.

Though they are a major part of the market chain for starch cassava production, factories seem to have a decreasing influence on farmers with distance from the factory. Most farmers have never visited either of the factories and have not interacted with their extension staff. In addition, the costs of transporting cassava from either of the communes is not insignificant, so farmers earn less per kilogram of harvested cassava than farmers closer to the factories (Bo Thach, etc.). It is unclear if any farmers in the two communes are aware of Long Giang's recommendation to increase crop spacing and use more fertilizer, or if the factory is relaying this message.

Individual farmers have little expectation that someone should help them improve their cassava or sweet potato cropping systems. When presented with a hypothetical situation of high crop losses, most farmers said they would take no action and try again the next year. Farmers said that they do not seek help for crop issues with cassava and sweet potatoes because they are generally unimportant, compared to crops bringing in more revenue like peanuts or pepper.

### **Gender and Information Access**

Almost all individuals and focus groups participants maintain that men and women have equal access to information and resources. They attend the same meetings and trainings and usually have participated in farming since childhood. One female farmer in Cao Quảng said that men find out new information more easily because they travel more often than women. Traders and some male farmers have visited factories and farmers in other regions while on business or for interest, while no woman (beside the Cao Quảng trader) had been to a factory or the farms around them. It is not clear how, or if, any pertinent outside information is disseminated from one farmer once it reaches the commune or village. Any information gleaned from factories or travels to other areas may only be known to a few farmers.



## 10. Conclusion

Most information about farming practices comes from family members. Outside the family, farmers communicate with few groups of people – mostly neighbors (other farmers), local government officials and input suppliers and traders. Village and commune life is fairly insular and information passes through farmer working groups and direct observation of other's cropping activities, along with discussion at social gatherings and farmer and other group meetings. Local groups are most helpful for providing loan assistance and governmental extension officers are valuable for their connections to possible market actors and prescriptive recommendations for crop issues (pesticides, etc.). Cassava buyers are the primary source of cassava price information for farmers and do not share other information. One starch factory has cassava cropping recommendations that could be considered “climate-smart”, but there is no evidence that their outreach reaches farmers in the communes surveyed. These farming communities are very homogenous and have few links with outside actors/networks.

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## 12. Appendix

### Map of Region



### Cao Quảng Survey Villages Map



**Village FGD: Important Crops Grown**

| Focus group   | Crops important to income             | Crops important to livelihood          |
|---------------|---------------------------------------|--|
| Cao Canh 1    | peanuts, acacia                       | maize, rice, cassava                   |
| Cao Canh 2    | peanut, acacia                        | animal husbandry, cassava, rice, maize |
| Phu Xuan      | peanut, acacia                        | rice, maize, animals, cassava          |
| Vinh Xuan - F | peanut, acacia                        | rice, maize, animals, cassava          |
| Vinh Xuan -M  | peanut, acacia                        | maize, rice, cassava                   |
| Village 5     | cassava, sweet potato, rice, pepper   | livestock                              |
| Village 8 - F | cassava, sweet potato, pepper, banana |  |
| Village 8 - M | sweet potato, cassava, acacia         | rice                                   |
| Village 3 - F | cassava, rice, pepper                 |  |
| Village 3 - M | cassava, pepper, ecalytpus            | livestock, sweet potato                |

(file in attached excel document)

| Name   | Variety <sup>a</sup> | Manure amount | Manure unit | Fertilizer type <sup>b</sup> | Fertilizer amount | Fertilizer unit | Supplemental fertilizer type <sup>b</sup> | Supplemental fertilizer amount | Supplemental Unit |
|--|----------------------|---------------|-------------|------------------------------|-------------------|-----------------|---|--------------------------------|-------------------|
| Cao Canh 1 - mixed   | no data              |               |             |                              |                   |                 |   |                                |                   |
| Cao Canh 2- mixed  | T                    | uk            |             |                              | none              |                 |   | uk                             |                   |
| Phu Xuan - all; mixed  | uk                   | 300-500       | kg/sào      | DT; D                        | 10; 10            | kg/sào          |   |                                |                   |
| Vinh Xuan - females  | T                    | 300           | kg/sào      | none                         |                   |                 | NPK                                       | 3-4                            | kg/sào            |
| Vinh Xuan - males  | T                    | 500           | kg/sào      | none                         |                   |                 | D+K                                       | 15                             | kg/sào            |
| Village 5 - all; mixed   | uk                   | uk            |             |                              | uk                |                 |   |                                |                   |
| Village 8 - women  | T                    | 700-1000      | kg/sào      | D                            | 5                 | kg/sap          | N   | 5                              | kg/sào            |
| Village 8 - men  | KD                   | 1             | kg/m        | U                            | 1                 | kg/m            | N   | 5                              | kg/sào            |
| Village 3 - women  | T                    | 500           | kg/sào      | P; D                         | 20; 5             | kg/sào          |   |                                |                   |
| Village 3 - men  | uk                   | 5             | kg/m        |                              | uk                |                 |   |                                |                   |
| <sup>a</sup> Variety: KD - Khoai Đỏ; T – unknown local   |                      |               |             |                              |                   |                 |   |                                |                   |
| <sup>b</sup> Fertilizer/supplemental type: K- Kali (potassium), P- Lân (phosphorus); DT - Dầu Trâu; NPK - balanced fertilizer; D- Đạm (nitrogen) |                      |               |             |                              |                   |                 |   |                                |                   |

FGD: Sweet Potato Cropping  
(file in attached excel document)