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Agricultural Development in Northern Haiti: Mechanisms and Means for Moving Key Crops Forward in a Changing Climate

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Abstract

With a population estimated at about 10 million, Haiti is considered one of the poorest nations in Western Hemisphere. Agriculture is the primary income-generating activity for rural Haitians and contributes up to 25 per cent of the gross domestic product. In Northern Haiti, about 145,000 farm households depend on agriculture. In order to increase the production and improve the level of food security in Northern Haiti, development projects are working to increase agricultural production in five crops (rice, corn, banana, cacao and beans) in the Northern Haiti. Farmers' Fields Schools (FFS) are used to train farmers and introduce new technologies. Adoption of new approaches and inputs is neither simple nor direct; little consistent extension assistance is offered. Fertilizer and farm chemicals are not available when needed and producers are averse to outlays that they can ill afford. The purpose of this paper is to assess the mechanisms and means that Haitian farmers use to improve agricultural productivity, the double bind of state and market failure, and the role that climate change plays in interventions intended to increase yields. The study leads to several modest conclusions about improving conditions for sustained advancements in food production in an important region of Haiti.

Keywords: Sustainable intensification, Haiti, practice adoption

1. Introduction

Agriculture is the primary income-generating activity for rural Haitians, (WEF 2011; Bargout and Raizada 2013; Wood 1961) and contributes to 25 per cent of the gross domestic product (Singh and Cohen 2014). Coffee and cacao are principal export crops. In Northern Haiti, about 145,000 farm households depend on agriculture (DAI 2014).

Haiti has been slow to recover from earthquakes that greatly affected the capital Port-au-Prince and surrounding area (Gronewold 2010; USDOS 2012). The agricultural heritage of Haiti is long and deep, yet the Haitian state has underfunded and otherwise neglected the institutions that serve farmers, as well as the infrastructure that supports agriculture and the marketing of agricultural products (Bellande 2010; Murray and Bannister 2004; Murray 1997; 1979). The broader economy is growing slowly but steadily. In the meantime, food production is not keeping pace with population growth and investors may see greater opportunity outside the agricultural sector (World Economic Forum 2011). [5]

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[5] The 7.0-magnitude earthquake that shook Haiti on January 12, 2010, killed over 220,000 people, injured another 300,000, and directly affected up to 3 million more Haitians. While only in Port-au-Prince and areas very close to the epicenter here agricultural production were directly affected, the indirect effects on food security and agricultural livelihoods were important

Weak or nonexistent extension support, untimely availability of inputs, and fragmented value chains are among the many conditions that impede agricultural systems in Haiti (Bayard et al.; Sperling 2010; Smucker et al. 2005; Smucker 2010). In order to increase food production and improve food security in Northern Haiti, several development interventions endeavor to facilitate the adoption of key agricultural practices. The AVANSE (Appui à la Valorisation du Potentiel Agricole du Nord, à la Sécurité Economique et Environnementale) project, a five year USAID-supported effort, aimed at increasing agricultural production in five crops (rice, corn, banana, cacao and beans) in Northern Haiti (DAI 2014; Njukwe et al. 2014). AVANSE supports agricultural activities in six watersheds in Northern Haiti. This study analyzes crop-specific insights about the barriers and constraints to yield improvement and risk reduction for the target crops. Verbatim quotations and insights generated by qualitative interviews provide a foundation for guiding project interventions based on the farmers' revealed perceptions of farming practices in the project target zone. The multiple conditions and constraints to yield improvement are not often holistically understood by technical advisors who often tend to focus on material limitations. The paper is organized as follows. The next section gives a brief presentation on AVANSE project, the third section describes the data collection procedures, and the fourth section presents the results for each target crop, and the last section concludes and summarizes the paper.

The AVANSE project aims at: (1) increasing agricultural productivity (2) improving watershed stability (3) strengthening agricultural markets and (4) enhancing capacity building of farmers. The project targeted 43,500 beneficiaries to be reached by its programs. AVANSE project activities covered six primary watersheds plus two extension areas in the Northern region (Figure 1). The watersheds are: Petit Bourg de Borgne, Port-Margot, Limbé, Haut-du-Cap, Grande Rivière du Nord, Trou-du-Nord, Marion and Jassa. The project encompasses seven communes in the North (Limbé, Bas-Limbé, Acul-du-Nord, Plaine-du-Nord, Quartier-Morin, Milot and Limonade) and six in the Northeast (Caracol, Trou-du-Nord, Terrier-Rouge, Fort-Liberté, Ferrier and Ouanaminthe). AVANSE uses Farmer Fields Schools (FFS) as an extension tool to train farmers on practices and introduce new technologies. The two-week events are conducted in a rolling sequence across the project area. Meeting on participant's farms, each FFS focuses on a single crop and a set of recommended practices that are presented and discussed in the context of actual fields and plantings.

Seed security is one antecedent of the broader condition of food security (Sperling 2010). Acute seed insecurity is brought on by distinct, short duration events that often affect a broad range of the population. It may be spurred by failure to plant, loss of a harvest, or high pest infestation of seed in storage. While in normal times households may have various degrees of seed security, all may be affected by an acute event, such as a flood. Chronic seed insecurity is independent of an acute stress or disaster, although it may be exacerbated by it. Sperling (2010) further explains that acute and chronic seed insecurity will very often exist together in emergency contexts. Indeed, in cases where emergencies are recurrent events, in drought-prone areas, for example, acute situations are nearly always superimposed on chronic problems rooted in poverty. For example, Haiti in 2010 had severe drought in several zones, in addition to the earthquake (which are both acute stresses. Both of these events were embedded in a context of chronic problems-- due to lack of agricultural innovation across rural areas of Haiti (Sperling 2010).

In a large-scale survey of the seed situation conducted after the 2010 earthquake, Sperling (2010) and her team found that central Haiti farmers generally cannot access new varieties, an array of other needed inputs, or even regular technical advice. Only 14% of farm households had access to any new variety over the previous 5 years; the earthquake emergency distribution alone provided 53% of these introductions. Few new sources supply seed to farmers (rice is an exception). Horticultural crops are especially important for income generation Fertilizer use was also higher than expected; 28% of farmers used some mineral fertilizer in Sperling's (2010) survey — a relative gain reflecting the improved availability of inputs, especially due to aid interventions. Overall, small farmer systems have been static for years and new variety introduction is minimal.

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nation-wide, characterized by loss of businesses, increased financial expenses from additional IDPs who fled Port-au-Prince.

AVANSE is intended to increase agricultural productivity by raising the competence and performance of farmers in terms of practices and application of inputs to enhance crop yield and productivity. The improved incomes through product sales and farm jobs enable households to increase consumption of nutritious foods and reduce poverty. The FFS are central to the intervention for the diffusion of agricultural technologies, the provision of planting materials to farmers, and training on agricultural practices.

Method

Study area

The study covered smallholder farmers in the AVANSE target zones in northern Haiti. These areas consist of Borgne/Limbé, Haut du Cap, Grand-Riviere du Nord, Marion/Trou-du-Nord, Jassa and Grisongarde Watersheds (Figure 1). The climate in the areas allows farmers to grow different crops in at least two main seasons (Mintz 1962). The average annual rainfall is about 700 to 900 mm in the plain and over 1200 mm in mountains. The two rainy seasons are September to January and April to June (DAI2014).

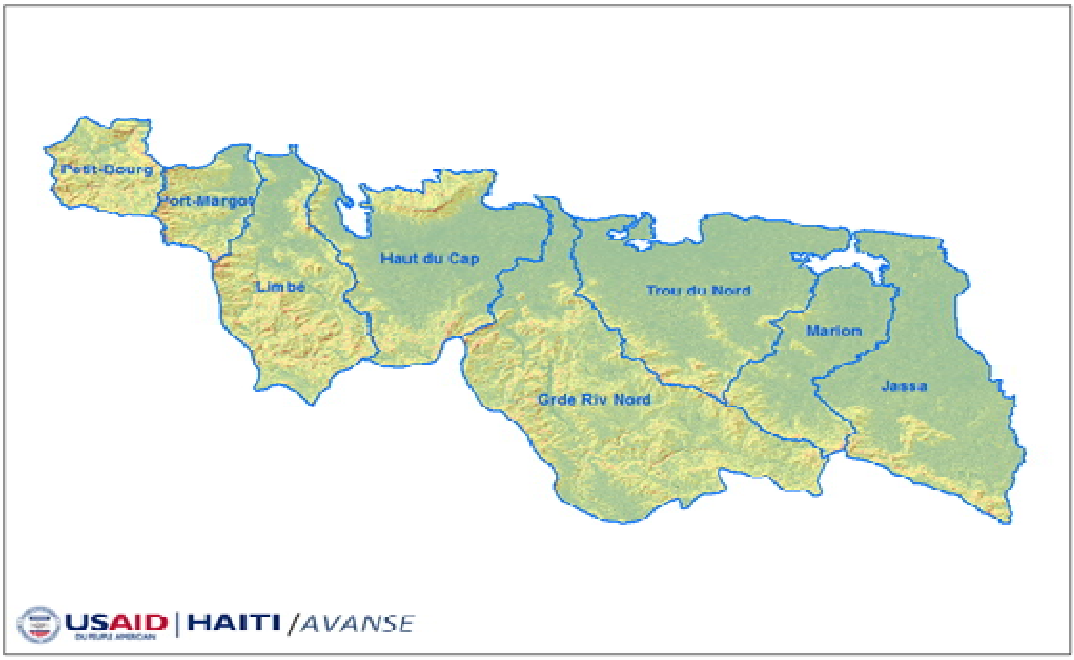


Figure 1: The AVANSE project target zones in Northern Haiti.

Sample and data collection

The study was conducted in November 2014 and January 2015. The basic information for the analysis was obtained from primary data collected during semi-structured interviews with leading farmers identified in AVANSE training programs. The producers were participants in on-going FFS for each target crop. In each field school, we worked with the agronomist (technical specialist leading the FFS) to identify the farmer with the best practices and knowledge in that particular group. Farmers speak Creole and often some French. A Creole translator accompanied the francophone Auburn University graduate student conducting the interviews (Gorden 1987; Casley and Lury 1987).

A total of 30 smallholder farmers were purposely selected as top farmers in each commodity and interviewed. The sample frame for the study was the AVANSE Project targeted districts in the six zones. Farmers interviewed include 6 banana farmers, 8 cacao farmers, 6 rice farmers, and 10 farmers growing maize and beans.

Table 1: Number of producers interviewed by location, Haiti, 2015

Crops	Number of producers interviewed by location						
	Borgne/Limbé	Haut-du-Cap	Grand-Rivière-du-Nord	Marion/Trou-du-Nord	Jassa	Grisongarde	Total
Bean/corn	-	-	-	2	4	4	10
Cacao	4	-	2	-	-	2	8
Rice	-	2	-		2	2	6
Plantain	-	4	2				6
Total	4	4	4	2	-	4	30

An interview guide was made up of a list of questions and topics to be covered during the conversation, usually in a particular order. The interviewer follows the guide, but is able to follow topical trajectories in the conversation that may stray from the guide when this is appropriate. The open-ended question format provides the potential to discover specialized knowledge, unanticipated topics, or other new ways of seeing and understanding the topic.

Since semi-structured interviews rely on open-ended questions and discussions and may diverge from the interview guide, interviews were audio recorded to facilitate translation and analysis of the results. Development of rapport is essential in interviewing. Tape recording conversations aided transcription and accurate representation of farmer comments made in the focused group discussions. An interview guide was used to guide the discussions. This reflexive flexibility can yield reliable, comparable qualitative data that can guide the conduct of farmer field schools and other interventions intended to increase and stabilize yields in the project's target area.

Results

Farmers interviewed were between 30-60 years of age. They range in experience from 5 to 30 years in cultivating one of the crops supported by the AVANSE project. They cultivated an area of 0.12 kawo[6] to 12 kawo equivalent to 0.15 ha to 15.48ha. Several constraints and barriers have been identified. We classified those constraints and barriers into three categories: technical, logistical, and financial. According to these categories the constraints stated by farmers for each crop are presented as follows:

Cacao farmers

In total, 8 cacao[7] farmers were surveyed. The responses given to each of the questions asked are summarized as follows. Asked how long they have been involved with the crop, the cacao farmers reported long experience. Some cultivated cacao since their childhood and some began to cultivate as adults. Three main motivations guided their choices to cultivate cacao. The first reason lies in having been born in a family where the father is cultivating cacao. The second is the presence of the previous USAID project 'Development Economique pour un Environnement Durable (DEED)', as well as AVANSE that supports them and motivates them to cultivate cacao.

Farmer: *"Mwen pa t 'vle kiltive kakawo paske mwen pa t' konnen benefis la soti nan li men ki gen prezans nan DEED ak Avanse mwen te bay sipò (plantules) ak mwen te kòmanse plante kakawo*
I didn't want to cultivate cacao because I didn't know the benefit from it but with the presence of DEED and AVANSE I have been given support (seedlings) and I started planting cacao".

The third reason is related to personal decision to cultivate cacao given the benefits gained from it. This gives an overview of how experienced farmers are in cultivating cacao and the motivations they have for being involved in this generally profitable enterprise. The AVANSE project has increased their motivation as they have been given support to increase their plantings.

[6] 1 kawo (Carreau in French) = 1.29 hectare = 3. 19 acres

[7] *Theobroma cacao* is a small (4–8 m (13–26 ft) tall) evergreen tree in the family Malvaceae, native to tropical regions of Central and South America. Its seeds are processed to make cocoa mass, cocoa powder, and chocolate.

The producers report cacao orchards from 0.12 to 5.75 kawo (0.15 ha to 7.42ha) in size. Most of the cacao plantations are old; AVANSE is supporting improvements in management and cultivar selection in order to increase yields. However, some farmers established new plantations that have not reached the age of harvest but receive project guidance. The question of yield for cacao was been one of the most difficult for farmers to answer. They do not weigh the harvest nor are they able to give a count or weight of the cacao beans they marketed. Typically, pods are collected over a period of time for occasional sales. However, some farmers interviewed were able to report an approximate amount of money they received from sales. From these estimates and considering the sale price we have estimated approximately the current yields that range from 320 to 430 kg/ha.[8]

Farmer*: Evalyasyon an gen yon jan difisil a kontrole*

The assessment is a bit difficult to measure

The main outside inputs for cacao planting are seedlings, generally available from two sources: the DEED and AVANSE projects. They provided the seedlings to farmers free in order to support them and encourage them to produce cacao. Other inputs are organic matter, compost, and manure. None of the respondents use chemical fertilizers. We asked farmers if chemical fertilizers were available, would they be willing to use them. Some stated that chemical fertilizer might pose a problem, given a lack of water, and farmers believe fertilizers might destroy the soil. They seemed to feel that water was a limiting resource for cacao improvement.

Farmer: *Mw panse angre chmik la bay te a problem e fok ou gen ampil dlo. Si ou pa gen dlo lap tije te a. yonn te wap itilize angre chimik wap rive yon le ou pap ka travay li.*

I think chemical fertilizer might cause problem to the soil and you need plenty of water. If we do not have water it will kill the soil. Soil in which you use fertilizer you will come to a time that you cannot work the soil.

Several diseases and insect pests' constrain the production of cacao. Insects and caterpillars cause losses of cacao pods that lead to decreases in cacao production. In response, some of farmers apply natural insecticide or a mixed natural and chemical insecticide composed of leaf of neem, pepper, tobacco and garlic, or pepper plus soap and chlorine. The issue has been discussed during the farmer field schools and the agronomist promoted the use of this natural insecticide, as stated by one farmer. Farmers manually remove infected leaves to limit the spread of plant disease when other treatments are not available.

Farmers finance their farm activities with different sources of funding. The main source is the personal fund or funds from the sale of previous harvest. All the farmers interviewed operate with personal funds. But they also use other sources such as loans from Haitian institutions called "caisse populaire" and from fellow farmers. The main complaint is on the interest rate offered by the 'caisse populaire", which is around 20%, a high rate by any standard. One farmer mentioned that the "konbit[9]" helps him to prepare his land, which reduces his investment costs. Credit is a constraint to improving cacao orchards. As farmers stated, not having adequate access to funding prevents them from buying materials, hiring labor and expanding their fields.

According to cacao farmers FFS have brought many benefits to them in terms of scientific knowledge and training on how to manage their plantations. Topics related to pruning, grafting, how to apply compost, as well as how to manage their nursery and transplant seedlings were discussed. All the farmers were satisfied with the content of the training as they improved their knowledge in cacao production. However, some complained about their lack of input materials necessary to actually implement what they had learned.

[8] Globally, yields per hectare (2.2 acres) vary greatly. Yields are around 350 kg (772 pounds) in West Africa (70 percent of the of world crop), where most cacao growers are small holders and therefore do not have the most professional farming skills or access to agricultural inputs and high-yield planting materials. Yields can be more than 1500 kg (3,307 pounds) on the most efficient farms, run by professional farmers, mostly in Latin America and some parts of Indonesia.

[9] *Konbit* refers to a farming cooperative, a traditional system in which the land owner or *met jaden* invites a small group (four to eight) people to help clear, till, plant, weed, or harvest their field. They provide a meal for the workers, and usually reciprocate and help the others in their fields (Gronewold 2010).

Farmers also commented on the conduct of the FFS. They suggested that AVANSE project provide food as the FFS lasts from 9 am to 3 pm. Some do not eat and become tired. Others bring their own food or fruit to eat during the FFS training sessions. Cacao farmers were asked to identify problems that hinder the achievement of their goal of increasing production. The first one is the lack of water. The region recently experienced a severe drought that caused harvest losses. They suggested that irrigation systems that will help them sustain their orchards. Their trees are also attacked by rats, termites, and birds that eat the pods. Organic matter, compost and manure are the principal fertilizers used by cacao farmers. Farmers receive training on how to apply compost that the AVANSE project is able to provide. Chemical fertilizers are largely absent and their use might be subject to enabling conditions like the supply of water. As to their overall view of the barriers to yield of cacao crops, a lack of material inputs, the availability of insecticides with rapid effect, the construction of wells and irrigation systems have been cited by farmers as very important activities necessary to improve yields and hence total production. They insisted on having better access to material inputs and irrigation. These items seem to be a noted priority for cacao producers.

Farmer: *Nou bezwen plis zouti nan lekol la. Ex: si elektrik, sekate.*

We need more tools for the FFS. Ex: electric saw, pruning shear.

During our discussion farmers were given opportunities to make suggestions about the functioning of the project and what they think might be useful to improve the project activities and the FFS. Farmers suggest more technicians be hired to provide technical support and guidance. They think it will be good if the project provide the technicians with motorcycles so that they can work more efficiently and respond to their request on time, as farmers need them. Access to market is a big problem for cacao producers. They deplore the absence of clear market policy by the Haitian authorities to fix and communicate the price of cacao. Private sector buyers seem to dominate the value chain and prices seem arbitrary, discouraging farmers when they face low prices that they do not know to be fair or accurate. Irrigation and access to rural banking services are highly demanded by farmers.

Farmer 1: *Sam ka di kip a satilfem, tankou pri kakao a pa janm stab vre*
We won't be satisfied as the price of cacao is never stable.

Farmer 2*: Bay agronomy o plis mwayen*
Give more means to agronomists.

Farmer 3*: Nou vle yo kontinye bay manje nan lekol la*
We want them to continue to give us food during the FFS.

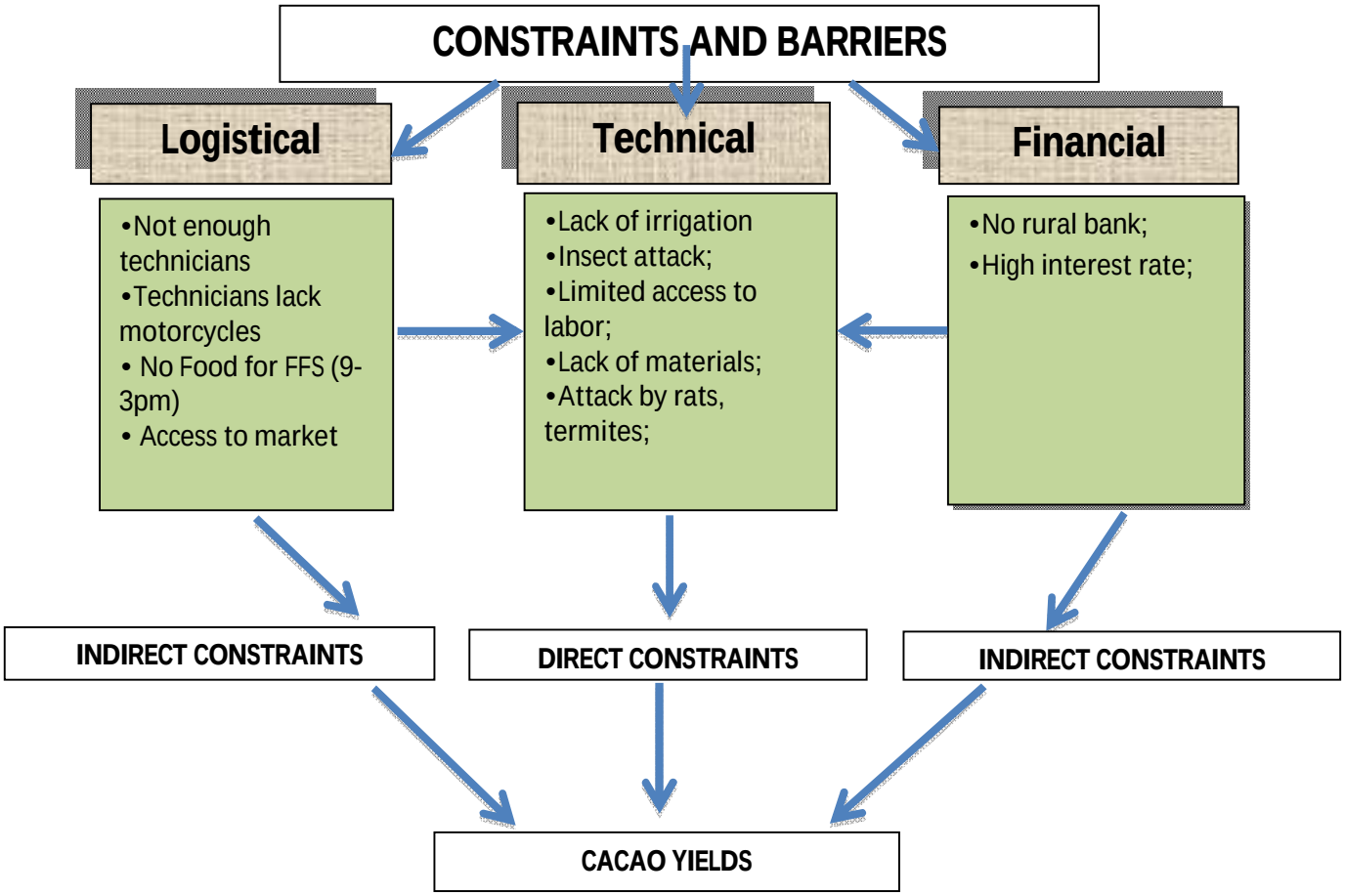
Farmer 4: *AVANSE empoten nan zon nan, men kakao a pa gen yon pri ki fix. Pa gen okenn regleman. Nou bezwen marche pou nou vann kakao yo.*

AVANSE is important in the area, but cacao has no fixed price. There are no regulations. We need access to the market to sell cacao.

Figure 2: AVANSE Technician during cacao FFS at Grande Riviere du Nord

Figure 3: Cacao farmer field school at Grand Riviere du Nord.

Diagram 1: Constraints and barriers to cacao yields as identified by farmers



Rice farmers

Rice farmers are quite experienced in rice cultivation, as they have been cultivating rice for 10 to 28 years. Land organized for rice farming requires investment and maintenance for water supply and control, a more enduring commitment than for many other crops.

The cultivated areas vary from 0.75 ha to 3 ha. Farmers claimed they have more land to plant rice but lacked the financial means to do so. The yields reported centered around 3, 875 kg/ha. Farmers believed they could get more if the appropriate conditions exist: good irrigation, and better management and control of diseases.

The inputs used by rice farmers are mainly seeds, fertilizers and herbicides. These are provided by AVANSE through SIBA (Systeme d'Incitation via les Bons d'Achat). With SIBA, the fertilizers are subsidized at 40% and the herbicides at 90%. However, fungicides are not subsidized by AVANSE for various technical and policy reasons. Attack of seedlings in the nursery by chenille (caterpillars) and snails is the major issue. Insecticides such as Diazinon and Tricel have been used. They have experienced "la maladie de la poussiere" (seemingly a fungus) where the infected rice yields a bitter tasting grain.

Apart from funding their activities with their own money and with the sale of their livestock, some famers obtain loans from rice wholesalers and repay the funds after harvest. For $100 of loan taken, they repay the wholesaler in rice an equivalent of $200, an outcome driven by high interest rates and a lack of agricultural credit alternatives.

FFS helps rice farmers to improve their technical practices. With *Konbit* (cooperative labor exchange) the costs of operation have been considerably reduced. System of Rice Intensification (SRI) production techniques increase yields in a reliable way, although they do increase the need for labor at key points in the production process. The lack of water collection limits the available water in the rice fields. At Chalopin, farmers lamented that all the water drains to the ocean because there is no system to collect and use it for the fields.

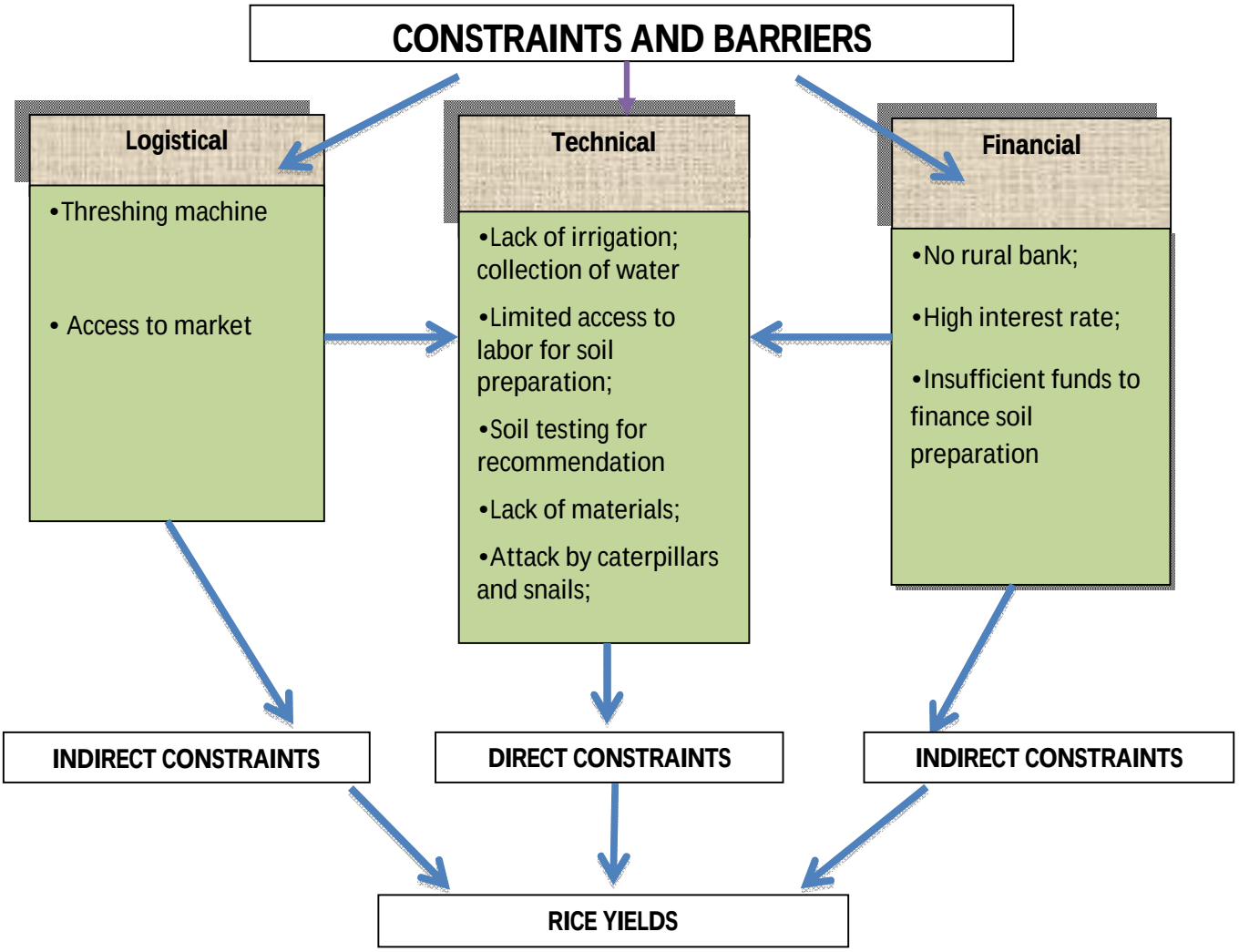
Farmers were asked about their fertilization practices for rice. Producers use both the traditional system and the project-recommended System of Rice Intensification (SRI).[10]For they follow the recommendation given by the technicians for the practices. The SRI system indicates spreading compost at rates of 10-15t/ha. In the absence of compost an application of Diammonium Phosphate (DAP) at 50kg/ha can be used.

Improved water availability repeatedly has been the main answer to this question of what would increase yields. Additionally support for soil preparation is also a concern and might help to improve rice production. After harvesting, farmers manually thresh the rice. This process is labor intensive and farmers seek the use of threshing machines to make the work easier for them. The picture below shows the manual threshing of rice. Farmers wanted assistance in soil preparation i.e., access to machine services for plowing. Rice farmers also suggested soil analysis for adequately assessing fertilizer and liming needs.

[10] The System of Rice Intensification (SRI) is a method aimed at increasing the yield of rice produced in farming. It is a low water, labor intensive method that uses younger seedlings singly spaced and typically hand weeded with special tools. It was developed in 1983 by the French Jesuit Father Henri de Laulanié in Madagascar, later promoted more broadly by Norman Uphoff of Cornell University.

Figure 5: Manual threshing of rice grain by farmers

Diagram 2: Constraints and barriers to rice yields as identified by farmers



Plantain and banana farmers

Six banana farmers were interviewed. Their responses are summarized as follows. Banana and plantain farmers who were interviewed had experience with the crop ranging from 7 to 23 years. A personal decision to cultivate bananas was the main reason for cultivating bananas. However, the AVANSE project has increased motivation for growing plantain and bananas. Several respondents have established new plantations that have not yet been harvested.

Banana-plantain farmers cultivated on average 0.25 to 7 kawo (0.32 ha to 9.03 ha) of land. The plantations were comprised of old and new plantations established with the help of the AVANSE project. The willingness to expand the acres to be cultivated exists, but given the lack of financial means they are not able to do so. Current yields of bananas were hard to estimate as farmers sell by various measures (bunch, hand or fingers) directly in the market without any formal weighing of the harvest. Farmers know their earnings, but due to variable marketing conditions it is not possible to estimate yields.

For fertilizers, banana and plantain farmers use compost and manure. Some do not apply any amendments as they think their soil is fertile. Additionally, AVANSE provides the *plantes issues de fragments de tiges* (PIF) (plants resulting from stem fragments). Investment in banana inputs is quite low, as farmers have traditionally managed bananas in a casual way without augmenting the soil in any systematic way. Black Sigatoka and yellow Sigatoka are the most frequent diseases encountered by banana farmers. However, AVANSE helps them to treat the banana plantings before they distribute them. This makes plantings less susceptible to disease. In case of Sigatoka, farmers were asked to remove the infected leaves in order to avoid the spread of the diseases to the whole plant. Before planting, the soil must be free of nematodes, a condition enhanced by crop rotation or tillage. The PIFs must be properly treated, possibly soaked in home-brewed nematicides.[11]

Farmer 1*: Fèy bannann yo vin tou jon epi yap desann konsa. Genyen piti rejim tou, yo pa fè gwo rejim.*

Banana leaves turned yellow and hang down so there are also smaller bunches.

Farmer 2: *Bon, maladi ki gen nan zon nan se sikatoka nwa. Nan tan pase nou te konn kampe gade men ak fomsyon AVANSE bay nou pa examp nou retire fèy yo.*

Well, disease of the area is black sigatoka. In the past we do not know how to manage but with the training provided to us, we remove leaves.

Farmer 3: *Nou genyen maladi sikatoka nwa et sikatoka jon. Nou pa te konen maladi sa men avèk AVANSE nou vin konnenl li montre nou koman pou fè trètman li pémét nou dekouvri sistèm maladi sa.*

We have as disease black sigatoka and yellow sigatoka. We didn't know about the disease but with AVANSE we become to know about it as they show us how to treat. It allows us to discover the system of disease.

Self-financing and loans from local banks are the major sources of funding by banana farmers. Some of the farmers sell livestock in order to secure operating capital. Once more, banana farmers have expressed a desire to have an agricultural bank to help them get loans to finance their activities, as the interest rate of the current local bank, called "caisse populaire," is high. Banana and plantain FFS have been appreciated by farmers as they improve their knowledge of the crops. Farmers are in need of pumps for irrigation. FFS farmers benefit from the *Konbit* labor

[11]The productivity and lifespan of banana and plantain fields have drastically reduced due to pest and disease pressure. This problem is escalating because farmers usually depend on natural regeneration of plants for the supply of planting materials, which are contaminated by pests and diseases. Banana and plantain can be propagated aseptically in the laboratory through tissue culture techniques. In vitro micro-propagation eliminates all sucker-transmitted pests and diseases, with the exception of viruses. However, tissue culture plants are relatively expensive and not readily accessed by resource poor farmers. The International Institute of Tropical Agriculture (IITA) has been investigating alternative means for producing clean planting material. Macro-propagation is a relatively easy technique that is carried out in a shed or even in the field. It consists of generating suckers from clean planting material by removing the apical dominance. Macro-propagation can be classified into two categories: field-based techniques, based on complete or partial decapitation, and detached corm techniques, practiced in a shed (Njukwe et al. 2014).

exchange that is organized among farmers within the FFS. Farmers also have cited this as an advantage of being in the FFS.

Farmer: *Nou ka di ke de 50-60% nou satilfè nou pa ka di plis paske afè irigasyon, afè dlo yo poko rezoud li. Eske yo pa ka fè nou jwenn kèk fi, kèk motè. Kom mwen di ou deja se pa la grandè de dye, se pa la mirak de dye nou travay.*

We can say that we are satisfied at 50-60%. We cannot say more because irrigation and water availability issue has not yet been solved. Can we have some materials (e.g. pump)? As I already told you it is by the grace of God, the miracle of God we are working.

We asked about the major problems faced in their operation, the things that cause the most problems for this crop. Recent flooding in Plaine du Nord and Bas Limbe has caused losses on banana and plantain plantations. Some farmers have lost their entire crop. Some have invested in draining the water from their land. This situation has been a big problem for farmers and has affected their production. They were expecting AVANSE to help them manage conditions to minimize the loss but have not received any help from them. Other farmers cited the presence of weeds as a major problem, they lack of means to weed the land.

One of the farmers said he wanted to use herbicides, but the technician had not allowed him to use it. Banana farmers used compost and manure to fertilize their soil. Farmers receive training on how to apply the compost and AVANSE provides them with compost**.**

Financial issue has been raised as the main constraint that must be solved in order to help farmers clear and weed their land. The funds are needed to hire labor. They believe with improved access to inputs they can increase their production.

Farmer: *Nou bezwen zouti tankou, manchèt, pikwa, rou, et tracteur.*

We need tools such as machetes, pickaxes, hoe, and tractor.

Producers made a number of general comments about problems they have with the crop. The road that goes to the village is not good and farmers think it prevents them from selling the bananas and plantains on the market even if they have a good harvest. Farmer's maintain that AVANSE is slow in responding to their requests. Access to markets and better prices is difficult, as farmers look to sell their product.

Farmer 1: *Lè nou fè rekot yo nou pa gen kote pou nou vann yo. Eskeu pa panse gen yon marche ki ka ouvri pou nou vann avèk lot peyi. Eske nou pas prevwa sa tou?*

When we harvest we have nowhere to sell them. Do you not think there is a market that could open where we can sell to other countries? Do not you foresee that also?

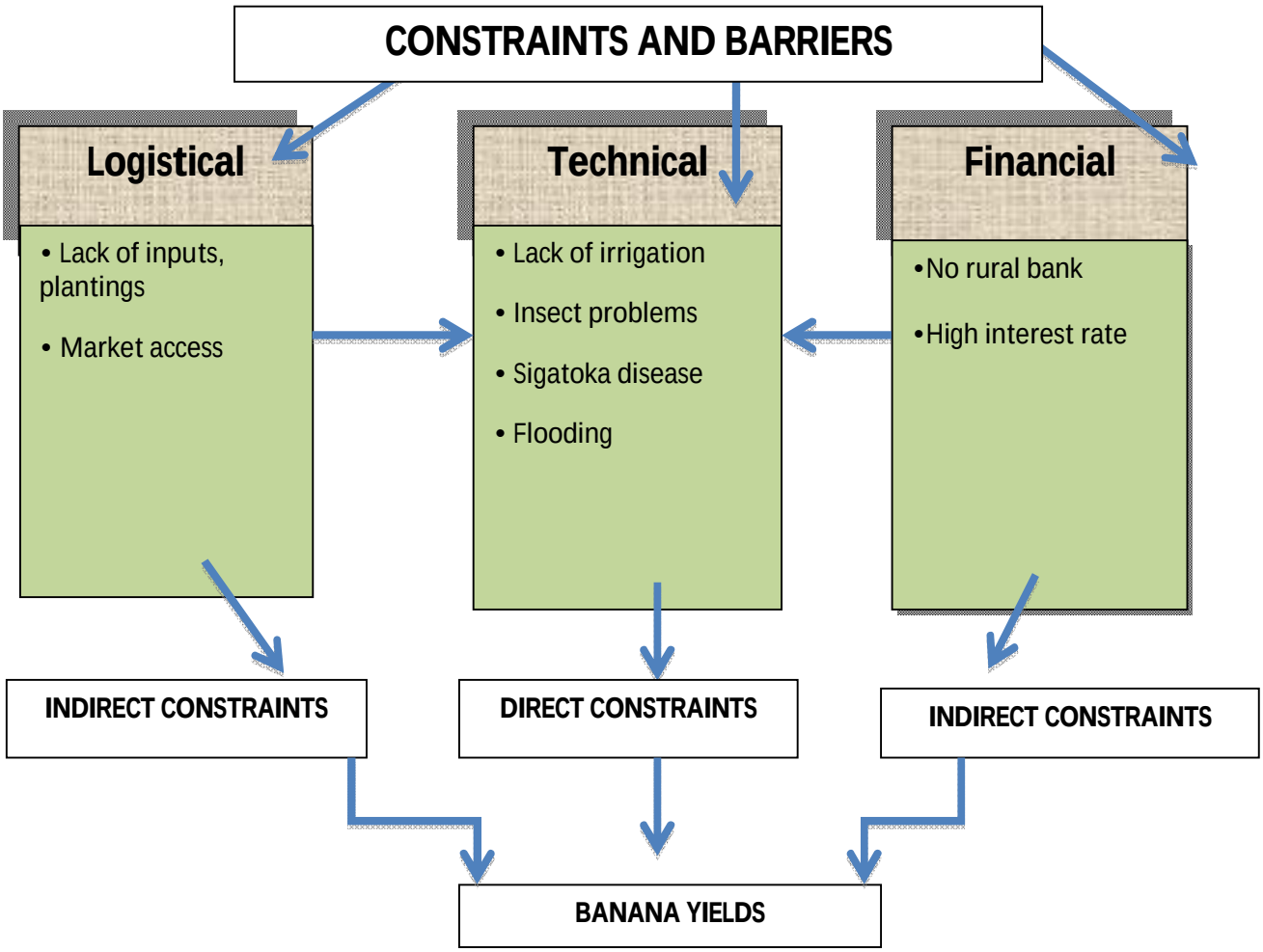
Farmer 2: *Sam ta vle ajoute, tankou nan chemin yo genyen kèk two rego, lè lapli tombe yo kombe ampil dlo, sa fè gen ampil labou, sa fè ke pa ka gen transpo. Menm lè ou ta va fè ampil rekot men ou pa ka al vann yo si wwout la pa bon.*

The roads have some streams and when it rains there is lots of water and it makes lots of mud. It means that there is no transportation. Even if you got more harvest you cannot sell if the roads are bad.

Farmer 3: *Mwen ta swete nan revandikasyon nou pal an.*

We wish that our requests are being processed on time.

Diagram 3: Constraints and barriers to banana and plantain yields as identified by farmers



Beans and maize farmers

Red, black, and other kinds of beans provide a main source of protein, along with pigeon peas for Haitian consumers. Maize and beans (*pwa*) are often intercropped and are combined here for analytic purposes. The study reached 10 pwa/maize farmers for interview in the different target zones of the project. The constraints perceived for beans and corn are summarized as follows. Pwa/maize farmers are quite experienced as some were involved in the cultivation since their childhood. Others have experience of 5 to 25 years. Pwa/maize farmers interviewed cultivate areas ranging from 0.75 kawo to 4 kawo (0.96 ha to 5.16ha). These crops are often intercropped, sometimes with bananas or plantain. Bean and maize food crops are among the staple foods of Haiti and are considered important by farmers.

We asked farmers what quantity they have harvested from the cultivation of both crops last season. Again this question was hard to answer given that they do not remember how much they have sold and how much they have eaten. Despite the difficulty in determining the harvest, we estimate harvests equal to 600 marmites[12] (1650 kg) from an area of 2 ha. This gives a yield equivalent to 825 kg/ha for corn. Farmers know these are not good yields. They

[12] 1 marmite=2.5-3 kg

assert that a good harvest must give around 1,000-1,200 marmites (2,750 kg-3,300 kg) for an area of 2ha giving 1,375 kg-1,650 kg per ha for corn. The yield for beans is evaluated to 700 kg/ha.

Farmers used an organic fertilizer called Abonfloliot at Caracol and pesticides called Carbaryl[13] for corn and Actara[14] and Tricel[15] for pwa. They sometimes buy these products from the Dominican Republic. They also buy insecticides from local shops. For instance at Guilmacon (Grisongarde) there is a local shop called "*Dieu Seul Est Grand*" where farmers buy their insecticides and other products to treat their crops. However, the quality of the items they purchase is doubtful. They think that they were sold products of bad quality and this has negative consequences for their harvest. Some of the farmers have also claimed to not want to use chemical fertilizer since there is no irrigation water available. With AVANSE, they received seeds and also the insecticides but the inputs provided by AVANSE were not available at the time we interviewed them and this was too late for them to use.

Corn and beans are troubled by insects such caterpillars (*chenille*), whiteflies, and other species. Farmers use insecticides. However, farmers complain about the effectiveness of those products and suggest that more potent products be provided to them. Some have lost their harvest even after using some of the insecticides. Another issue is the dose to apply. They have limited ideas about the manner and amount to apply and application errors might cause some harvest losses. In the same way, fertilizer recommendations are not available and farmers apply whatever they feel appropriate to untested soils.

Figure 6: Bean leaf attacked by insects

Farmers either use their own means to finance their activities or rely on the income from animal sales or loan taken from their fellows. Pwa/maize farmers suggested the establishment of an agricultural bank where they can be able to get loans for farming.

FFS helps improve agricultural practices by showing how to plant and manage beans and maize. For instance farmers traditionally use four seeds per hole when planting, but with AVANSE they have learned to put two seeds per hole, thus saving on cost of seed. They also tend to apply insecticides without any personal protection measures. But AVANSE through the FFS helps them to improve their knowledge of using self-protecting gear during pesticide applications. They know, for instance, that they cannot apply insecticides when there is wind. The training focuses also on the preparation of soil. The FFS creates a spirit of collaboration—*konbit*— among farmers and help them to increase yields in some cases. They also think that FFS helps them to communicate, exchange ideas, to learn from each other. However, some of farmers are absent during the FFS, a complaint of one farmer.

[13] http://pmep.cce.cornell.edu/profiles/extoxnet/carbaryl-dicrotophos/carbaryl-ext.html

[14] Active ingredient=Thiamethoxam. http://www.syngenta.com/global/corporate/en/products-and-innovation/product-brands/crop-protection/insecticides/Pages/actara.aspx

[15] https://en.wikipedia.org/wiki/Chlorpyrifos

Availability of insecticides and financial assistance were major problems faced in their operations. They also experienced drought issues. Water availability is a central problem faced by many farmers. At Grisongarde for instance, given the position of the plot, one farmer has not received water from the irrigation system on his plot. At Haut Dilere-Ouanaminthe the farmers said the irrigation system installed by Action Allemande and USAID is not functioning and they do not receive the water for their plots.

Farmers rely mostly on their intuitive perception of soil quality in deciding about fertilization. Some requested a soil test in order to know the nutrients lacking in their fields, but this information is not readily available to most farmers. Insecticides of good quality are essential for pwa/maize. The inputs should arrive on time. They hope to get help from AVANSE for soil preparation as it is important to increase the yields and they lack financial means to do the preparation on large plots. The irrigation system needs improvement in some areas. The lack of material and equipment, such as tractors for plowing the soil was mentioned as a main constraint.

Pwa/maize farmers have made some comments and recommendations concerning AVANSE and the different actions that they felt needed to be taken in the near future to improve the activities on the ground. Given that there are no fertilizer recommendations, application is infrequent and random; fertility depends on the farmers' traditional knowledge of their land. Farmers wanted agronomists be able to test the soil and provide guidance for liming and fertilizer use.

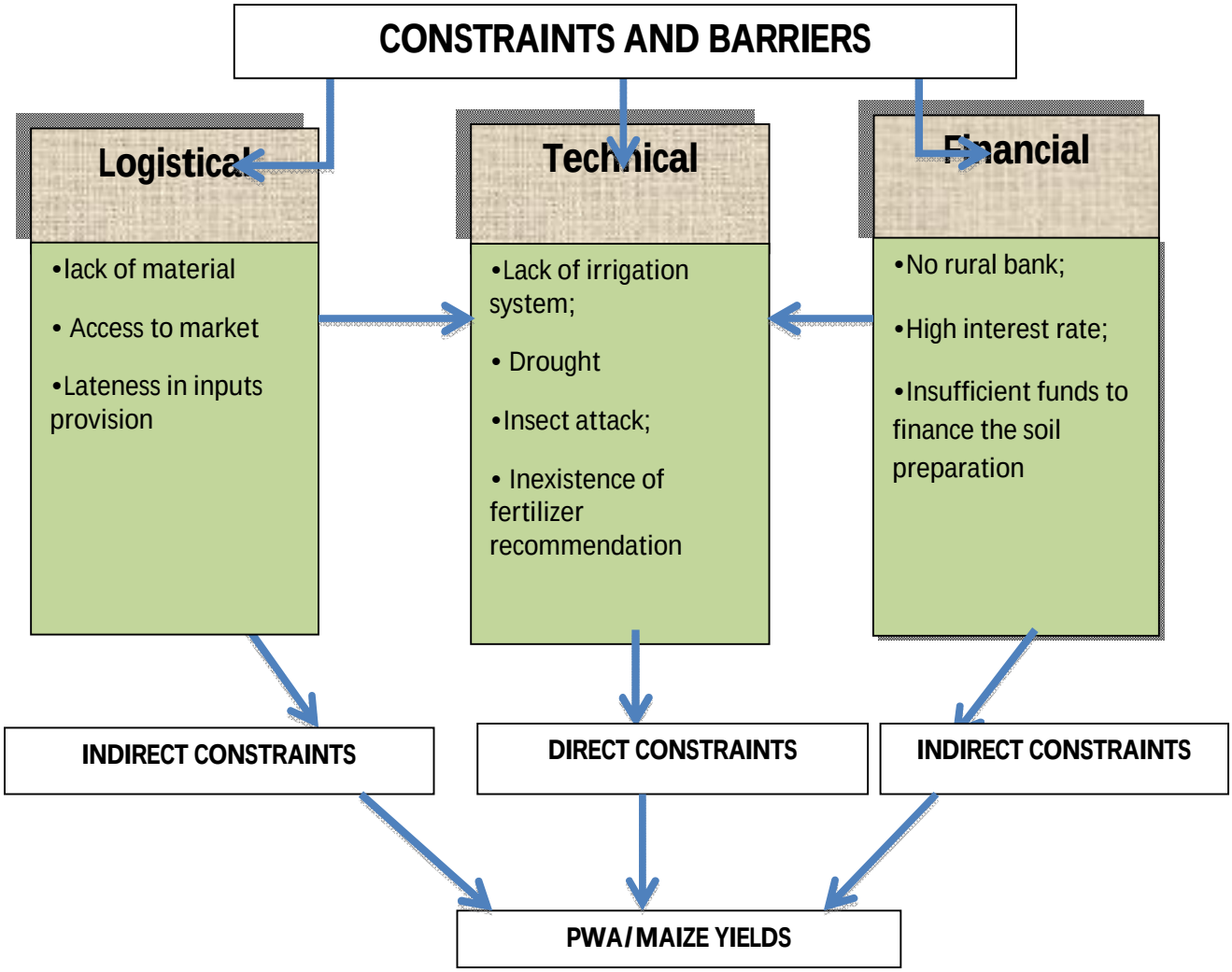
Farmer 1:*"yonn nan pwoblèm majè nou renkontre: pa genyen yon etid ki fèt nan sol la pou nou konnen bezwen ki genyen yo pou kiltie-Nou genyen pwoblèm laboratwa pou fè etid sol la.*
The major problem we face is: we do not have studies on soil in order to know the needs of the crops, we have problem of soil lab to do studies on soil"

Farmer 2:"*We recommend that agronomists have capacity to test the soil in order to make fertilizer recommendation"*
The soil also needs basal application of fertilizer as they are poor in nutrients (from farmers at Ouanaminthe).

During the distribution of inputs, technicians have difficulty managing multiple responsibilities. Farmers believe AVANSE should have a local representative who will help them. The inputs should also be distributed on time. Farmers said "*if we do not have inputs before 22nd December, the yields will be low*". Planting begins at the end of November and if they plant after 25th of December the yields are considerably lower. The price of corn on the market is not good. They are seeking AVANSE intervention on the marketing side.

Figure 7: Seed distribution to Pwa farmers at Caracol Diagram 4: Constraints and barriers to pwa/maize yields as identified by farmers

Diagram 4: Constraints and barriers to pwa/maize yields as identified by farmers



Conclusions

This study identified constraints faced by selected farmers in Northern Haiti in their operation and their suggestions to remedy these constraints. The constraints are related to the irrigation systems as farmers experienced droughts and the lower yields obtained in the previous season. In some cases the irrigation system exists but needs maintenance work to function efficiently. Fertilizers use is absent in some areas but fertilizers are applied to a limited extent in some areas. Farmers apply fertilizers at random with no recommendations. Plant disease and insectpests are problems; appropriate pesticide technologies are not always available to farmers.

A major limitation of the study is the omission of women farmers. The study was conducted as a diagnostic effort to guide the conduct of the FFS and other project interventions. We relied on largely-male project staff to make referrals to leading farmer participants in the FFS.

Despite the constraints, farmers notice progress with the support of AVANSE and are hoping that further progress will be attained with the suggestions made to remedy these constraints. A number of major issues emanate from the study:

1) Timely availability of inputs, especially fertilizer, seeds, and pesticides. Farmers cannot use what they cannot obtain a the time when it is needed.

2) Credit access, use, and costs also are critical barriers to agricultural development in the target zone. Farmers have been failed by the institutions designed to serve them, and are often burdened by high interest rates when and if credit is available. The Bank Populaire may offer some possibilities, but apparently there are few convenient offices where producers can apply for loan. There does not seem to be any systematic program of outreach or means of assisting farmers to obtain credit from the financial institutions.

3) Farmer Field Schools seem to be valued and respected among farmers involved in the production of the target crops. Our objective was not to evaluate these extension mechanisms, but they do seem to be fruitful and appreciated by farmers. Farmers seem to value the technology packages for crop production extended by AVANSE even though they may not have the fertilizer available when it is needed, or access to pest control materials when the problems are manifested. SRI for rice and other recipes for productivity improvement are demonstrably effective, even though producer compliance may not be complete due to input and labor availability constraints.

4) Water is a key barrier to productivity improvement across the enterprises we examined. In a time of increased climate variability, irrigation systems, wells, pumps, and other means for decreasing risk to plant growth and development are central wants expressed by producers.

5) Although soil fertility and fertilizer were concerns, these seemed largely secondary to more immediate threats to crop security from drought and pests. Except in the case of rice, fertilizer use may be an unfelt need, as producers seem to perceive that their soils were sufficiently productive and not the primary limit to yield. Years of erratic availability and high costs seem to have engendered a fatalistic attitude toward chemical fertilizer use and other tools for fertility management. We observe that repeated disappointment with the supply of fertilizer has engendered a reduced demand for this input.

6) While improved plant varieties make a demonstrable difference in productivity, this also seemed to be a largely unfelt need among producers. When the supply of clean banana and plantain PIF improves, farmers will likely seek the disease-free plantings. Again, when improved plant material is not systematically available, producer interest in adoption remains low.

Finally, the crop specific comments of top farmers provide some primary data on what limits productivity increases in the croplands of Northern Haiti. This paper may provide some guidance for development of interventions that seek to increase the agricultural productivity of major crops in Northern Haiti. The FFS will sharpen the level of practice among participants, but if the ingredients necessary to fully implement the technology package are not available, then the results will disappoint.

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