REGENERATIVE AGRICULTURE FOR HAITI'S CENTRAL PLATEAU— A SUSTAINABLE FOUNDATION FOR FOOD AND NUTRITION SECURITY

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All photos are by the author unless otherwise noted.

Contents

1. Introduction

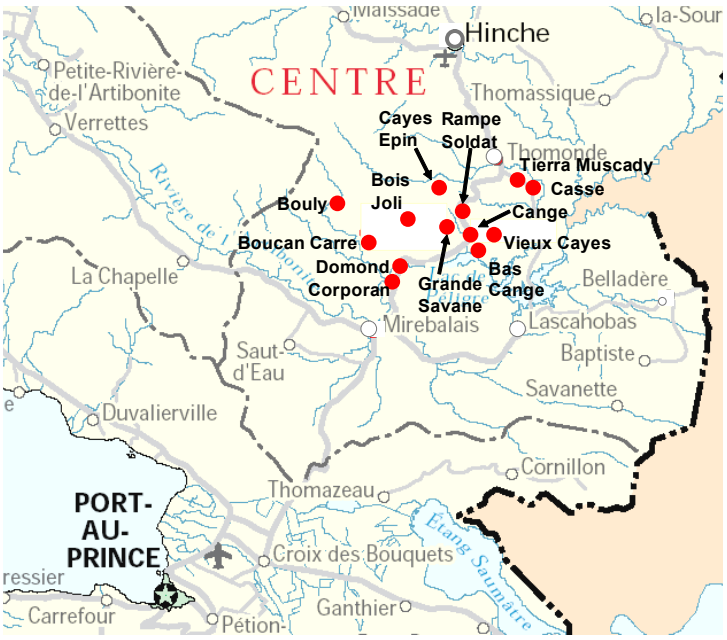
Over the past two decades, Zanmi Lasante has succeeded in bringing health care to the previously underserved or forgotten rural poor Haiti's Central Plateau. Despite huge advances in the treatment of HIV/AIDS and tuberculosis and success in the promethean task of providing basic health care to patients throughout the region, chronic malnutrition continues to plague the population of the region, thereby lowering immunity and resistance to diseases, increasing the likelihood of opportunistic infections, and diminishing the physical and mental strength of the hungry. Children are the primary victims of malnutrition and hunger.

An obvious but difficult path to stemming chronic malnutrition is to address the food insecurity ubiquitous throughout Haiti. Agricultural productivity is seriously compromised by severe soil degradation, due largely to centuries of deforestation and hillside cultivation. In addition to inadequate production of food, food insecurity in the Central Plateau is exacerbated by its history of isolation, or *anklavman*. Often impassable roads greatly limit access to markets and lead to high prices for food. The lack of infrastructure has also left the region bereft of agricultural extension and education activities. While there is a long history of NGO and multilateral natural resource management projects in Haiti, few have endured the political instability of the last few decades, and few have included local groups in the planning and implementation process. Projects in the Plateau Central have often been short-lived or limited in geographic range due to the lack of infrastructure.

To explore the possibilities of sustainable agricultural development in the area, Zanmi Lasante Paris, a partner organization dedicated to supporting Zanmi Lasante's activities and other community development initiatives in the Central Plateau, funded this report. The objectives of this report are to:

- detail the state of food and nutrition security in the Central Plateau
- characterize the current farming systems in place and the constraints limiting production
- provide recommendations for sustainable practices that could help buffer farmers from ecological and socio-economic instability
- suggest a path by which local agricultural potential and food security could an be enhanced in a participatory manner though future agricultural programs

2. Methodology



The Central Plateau and some of the survey villages
(adapted from Partners in Health http://www.pih.org/wherewework/haiti/index.html)

In addition to researching secondary sources, the author made two trips to Haiti in the summer of 2004, from 20 June to 1 July, and again from 10 to 22 August. Both qualitative and quantitative data were collected used standard rapid rural appraisal methods, such as focus groups, formal and informal interviews and surveys, field visits, and transect walks. Several focus groups were held: with farmers in Bas Cange, with residents of Cange, and with representatives of four *gwoupman peyizan* (peasants' groups), SOPABO in Boucan Carré, ASEDECC in Cange, and AFPM and OPP in Bouly.

During the first visit, a formal survey instrument was developed and distributed to members of SOPABO and ASEDECC. Working with a team of 2 to 4 assistants,

the author interviewed approximately 60 farmers in 14 villages or localities (*localités*), mostly in the Cange zone. Several of these interviews were conducted with farmers during visits to fields to better understand management practices and problems affecting production (such as erosion, pest damage, and nutrient deficiency). SOPABO members and an American ZL volunteer completed the remainder of surveys in early August, mostly in the Boucan Carré zone. Overall, 200 farmers were interviewed (142 men, 58 women) in 53 localities in three *sections communales* of the Boucan Carré commune (Petit-Montaille, Boucan Carré, and Des Bayes) and one section (La Hoye) of the commune of Las Cahobas (see Table 1). Statistical analysis was completed using SAS.

Soil was sampled from two fields in Corporan, three in Vieux Cayes, three in Grande Savane, and two in Bouly. In each field, five to eight sub-samples taken from a depth of 10 cm and mixed to form a composite sample for chemical analysis.

Table 1: Localités included in the survey

Boucan Carré		Des Bayes	La Hoye	Petit-Montaille
Aupigue	Grand Chemin	Ballumetre	Bas Cange	Bouly
Belair	Grands Herbes	Campeche Felix	Fond Boisdhomme	
Bellevue	Haut-Pissa	Cange	Moge	
Berreux	La Chausee	Cayes Epin	Mont-Toumonde	
Cachoute	Laise Claniade	Chevry	Rampe Soldat	
Capussin	Laracointe	Delagon	Savanette Cabral	
Chambeau	Lasses	Domond	Tierra Muscady	
Chimoreau	Maneville	Dufailly	Vieux Cayes	
Corvel	Montas	Grande Savane	Ravin Roseau	
Dablette	Nicholas	Jasmin		
Dermas	Pageste	L'Acheteau		
Douillard	Pepin	Manoire		
Duchemin	Pouillee	Moreau		
Ferrobien	Riviere Guillaume	Parc Cabrit		
Glory	Soubier	Terre Salle		
Grabaille	Syvol	Viette		
Gappy	Pierrelis			

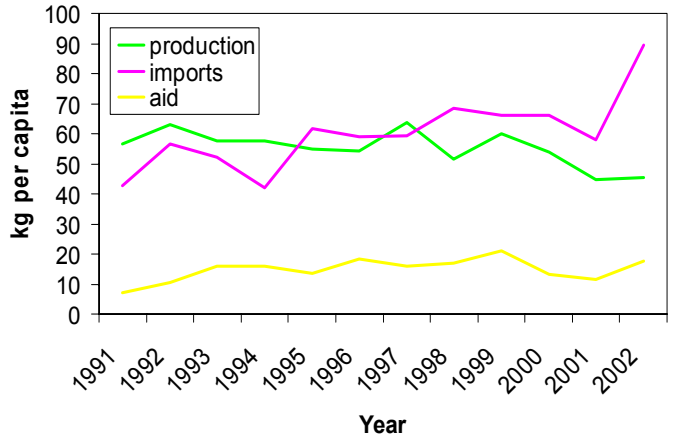
3. Food and agriculture in Haiti

The Republic of Haiti, comprising the western third (27,750 km^2) of the island of Hispaniola, between 18 and 23° N in the Caribbean's Greater Antilles, is the poorest country in the Western Hemisphere. Haiti suffers from high rates of illiteracy (49%), and only 13% of the population has access to potable water, 6% to electricity. The nation's external debt (outstanding and disbursed) has nearly tripled over the last two decades, amounting to $1.25 billion in 2001. Average per capita income in 2001 was $480, more than seven times less than the average for Latin America and the Caribbean, yet mean income for the majority of the (mostly rural) population is estimated at less than $100 per year[1].

According to the World Food Programme of the UN, 23% of Haitian children suffer from malnutrition, and 4.5% from acute malnutrition. In 2001, per capita daily energy consumption was estimated at 2,045 Kcal. Daily per capita protein intake was estimated at 42 g, and fat at 41 g. Approximately half of Haiti's population experienced some level of food insecurity at the time. This has surely risen in the last two years, and more drastically since the coup in February 2004.

[1] World Bank, 2002; Smith, 2001

Figure 1: Per capita cereal consumption in Haiti



Over the last decade (1991 – 2002), Haiti's total population increased 17% from 7 to 8.2 million people, while the agricultural population increased only 6%, from 4.7 to 5 million. This trend implies an increasing burden on rural farmers to produce for an increasingly urban population. In reality, the majority of food in Haiti is now imported (Figure 1). Per capita food production has dropped nearly 30% in the last decade (Table 2), and resources are continually depleted. Only fruit production has increased since 1991, while production of cereals, roots and tubers, vegetables and melons, and pulses has steadily declined. Per capita production of all food has decreased[2].

Table 2: Total and per capita agricultural production in Haiti, 1992 and 2002

Product	Total production (**metric tons**)			Per capita production (**kg/person**)		
	1992	**2002**	**% change**	**1992**	**2002**	**% change**
Cereal	451,796	374,000	-17	63.1	45.5	-27
Roots and tubers	794,043	759,500	-4	110.8	92.4	-16
Pulses	106,523	70,650	-56	14.9	8.6	-42
Fruits excluding melons	889,305	1,001,600	+13	124.1	121.9	-2
Vegetables and melons	235,760	200,050	-15	32.9	24.3	-26

A host of environmental, political, and economic factors have led to this decline in food production and rising dependence on imports and food aid. Following independence in 1804, the peasant class was forced off the low-lying fertile plains by upper-class speculators and planters, and has since farmed the steep, marginal land that comprises two-thirds of the country. Intensive production is limited mostly to the fertile Artibonite Valley, yet the majority of rural population has access only to the hillsides for subsistence agriculture of maize, beans, cassava, and fruit. Subdivision of inherited plots over several generations has left the majority of Haitian farmers with land holdings of only a couple of hectares or less, making fallowing difficult. As a result, farmers intensively cultivate their plots year after year, expediting the erosion that renders their land less and less fertile. While only 20% of land is considered arable, 50% is under agricultural production[3].

Widespread deforestation has also played a major role in the degradation of soils in Haiti. Rapid deforestation began during the colonial period, and was intensified when coffee was introduced in the early 18th century. Highland forests were cleared within half a century, and a quarter of the colony's land was under coffee. The plantation system—monocultures of coffee, indigo, tobacco, and sugarcane—exhausted soil nutrients and left soil susceptible to rapid erosion. Gunboat diplomacy also hastened the degradation of Haiti's natural resources. Under threat of military intervention, France forced Haiti to pay for its independence following the revolution of 1804. Haiti exported timber throughout the 19th century to pay off the 93 million franc indemnity. Forested land was estimated in 1940 at approximately 30% of Haiti's total area, and dropped to 10% by 1970. Current estimates lie between 1.4 and 2%[4].

[2] FAOSTAT
[3] Pellek, 1992; White and Jickling, 1995, Smith 2001, FAOSTAT
[4] Paskett and Philoctete, 1990, Michel, 2001

Charcoal market, Domond

Continued deforestation is largely due to charcoal production, the only viable form of revenue for most rural Haitians. Charcoal production has doubled over the last two decades, from 13.1 million metric tons per year to 26.4 in 2002[5]. Overall, charcoal and firewood provide 85 to 90% of Haiti's energy for home and industrial use, and firewood consumption is estimated at 500 kg per person per year. Currently, a quarter of the country's population of 8.1 million is concentrated in the capital Port-au-Prince, 61% of whom rely on solely on charcoal as their cooking fuel. With the population growing at a rate of 2.1%, the increasing trend towards urban migration will further exhaust natural resources as the fuel needs of the urban population are met.

Decreases in agricultural production can also be linked to fiscal policy shifts. President Aristide's 1994 return to power by the US military and delivery of $2.1 billion in aid following the 1991 coup was contingent on the implementation of a structural adjustment program mandated by the World Trade Organization and international lending institutions, requiring regular debt service, maintenance of low wages, privatization of state enterprise, as well as the lifting of agricultural subsidies and price supports[6]. While coffee and sugarcane traditionally provided the nations' primary export revenues, assembly plants now dominate Haiti's economy, providing 80 to 90% of the nation's exports[7].

Agricultural imports and food aid have increased since 1994 with the lowering of import tariffs as required by structural adjustment. The resulting influx of cheap food imports has pushed market prices below competitive levels. Approximately 81% of rice consumed in Haiti is imported, 83% of which comes from the US[8]. Current tariffs on rice rest at 3%, yet the US continues to advocate a zero-tariff policy. Rice accounts for 11% of food expenditures in urban Haitian households, versus 6% in rural households[9], yet persistent devaluation of the Haitian *gourde* on the international market has severely reduced the purchasing power of consumers.

Food security has therefore become more and more dependent on the purchasing power of the consumer. Indeed, national and foreign food security policy has shifted its focus away from production. For example, US policy emphasizes, "Food security does not mean food self-

US rice for sale, Domond

[5] Michel, 2001, FAOSTAT
[6] Smith, 2001
[7] FAO, 2001
[8] FAOSTAT
[9] USAID, 2000

sufficiency. Since most foods can be traded internationally, national self-sufficiency only makes sense when a country has a comparative advantage in producing them"[10].

This perspective, deeply rooted in the neo-liberal economic paradigm of globalization, assumes that economic development on a macro-level will eventually "trickle down" to individuals, increasing their purchasing power and access to food. In the opinion of USAID, "food self-sufficiency has no intrinsic value in eliminating chronic food insecurity" and that "costly and uneconomic investments […] have tended to undermine, not only per capita income growth, but also food self-sufficiency itself, by diverting resources from otherwise productive uses." However, advocates of this top-down approach to development often fail to account for the immediate effects on those who bear the burden of trade liberalization, the poor majority. More than half of Haiti's population is agricultural, the majority of whom are smallholders farming only a hectare of land. When policy-makers cut agricultural extension and education programs, writing them off as costly and ineffective, they ultimately deprive the majority of the population opportunities to improve their livelihood. While total food self-sufficiency may not be a realistic goal, increased self-sufficiency and market development is necessary to help farmers increase their purchasing power, as well as to buffer them from fluctuations in food prices and low-productivity due to ecological variability such as droughts or excessive rains and temperatures.

The neo-liberal approach to food security also fails to acknowledge the right of food sovereignty. Food sovereignty is "the right of peoples to define their own food and agriculture; to protect and regulate domestic agricultural production and trade in order to achieve sustainable development objectives; to determine the extent to which they want to be self-reliant; [and] to restrict the dumping of products in their markets…Food sovereignty does not negate trade, but rather, it promotes the formulation of trade policies and practices that serve the rights of peoples to safe, healthy and ecologically sustainable production"[11]. Food sovereignty is the ability of communities or nations to decide where their food comes from. If Haitian rice producers can no longer compete against cheaper imports, they may be forced out of business. Agriculture then remains a subsistence activity, as commercial production for smallholders is no longer a viable endeavor. When a community no longer has the choice to grow its own food due to economic or policy constraints, its food sovereignty has been usurped.

4. The Central Plateau

4.1 Geography

Route Nationale 3 near Thomonde

The Central Plateau (Département du Centre) is a large massif rising up 600 m from the low-lying Plaine du Cul-de-Sac to the south and the Artibonite Valley to the wast, and hemmed by the Dominican border to the east. Route Nationale 3 provides access to the Plateau from Croix-des-Bouquets in the south and from Cap Haitien and the Plaine du Nord. This "highway", a gullied dirt road strewn with boulders, is the only major thoroughfare connecting the departmental capital Hinche and other large towns such as Mirebalais and Thomonde to the national capital. During the rainy seasons, April/May and August, the road is often impassible. Nevertheless, large trucks and buses slowly ply the road daily carrying passengers, food and other goods. Descending from the Plateau, trucks are loaded down with sacks of charcoal for sale in the capital. A secondary highway leads from Mirebalais to the Artibonite Valley and on to Saint-Marc on the west coast.

[10] USAID, 2000
[11] Via Campesina et al

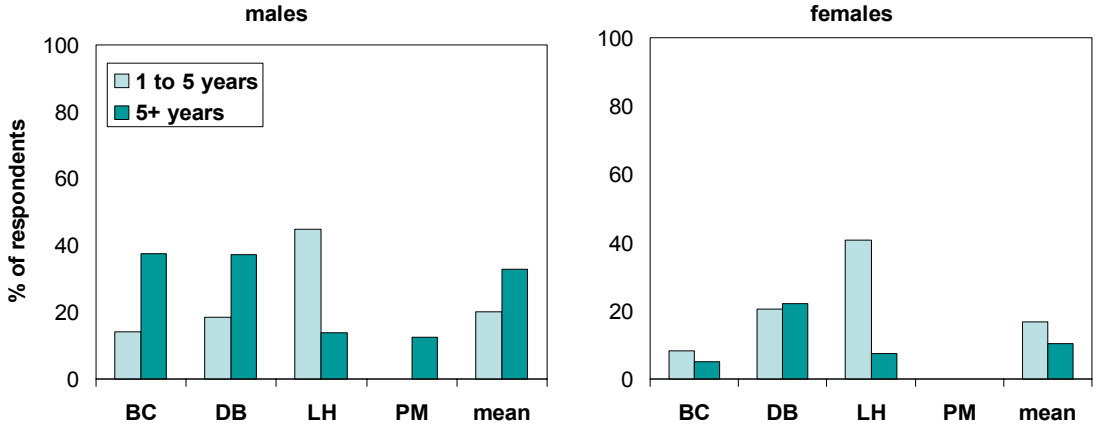
Zanmi Lasante's work in the Central Plateau has been centered in Cange, a three hour drive from Port-au-Prince. In order to meet the health needs of a larger part of the Plateau's population, ZL has recently expanded to open new hospitals in Hinche, Thomonde, Boucan Carré, and Las Cahobas.

Cange lies on the eastern edge of the commune of Boucan Carré, one of three communes in the Département du Centre. Boucan Carré's population according to a 2003 census was 48,700 inhabitants living on 399.3 km^2, a population density of 122 persons/ km^2. The commune consists of 45 localités and is subdivided into three *sections communales*: Petit Montaille, Boucan Carré, and Des Bayes. Other villages in ZL's catchment zone and included in this survey are located in the adjacent Section Communale de La Hoye, part of the commune of Las Cahobas.

4.2. Household Composition, Education & Out-Migration

The mean number of adults living in each household surveyed was 2.4. The mean number of children per household was 4.8 children. This did not vary greatly across *sections communales*. In the Boucan Carré zone (BC and Petit-Montaille), 43% of males interviewed (and spouses of women interviewed) had received no schooling, 14% had studied for less than 5 years, and 43% had studied for 5 years or more (Figure 2). In the Cange zone (Des Bayes and La Hoye), 51% had received no schooling, 30% had less than five years, and 19% had studied for five years or more.

Figure 2: Education



Amongst women interviewed (and spouses of male farmers) in Boucan Carré, 78% had never been to school, 10% had been for less than five years, and 12% had been to school for five years or more. In the Cange zone, 57% of women were unschooled, 33% had been to school for less than 5 years, and 10% for five years or more.

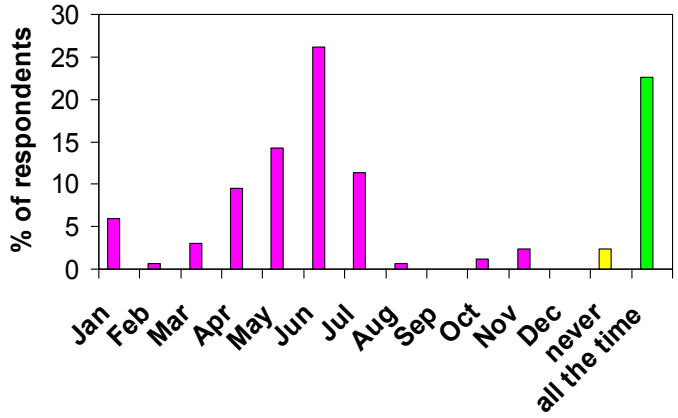
Half of surveyed farmers (51%) said that they had a family member in the household who had migrated elsewhere for work. The majority had gone to Port-au-Prince or the Dominican Republic, some to smaller cities such as Mirebalais and Saint-Marc. One farmer in Cayes Epin had two sons in New York. Out-migration of member of the household did not vary considerably between *sections*, ranging from 43% (Petit-Montaille) to 55% (Boucan Carré).

Since we only surveyed farmers, we cannot estimate what percentage of the Central Plateau's population are agriculturalists. In Haiti overall, 61% of the population are farmers. Due to the isolation of the region, the absence of industry or a coastline, however, we may assume that a higher percentage of the population in the Central Plateau draws their livelihood from the land. Farmers were asked how else they supported their families. Most replied, "*M'ap travay tè a selman*. I only work the land". Others stated that they make charcoal or engage in *ti komès*, small business, or work as day laborers.

4.3. Food & Nutrition Security

Household food security can be defined as "access by all people at all times to enough food for an active, healthy life"[12]. Available food must be safe and nutritionally adequate, and available in a socially acceptable manner. Food insecurity is thus the converse: limited or inconsistent access to nutritious or safe food or to the ability to obtain food in a socially acceptable manner. Community food security is, in essence, an extension of household food security, also taking into account the "underlying social, economic, and institutional factors within a community that affect the quantity and quality of available food and its affordability or price relative to the sufficiency of financial resources available to acquire it."

Figure 3: Month that farmers begin purchasing food



When asked if and when they had to buy food, only 2% of farmers responded that they never had to buy food. By planting a diversity of crops, these farmers were able to maintain a minimal level of food security: "*Lè mayi a fini, nou mange banan. Lè banan fini, nou mange manyok*. When the corn's finished, we eat plantains. When plantains are gone, we eat cassava." Almost a quarter responded that they have to buy food all the time. Some qualified this by saying that they had to buy rice or processed foods or vegetables that they did not grow themselves. The vast majority of farmers interviewed (61%), however, reported having to buy food beginning April to July, when the previous year's harvests are exhausted (Figure 3).

One of the largest markets in the region is the Monday market in Domond, 7 km southwest of Cange and several kilometers east of Boucan Carré. In addition to household goods, used clothing, charcoal, and tools, livestock and a wide variety of produce are available. Most of the rice here is purchased in bulk in Port-au-Prince, where it is imported from the US and Asia. When asked if Haitian rice was available, a vendor replied, "*Li two chè*. It's too expensive." Imported ground wheat and corn is also sold for livestock feed. Most of the vegetables such as carrots, eggplants, cabbage, garlic, onlions, and tomatoes, are purchased wholesale in Port-au-Prince and resold at the Domond market.

The village of Casse, past Tierra Muscady in La Hoye, holds a weekly market on Mondays. The market is one of the largest in the region, even larger than the market at Domond. While a wide variety of food stuffs, farming equipment, clothing, and other utilitarian goods are available to buyers, the Casse market is particularly well known for its livestock market (asking prices for several species of livestock are noted in section 5.5). Most of the non-refined food items sold at the Casse market are produced locally on farms in or adjacent to the commune. Exceptions were rice and coffee, purchased in Port-au-Prince or the Dominican Republic. Asking price and origin of several food items are noted in Table 3.

Port-au-Prince produce for sale at Domond market

[12] USDA, 2002.

Table 3: Asking price for selected produce at Casse, June 2004

Product	Origin	Price (H$/unit)[13]
Millet	Thomonde	7 to 12/marmite[14]
Rice	Dominican Republic (re-sale)	14/marmite
Peanuts	Tierra Muscady	20/marmite
Yams	Delevé	13/four yams
Meliton	Domond (re-sale)	3/each
Pigeon pea (*pwa kongo*)	Local	28/marmite
Field pea (*pwa enkoni*)	Local	21/marmite
Coffee	Port-au-Prince (re-sale)	32/marmite
Pressed cane (*rapadou*)	Casse	15/stick (30 cm length)
Fresh fish	Local	10/string (*kre*)
Lemons	Savanette	9/basket
Bananas	Casse	25/bunch
Tobacco	Casse	17/bale

In Cange, a daily market of about 100 mostly female vendors lies alongside the main road where public transport stops. Approximately ten stalls at the bottom of the market serve cooked food—coffee, rice, bean sauce, boiled bananas, *frit* (French fries), meat and greens. Most of the cooked produce (bananas, vegetables, etc) is purchased in Cange, and most fresh produce grown in or nearby Cange. Other vendors sell food from open stalls, tables, or tarps laid on the ground. While some pre-packaged goods such as crackers, cookies, and pasta are available, most of these vendors sell bulk items such as rice and beans purchased at weekly markets in Domond and Mirebalais.

As in most developing countries, many residents of the Central Plateau spend the majority of their income on food. On average, a laborer may earn H$20 to H$30 per day, a skilled worker such as a mason may earn H$50 gourds/day. Food insecurity is high, as laborers often have to buy food on credit or borrow money from friends or family. While a regular job guarantees steady income, laborers also complain that they don't have as much time to farm in order to offset their food expenses. A group of three laborers men listed the following monthly food expenses for a family of 3:

Table 4: Monthly expenditures on food as reported by three laborers in Cange

Item	Quantity	Total cost **(H$/month)**
Rice	1 sack	32
Palm oil	1 gallon	50
Corn meal	3 marmites	39
Sweet potatoes	2 sacks	60
Meat (goat/pig)	3 times weekly	240
Plantains	3 branches monthly	60
Sugar	1 sack	300
Maggi cubes	3 sachets	12
Other spices/vegetables	Variable	40
TOTAL		**H$ 1001 per month**

Another interviewee claimed that food expenses for a family of 3 were slightly higher, between H$50 and H$60 daily, or H$1,500 to H$1,800 per month. These estimates may be high, however, or may be accurate during the "hungry period" following the exhaustion of home garden food stocks. Several farmers and laborers also noted that prices have increased steeply since the February coup.

Even when there is sufficient food, it may not be enough to provide adequate nutrition for children. In the summer of 2003, ZL established an emergency nutrition program in Boucan Carré to assess the severity of malnutrition in the commune and to intervene though home visits, free health care, and nutritional supplements. In one of the more remote villages of the Boucan Carré commune, ZL estimated that approximately half of children under the age of five suffer from chronic or acute malnutrition.

[13] One Haitian dollar (H$) = 5 *gourdes* = US$ 0.143, or conversely H$ 7 = US$ 1
[14] a marmite (cooking pot) is a unit of measure equal to about 7 cups, or 1.5 liters

An 18-month-old with severe kwashiorkor

A 4 year-old with severe marasmus (photos: J Mutter)

Since the summer of 2003, fifteen children have died from acute malnutrition during treatment in Boucan Carré or Cange. The number of malnutrition deaths in the villages is unknown.

In 2004, ZL partnered with World Vision to provide nutritional supplements to malnourished children in Boucan Carré. While the supplement program has been successful in terms of providing emergency care for the severely malnourished, nutrition security can only be guaranteed when the root causes of food insecurity are addressed.

In 2003, ZL partnered with a group from the Episcopal Diocese of Upper South Carolina to begin the Haiti Hort project. The purpose of the project is to grow food for ZL's hospitals and for distribution to the poorest and most malnourished in ZL's catchment zones. In 2004 they acquired a 26 ha farm in Corporan where intensive production of plantain, maize, beans, and vegetables will take place. The project's secondary goal is to provide agricultural training to the area's farmers.

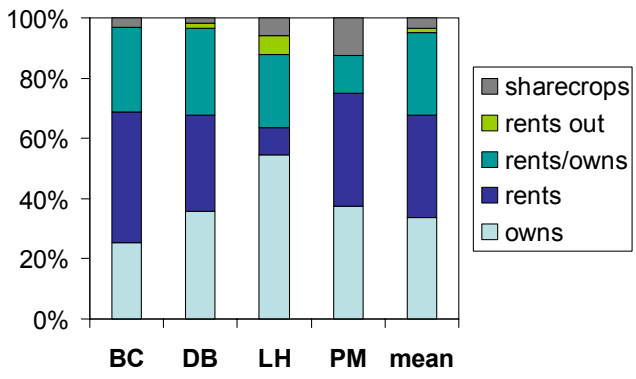
5. Farming systems of the Central Plateau

5.1. Land holdings and tenure

Unlike many peasant farmers in Latin America and the Caribbean, Haitian farmers by-and-large own the land they work. Following independence in 1803, former slaves became landowners. However, as land was equally divided and subdivided equally between children of the deceased, holdings grew smaller from one generation to the next. Land tenure in Haiti is pluralistic, guaranteed by both formal legal and informal social agreements[15]. Access, therefore, is not solely guaranteed by a legal title or contract, but also by verbal or social agreement, inheritance, or usufruct land use.

Most of the farmers in the survey area own the land that they farm (Figure 4). In the Boucan Carré catchment zone (Boucan Carré and Petit-Montaille), 24% own all of their land, 26% both own and rent land, while 43% only farm rented fields. In and around Cange (Des Bayes and La Hoye), most farmers own all of their land (42%), while 27% both rent own, and 24% only rent their land. Only 3 to 4% of surveyed farmers solely sharecrop. These results are similar to those reported in other surveys of land tenure in Haiti. Ownership of land in previous reports has ranged from 60 to 74%, while 8 to 14% rent, and 6 to 14% sharecrop[16].

Figure 4: Land Tenure



On average, farmers in the survey area farm several small fields or *jaden*, totaling 1.34 *kawo*[17] (1.73 ha). The average number of fields per household is 2.26, slightly fewer than the 3.7 dispersed plots reported in a recent USAID survey. Only eight of the 200

[15] Smucker et al 2000.
[16] Ibid.
[17] 1 *kawo* = 1.29 ha

farms were greater than 4 *kawo* (and were therefore excluded from the calculation of mean farm size).

5.2. Labor

More than half (60%) of surveyed farmers in the Central Plateau participate in work groups, called *konbit, kòve, met tet ansanm, gwoupman*, or *konsey*[18]. In this system, 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. It is rare for farmer to pay laborers to help with field work. Only the few farmers who had large land holdings (> 5 ha) reported that they paid laborers to work their fields.

Work group clearing a field, Petit-Montaille

Participation in work groups varies by *section communale*, however. In Petit-Montaille and Boucan Carré, 73 to 75% of farmers rely on group labor to clear, till, and harvest. In Des Bayes, about half (52%) work in groups, while in La Hoye, only a third (31%) rely on group labor. Additionally, women's groups were often smaller, consisting of 2 to 4 people. Many older farmers laughed when asked if they participated in group work, saying that they had grown too old. One farmer in Vieux Cayes said, "*Yo vin gran moun, yo gate konsey. Yo pa kap travay kounye a*. They grew up, and that wrecked the work group. They can't work any more." Other farmers complained that people now will not work without payment, and that group work was a thing of the past.

Both men and women participate in all facets of agricultural production in the Central Plateau due to the nuclear nature of households. While men may do the majority of tillage, women frequently plant, cultivate, and harvest alongside the men. In female-headed households, women obviously perform all tasks. Women commonly care for livestock than men, but animal husbandry is by no means limited to women. Only during the marketing of agricultural products is there a clear distinction of gender roles. Women are mostly responsible for selling their products at market, or for any post-harvest transformation (cooking or drying of vegetables, milking animals, etc.).

5.3. Agronomic practices

As in much of Haiti, fallowing—the practice of leaving a field idle for a year or more to allow nutrients to regenerate—has grown more and more rare in the Central Plateau, as plot sizes decrease due to subdivisions at inheritance. Less than a third of surveyed farmers fallow their fields. Since most farmers farm less than 1.75 ha, they must farm all of it in order to feed their families. When asked if they fallowed, most responded "*M pa kap kite-l poze-l paske m pa gen lot tè*! I can't fallow because I don't have any other land!" Indeed, most farmers who fallowed had larger holdings or a greater number of fields, a positive association that was also revealed in a statistical analysis. Incidence of fallowing varied only slightly between zones, ranging from 32 to 42% of farmers (Table 5).

Farmers in the Central Plateau begin preparing a fallow field by cutting down grass with a sickle (*digo*). If there a large amount of biomass or if the soil is to be tilled with a plow, they often set fire to the residues. One Grande Savane farmer explained that a plow would not be able to till the soil were the grass left on the surface. In instances where the field has been cropped in the previous season, the weed biomass (*zèb*) and crop residues (*bwa mayi*) may be simply left to decay on the surface as mulch, or incorporated during the preliminary tillage. Others pile the residues in mounds, covering them with a layer of topsoil, then plant maize or sorghum in the mounds. Most farmers recognize the fertilizing capacity of these

[18] For a detailed discussion of group labor in Haiti, see Smith 2001, chapters 4 and 5.

residues, referring to them as *fimye*, or manure. Overall, 59% of farmers reported using *fimye* to maintain soil fertility. In Des Bayes, 73% rely on residues, while in Petit-Montaille, only 38% reported using them (Table 5).

Following the removal of above-ground weed biomass, farmers till the soil by hand using a pick (*pikwa*). If a farmer has a field on flat land and has access (physically or financially) he may use animal (usually ox) traction to plow the field. Sowing is generally done by hand by jabbing a stick in the soil and dropping seeds into the hole. Ox-drawn seeders are rare or expensive, and animal traction impossible on steep slopes.

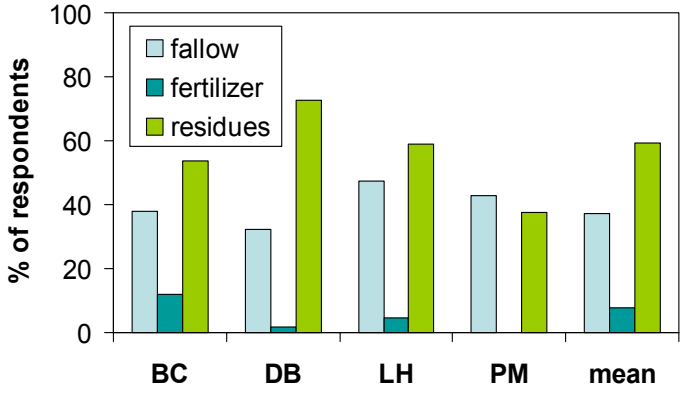
Field preparation using animal traction, Moge

Jab-planting, Bois Joli

As elsewhere in Haiti, farmers of the Central Plateau primarily grow *mayi* (maize, *Zea mays*) and *pitimi* (sorghum, *Sorghum bicolor*) intercropped with various types of beans: *pwa kongo* (pigeonpea, *Cajanus cajan*), *pwa enkoni* (cowpea or fieldpea, *Vigna unguiculata*), *pwa nwa* or *pwa wouj* (common black or red bean, *Phaseolus vulgaris*). Roots and tubers such as *manyok* (cassava, Manihot esculentus), *yanm* (yam, *Dioscorea* spp.), and *patat* (sweet potato, *Ipomoea batatas*) are also intercropped. *Malanga* (taro, *Xanthasoma* spp.) is planted in shady, moist areas, generally along gullies or ravines. Yam, a climbing vine, is generally planted alongside trees, maize, or sorghum plants.

Most farmers cultivate with a sickle two or three times during the growing season to remove weeds. They leave the weeds as a mulch to fertilize the crops for the duration of the growth of the crop.

Figure 5: Soil fertility management practices



Due to limited availability and high costs, very few farmers use synthetic fertilizers (*angre*) in their fields (Figure 5): 12% in Boucan Carré, 5% in La Hoye, and 2% in Des Bayes. Almost all respondents who reported using *angre* reside in the village of Bellevue where there may be a retailer. Throughout Haiti, fertilizer use increased nearly five-fold from 2.9 to 13.9 metric tons between 1991 and 2002. However, most of this use likely increased in the industrial farming systems of the fertile Artibonite valley and in production of export commodities such as coffee and mangoes.

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Most households have fruit trees such as *mango* (*Mangifera indica*), *zavoka* (avocado, *Persea* spp.), *sitwon* and *zoranj (Citrus* spp.), *papay* (*Carica papaya*), *grenadya*, *gwyav* (guava, *Psidium* spp), and

kokotye, in the *jaden lakou*, the field or garden plot immediately adjacent to the house. Sale of fruits from these trees makes up a significant portion of farm revenues for many farmers. Other multipurpose trees such as *kalabas, gomye* (*Bursera simaruba*), *fren* (*Simaruba glauca*), *kasya* (*Cassia siamea*), and *flamboya* are also planted or selected and left to grow, providing famers with fodder, building materials, fuelwood, fiber, and shade.

5.4. Post-harvest

Granaries (*kolonbye*), Petit-Montaille

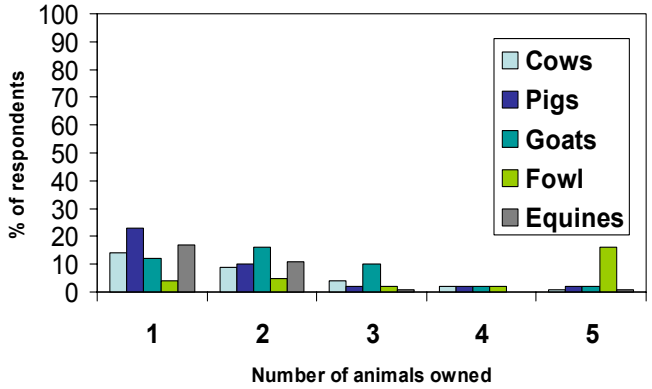
Following harvest, grains and tubers are stored in elevated granaries (*kolonbye*). Small plates made of metal or calabashes surround the base posts to prevent animals from climbing up into the granary. Roofs, like houses, are either made with corrugated tin or thatched with reeds or plantain leaves. Grain is consumed or sold in exchange for processed food products or household goods such as clothing, tools, or building materials. A few marmites full of seed are saved for the following year. However these are often used for household consumption or lost to pests.

5.5. Livestock management

Livestock husbandry in the Central Plateau is widespread, but practiced on a small scale. As in most agrarian societies, livestock serve the role of a savings account, a form of equity that accrues interest (in the form of offspring), and that can be sold in times of financial need—weddings, funerals, school fees, sickness. In the early 1980s when the US government facilitated the mass slaughter of 1.3 million native pigs to stem an outbreak of African swine fever, the socio-economic impact on rural Haitians was enormous[19]. Malnutrition rose and school attendance dropped because parents could no longer sell their pigs to pay for uniforms and school fees. During the survey, several farmers made reference to the disastrous effects of the pig eradication.

Seventy percent of surveyed farmers own some kind of livestock. However, those farmers who do have livestock rarely own more than one or two head (see Table 6) due to the difficulty in finding sufficient fodder during the dry season. Goats are the most common form of livestock: 42% of farmers own goats. Thirty-nine percent of farmers own pigs, mostly the descendents of American varieties imported during the eradication program. Thirty percent own cattle (for milk production and tillage), and thirty percent own equines (donkey, horses, or mules) for transportation

Figure 6: Livestock ownership



[19] Farmer 1994, Smith 2001

More than a third of farmers have fowl (chickens, guinea fowl, turkeys, or ducks). Many farmers reported losing their chickens when the rains began in April. The symptoms they described—coughing and dizziness—are symptomatic of Newcastle's disease which spreads rapidly in moist tropical environments where chickens roam freely.

Goat tethered to fodder species, Cange

During the cropping season, animals are tethered to stakes or trees while they graze, and are often tended by children who move the animals around during the day to provide them fresh forage. Following harvest, animals are allowed roam freely, grazing the residues. Animals are fed household kitchen waste to supplement what they are able to graze during the day. Overall, only 15% of farmers corral their livestock in pens. The percentage of farmers who corral their animals is highest in La Hoye (46%), and lowest in Boucan Carré (9%) and Petit-Montaille (0%). In this system of livestock management, nutrients from the manure are largely lost. Because the animals are generally not tethered in cropping areas, manure nutrients are not cycled back to the areas of the highest nutrient uptake.

Farmers market livestock primarily at the Domond and Casse markets. Asking prices of some species are noted in Table 5. Some farmers also take their livestock off of the Plateau to Croix-des-Bouquets and Port-au-Prince where selling prices can be higher.

Table 5: Asking prices for livestock at Casse, June 2004

Livestock	Price per head (*H$*)
Mule	400
Horse	300
Cow	400 to 1,000
Goat	56 to 70
Chicken	4
Pig (~1 year-old)	40 to 48
Piglet	4

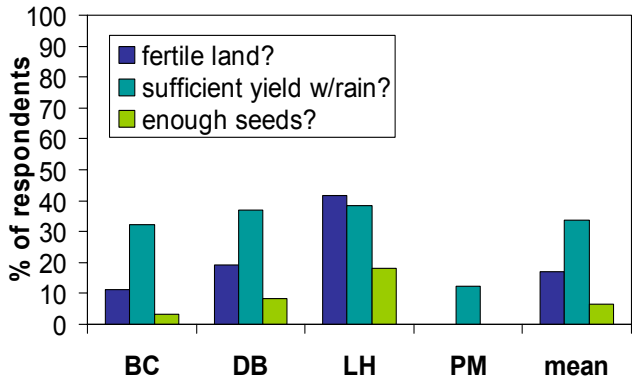
Casse livestock market

6. Constraints limiting agricultural production

6.1. Farmers' perceptions of constraints

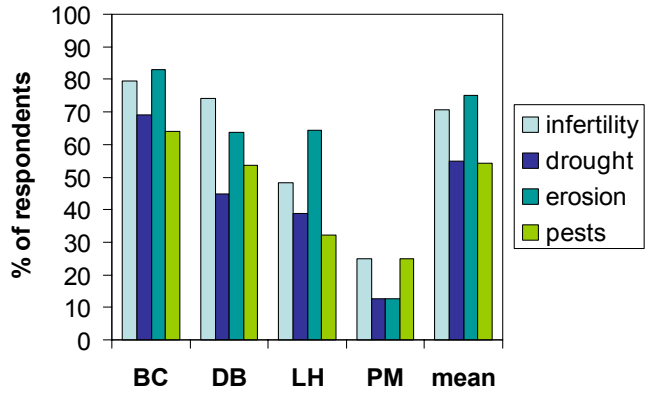
Farmers in the Central Plateau are acutely aware of the fact that their fields are becoming less and less productive. Only 17% of farmers consider their land "good" or fertile, responding "yes" to the question "*Eske tè a bon, eske li bay anpil?* Is the land good, does it yield a lot?" (Figure 7). More farmers responded positively in La Hoye (42%) than in the others (0 to 19%). When asked if yields in years with adequate rainfall were sufficient to feed their households,

Figure 7: Farmer perceptions of soil fertility



about a third (34%) of farmers replied affirmatively, ranging from 13 to 39% across zones. Only 6% of farmers reported having enough seeds left over to plant the following season. In Petit-Montaille, farmers reported having to buy on average 23 marmites of seed each year. In the other zones, farmers had to purchase between 3 and 13 marmites of seed.

Figure 8: Farmers' perceptions of constraints



The vast majority of farmers (75%) recognized erosion as a major factor limiting their production (Figure 8). Similarly, when asked what major agricultural problems they faced, 71% responded "*Tè a fatige. Li pa bay anpil*. The earth is tired. It doesn't yield much." Similarly, 55% cited drought: "*Lapli pa vini. Pa genyen dlo*. It doesn't rain. There is no water." More than half (51%) said that pests seriously damaged their crops.

6.2. Land tenure and farm size

The small size of plots and limited access to land in Haiti are among the primary factors limiting production in Haiti. Because plots are so small, farmers with only one or two *kawo* of land cannot afford to fallow even a portion their fields. Land that is rented, sharecropped, or shared with other inheritors, is often more degraded because farmers are less likely to plant trees on land where long-term tenure is insecure. However, fallowing may actually be more common on land farmed by tenants. A tenant farmer may abandon a field after a few seasons once yields begin to decline. Several farmers interviewed in this survey reported taking this approach. A farmer who owns his field may invest more energy or resources into tree planting than would a tenant, but less likely to fallow if he has only one or two small plots.

Nevertheless, since farmers have implemented soil improvement technologies on land held under a range of tenure, previous studies have failed to link tenure to technology adoption in any consistent manner. Some argue that tenure is overemphasized and conclude that investment in SWC techniques are dependant on a variety of factors such as plot size and fertility, distance to the house, and duration of access rather than the form of tenure, ie, if a farmer continues farming the same plot, he is likely to invest in its improvement, whether he rents it or owns it[20].

6.3. Climatic variability

Climate data for the Central Plateau was unavailable for this survey. However, previous studies in Haiti have cited the increasing variability in rainfall as a major constraint facing farmers. Climatic variability (which many have linked to global warming) means that yields are less predictable, threatening food security. On a national level, the large-scale deforestation of the last fifty years has likely led to a decrease in rainfall as less water is absorbed and then evaporated or transpired. Many farmers cited drought as a major limiting factor, and many commented that because of low rainfall, their yields were poor despite good soil.

[20] Smucker et al, 2000

While rain may fall less frequently, rainfall is often more violent. Indeed, most of the season's rain may fall during only a few events. Since precipitation is bi-modal, ie, all rainfall occurs during the two short rainy seasons, more rain falls than can be absorbed by the soil and vegetation. The resulting runoff can lead to linear and sheet erosion even after 30 mm of rainfall. The situation in the Plateau is particularly pronounced—the zone around Mirebalais, in the southern Plateau, reports the highest annual precipitation in the country, more than 2,000 mm. When storms are particularly violent, mass movement of soil can occur, and entire hillsides are washed away. Such events are not only destructive to agriculture and property, but are often fatal, eg, landslides and floods of May 2000 in southeastern Haiti.

6.4. Erosion losses

Three centuries of deforestation and cultivation on Haiti's steep slopes has resulted in a massive soil erosion problem and a concomitant reduction in soil fertility and productivity[21]. Hillside cultivation is necessary in a country with more than 63% of slopes greater than 20%[22]. Given that the Central Plateau is a massif, the majority of farmers cultivate tiny plots on the steep slopes. Without appropriate soil and water conservation (SWC) measures in place, such as mulching, contour tillage, agroforestry, terracing, and rock or vegetative bunds, the majority of nutrient-rich topsoil is lost to rainfall-induced erosion In some cases, erosion is so severe that the calcareous parent material or bedrock is exposed, leading some Haitians to comment that "The mountains have grown old. You can see their bones poking through their skin"[23].

Exposed parent rock on a cultivated field, Des Bayes

Hillside cultivation on steep slopes

Fields are particularly susceptible to erosion losses immediately following clearing and burning, when bare soil is exposed and before advanced stages of crop development. Even later, when crops are large enough to utilize a significant amount of water, the volume of rain falling during violent downpours quickly infiltrate and saturate the soil, and the rest is lost as runoff.

In May and June 2004 in Bouly, massive runoff flowing through several ravines and gullies overflowed and destroyed many of the village's fields. This kind of destructive force is common on steep, denuded slopes.

[21] for a detailed description of erosion in Haiti, see Chapter 12 of Roose 1996
[22] Pellek 1992; White and Jickling 1995; Smith 2001
[23] Smith 2001

6.3. Nutrient and organic matter deficiencies

P deficiency in maize, Bouly

Chemical analysis of soil samples taken from ten fields in four villages revealed that severe phosphorus (P) deficiency is widespread (Table 6). The only field in which P levels were high had only been in production one year, and was a *jaden lakou*, a field adjacent to the house that likely receives most of the nutrient-rich household waste such as potassium (K)-rich cooking ashes. High calcium (Ca) levels may be partially responsible for P deficiency, as Ca binds P in a form unavailable to plants (calcium phosphate). Phosphorus is vital to photosynthesis, rooting, flowering, fruiting/seed production, nitrogen-fixation, and maturation. A deficiency of this essential element seriously stunts growth. Symptoms of P deficiency (severe purpling of leaves) were visible throughout many fields in the Central Plateau. In Petit-Montaille (Bouly) in particular, many corn plants exhibit purple leaves.

High Ca concentrations raise soil pH above the 6.0 to 6.5 range optimal for plant growth, and can limit availability of some micro-nutrients (such as boron, iron, zinc, and molybdenum) in addition to P. Molybdenum deficiency can inhibit mineralization of nitrogen for plant uptake. Iron is important for chlorophyll production, and boron is necessary for cell and structural development. Moderate zinc deficiency (concentrations of 2 kg/ha and lower) at some sites may be responsible for poor seed production and maturation.

Almost all soil samples revealed low levels of sulfur (S). Yellowing of young leaves and faint striping of veins is an indicator of S deficiency. Sulfur deficiency leads to delayed maturation, as it is closely associated with nitrogen (N) in protein and enzyme synthesis.

Chlorosis (yellowing) of older leaves and stunted growth also suggest N-deficiency, common to subsistence agriculture. Since farmers rely solely on residues but do not add manure or synthetic fertilizers to their fields, very little N is entering into the system.

Table 6: Soil chemical and physical characteristics from 10 Central Plateau fields

Localite	Humic matter	Bulk density	CEC	pH	Ca	Mg	P	K	Mn	Zn	Cu	S
	%	g/cm^3	cmol/cm^3		metric tons/ha	kg/ha						
Bouly	0.04	1.06	53.8	7.8	20.4	523	10	497	278	1	3	8
Bouly	1.19	0.94	12.4	5.5	3.1	452	12	430	129	2	32	18
Cayes Epin	0.13	1.07	27.9	6.6	8.8	1086	<1	180	426	2	5	18
Corporan	1.31	1.10	22.4	6.5	6.9	1012	19	282	374	4	11	15
Corporan	0.41	1.24	39.2	7.9	14.9	1030	12	356	927	2	11	16
Grande Savane	1.19	1.10	20.8	6.2	5.7	638	12	313	1001	5	6	18
Grande Savane	1.14	0.97	35.3	7.3	11.4	413	151	1826	1545	18	9	17
Grande Savane	1.14	1.02	16.4	5.9	4.9	531	12	282	898	4	7	12
Vieux Cayes	0.32	0.98	42.5	7.9	16.2	926	24	485	910	3	5	18
Vieux Cayes	0.36	0.91	43.7	8.0	16.3	381	24	637	547	7	4	22

Most soils were extremely low in humic matter. Humic matter, or organic matter (OM), adsorbs nutrients, reducing the leaching losses, and "safeguards" them for plant uptake. Organic matter also improves the porosity of the soil, increasing its water holding capacity. Increased pore space between soil particles allows more water to infiltrate, thereby reducing the potential for runoff and erosion, while storing more

water for plant uptake. Increased porosity also allows deeper root penetration, important for nutrient uptake and structural stability. Conversely, a lack of OM is generally associated with soil infertility, low porosity, and a resulting increased soil bulk density that hinders root penetration, nutrient uptake, and structural stability.

6.4. Pests and disease

Attack of corn plants by caterpillar (*cheni*) species, likely cutworm, is widespread on farms in the area of study. In Cange and Rampe Soldat, several farmers complained of plantain losses due to infestation by *mawoka*, a type of beetle (Scarabaeid) larvae. Overall, about half (54%) of surveyed farmers cited pest pressure as a major problem limiting production. Additionally, insect and rodent pests are responsible for a considerable amount of post-harvest losses of grains.

Some farmers complained of plant diseases affecting their crops. *Helminthosporium* leaf spot was widespread in several locations, and can be common when temperatures drop during the rainy season. Most leaf spot was evident on plants suffering from serious nutrient deficiencies. Nutrient deficiencies weaken a plant's resistance to secondary infection by fungal or viral pathogens, as well as losses due to predation by insect pests.

***Mawoka* (beetle larvae) damage to plantain**

Severe N, P, and S deficiency and secondary infection of *helmintho-sporium* leaf spot on sorghum

6.5. Cost and availability of tools

Tools are a significant expense for farmers in the Central Plateau. Most farmers in the Cange area purchase them at the Domond or Mirebalais markets. Total costs for the five main tools used in hillside agriculture can run as high as H$280 (Table 7). However, most farmers are unable to afford all of these and must share. "*Sa-a pou senk moun! Nou prete, prete, prete*. That's for five people! We share, share, share."

Table 7: Tool costs in the Central Plateau

Tool **(English)**	Zouti **(Kreyol)**	Price **(H$)**
Pick	*Pikwa*	50
Sickle	*Digo*	100
Machete	*machet*	30
Shovel	*pèl*	50
Hoe	*wou*	60
TOTAL		**280**

Overall, 85% of farmers surveyed borrow the tools they need from other farmers. In Boucan Carré 90% of farmers borrow tools, 81% in La Hoye, and 54% in Des Bayes. In Petit-Montaille, all farmers responded that they borrow tools.

6.6. Poverty and disenfranchisement

No discussion of the realities constraining agricultural development in Haiti is complete without addressing the disenfranchisement of rural Haitians. The environmental degradation that so limits agricultural production is symptomatic of a systemic exploitation and neglect of the rural poor on both national and international levels dating from colonial times. The squandering of the nation's wealth by a long line of dictators, and crippling debt burden have resulted in little to no infrastructure investment in rural areas. The limited infrastructure that does exist is further undermined by graft and corruption on the local level, making rural Haitians wary of government involvement. In the Central Plateau, this neglect is even more acute, amplified by the region's physical isolation.

The lack of public infrastructure—roads, health care, water and sanitation, electricity, and education—reinforce a cycle of poverty that few rural Haitians have the opportunity to escape. Even those who do leave the land are forced to migrate to Port-au-Prince where the urban poverty that awaits them is often more sinister than that they are attempting to escape. The Central Plateau's physical isolation far from the reach of the UN Peacekeeping Mission also makes it a prime venue for political violence. Following the coup of February 2004, violent attacks against former Aristide supporters have continued in the more isolated parts of the Central Plateau such as Petit-Montaille.

For most Central Plateau farmers, agriculture is only viable on a subsistence level, not only because of the environmental constraints discussed earlier, but also due to changes in the agricultural market in the years following structural adjustment. The comparative advantage of cheap Haitian labor outweighs that of agricultural production, so investment in the agricultural sector has dwindled considerably. As a result, Haitian youth see little opportunity in agriculture and leave farming to their parents. For the farmers themselves, charcoal production is the only profitable venture, and the cycle of environmental degradation, food insecurity, and poverty thus continues.

As the demographic data presented in section 4.2 reveals, education in the Central Plateau is limited, particularly among women. Curriculum emphasis on environmental protection is cursory at best, and agriculture plays a limited role, if any at all. Perhaps this is due to a partially justified assumption that a student who makes it through school will most likely leave the land. Nevertheless, more than half of male farmers in the region do indeed have some schooling.

Once a child leaves school, educational opportunities are even more limited. The lack of a functioning governmental agricultural extension service has helped to keep farmers ignorant of innovations in agricultural practices. Only 13 of 197, or about 7% of farmers surveyed had ever been visited by an extension agent, agronomist, or technician, or participated in a technical training.

Farmers have responded to the environmental constraints in a number of creative ways that have modestly bolstered household food security. However, population pressure on natural resources increases at an exponential rate, and these traditional technologies may only prove effective on a farm-scale. Until the larger systemic foundations of poverty are addressed on a policy level, direct natural resource management intervention programs will have only a localized and potentially short-lived effect. Nevertheless, by building participatory agricultural development programs on the traditional knowledge of farmers within a framework of regenerative agriculture, a stable agroecology and healthy economic opportunity is possible for agriculture in the Central Plateau.

7. Traditional responses to agricultural constraints

7.1. Addition of organic matter

The addition of organic matter (OM) to the soil is fundamental to regenerating soil fertility. In addition to supplementing organic and mineral nutrients to the soil, OM additions improve the soil's physical structure by increasing the porosity of the soil. Humic matter in the OM acts as a cementing agent, improving the stability of soil aggregates during wetting events such as rainfall, thereby reducing soil losses to erosion. Larger soil aggregates improve aeration, providing oxygen to soil microorganisms. Organic matter fuels microbial activity, vital to soil fertility and a healthy soil ecology. Microorganisms are needed to transform organic nutrients into a mineral form available for plant uptake. The presence of microflora attracts microfaunal "grazers" such as mites, beetles, and earthworms, which help break down organic residues and increases soil porosity and infiltration of water.

Increases in OM can lower incidence of soil-borne plant pathogens by attracting a diversity of soil microbes which in turn out-compete pathogens for resources. Some beneficial microbial species control pathogens through antibiosis, while other species (plant growth promoting rhizobacteria) promote "induced systemic resistance" to pathogens in the host plant.

Residue mulch, Grande-Savane

As described in section 4.1.3, nearly two-thirds or surveyed farmers rely on crop and weed residues (*fimye*) to fertilize their crops. By cycling this organic material back into the soil, they are likely able to maintain a minimum of soil aggregate stability, porosity, microbial activity, and mineralization of organic nutrients. When left on the soil surface in the form of mulch, residues insulate the soil from the scorching tropical sun, lowering soil temperatures by a couple of degrees, thereby slowing evaporation of moisture and reducing the incidence of yield-reducing drought stress. During periods of drought, this blanketing effect is particularly important. Additionally, a mulch layer buffer soil aggregates from the impact of violent rainfall that can break apart aggregates and wash them away.

7.2. Residue bunds and rock walls

As a response to the erosion endemic to Haiti's denuded hillsides, many farmers practice SWC by building bunds with crop reside along the contour to slow the flow of water and reduce soil losses. The bunds are held in place with vertical stakes spaced to retain horizontally paced corn and millet stalks. Plantain leaves are also frequently used. Use of these bunds, called *ramp pay*, *ramp zèb*, *pay banan* or *pike*, is widespread in the Central Plateau (64% of farmers in this survey). In Petit-Montaille, however, only 25% of farmers reported using *ramp pay* to control erosion.

Residue barriers, Bouly

Unfortunately, residue bunds are not strong enough to resist the heavier rains, and must be maintained and rebuilt every couple of years. Many farmers lamented that rains had washed away their *ramp pay*.

Rock lines, Bois Joli

A sturdier, but much more labor intensive alternative to a residue contour bund is a bund or low wall built with rocks, called a *ramp woch* or *band woch* in Kreyol About half of surveyed farmers use rock walls as a SWC measure (again, this percentage is significantly lower in Petit-Montaille, Figure 9). Many who build *ramp woch* do so primarily because their fields are rocky. As they clear the rocks, they stack them along the contour. Most farmers who build rock walls also build residue bunds as well, a statistically significant correlation.

Farmers clearly recognize the importance of building rock walls to protect their soil and crops from runoff, and to capture nutrient-rich organic matter. One farmer interviewed in Vieux Cayes had lived in the Dominican Republic for 26 years before returning to his childhood home. While in the DR, he learned to build rock lines in order to prevent hillside soil erosion. Having observed the superior agricultural production there, he decided to try them out at home in Haiti. "*Me dió la idea*. *Allá no está como aquí*. It gave me an idea. Over there is not like here."

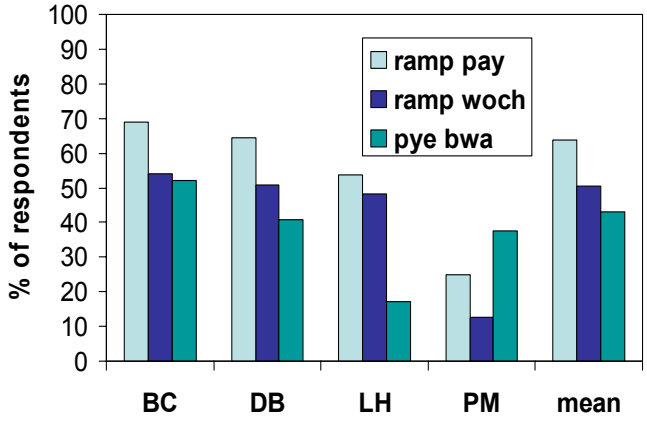
Because rock walls are often a secondary project built in conjunction with the clearing of a field, many are built quickly and somewhat haphazardly. As a result, like residue bunds, they often collapse under the force of run-off, particularly if they are built at the bottom of a steep, deforested slope. Farmers rarely have the time or energy to build a solid wall, particularly if they do not own the field they are farming. During a focus group with a farmers' group in Petit-Montaille, several farmers stated that that while they were aware of the importance of building *ramp woch*, they lacked the technical knowledge to build a lasting barrier. More importantly, they felt that they wouldn't be able to take time away from their fields to build them.

Since the velocity and force of runoff is greatest in gullies and ravines, rock bunds or "gully plugs" (*sey*) need to be particularly strong. These can be built by stacking gabions (large rocks reinforced with chain link or hardware fabric) or with cement. Regardless of the fact that gully runoff can affect several different farms, many farmers will not invest the time, energy, or capital in a SWC project that is not on their own land. Gullies on public land are even less likely to be reclaimed, unless under the auspices of a public works project in which farmers are hired as laborers by the government or an NGO.

Gully plugs, Boucan Carre

Gully plugs, Grande-Savane

Figure 9: SWC techniques employed



7.3. Agroforestry

The vast majority of farmers are aware of the important role trees and other woody perennials play in conserving soil and water; as described in section 5.3, trees are an integral part of the farming systems of the Central Plateau. On average, 43% of farmers in the survey have planted trees in their fields (Figure 9). Farmers usually plant fruit trees in the *jaden lakou* to guard them from livestock during the sapling stage and to later prevent theft of fruit. Previous studies in Haiti report that more mature trees are found on land with secure tenure (either ownership or divided inheritance)[24]. Since fruit and wood trees take several years to mature, farmers generally plant trees on land that they are sure to have access to in the future. On undivided plots (inherited land shared by several farmers), tree planting may be a way to claim ownership over a particular portion[25].

Most fields or gardens, particularly in those adjacent or near the house (*jadèn lakou*) are delineated and protected from roaming livestock using live fences (*kloti pit*). Farmers plant spiny cactus species such as *kandelab* (pencil cactus, *Euphorbia tirucalli*) or *pit* (*Yucca* spp.) closely alongside each other. Plants with unpalatable or caustic foliage such as *brizyet* are also used. While the establishment of these fences is labor intensive, it is a sustainable practice requiring little to no capital investment. On rare occasions, farmers with disposable income may invest in barbed wire attached to *pike* (stakes) of dead wood or to a live fencepost such as *gomye* (*Dacryodes excelsa*) or the fruit-bearing *wob* (jocote, *Spondia mombin*) to prevent livestock from entering the field before the living species of cactus are fully established.

7.4. Intercropping

The intercropping of grain crops with leguminous species such as field pea or cowpea, or with tubers such as yam, manioc, or taro is a traditional and effective means of managing fertility and guaranteeing a modicum of food security. In Haiti, where yields are primarily a function of rainfall due the degraded state of soils, a diversity of food crops ensures an alternative food supply if the primary cereal crop fails due to drought. Similarly, If one crops fails due to disease, the farmer and his household is buffered from starvation by the harvest of another crop that may not be the host for the same disease. The intercropping of a late-maturing crop will provide a household with food after stocks of the earlier crop have diminished. Essentially, intercropping is another example of the risk minimization characteristic of Haitian agriculture (and peasant agriculture worldwide).

Intercropping also helps to stabilize an agroecosystem by filling spatial niches. The presence of a different plant species in a field acts as a biological barrier, interfering with the spread of host-specific disease and insect pests. Additionally, the varied canopy heights and plant architecture provide helps to attract beneficial

Yam and corn, Fond Boisdhomme

Corn, sorghum, and cowpea, Bois Joli

[24] Bannister and Nair 2003
[25] Smucker et al 2000

insects that prey on pests. A monoculture (one crop) quickly exhausts soil nutrients, whereas a polyculture of species with varying rooting depths and nutritional requirements use soil nutrient resources more efficiently. Leguminous species, in particular, improve soil fertility by fixing atmospheric nitrogen into the soil. Most of the bean species common in the Central Plateau are N-fixing. Cowpea (*pwa enkoni, Vigna unguiculata*), in particular, is an excellent fertility source.

7.5. Pest control

Insecticide use is limited due to poor access and high cost. Indeed, pesticide and fungicide use nationwide in Haiti has been minimal and remained relatively stagnant over the last decade (7 metric tons or bactericides/fungicides and 7 tons of insecticides in 2000[26]). A couple of farmers interviewed revealed that they inoculated their millet seed with the powder from ground up spent batteries to prevent pests from consuming seeds prior to germination. While this may be an effective practice, it is possible that both plant and human health could be adversely affected by this potentially toxic substance.

8. Enhancing sustainability through regenerative agriculture

8.1. The regenerative agriculture model

It is important to recognize that there is no panacea to alleviate food insecurity in the Central Plateau. As elsewhere in the developing world, much of food crisis in Haiti can be associated with global and national economic policies. Sustainable agriculture—unlike the current industrial model of production-centered specialization—is a paradigm incorporating the ecological, economic, and social aspects of agriculture. An agriculture that neglects or exploits one of these aspects can never be truly sustainable. A "sustainable" farming system, or one that aspires to sustainability, relies on ecological and economic diversity to buffer the "farmscape" and "foodshed" from economic and environmental instability.

While there is no "silver bullet" approach to make agriculture sustainable or more productive, there are practices appropriate to the locale that can help strengthen this buffering capacity. When these low-input technologies are practiced simultaneously as parts of a system, they work synergistically, resulting in production that is often equal to or greater than that of an input-intensive industrialized farming system. The difference is that a regenerative system constantly replenishes itself whereas an industrialized approach depends on capital-intensive inputs to maintain production. The latter approach—unfortunately, the model often imposed on developing countries despite economic and ecological dissimilarities—ultimately depletes natural resources, proving ecologically unsustainable.

Regenerative agriculture, a proven means of increasing production on intensively cropped, exhausted soils, "relies on soil biotic processes to increase nutrient use efficiency and increase agro-ecosystem outputs"[27]. By maximizing returns of organic matter (OM) to the soil and ensuring moisture conservation, farmers can improve the physical structure of the soil, protecting it against erosion, and steward soil microbial populations responsible for transforming organic nutrients into plant available forms.

The underlying tenet of the regenerative agricultural development model as summarized by The Rodale Institute is this:

> The soil biological community of degraded soils must be rehabilitated and subsequently maintained through investments of organic matter and soil moisture conservation. Simply put, every management step is focused primarily upon improving the soil ecosystem in favor of moisture and nutrient retention and availability[28].

[26] FAOSTAT
[27] The Rodale Institute 1989
[28] ibid

The emphasis on long-term soil rehabilitation is a difficult idea to promote in Haiti, where farmers are concerned with maximizing the short-term benefits of their cropping system in order to guarantee basic food security. Nevertheless, the widespread use of traditional SWC techniques described in section 7 illustrates their understanding of the importance of investing in soil rehabilitation. The most readily adopted agroforestry or soil conservation techniques are those that incorporate these local practices (*ramp pay, ramp woch,* residue mulch). Government and NGOs can be most effective by investing heavily in this grassroots participatory approach, relying on farmer knowledge and input. Only by incorporating farmers into the decision-making process can we hope for these solutions to be durable. As agroforestry and SWC techniques are passed along from trainers to peasants groups and farmers, tested on-farm, and integrated into farming systems, rural farmers will gain a sense of proprietorship over the technologies, ensuring at least a minimum standard of resource conservation in the Central Plateau.

8.2. Additional technologies and practices

In addition to promoting and improving the traditional techniques already in use (described in section 7), there are some additional practices or variations that contribute to the success of the regenerative approach:

8.2.1. Contour hedgerows

One of the most widely promoted SWC techniques used by development projects in Haiti and elsewhere in tropical hillside agriculture worldwide is alley cropping with contour hedgerows of leguminous nitrogen-fixing shrub species such as *Leucaena leucocephala* and *Gliricidia sepium*. Unlike the traditional live fence that is built to delineate and protect fields, hedgerows follow the contour on a slope, and are spaced according to the gradient (Table 8). Shrubs are periodically coppiced and prunings are scattered as mulch on the soil surface between the hedgerows (alley cropping). The mulch layer improves infiltration and soil water holding capacity, thereby reducing erosion and maintaining soil moisture during dry periods. Organic nutrients are slowly mineralized for uptake by crops.

Table 8: Recommended spacing between hedgerows[29]

Slope **(%)**	Distance **(m)**
5 – 10	20 – 17
10 – 15	17 – 13
15 – 25	13 – 8
25 – 35	8 – 6
35 – 50	6 – 4
> 50	4 – 2

The wide range of agroecological conditions—due to changes in elevations and resulting differences in temperature and rainfall—make it difficult to generalize on the success of a particular species. Recent scientific research has evaluated the germination, seed size, and establishment of several species of shrub for use in alley cropping in various agroecological zones across Haiti[30] as well the rate of nutrient mineralization at different elevations[31]. Important factors to consider when selecting a species include: palatability and nutritive benefit to livestock, drought and pest resistance, facility of propagation and planting, N-fixation capacity, and use as a fuel wood.

Similar to a contour hedgerow is a *band manje*, a crop band. A crop band is a vegetative strip containing perennial crops for human consumption such as pineapple, sugarcane, and plantain. These are a traditional technology but generally are planted in the *jaden lakou* rather than along the contour of a sloped field. Farmers often incorporate *band manje* of crops such as taro (*malanga*) and plantain (*banan*) behind gully plugs, where soil moisture has been retained.

[29] Pellek 1992
[30] see Shannon et al 1997
[31] see Isaac et al 2000, 2003

During a five-year project, about 1.4 million meters of hedgerows were established throughout Haiti, estimated to have saved 350,000 metric tons of soil[32]. An assessment of a later agroforestry project run by the PADF concluded that hedgerows were the most widely adopted technology[33]. Farmers were more likely to plant hedgerows on plots that they sharecropped, rented, or were part of an undivided inheritance, ie, a plot shared with relatives, and that they deemed less fertile. These plots were generally on steeper slopes and farther from the farmer's house. Crop bands, gully plugs, tree planting, and tree grafting, on the other hand, were more common on land with secure tenure (ownership or divided inheritance). Since hedgerows are relatively easy to plant but have no immediate tangible impact aside from providing fodder, many farmers may plant them on land they deem as less fertile, or in fields with less secure tenure. This is perhaps a form of risk minimization (to avoid taking up space on fertile land with an inedible plant) or a means of establishing usufruct right of ownership of an insecure plot.

8.2.2. Cover cropping with legumes

Intercropping is practiced by nearly all farmers in the Central Plateau, as described in section 7.4. However, by promoting more intense cropping of leguminous crop and fodder species such as cowpea (*Vigna unguiculata*), pigeonpea (*Cajanus cajan*), velvetbean (*Macuna utilis*), and lablab (*Dolichos lablab*), farmers can improve soil fertility and increase vegetative biomass production that can be used as fodder, mulch, or incorporated as green manure. The benefits of these N-fixing plants are well documented, and in many cases can provide a following crop with as much nitrogen as would an application of synthetic fertilizer. Unlike a synthetic, however, the nutrients in the biomass are slowly released over the duration of the growing season as they decompose, coinciding with uptake by the crop. Additionally, the organic acids exuded by from the roots of the living legume or by the decomposing legume biomass following incorporation into the soil help to low soil pH in the rhizosphere (root zone), freeing up phosphorus (P) bound by calcium in the soil solution. Similarly, the mineralization of organic N releases hydrogen ions that lower the soil pH and can free bound P.

Legumes can be sown under a cereal crop (as is the traditional practice) in order to smother weeds, lower soil temperature, and conserve moisture. Another alternative would be to rotate small plots of legumes with small plots of cereals. This would help to maximize N-fixation and soil fertility improvement, and break weed, pest, and pathogen cycles.

In fallow plots, legumes inter-seeded with a grass species can provide nutritious fodder for livestock while improving enhancing soil fertility. The legume can fix atmospheric N. In addition, since a grass has roots that grow deeper than those of a legume and most crops, it can draw up nutrients from deeper in the soil, incorporating them into their vegetative growth. When the legume/grass cover crop is cut, the nutrients in the biomass remain on the surface and are slowly released for uptake by the following crop.

8.2.3. Pest control

As mentioned, in the previous section, crop rotation can disrupt the life cycles of host-specific pests and soil-borne plant pathogens. If a farmer sees major incidence of foliar disease, he should consider planting an entirely different crop in the same plot the following season. The pathogen thereby loses its host. The same principle is applicable to insect pests and some weeds.

Natural pesticides, such as those made from neem (*Azadirachta indica*) leaves and seeds, or garlic and hot pepper have proven effective as a means of insect pest control in many tropical production systems. These natural pesticides are easy to make, effective, and require little to no capital. Neem trees are common in the Central Plateau, but most farmers are unaware of its benefits. In fact, many are wary of planting neem because they claim it "dries up the soil."

[32] Pellek, 1992
[33] Bannister and Nair 2003; Smucker et al 2000

8.2.4. Integration of livestock and crops

Animal manure is perhaps the greatest untapped resource in the farming systems of the Central Plateau. Because livestock remained tethered in different locations every day or roam freely, farmers have no means of collecting sizable quantities of manure. Manure nutrients and humic matter are lost. By corralling animals at night in a stable, corral, or park (*pak*), farmers can both feed the animal nutritious fodder (such as that grown in a contour hedgerow) and collect all of the manure produced during the night. Manure should be collected daily, in order to keep the corral clean and reduce the risk for parasites. Care should also be taken that fodder does not touch the ground where it could become infected with parasites. During the day, animals should be tethered according to local practice.

Once manure is removed, it should be placed in a compost pile or pit where it should be turned regularly until it matures, or cools down. The composting process stabilizes remaining carbon in the form of humic matter that can be added to the soil to improve soil aggregate stability, porosity, and water holding capacity. It is rich in nutrients, particularly in N and P, and can serve as a fertilizer. Compost, rich in microbial flora and fauna, helps inoculate the soil with beneficial microbes that can out-compete pathogens for resources. Additionally, the composting process is an effective medium for adding P to the soil. Organic acids in the compost help to release P in natural fertilizers such as rock phosphate or bat guano.

Corralling also opens up the possibility of biogas production. A biogas digester—a small cement trough covered with a plastic membrane—is inexpensive to build and can provide households with methane for cooking. The manure collected from two cows twice daily during milking creates enough methane to meet a household's daily fuel needs. Using biogas could also reduce dependence on charcoal.

Pisciculture (fish farming) and apiculture (bee-keeping) are other important forms of livestock husbandry that should be explored. Fish are a excellent source of protein, and fish waste is an excellent feedstock for compost. Fish can also be dried and stored for a long time, buffering household food supplies and facilitating marketing in the capital. Bees are vital components of any sustainable farming system, as they pollinate vegetable and tree crops. Honey, which is non-perishable if properly jarred, has tremendous market potential as a value-added product.

8.2.5. Water catchment technologies

The lack of water is a major constraint to production in the Central Plateau, and many farmers asked what could be done to bring water to their fields. It would be impossible to furnish water to all the fields in the Central Plateau. The approach to water management should be two-fold: first, the adoption or enhancement of existing regenerative techniques that maximize OM applications should me promoted. These techniques help to maintain soil moisture. Second, the possibility of small-scale water catchment should be examined on both a farm and village level. In the *jaden lakou*, the cropping area immediately surrounding the house, water can be harvested from household roves for collection in a cement cistern. Windmill technology is also possible, although on a farm scale, the cost of drilling would be prohibitive.

On the village scale, irrigation is more of a possibility. Several village organizations expressed interest in procuring a solar pump for a village garden. This would be possible in the many villages that lie alongside rivers. During a focus group in Cange, a few farmers raised the possibility of building several large-scale catchment basins on mountain slopes that would feed into cisterns.

In is also possible to cap springs, but this is riskier; any error in capping the spring could permanently destroy the village's only water source. Flow must be determined carefully, to make sure that household consumption needs are met before irrigation consumption. Irrigation schemes should be viewed as public works projects, and should not be undertaken without carefully strategizing a management plan ensuring fair and equal access to water and responsible water use.

8.2.6. Post-harvest transformation and "value-added" production

Transforming produce into another form is a common mean of adding value to an agricultural product. Products such as juice and juice concentrates, jams and preserves, dried fruits or vegetables, cheese, milk, and yogurt, and bread are all examples of post-harvest transformation. Since women are usually the ones involved in transformation, a development program integrating post-harvest value-added products would benefit women considerably, providing them with the technical knowledge and management skills necessary to succeed in a small business.

During a focus group with ASEDECC's women's sub-committee, members were very vocal about their desire to improve their business skills. They were excited about the possibility of learning transformation techniques and the potential to organize a women's cooperative that could grant them access to start-up capital for an incubator kitchen (a shared kitchen used for value-added post-harvest transformation), as well as access to Port-au-Prince or export markets.

8.2.7. Cooperative fruit and coffee production

Because of the small size on land holdings in the Central Plateau, individual farmers are unlikely to move beyond subsistence levels of production unless production is diversified. Since one of the goals of development is to make farming both an ecologically sustainable and economically profitable venture, then production needs to increase to become an economy of scale. By organizing as small cooperatives of fifteen to thirty farmers, farmers would be able to produce sufficient amounts to tap into export markets. Cooperatives larger than thirty farmers risk losing transparency and consensus. By using regenerative methods, farmers could also access the organic market, which offers a premium that is often double to triple that of conventional produce.

There are a number of possibilities for cooperative production for the export market in the Central Plateau: crops, fruit, honey, fish, milk, etc. Fruit trees—mangoes, in particular—are enormously popular and several farmers expressed their interest in learning how to propagate, plant, and graft fruit trees. Another exciting possibility is shade grown coffee. Altitude in the Central Plateau is sufficient for Arabica coffee, which s still grown occasionally, particularly in Petit-Montaille. Conventional coffee—a chemical-intensive monoculture—is not an environmentally or economically viable option for Haitian peasants. Input costs are high and the coffee monoculture would contribute to further erosion. Organic shade-grown coffee, on the other hand, earns two to three times as much as conventional beans, and has been a successful means of empowering cooperatives and regenerating degraded hillsides throughout Central America.

Shade-grown coffee is planted beneath a medium-density tree canopy. In general, farmers are hesitant to reforest hillsides because it may take five to ten years before a tree is mature enough to bear fruit or be cut for wood or charcoal. Plantains and bananas, however, can be planted and will bear fruit in the first year or two. In this same amount of time, they grow tall enough to shade coffee plants, which also produce after the first year. Were farmers to plant plantains and coffee, as well as slower-maturing multi-purpose species, degraded slopes could be protected within a few years. The short-term benefit of coffee and plantain sales would motivate the plantation of a canopy that would contribute to the long-term benefit of the soil. As canopy leaves fall and decompose, they enrich the soil with organic matter and nutrients, serve as moisture-conserving mulch, and stabilize the soil. A diversity of plant species within the canopy attracts beneficial insects, reducing the need for pesticides. By integrating the system with livestock production, a farmer can produce sufficient quantities of compost to fertilize the soil.

Cooperative production allows small-holders to produce on a large scale and access markers and capital for infrastructure. If coffee production reaches profitable levels, a processing plant can be built. There are processing plants throughout Central America that de-hull coffee using sustainable methods: They recycle water, use the coffee berry pulp to produce biogas that operates an electricity-producing generator, and return the dried coffee hulls to farmers for use as livestock bedding. This bedding is ultimately composted and returned to the coffee, closing the nutrient cycle.

8.2.8. Market garden vegetable production

Many of the vegetables purchased in the markets of the Central Plateau come from Port-au-Prince and are of mediocre or poor quality. By creating community vegetable gardens in which individuals lease a small plot, vegetable production can be localized, improving the nutrition security of Central Plateau households. In a community garden, multiple farmers share communal infrastructure (irrigation, tools, fencing, compost) that are prohibitively expensive when purchased by individual farmers.

Vegetable gardening is important for women, especially, as they are the most involved in commerce. The women's subcommittee of ASEDECC requested training workshops in vegetable gardening and help with the infrastructure.

8.2.9. Livestock fattening micro-credit initiative

Many farmers are prevented from improving their farming systems due to a lack of capital. Oftentimes, a small amount of money can provide a farmer with just enough capital to undertake an entirely new activity. Micro-credit is therefore an extremely important aspect of most successful development projects.

In Senegal, the Rodale Institute has been able to provide women farmers with small amounts of capital while simultaneously promoting livestock husbandry and compost production. They give women's group members a young animal (a goat or sheep) as a zero-interest loan. The farmer then fattens the animal for the rest of the year. When they sell the animal, they must reimburse the project for the value of the young animal, but keep the profit, several times more than the value of the loan. The project has had 100% repayment of loans, and women are excited to acquire capital to help them expand other small business endeavors.

The project is integrated with a community gardening project. While the woman is fattening her animal, she also collects the manure and makes compost which can then be used on her garden plot.

8.2.10. Seed and tool banks

As described in sections 6.1 and 6.5, most farmers in the Central Plateau lack the tools and seeds necessary for production. SOPABO in Boucan Carré has expressed their desire for a *bank zouti*, a tool bank. With an initial capital investment, the group would purchase several hundred brand new tools at wholesale prices, then rent them out to farmers for a minimal fee (of 5 *gourdes*, or H$1). Revenue would be used to replace worn out tools. When this idea was shared with other farmers and farmers' groups, they too expressed their interest.

Similarly, a seed bank would provide farmers with an initial "loan" of seeds prior to planting. Following harvest, the farmers would have to repay the seed bank with the same quantity of seed, along with a small additional amount (interest). This would prevent farmers from having to spend money annually on seeds, and would also guarantee a rotating local seed supply that could also be tapped for emergencies.

8.3. Social capital

While natural resources in the Central Plateau are limited, social resources are vast. Widespread participation in work groups is an effective vehicle for agricultural and economic innovation on a village.and regional level. Where social structures such as kinship groups, traditional labor groups, or *gwoupman peyizan* are in place, farmers are often more likely to adopt new techniques on land with short-term access (sharecropping or leased land). This social aspect of agricultural development is often underemphasized. Indeed, some of the more successful agricultural extension programs in Haiti have been based on participation of peasants' organizations[34]. By reinforcing these group structures through capacity-building trainings focusing on management, micro-credit, and monitoring and evaluation,

[34] Zimmerman 1986; Smith 2001

agricultural development becomes a participatory endeavor, one which farmers themselves will feel confident and competent to lead and continue.

Farmers' groups are numerous in the Central Plateau (Table 9), many of which have already completed several development projects already. Many of these groups, however, are dormant, lacking access to capital to undertake new projects.

Table 9: Some farmer groups in the survey area expressing interest in trainings and support

Acronym	Name	Location	Contact
SOPABO	Solidarite Peyzan Boukan Kare	Boucan Carré	Benicé Derat
ASEDECC	Association de soutien à l'education et au développement de la communauté.de Cange	Cange	Lénéus Joseph
ODUL	Oganizasyon pou developman inivèsel an Lawoy	Vieux Cayes	Luc Potot
COVIM		Ti Peligre	Vincent Fontelus
ACADET	Assoc. Communautaire du Développement et l'Evangelisation de Thomonde	Mogé	Maurin Caneste
Bonbeje		Cobrat	Edouard Jean
AFPM	Asosyason Fanm Petit-Montay	Bouly	
OPP	Oganizasyon Peyzan Petit-Montay	Petit-Montaille	
ODIT	Oganizasyon pou developman inivèsel an Tyera Muskadi	Tierra Muscady	Michel Claussaint/ Smith Jianouis

8.4. Closing the system to minimize resource loss and increase revenue

Currently, agriculture in the Central Plateau is a "leaky" system, characterized by a number of resource losses: ecological, social, and economic (Figure 11). On-farm nutrient and organic matter resources are permanently lost to erosion, charcoal production, and residue burning. Livestock manure nutrients and OM are lost elsewhere in the community, and are not returned to the farmer's fields in any significant manner. Labor and social capital is lost to out-migration, which may sporadically return to the farm in the form of monetary income. Charcoal production is the primary source of revenue, followed by livestock and crop sales to local and regional markets. Food and fodder production is low. Off-farm food is the major expense. All in all, few resources remain on the farm itself.

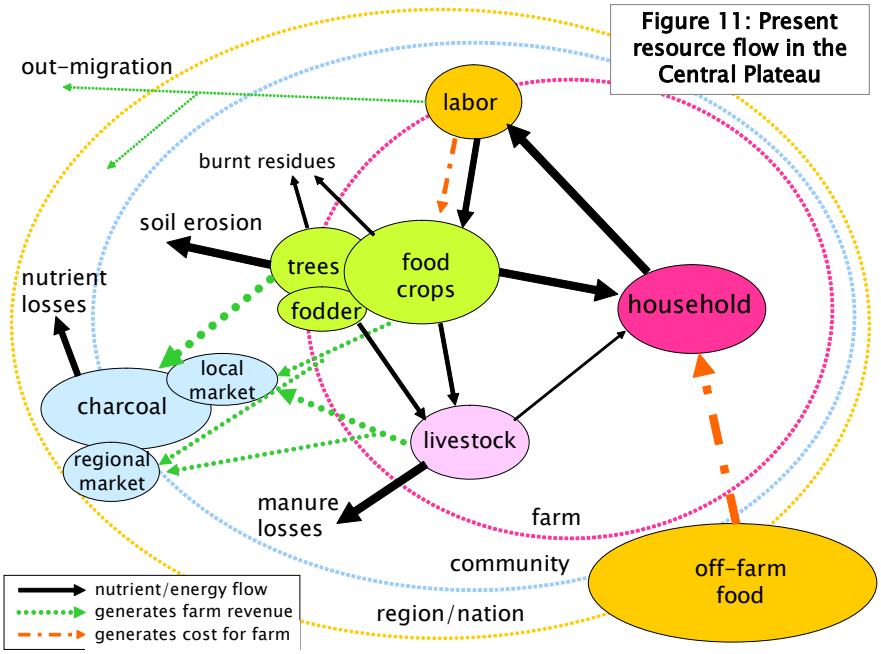


Figure 11: Present resource flow in the Central Plateau

By integrating regenerative techniques with the establishment of a production cooperative, food, fodder, and livestock production increases, followed by revenue increases due to improved in yield and access to an export market (Figure 12}. Increased food production also reduces the need to import off-farm food. The increase in revenue reduces the farmer's need to produce charcoal, which, along with trees and hedgerows, reduces erosion losses. By corralling livestock at night and composting the manure, the farmer can return nutrients to his fields. Similarly, he can convert manure to biogas for cooking, again reducing his dependence on charcoal. Labor expenses for the farmer may rise, but these costs should be offset by increased revenue. The household does not lose labor to out-migration, since work may be available with the cooperative. Agrotourism provides an additional source of income. This system—modeled after an organic shade-grown farm and cooperative community in Costa Rica—valorizes social capital and regenerative techniques. As a result, resources remain on the farm and in the community. Agriculture becomes viable and productive, and a step closer towards ecological, social, and economic sustainability.

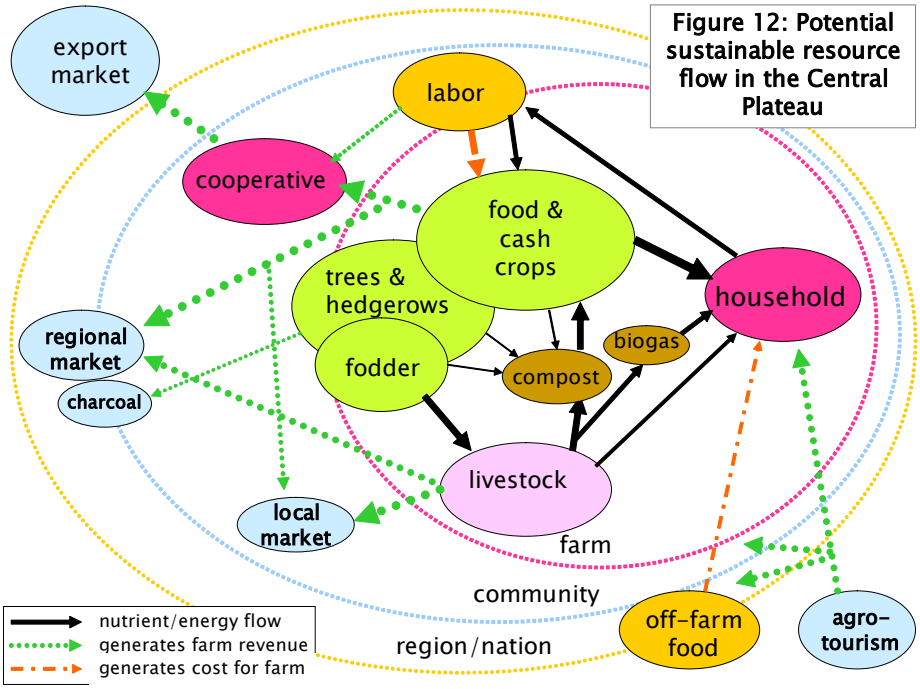


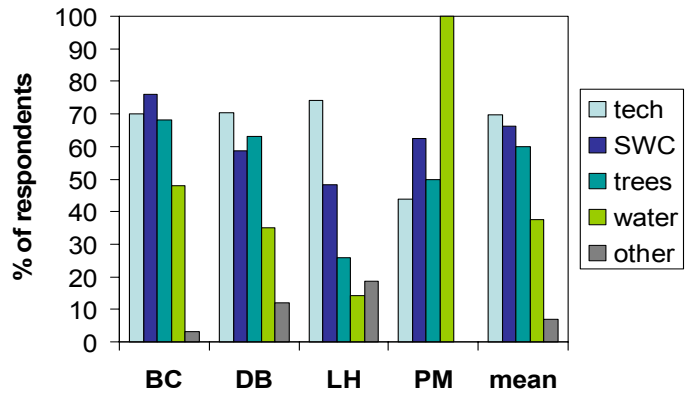
Figure 12: Potential sustainable resource flow in the Central Plateau

8.5. Education and Training

Promoting regenerative agricultural techniques in the Central Plateau will rely first and foremost on the development of an extensive network of agricultural education and training opportunities for farmers, extension agents, and students. Most farmers surveyed lamented their lack of "*teknik*" or technical knowledge and eagerly expressed their interest in receiving basic agricultural training.

Roughly 70% of farmers expressed interest in training workshops (*fòmasyon*) in basic techniques, such as how to cultivate, what crops to plant, and how to increase the productivity of their farms (Figure 13). More specifically, 66% expressed interest in improved SWC techniques—how to build durable gully plugs, contour bunds, and vegetative strips. Sixty percent expressed interest in tree planting training workshops, although fewer expressed interest in La Hoye (25%). Farmers in Petit-Montaille unanimously expressed interest in learning water catchment techniques. Nearly half of Boucan Carré farmers were interested in learning about water catchment. In the village of Grand-Savane in Des Bayes, on a plateau above Cange, farmers unanimously voiced their need for training in water management.

Figure 13: Farmers' training preferences



Other topics of interest included: fruit tree propagation and grafting, live fencing, pest control, and fertilizer use. Several farmers also voiced the need for basic organizational help, recognizing the importance of developing farmer groups.

9. Two strategies for education and intervention

9.1. Development of an agricultural education, training, and extension program

A technical training and extension program is necessary at the grassroots level in order to promote the regenerative agriculture techniques described above. While much of Haiti's natural resource degradation is symptomatic of the nation's inability to extricate itself from a paralyzing debt burden and the repercussions of neo-liberal economic policy, *in situ* regenerative agriculture can at least help to alleviate some of this pressure, and guarantee basic food and livelihood security.

To facilitate the extension and adoption of these techniques in the field, the program should work with farmers' organizations already in place in the region. These include *gwoupman peyizan*, women's groups, and work groups such as *gwoupman travay met tet ansanm*, *konbit*, *konsey*, or *kòve.*

One or two groups should be targeted for participation in the pilot project. Given their high level of organization and participation in the study, SOPABO (*Solidarite Peyizan Boukan Kare*), the farmer group from Boucan Carré, should be included in the pilot program. They are already operating a tree nursery (*pepinyè*) that produces fruit tree and agroforestry species, and have installed several gully plus in Boucan Carré. The program at Fondwa (above Pétionville) is a successful model of agricultural extension, relying on Cuban trainers familiar with sustainable agriculture in tropical agroecosystems.

Participatory planning

Participatory meetings with group members are necessary to collectively determine agricultural constraints and prioritize zones and methods of intervention.

Experimentation

An experimental plot (~1 ha) is to be created at Corporan, near Domond, on the Haiti Hort farm in order to determine varieties and techniques appropriate and adaptable to the agroecology of the Central Plateau. The site is anticipated to become a training farm. In conjunction with these trials, on-farm experiments should be set up with participating farmers in order to promote the adoption of regenerative techniques and their integration into the local farming system.

The World Vision experimental farm (Centre de Demonstration de Techniques Agricoles Ameliorées) at Fond Pierre, near Casse, is an excellent example of what an experimental training farm can become. They are experimenting with leguminous cover crops, mulching, composting, and variety selection. Once

they select a successful variety, they distribute seeds or transplants to farmers. These farmers must then distribute seeds or transplants of the ameliorated variety to their neighbors following harvest.

Training sequence

1. Training of two or three technicians from each group by a contracted trainer. Emphasis should be placed on SWC.

2. Training of the 2nd tier of trainers (field or village agents). This training will be conducted by the group technicians, with the support and guidance of the contracted trainer.

3. Village-level training of farmers by the village agent. In the first year, emphasis should be placed on SWC and agroforestry. It is important to begin slowly, to avoid overwhelming farmers with too much information. Each following year, two new techniques should be added.

Technical support

With the assistance of the technicians, the village agents will help model farmers establish on-farm experimental plots. Materials (seeds, transplants, tools) will be available at the group level.

Monitoring and evaluation

Field agents will visit the plots of the model farmers on a bi-weekly basis to monitor the progress of the project and assess the level of adoption/adaptation by the model farmer. The group technicians will help them collect yield data, which they will analyze with the help of an agronomist. An agronomist should also evaluate the results of experimental plots at Corporan.

Integration of micro-credit programs

As previously discussed, agricultural extension and the successful expansion of the regenerative model is dependant on successful integration of micro-credit opportunities. If a farmer has some short-term gain, he or she is more likely to place emphasis on this technology. It is therefore essential to pair short-term approaches with longer-term investments such as SWC. Again, Fondwa can serve s an effective model.

9.2. Construction of an agricultural vocational school

As part of their Lavi Nouvo campaign, ZLP formalized an agreement with ASEDECC and Collège Mixte La Pléiade in August 2004 to support the construction of a agricultural and vocational school. Currently, La Pleiade has both a primary and secondary school. There are 7 teachers in the primary school, teaching 230 children. The secondary school has an enrollment of 125 students and a teaching staff of 11. To ensure food and nutrition security for the students, ZLP helped to build a kitchen and continues to fund a lunch program for the students.

In addition to providing academic instruction, the school's goal is to provide students in the Central Plateau with the necessary skills to succeed in agriculture or in a vocation such as carpentry, masonry, electricity, or plumbing. By providing youth with a solid educational foundation in business skills (marketing, management, cooperatives) as well as agroecological principles and practices, they will be well prepared to steward the area's agriculture in an ecologically, socially, and economically sustainable fashion. The school director, ZLP, and architectural and agronomic consultants have begun the planning and design of the school. A water catchment reservoir has been dug and construction of an access road onto the 4 ha property will soon be underway.

Technical training should be centered on the principles of regenerative agriculture, not necessarily a totally organic production system, but one that attempts to minimize off-farm inputs and that fosters beneficial ecological relationships within the system. Maximizing nutrient cycling, soil and water conservation, and organic matter management should be a priority. A curriculum should include:

Soil and water conservation (SWC)
- Contour vegetative strips and rock walls
- Ravine stabilization
- Organic matter management (mulching and cover cropping)
- Rainwater catchment
- Drip irrigation

Agroforestry principles and practice
- Propagation of agroforestry and fruit tree species (for market, fodder, and SWC)
- Woodlot silviculture for charcoal and construction wood

Livestock husbandry
- Basic veterinary care and animal nutrition
- Integrating livestock and tree/crop production

Soil fertility management
- Organic matter cycling and management
- Compost production and use
- Cover cropping for N-fixation and biomass production
- Crop rotations

Regenerative agronomic practices
- Contour tillage
- Improved crop varieties (drought & pest-resistant)
- Natural pesticide production and use
- Weed management
- Integrated Pest Management

Post-harvest
- Seed saving
- Post-harvest stocking and conservation

To address the curriculum needs of the school and to make it as self-sufficient as possible, the following infrastructure is recommended:

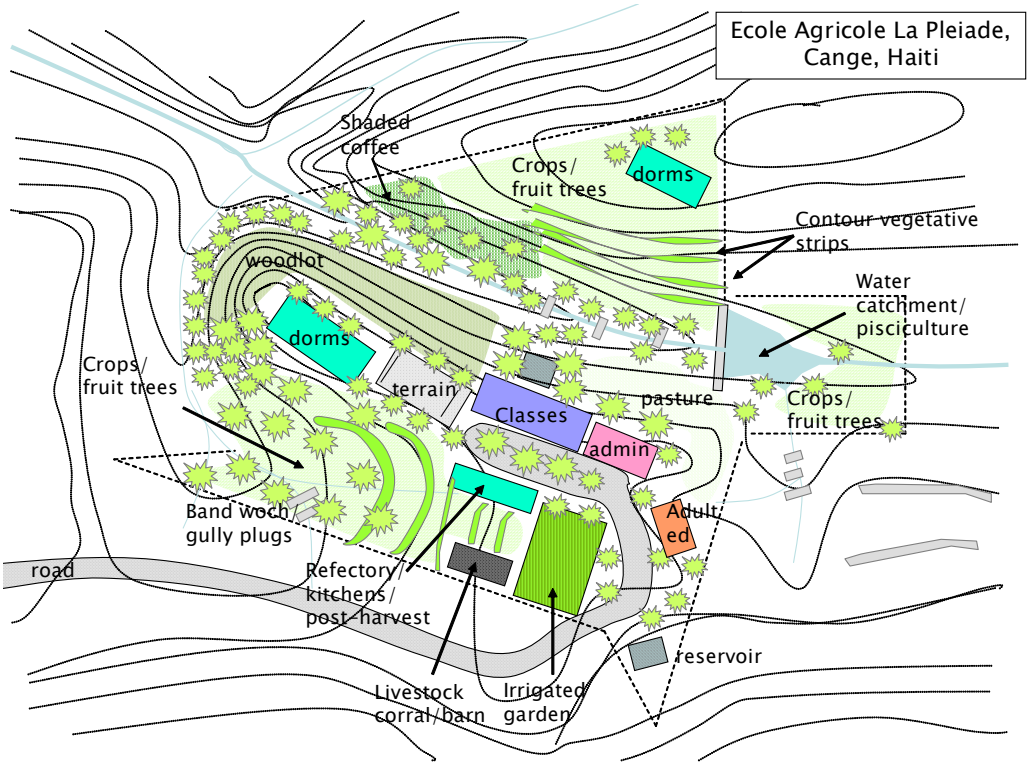
Post-harvest transformation/incubator kitchen.
Located adjacent to garden and primary crop production area, perhaps integrated with school cafeteria kitchen. An area for post-harvest transformation of goods, eg, jam-making, fruit drying, milk drying, cheese and yogurt making, canning or bottling, syrup and juice making.

A livestock corral/barn complex.
A nighttime "park" or corral for livestock. This would allow improved monitoring of nutrition and veterinary care for livestock, as well as a means of concentrating manure production. Compost pits or piles and a vermicomposting bin should be constructed adjacent to the facility. The complex should be located in close proximity to the garden and primary field crop production to minimize labor expenditure of manure application. Chickens could be kept in "chicken tractors", mobile coops that are moved every few days to provide chickens with new fodder. Chicken tractors can be incorporated into crop rotations in both the field and garden areas, contributing to fertilization and pest control.

Water catchment/Fish farming
All buildings should be equipped with gutters and cisterns for rainwater catchment. Two water catchment reservoirs are currently planned. A small dam or micro-barrage at the base of the ravine would allow for some water catchment, or a *lac culinaire*. Capturing enough water to maintain a year-round supply would be contingent on clay content of the soil, and the construction of a high enough dam. As evaporation losses in the tropics are high, it may be more feasible to plan a rainy-season pond or a series of seasonal pisciculture tanks.

Experimental garden
An experimental and educational vegetable garden would provide food for the students and revenue for the school, and could be irrigated by a gravity-fed drip irrigation system from the upper reservoir.

In order to both educate students and maximize stability and long-term productivity of the school farm, the regenerative practices detailed earlier in this report should be incorporated on the agricultural land surrounding the school facilities.



10. Summary and conclusions

Farmers in the Central Plateau are faced with a number of constraints limiting agricultural production, including erosion, drought, pests, declining soil fertility, flooding, cheap imported grain that undercuts fair market prices, poor infrastructure, lack of training and extension, small land holdings, insecure tenure, geographic, socioeconomic, and political isolation, deforestation, and political violence; in the words of a Boucan Carré farmer, "*Nou travay di pou nou kapab viv*. We work hard so that we can live."

Haitian farmers have developed a range of techniques to address these constraints—rock walls, residue bunds, intercropping, work groups, etc. It is vital that an agricultural development program build on these already-existing technologies to assure widespread adoption of the improved technique. While the implementation of regenerative agriculture techniques may not resolve all food insecurity in the Central Plateau, it will help stabilize the ecological constraints that currently limit food production. Soil and water conservation should be a priority. However, this must be promoted in conjunction with short-term approaches, that create revenue within the first year or two, otherwise farmers will likely abandon the SWC techniques after seeing a couple of years with no immediate results.

Additionally, any agricultural development project should also integrate organizational capacity-building, providing financial and management skills. Micro-credit financing of small projects allows farmers, women in particular, to invest capital in a revenue-earning project of their own. Micro-credit schemes are often good ways to compliment long-term results with short-term revenue.

By organizing into small production and marketing cooperatives, farmers also stand to increase production and revenues. Cooperatives would allow Central Plateau farmers to produce in economies of scale, opening up export markets. Organic production in particular, would lead to land stewardship using regenerative techniques and receive premium prices on the export market.

Education is central to any development program. Farmers in this survey overwhelmingly expressed their desire for technical training and education. Training must be extended to an extension program, however, in which local farmers become technicians who support participating farmers with on-farm trials. Without continued monitoring and evaluation, adoption rates of improved techniques drop following the end of funding.

The state of food security and agriculture in the Central Plateau is dire, but not unlike that of poor rural farmers throughout the less-industrialized world. While the underlying forces affecting production largely lie on a macro-economic level, the promotion of regenerative agriculture paired with grassroots economic capacity-building can help buffer farmers in the Central Plateau against the environmental and economic flux that so deeply destabilizes food security. Success, even on a local or regional scale, can help prove that there is indeed value and opportunity for a sustainable livelihood in agriculture.

After thanking the survey team for coming, a villager in Bouly concluded a focus group discussion with the following comment that illustrates the spirit of resilience of the rural Haitian poor, and should be used as a rallying call for those in the industrial North seeking to help:

"*Genyen yon sel lot bagay. Pa dekouraje, toujou panse nou*… There's one last thing. Don't give up. Think of us always..."

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12. Sommaire

Les agriculteurs du Plateau Central sont confrontés à diverses contraintes qui limitent leur production agricole, dont l'érosion, la sécheresse, les attaques d'insectes, une abaissement de la fertilité du sol, les innondations pluviales, la chûte des prix`a cause de l'importation des produits alimentaires, le manque d'infrastructure, le manque d'éducation et de formation, la petite taille des terrains, le système foncier incertain, l'isolation géographique, socioéconomique et politique, le déboisement et la violence politique. Selon un fermier de Boucan Carré, «*Nou travay di pou nou kapab viv.* Nous travaillons dûr pour vivre.»

Les agriculteurs haïtiens ont développé une variété de techniques pour s'adapter à ces contraintes, telles les murailles de pierres (« *band woch* »), les barrières d'herbes sèches (« *ramp pay* »), l'association de cultures, les groupements de travail, etc. Il est essentiel d'en faire la base d'un programme global de développement agricole porteur de techniques. L'adoption de techniques agricoles régénératrices ne pourra pas résoudre le problème de l'insécurite alimentaire dans le Plateau Centrale, mais il agira sur la stabilisation des contraintes écologiques qui limitent présentement la production. La conservation des eaux et du sol (CES) doit être une priorité. Cependant, on devra l'accompagner inititatives génératrices de revenus à court-terme (dans les premiers deux ans), pour éviter l'abandon des techniques CES par les agriculteurs.

Par la suite, tout projet de développement agricole devra intégrer le renforcement des capacités, d'organisation, de gestion et de financement Le financement micro-crédit des petits projets permet aux cultivateurs—les femmes, en particulier—un investissement en capital générateur de revenus. L'intégration d'une initiative micro-crédit est souvent un bon moyen d'allier la recherche de résultats à long-terme avec celle de revenus à court terme.

En s'organisant en coopératives de production et de commercialisation, les cultivateurs sont plus à même d'augmenter production et revenus. Les coopératives permettraient aux cultivateurs du Plateau Central de produire à grande échelle, en ouvrant des marchés d'exportation. La production biologique, en particulier, dirigerait les cultivateurs vers la gestion régénératrice des terrains, et leur donnerait de meilleurs prix sur le marché extérieur.

L'éducation est le fondement de tout projet de développement. Les fermiers qui ont participé à cette étude ont tous exprimé leur désir de formation et d'enseignement. La formation devra être étendue pour que les fermiers deviennent à leur tour des techniciens qui appuient les autres participants avec des experimentations sur site. A défaut de suivi et d'évaluation continus, les taux d'adoption des techniques améliorées baissent après la fin du projet.

L'état de l'agriculture et dela sécurité alimentaire dans le Plateau Central est grave, mais pas pire que celui de la majorité des agriculteurs pauvres et ruraux travers le monde non-industrialisé. Même si les forces majeures affectant la production agricole se trouvent au niveau macro-économique, la promotion de l'agriculture régéneratrice parallèlement au renforcement des capacités économiques pourront protéger les agriculeurs du Plateau Central contre les changements environnementaux et économiques qui déstabilisent si sévèrement la sécurite alimentaire. Le succès, même au niveau local ou régional, pourrait prouver qu'il y a valeur et opportunité à promouvoir un mode de vie durable dans l'agriculture.

13. Rizime

Pou moun k ap fè agrikilti nan Plato Santral la, genyen yon pakèt bagay k ap limite pwodwi agrikòl tankou tè k ap soti ale, sechrès yo, cheni k ap manje plant yo, gwò lavalas, manje k ap soti lòt peyi k ap bese pri manje pa ayisyen yo, vitamin tè a k ap redwi, yon mank enfrastrikti, yon mank fomasyon ak edikasyon, mosò tè ki twò pitit, ensekirite tè moun, debwazman, ak vyolans k ap soti nan zafè politik. Epi tou gen kote nan Plato Santral la ki nan kanpe lwen, annegad zafè jeyografik, ekonomik, ak politik. Jan yon kiltivatè bò Boukan Kare te konn di, fok *nou travay di pou n kapab viv*.

Kiltivatè ayisyen yo te gentan develope kèk mwayen pou y ta ka konbat movè kondisyon sa yo, tankou ranp woch, ranp zèb, melanj plant, konbit, eksetera. Si yon pwoje developman agrikòl pral fèt, li enpotan ke nou baze-l andann mwayen sa yo ki gentan sou terin an, pou ke tout moun k ap travay tè a ta kapab byen aksepte teknik k ap soti nan developman yo. Menm si nou ta ka mete kèk mwayen pou n pi develope zafè agrikiliti a, nou konnen ke nou pa t ap kapab resoud nèt tout movè kondisyon yo. Men sa developman sa-a ka fè vre se ke li kapab stabilize pwoblèm ekolojik yo k ap limite kiltivitè yo kouyne-a. Sa vle di, fòk se konsevasyon sòl ak dlo k ap pryorize a. Sepandan, nou dwe anvisaje tout mwayen sa yo ansanm avèk kèk demach k ap fè kòb touswit (pandan dè premye ane yo) pou n evite yon sityasyon kote ke patisipan yo pèdi kouraj annegad teknik ki t ap ogmante yo.

Answit, fòk tout pwoje nan developman agrikòl yo ka entegre travay la avèk oganizasyon sou baz la pou moun ka vinn gen plis konpreyansyon nan zafè jesyon ak finansman. Opsyon mikwokrèdi yo pou kèk pitit pwoje ka pemèt ke kiltivatè yo—e sitou fanm yo—ka envèsti kòb nan pwoje pa yo pou kòb la kapab vinn ogmante. Souvan, mikwokrèdi a kapab byen sèvi rezilta k ap dire yo pou stabilize sa yo k ap parèt touswit.

Si kiltivatè yo ap mete tèt ansanm nan gwoupman agrikòl pou pi byen pwodwi ak vann rekòt yo, y'ap kapab ogmante sa yo pral rekolte avèk kòb yo pral jwenn. Gwoupman kòm sa yo ta pemèt ke kiltivatè nan Plato Santral ka antre nan sistèm ekonomik pi gran yo, tankou ekspò ki pral nan lòt peyi. Sitou pwodwiksyon byolojik ta kreye mwayen pou kiltivatè yo kapab pi byen dirije tè pandan y'ap itilize teknik k ap soti nan developman, epi pou yo kapab jwenn pi bon pri pou pwodwi yo kòm ekspò.

Pou nempòt ki pwogram developman kapab reyisi, fòk li konte sou edikasyon. Kiltivatè ki te patisipe nan kesyonè sa-a te vreman esprime lespwa yo pou jwenn plis fomasyon ak edikasyon. Men fomasyon an pa ka nempòt ki fomasyon. Fòk li vinn sou terin an tankou yon pwogram ekstensyon k ap fè kiltivatè nan zòn pa yo vinn teknisyen ki kapab sipote lòt kiltivatè yo avèk eksperimantasyon lokal. Lè fon pou pwoje a vinn desann, si nou pa gen bon jesyon e evalyasyon, moun ap pèdi kouraj epi yo ka vle kite teknik yo.

Li klè ke kondisyon sekirite manje ak agrikilti a nan Plato Santral la pa rete anfòm, menm jan lòt sityasyon nan peyi pòv k ap depan sou sa tè pa yo k ap bay. Tandiske limitasyon pa yo ap rete plis nan nivò gran sistem ekonomik la, developman agrikòl sou terin an ak fomasyon sou baz la ap ba-y fòs pou yo kapab pi byen pwoteje tèt yo kont move chanjman ekolojik ak ekonomik yo k ap destabilize sistèm agrikòl lokal. Yon reyisit ta ede-n montre ke moun nan peyi pòv yo kapab vreman konte sou agrikilti pou-l ba yo mwayen pou viv.

Apre li te finn remesye ekip kesyonè a pou vizit la, yon kiltivatè Bouly te fème yon reyinyon peyizan avèk ti mò sa yo: *Genyen yon sèl lòt bagay*. *Pa dekouraje*. *Toujou panse avè-n*.