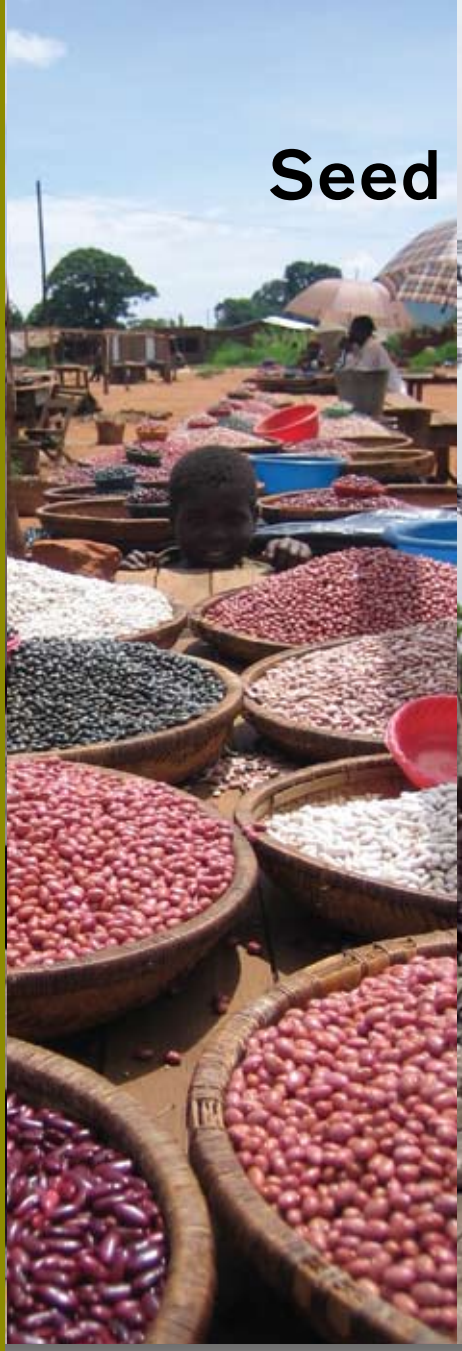
Seed System Security Assessment

HAITI



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Seed System Security Assessment
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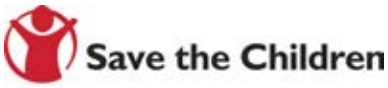

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These are critical times for Haitian farmers. We hope that the positive opportunities for catalyzing seed security (recommended herein) are seized upon soon and with vigor.

Acronyms

AFUP	Association des Femmes Unies de Poulie
AID	Association des Irrigants de Dubreuil
AIW	Association des Irrigants de Welch
BAC	Bureau Agricole Communal
BCMNV	Bean Common Mosaic Virus, necrotic strains
BCMV	Bean Common Mosaic Virus
BGYMV	Bean Golden Yellow Mosaic Virus
BIA	Agricultural Input Boutique (French)
CADI	Cooperative d'agriculture au développement de l'industrie
CECOSAM	Centre de Conditionnement et de Stockage des Semences de Maïs
CIAT	International Center for Tropical Agriculture
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
CIPDSA	Commission intersectorielle de production et distribution des semences améliorées
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (France)
CNSA	Coordination Nationale de la Sécurité Alimentaire
CRDA	Centre de Recherche et de Documentation Agricoles
CRS	Catholic Relief Services
CRSP	Collaborative Research Support Program, USAID
DDA	Direction Départementale Agricole
DDAS	Direction Départementale Agricole Sud
DEFI	Développement Économique des Filières
EMMA	Emergency Market Mapping and Analysis (methodology)
FAC	Fonds d'Aide et de Coopération (France)
FAO	Food and Agriculture Organization of the United Nations
FAMV	Faculté d'Agronomie et de Médecine Vétérinaire de l'Université d'Haïti
FFS	Farmer Field School
FGD	Focus Group Discussion
FLM	Fédération Luthérienne Mondiale
GPAS	Groupements de Production Artisanale de Semences
GRAMIR	Groupe de Recherche et d'Appui au Milieu Rural
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDPs	Internally displaced persons
IICA	Inter-American Institute for Cooperation on Agriculture
IITA	International Institute of Tropical Agriculture

ISTA	International Seed Testing Association
KNFP	Conseil National de Financement Populaire
LABSEM	LABoratoire SEMencier
MARNDR	Ministère de l'Agriculture, des Ressources Naturelles et du Développement Rural
MUSO	Mutuelles de Solidarité
NERICA	New Rice for Africa
NGO	Non-governmental organization
ODN	Organization for Development of the North
ODVA	Organisme pour le Développement de la Vallée de l'Artibonite
ORE	Organization for the Rehabilitation of the Environment
PIA	Programme d'intensification agricole de la Vallée de l'Artibonite (MARNDR / Inter-American Development Bank)
PICV	Projet d'Intensification des Cultures Vivrières
PNSA	Programme National de Sécurité Alimentaire
Project Taiwan	Projet d'Intensification de la Riziculture dans la Région de Torbeck, Plaine des Cayes
RACPABA	Réseau d'associations pour la commercialisation de la production agricole du Bas Artibonite
SEED	SEED Ministries, agricultural technical school, college level
SECID	Southeast Consortium for International Development
SENASA	Service National des Semences Améliorées
SERA	Service de Recherche Agricole (early name of CRDA)
SNS	Service National Semencier (National Seed Service)
SOCODEVI	Société Coopérative pour le Développement International
SOGESEP	Société de Gestion, d'Exécution, de Supervision et d'Évaluation de Programmes de Développement
SSSA	Seed System Security Assessment
SVF	Seed Vouchers and Fairs
UNDP	United Nations Development Programme
UPSA	Unités de production de semences artisanales (Artisanal Seed Production Units)
USAID/OFDA	United States Agency for International Development / Office of Foreign Disaster Assistance
UPR	University of Puerto Rico
WARDA	Africa Rice Center / AfricaRice
WINNER	Watershed Initiative for National Natural Environmental Resources, USAID project
WV	World Vision

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Citation: CIAT, CRS, SNS-MARDNR, UEA, FAO, World Concern, Save the Children, ACDI/VOCA, Save the Children and World Vision, 2010. Seed System Security Assessment, Haiti. A study funded by the United States Agency for International Development, Office of Foreign Disaster Assistance. (USAID/ODFA) August 2010. Arusha, Tanzania: International Center for Tropical Agriculture.

The SSSA team welcomes comments and updates. Contact the assessment coordinator at l.sperling@cgiar.org.

EXECUTIVE SUMMARY

A Seed System Security Assessment (SSSA) was carried out in Haiti in May-June 2010. The work assessed the impact of the 12 January 2010 earthquake on households and agricultural livelihoods, including possible changes in assets, land holdings, labor availability, income generation activities, crop profiles and seed use. The work also analyzed acute seed security issues, monitoring farmers' seed procurement strategies and examining the effects of any aid given. As a third thrust, the SSSA looked at chronic seed security problems, including those related to seed/grain markets, agricultural product transformation and access to modern varieties. Hence the foci included 'very short term', as well as short- and medium-term issues.

Ten sites have been included in the assessment. These are located in the following communes: Bassin Bleu, Chantal, Hinche, Lascahobas, Verrettes, Marigot, Le Petit Goave (plains/hills), Léogâne, Belle Anse and La Vallée de Jacmel. The sites typify Haiti smallholder agricultural regions and allow for insights into the mix of areas in which humanitarian and development aid unfolds. In terms of agro-ecology, the sites range from the better-off irrigated areas of Verrettes, to some of the drought-prone zones of Bassin Bleu, and include a range of mountainous and lowland locales . Furthermore, Léogâne, La Vallée de Jacmel, and Le Petite Goave are located directly in the earthquake epicenter and can be contrasted and compared with the other seven sites scattered across the country.

The SSSA consisted of a total of 983 comprehensive farmer interviews, plus 35 focus group sessions (21 mixed, 15 women only), key informant interviews, and commissioned studies on special topics. Note that an SSSA goes well beyond a conventional seed needs assessment as it homes in on specific seed security problems communities face, and then recommends actions to alleviate specific constraints, and often improve systems. (For more on the SSSA method, see Sperling, 2008, http://webapp.ciat.cgiar.org/africa/pdf/sssa_manual_ciat.pdf.)

Findings are summarized below under three headings: immediate effects of the earthquake; acute problems in the area of seed security; and c) chronic concerns regarding the seed system.

I. Immediate effects of earthquake on households and agriculture

The immediate stress was formidable: Average household size swelled from 6.44 to 8.68 persons and almost half of households (48%) reported steep drops in food consumption, from 2.48 to 1.59 meals/day. However, rural household sizes have begun to normalize (in June, 7.18 overall, a 10.44% increase over the pre-earthquake figure), and other key indicators show that the effects of the earthquake have been minimal or are stabilizing: land area under cultivation has decreased by a mere 3.13% since January 12, and labor available for agriculture by 0.30%, across all households. The major lingering overall agricultural trend has to do with petty rural commerce: managed mostly by women, it has decreased by up to 91% in the cases monitored.

II. Acute seed security

In the season immediately after the earthquake, farmers overall sowed less seed than normal, a drop of 15.9% across crops and regions. This reduction was largely due to financial constraints but also linked to land tenure concerns, routine health problems, and acute stresses such as drought. In fact, the highest seed use drop occurred in drought-stricken areas of the Northwest (declines of 35.9% in Bassin Bleu), rather than areas near the earthquake epicenter (e.g., 13.3% in Léogâne). Seed availability did not emerge as an important cause of declining seed use (only 4% of some 1237 responses).

For the second season post-earthquake, which is staggered by crop and region, farmers plan to increase the amounts they sow (15.3% above normal), across the sites sampled. There is heavy emphasis on re-stimulating the agriculture sector, and especially on creating income-generating opportunities. The epicenter areas are also showing considerable rebound. For example, in Léogâne seed use is projected at only 2.8% below normal. Overall, acute seed security issues are minimal, aside from those associated with the general drop in purchasing power.

Analysis of the seed sources used in two consecutive seasons (representing routine trends) shows that farmers depend heavily on local markets, from which they access about 75% of their seed across crops. Their own stocks provide 15-20% of seed sown, with other potential sources – input shops, farmer seed producers, gifts via family and friends, and seed aid – providing negligible amounts. Immediately after the earthquake, seed aid (including both emergency and development aid) provided about 4% of the total seed sown.

III. Chronic seed system concerns

The large majority of seed security constraints identified are deeply chronic ones. Unlike nearly everywhere else in the world, "eating one's seed" is not a signal of distress in Haiti; it is a normal practice, particularly for crops such as beans. Furthermore, farmers generally cannot access new varieties, an array of other needed inputs, or even regular technical advice. Only 14% of farming households have had access to *any* new variety over the past five years; the February/March 2010 emergency distribution alone provided 53% of these introductions.

There is virtually no dynamism in seed systems across major crops, with few new sources supplying seed to farmers (rice is an exception), and little agricultural transformation. The major area of agricultural innovation is horticultural crops, which are especially important for income generation. Fertilizer use was also higher than expected, with 28% of farmers using some mineral fertilizer this season – a relative gain reflecting the improved availability of inputs, especially due to aid interventions.

Overall, small farmer systems have been static for years and new variety introduction is minimal. Farmers' current heavy reliance on markets for seed raised particular concerns about the economics of routine seed use. The average farmer spends at least $US 60-70 per season, which is a considerable expense for farmers already hovering near the poverty line.

IV. Recommendations

The report makes 44 separate recommendations (see Chapter VII). Overall, it concludes that there are no short-term emergency seed security problems, aside from those important ones linked to household finances**. Right now there should be a move away from the emergency focus in agricultural interventions**. Specific recommendations are made in terms of new varieties (*not* to introduce them under emergency programs) and to ensure review of emergency programs after any three years of continuous implementation.

The bulk of the recommendations focus on short- and medium-term developmental actions. **Significant investment in small farmer-driven variety, seed and agricultural marketing systems is recommended**.

Specific actions are proposed, among them the following:

- Develop decentralized crop variety screening programs, using networks of NGO/university partners and led by MARNDR.
- Create cost-effective decentralized seed production and marketing systems (moving away from institutional clients toward a wider client base of small farmers).
- Catalyze the development of input delivery through outlets where farmers routinely buy goods.
- Test business models for value-added market chains that are low-risk for farmers.
- Develop farmer-oriented market and variety information systems, building especially on two-way mobile communication options.
- Stimulate initiatives that enhance capital creation and agroenterprise development, particularly initiatives targeted on women.

The full report in English is attached. The Executive Summary of this Seed System Security Assessment and the full set of Recommendations are also available in French.

http://www.ciat.cgiar.org/work/Africa/Documents/SSSA_Haiti_2010_resume_executif.pdf

http://www.ciat.cgiar.org/work/Africa/Documents/SSSA_Haiti_2010_recommandations.pdf

Veulliez trouver le rapport complet, en anglais, ci-joint. Le Resume Exécutif de cette évaluation de sécurité des systèmes de semences, ainsi que toutes les Recommandations sont disponibles en français.

http://www.ciat.cgiar.org/work/Africa/Documents/SSSA_Haiti_2010_resume_executif.pdf

http://www.ciat.cgiar.org/work/Africa/Documents/SSSA_Haiti_2010_recommandations.pdf

I: INTRODUCTION

Rationale for Report

This report presents the results of a *Seed System Security Assessment* (SSSA) in ten sites in Haiti, allowing for nationwide extrapolation. The assessment took place in May-June 2010 and was implemented for four reasons.

An earthquake hit Haiti on January 12, 2010 at 16:53 pm (local time). It was the strongest earthquake in Haiti for more than 200 years and resulted in an estimated 230,000 dead and 300,000 injured. With the epicenter near the town of Léogâne, some 25 km (16 miles) west of Port-au-Prince, many feared that select farming systems, as well as the capital region, had been severely damaged.

Abundant aid, including agricultural-related seed aid, poured into Haiti. Distributions extended across the south and into the central and even northern areas, with significant aid being programmed for both the first and second season post-earthquake. One organization alone, the UN-Food and Agricultural Organization, aimed to reach just over 68,000 families. An issue is whether such direct distributions were necessary and effective.

Third, the short-term shock catalyzed renewed attention toward the more extensive problems in Haiti—which indeed are chronic ones. Haiti is the poorest country in the Western Hemisphere and is ranked 149th of 182 countries on the Human Development Index. Farmers make up about 60% of the population but agriculture accounts for just 28% of the national GDP. As only one-third of the land is arable, with much of this under low performing varieties and other agricultural technologies, questions have been raised about what is needed to jumpstart these farming systems. The food riots in Haiti in 2008 that led to the change of the government particularly highlighted the need to increase domestic food production.

Finally, the work took place to build assessment capacity. Seed security assessment is linked to food security assessments, but is also quiet distinct: for example, an assessment of a production shortfall, which often leads to food gaps, in most cases does not lead to a seed shortfall. The *Seed System Security Assessment* (SSSA) in Haiti was designed to give technical insights to guide action and to train professionals in fast-evolving seed security assessment and intervention design methods.

Aims and Structure of Report

Chapter II gives background information on the seed security concept and on current options for seed-related aid response. Chapter III summarizes the stress context, introduces the SSSA methodology, and reviews the methods actually used in Haiti, as well as the rationale for the choice of sites. Chapter IV gives an overview on how the formal and informal seed sectors are organized and currently function in Haiti. It also includes a short introduction to the links between gender and food/seed security. Chapter V provides a parallel overview of the input supply chain for the fertilizer sector, including discussion of both mineral and organic amendments.

Chapter VI presents the heart of the field findings. It first analyzes the general effects of the earthquake on households and agricultural strategy, and then focuses on acute and chronic seed security/agricultural concerns. Chapter VII presents the overall recommendations. These are intended to lead to specific actions in a range of areas: emergency aid; variety introduction; decentralized seed production; fertilizer and organic amendment use; information innovation; market chain development; and rural women and commerce.

The report ends with a set of references. Annex I posts the actual field instruments and Annex II presents a list of all the crop varieties suggested for use. Annex III provides the full set of site-specific results, which includes some 117 tables. The three annexes can be found as a separate file at:

http://www.ciat.cgiar.org/work/Africa/Documents/SSSA_Haiti_2010_final_report_annex.pdf

Within the report, boxes have been inserted to highlight important experiences and to raise issues for further discussion.

This is not an academic report: the fieldwork was carried out relatively quickly to help partners plan for upcoming agricultural seasons. Nevertheless, the assessment team has aimed for considerable rigor, including the use of multiple methods, triangulation of results (with quantitative and qualitative data), and research drawing on substantial sample sizes.

II. BACKGROUND TO SEED SECURITY + AID RESPONSE

This chapter presents the necessary background to interpret this SSSA. It introduces the concept of seed security and the different types of seed aid approaches that might be matched to diverse seed security problems (and opportunities) encountered on the ground.[1]

The Concept of Seed Security

Farm families are seed secure when they have access to seed (and other planting material) of adequate quantity, acceptable quality, and in time for planting. Seed security is best framed within the broader context of food and livelihood security. Helping farmers to obtain the planting materials they need enables them to produce for their own consumption and sale.

Achieving seed security is quite different from attaining food security, despite their obvious links. One can have enough seed to sow a plot but lack sufficient food to eat, for example during the 'hungry season' prior to harvest. Conversely, a household can have adequate food but lack access to appropriate seed for planting. Despite these important differences between food security and seed security, determinations of seed security are normally based, implicitly or explicitly, on food security assessments. This results from a lack of appreciation and understanding of seed security issues.

The Dimensions of Seed Security: a Framework

The concept of seed security embodies several fundamental aspects. Differentiating among these is crucial for promoting those features that foster seed security as well as for anticipating the ways in which such security might be threatened.

Table 1 outlines the fundamental elements of seed security: seed has to be available, farmers need to have the means to access it, and the seed quality must be sufficient to promote healthy seed system use.

Table 1: Seed security framework: basic elements

PARAMETER	SEED SECURITY
Availability	Sufficient quantity of seed of adapted crops is within reasonable proximity (spatial availability) and in time for critical sowing periods (temporal availability).
Access	People have adequate income or other resources to purchase or barter for appropriate seeds.
Quality	Seed is of acceptable quality: • 'healthy' (physical, physiological and sanitary quality) • adapted and farmer-acceptable varieties

Source: Remington et al. 2002.

1 This section draws on L. Sperling, H.D. Cooper and T. Remington, 2008.

Availability is defined narrowly as whether a sufficient quantity of seed of target crops is present within reasonable proximity (spatial availability) and in time for critical sowing periods (temporal availability). It is essentially a geographically based parameter, and so is independent of the socioeconomic status of farmers.

Seed **access** is a parameter specific to farmers or communities. It largely depends upon the assets of the farmer or household in question: whether they have the cash (financial capital) or social networks (social capital) to purchase or barter for seed.

Seed **quality** includes two broad aspects: seed quality *per se*, and variety quality. Seed quality consists of physical, physiological and sanitary attributes (such as germination rate and the absence or presence of disease, stones, sand, broken seed or weeds). *Variety quality* consists of genetic attributes, such as plant type, duration of growth cycle, seed color and shape, and palatability.

In situations of stress, it is rare to have constraints in all three seed security features at the same time. The challenge is to zero in on the real problem and then target actions to alleviate that problem.

Acute and Chronic Seed Insecurity

Analysis of seed security requires consideration of the duration of the stress: whether it is 'acute' or 'chronic' (recognizing that the divisions are not absolute).

Acute seed insecurity is brought on by distinct, short-lived events that often affect a broad range of the population. It may be spurred by failure to plant, loss of a harvest, or high pest infestation of seed in storage. While in normal times households may have various degrees of seed security, all may be affected by an acute event, such as a flood.

Chronic seed insecurity is independent of an acute stress or disaster, although it may be exacerbated by it. It may be found among groups who have been marginalized in different ways: economically (for example, due to poor, inadequate land or insufficient labor); ecologically (for example, in areas of repeated drought and degraded land); or politically (in insecure areas, or on land with uncertain tenure arrangements). Chronically seed insecure populations may have ongoing difficulties in acquiring off-farm seed due to lack of funds; or they may routinely use low-quality seed and unwanted varieties. The result is households with built-in vulnerabilities.

Acute and chronic seed insecurity often exist together in emergency contexts. Indeed, in cases where emergencies recur — in drought-prone areas, for example — acute problems are nearly always superimposed on chronic problems rooted in poverty. Haiti in 2010 had severe drought in several zones, in addition to the earthquake. Both events were embedded in a context of chronic problems, due to lack of agricultural innovation across rural Haiti.

More Refined Analyses Leading to More Targeted Response

Table 2 gives examples of how identification of a specific seed security constraint should lead to a targeted response, as we are aiming for in this Haiti assessment. So, for example, if 'seed availability' is assessed as the problem in the short term, seed-based interventions, such as seed importation (for acute shocks) may be appropriate. (Seed availability problems rarely persist over the long term.) In contrast, a diagnosis of a problem of 'seed access' might wisely trigger a holistic analysis of livelihood strategies. In the acute phase, providing farmers with cash or vouchers to get their desired seed might be effective. However, an identification of access problems on a chronic basis should lead practitioners to look well beyond seed and seed security constraints. The inability to access certain necessary goods on a repeated basis is usually equated with problems of basic poverty. Initiatives to help farmers generate income and strengthen their livelihoods would be essential. Seed quality problems, whether they relate to concerns with the

varieties or with seed health *per se,* are rarely short-term. Responses usually require significant development programs, linked to plant breeding or seed quality initiatives, depending on the specific constraint identified.

Table 2: Types of seed security problems and broadly appropriate responses

PARAMETER	ACUTE	CHRONIC
Unavailability of seed	Direct distribution of seed	(Happens rarely or never)
Farmers lack access to seed	Vouchers and cash (sometimes with seed fairs)	Income-generation activity Agroenterprise development
Poor seed quality • **poor varieties** • **unhealthy seed**	**Limited** introductions of new varieties	Introduce new varieties and give technical support Variety selection / breeding Development of seed enterprises linked to new varieties and other quality enhancements

Current Major Response Options Being Used in Emergency

Various seed-related interventions are currently being implemented in emergency and chronic stress contexts in different parts of the world. Two broad categories can be distinguished: those that deliver direct forms of aid (and generally assume 'a lack of available seed') and those that are market-based and give recipients cash or vouchers to procure seed themselves (and hence assume 'lack of access' as the driving need). Responses might also focus on seed quality issues, both varietal quality and seed quality *per se* (health, germination rates and purity), although these tend to be medium- or longer-term interventions (Table 3).

Within the emergency seed assistance field, Direct Seed Distribution (DSD – also known as "Seeds and Tools") has dominated seed aid response for many years. It is, by far, the most common seed-related response in Haiti. DSD techniques often involve promotion of modern varieties as their central 'emergency' element. Emergency DSD in Haiti has, in fact, been more important than normal research and development (R&D) channels as a way to get new varieties to farmers (see Chapter VI), although this extension function might better be served by development agencies that can also provide technical advice and field follow-up.

Voucher and cash approaches, linked to seed-related assistance, have been promoted globally mostly within the last five years, and began to be used in Haiti about 2009 (see CRS, 2002 for approach). Both these forms of assistance are based on the assumption that seed *is* available in a given context, and that farmers simply need enhanced means to buy it (i.e., that their problem is one of access).

In theory, each approach currently in use carries with it a set of assumptions as to what specific seed security problem is being addressed (availability, access, seed/varietal quality) and whether this problem is short-term or long-term (Table 3). In practice, these approaches are almost always used in the absence of any real diagnosis of the seed security problem and are chosen for reasons disconnected from on-the ground analysis. For example, one implementer might always favor DSD and only knows how to deliver this type of assistance, while another might always prefer cash, as this coincides with his/her institutional philosophy. This indiscriminate use of seed-related responses is making the seed aid field much less effective than it might otherwise be. Often, problems are not solved, and there may be unintended effects, such as the creation of aid dependency or the undermining of markets.

Table 3: Typology of current seed system interventions

	DESCRIPTION / RATIONALE	CONSTRAINTS ON WHICH THEY SHOULD BE TARGETED
DIRECT AID		
1. Direct seed distribution Emergency seed provision 'Seeds and tools'	Procurement of quality seed from outside the agroecological region, for delivery to farmers. The most widely used approach to seed relief.	Short-term response to address problems of seed availability especially in situations of total crop failure and/or long-term displacement of farmers. Response sometimes also used as 'on-off action' to introduce new crops or varieties usually supplied by the formal sector.
2. Local procurement and distribution of seed	Procurement of quality seed from within the agroecological region, for delivery to farmers. A variant of 1.	Short-term response to address problems of seed access or highly localized problems of seed availability.
3. Food aid 'Seed aid protection ration'	Food aid is often supplied during emergencies alongside seed aid so that the farm family does not need to consume the seed provided. Where local seed systems are functioning, but the previous harvest was poor, food aid can similarly protect farmers' own seed stocks.	Short-term response accompanying direct seed distribution to address problems of seed availability.
MARKET-BASED AID		
4. Vouchers / cash to farmers	Vouchers or cash can provide poorer farmers with the means to access seed where it is available, from local markets, or the commercial sector. Vouchers or cash enables farmers to access crops and varieties of their choice.	Short-term response to address problems of seed access especially in situations of local seed shortages and local markets or farmer-farmer barter normally used. Can also be used to link farmers with agro-dealers.
5. Seed fairs	Seed fairs provide an *ad hoc* market place to facilitate access to seeds, or specific crops and varieties, from other farmers, traders and the formal sector. Usually used in conjunction with vouchers to provide poorer farmers with purchasing power.	Short- or medium-term response to address problems of seed access especially for subsistence crops, and where local markets normally used. Increasingly used to give farmers access to new varieties as well.
SEED PRODUCTION AND VARIETAL DEVELOPMENT		
6. Seed production Community-based, local seed production	Farmers are trained and/or contracted to produce seed, distinct from their regular production activities, often based on formal seed standards. Some approaches focus on improving quality attributes, others are designed specifically to facilitate the movement of new improved varieties into local systems; still others are conceived as basically income-generating or profit-making enterprises.	Medium- or long-term response to address problems of seed quality (of local materials) or of access to, or availability of, new varieties.
7. Provision or development of better varieties through small packets, varietal selection, or plant breeding	Important where farmers need access to new genetic material.	Medium- or long-term response to address problems of seed quality (genetic/ varietal attributes).

Source: modified from Sperling et al., 2008.

III. THE STRESS CONTEXT, METHODS AND SITES

The 7.0-magnitude earthquake that shook Haiti on January 12, 2010, killed over 220,000 people, injured another 300,000, and directly affected up to 3 million more Haitians. While only in Port-au-Prince and areas very close to the epicenter was agricultural production directly affected, the indirect effects on food security and agricultural livelihoods were important nationwide. Businesses were lost, financial expenses increased due to additional internally displaced persons (IDPs) fleeing Port-au-Prince for rural households, access to credit decreased, and there was a drop in demand for traded goods. The UN estimates the earthquake caused $4.3 billion in physical damage and $3.5 billion in economic losses.

While the SSSA was triggered by the earthquake, Haiti had been experiencing deep and widespread stress in its agricultural systems well before the disaster, due to lack of innovation in both the formal and informal systems. Even before the earthquake, Haiti's economy was in sharp decline, its real GDP having dropped by 30% over the past 40 years (Taft-Morales and Drummer, 2007).

Below we provide a glimpse of the kinds of stresses that have affected agricultural production and, by extension, seed security in Haiti over the past few decades.

Agriculture, Production and Livelihoods

Haiti encompasses a set of diverse agroecological zones that are generally divided into five basic production ecosystems: rainfed lowland agriculture, dryland lowland agriculture, rainfed hill and mountain agriculture, dryland hill and mountain agriculture, and irrigated areas (mainly associated with rice). Much of the cultivated area is planted to poorly performing varieties, and the use of low-performance agricultural technologies is also widespread. From 1 to 1.2 million hectares are cultivated in Haiti every year.

An array of crops is grown in Haiti: cereals such as maize, sorghum and rice; legumes such as common beans, cowpeas, pigeon peas and groundnuts (peanuts); and roots, tubers and other vegetatively propagated starchy crops like plantain and dessert banana, manioc (cassava), sweet potato, yam, taro, breadfruit, jackfruit and Irish potato. Vegetables and fruits are coming into greater prominence: cabbage, tomato, eggplant, leaf amaranth, watermelon, and tree fruits such as mango, papaya and acerola. Among the country's export crops are coffee, cocoa and essential oils. While Haiti practices this unusual form of farming called arboriculture, which combines fruit trees and root crops, the SSSA focused on the annual food crops and seed-based crops, as it is towards these foods that the majority of emergency and developmental aid interventions are currently targeted. The food riots in Haiti in 2008, which led to a change in government, coupled with food shortages on the world market, highlight the need to increase domestic food production.

The majority of Haitians are farmers, with 59.6% of workers participating in agricultural labor, and women accounting for one-third of the agricultural labor force (FAO, 2009). However, agriculture contributes only 28% of Haiti's GDP (CIA, 2007). Haiti's annual production ranges between 380 and 455 thousand tons per year, depending on a number of factors, including recurring hurricanes and other emergencies (FAOSTAT, 2009). Key food security crops include beans, maize, sorghum, pigeon pea, cowpea, cassava, sweet potato, rice and bananas. Eighty percent of farmers own less than 2 ha of land, and half own less than 0.5 ha (UNCTAD, 2006). Within the SSSA sites, the average size of household land area was 1 karo or 1.29 ha.

In Haitian rural areas, and particularly in mountain zones, deforestation and land degradation remain compelling challenges. The erosion rate is an estimated 36.6 million tons of soil, or 12,000 hectares, per year. Between 30

and 50% of the population work on fragile lands (defined as arid, or with steep slopes, or with fragile soils), thus accelerating degradation.

Haiti is a net importer of food: 137 million MT, or almost 12% of net imports (Ng and Aksoy, 2008)[2]. Milled rice is quite consistently the number one import, amounting to 311,811 tons in 2007 (FAO, 2009). Although it is a large bean producer, particularly in the South, the Northwest, the Central Plateau and the Southeast (FEWSNET, 2009), Haiti also imports about 20,000 tons of beans annually (FAOSTAT). Local production accounts for about 70-80% of beans consumed in Haiti; about 10-15% is imported, and 10-15% is food aid (USAID, 2010b).[3]

Haiti's informal economy is about 85% of the total economy, and women's commercial activities make up the majority of this sector (Gardella, 2006). The female and male labor forces are almost equal in size. Haiti has one of the highest female Economically Active Population (EAP) rates in the developing world, with 62% of women being part of the labor force (Correia, 2002). Many women are agricultural traders, and are thus the face of both commerce and food security for their households.

Food Insecurity and Chronic Vulnerability

Prior to January 12, 2010, Haiti had the worst health indicators for women and children under five in the Western Hemisphere. The maternal mortality rate is 523 per 100,000 live births, about four times higher than the regional average of 140. The mortality rate for children under five is 76 per 1,000 live births (UNICEF, 2007), and 23.8% of children are stunted (FAO, 2009). The daily per capita caloric deficit is 430 kcal, and 58% of the population is undernourished (*ibid.*). About 87% of the rural population do not get the minimum daily food ration as defined by the WHO (Taft-Morales and Drummer, 2007). Before the earthquake, two-thirds of all Haitians limited food consumption at least three times a week by cutting portions, skipping meals and not eating for an entire day to cope with chronic food insecurity. The poorest 40% of Haitians do so even more frequently (FAO, 2009).

Areas such as the Northwest, as well as other mountainous and isolated areas suffer from chronic food insecurity. This was exacerbated by the earthquake. Other areas of chronic stress include zones experiencing almost annual destruction from hurricanes. In the past two years, zones in the south and west were hit particularly hard – by Tropical Storm Fay (15-16 August 2008), Hurricane Gustav (26 August 2008), Tropical Storm Hanna (1 September 2008), and Tropical Storm Ike (6 September 2008). Crops and infrastructure were destroyed.

Food Aid and Seed Aid

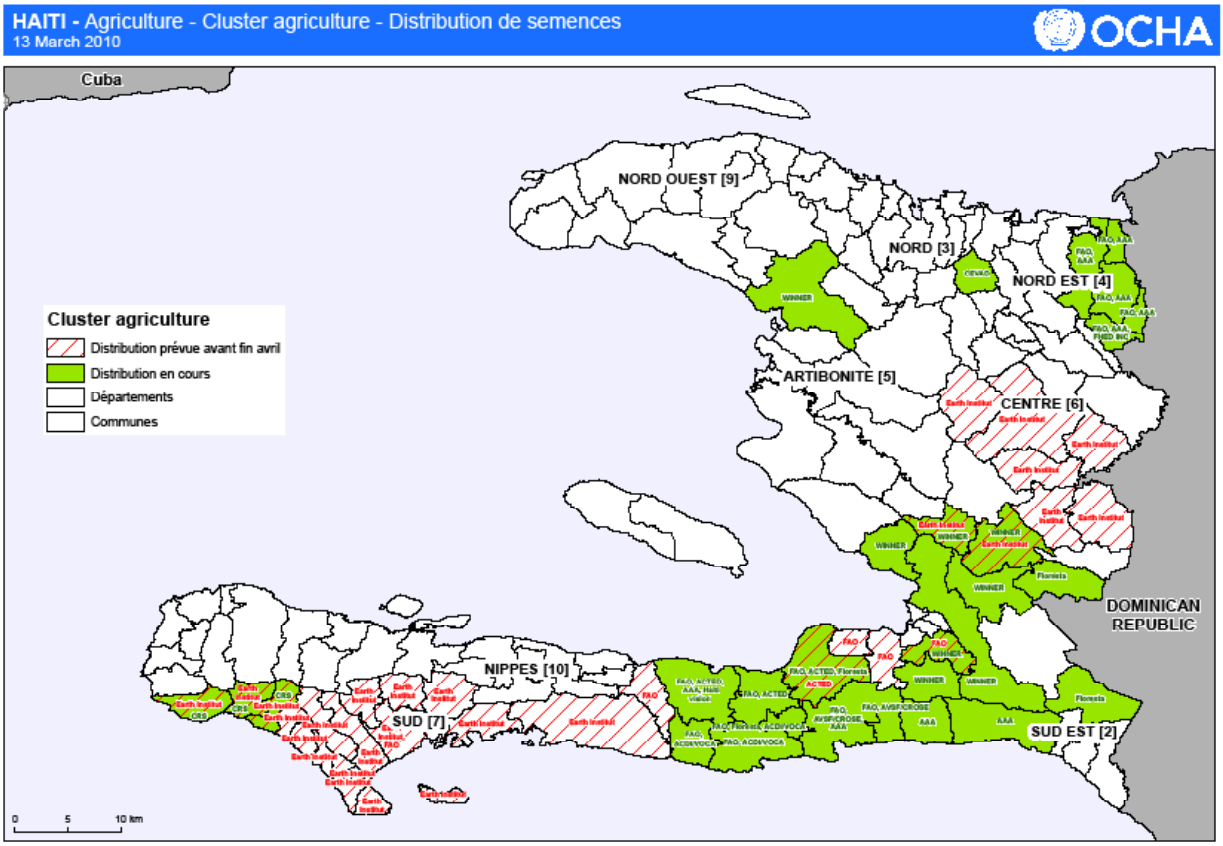
Much of the aid received by Haiti in recent years has been given under the guise of emergency aid. Food aid, mostly cereals, has been given on and off for much of the last decade. Between 2004 and 2006, for instance, the country received 95,000 MT of cereal food aid (FAO, 2009).

Historical figures on emergency seed aid are not available. Immediately after the earthquake, however, abundant seed aid poured into Haiti. Distributions extended across the south and into the central and even northern areas, with many being programmed for both the first and second season post-earthquake. Figure 1 maps these distributions. One organization alone, the UN Food and Agriculture Organization (FAO), aimed to reach just over 68,000 families.

2 Haiti is one of five low-income countries that has an agricultural trade deficit of more than 10% of their imports. (World Bank, 2008)

3 In 2008, WFP donated 5,505 MT of beans as aid. (WFP, 2008)

Figure 1: Seed distributions in Haiti (Agricultural Cluster information, 13 March 2010)



Emergency seed aid practice now seems to be expanding in Haiti. (See Annex II for a list of varieties accepted by the Ministry of Agriculture to guide emergency and developmental seed-related interventions.) Demands for multiple types of future aid are escalating. For instance, in the agriculture sector, the GoH/UN appeal on March 17 alone asked for US$790 million.

It is in this context of stress, also marked by an abundance of outside aid, that the SSSA unfolded.

Seed System Security Assessment

A seed system security assessment reviews the functioning of the seed systems, both formal and informal, used by farmers. It investigates whether seed of adequate quality is available and whether farmers can access it. The SSSA approach also promotes strategic thinking about the relief, recovery or development vision needed. For instance, during a period of stress, should efforts aim to restore the seed system to its former state, or should they aim to strengthen it? Should seed system-related support focus on crops for food, income or both? Should interventions home in on crops linked with the most vulnerable (e.g., women)? A full description of the SSSA method (Sperling, 2008) can be found at http://webapp.ciat.cgiar.org/africa/pdf/sssa_manual_ciat.pdf. Box 1 summarizes the steps.

BOX 1. SEVEN BASIC STEPS IN ASSESSING SEED SYSTEM SECURITY

1. Identify zones for assessment and possible intervention.
2. Describe the normal status of crop and seed systems.
3. Describe the broad effects of the disaster on these farming systems.
4. Set goals for relief and recovery operations based on farmers' need.
5. Assess the post-crisis functioning of seed channels to determine whether short-term assistance is needed.
6. Identify any chronic stresses requiring longer-term solutions and identify emerging development opportunities.
7. Determine appropriate short- and longer-term responses based on analysis of priority constraints, opportunities and farmers' needs.

The task of conducting an SSSA in Haiti was particularly challenging. There were few baselines that could be used to describe the 'normal' situation since, over many years, only a modest amount of research and monitoring had been done in the countryside.

Methods Used

The range of methods used and themes explored in the SSSA are sketched out in Table 4. The team investigated the functioning of seed systems using a mix of qualitative and quantitative methods, focused on multiple stakeholder insights, and cross-checked information from the supply and user side. Of special note is that the sample sizes were relatively big for a quick assessment: 983 comprehensive individual farmer interviews and 36 focus group discussions (FGDs), often with community meetings of 50 people or more. Annex I presents the field instruments used.

Table 4: Investigative thrusts used in the SSSA work in Haiti, May-June 2010

TYPE OF INVESTIGATION	COMMENTARY
Background information collection	Commissioning of specific documents on: • plant breeding • formal sector seed supply trends • fertilizer supply trends • gender-related livelihoods
Database utilization	Use of MARDNR and FAO databases on seed aid history
Key informant interviews	Agro-dealers MARNDR / project personnel Crop-specific specialists (maize, sorghum, legumes) Civil society key initiatives (e.g., trader agent)
Focus group discussions (N=36) **Community-based (N=21)** **Women's groups (N=15)**	Separate community and women-only FGDs, discussing: • agricultural and variety use and trends • seed source strategies, by crop • community seed security assessment • women's crop/seed constraints/opportunities • effects of earthquake • livelihood/coping strategies
Farmer interviews (N=983)	• Topics covered: • agricultural trends • seed source patterns/fertilizer use • effects of earthquake
Seed/grain market analysis	Assessment of: • crop and variety supplies on the market • pricing patterns and sourcing areas • seed quality management procedures

Site Choice

Sites were chosen so as to link assessment to action, and also to allow for some extrapolation of findings nationwide. Areas of assessment were chosen to provide a balance among the following criteria:

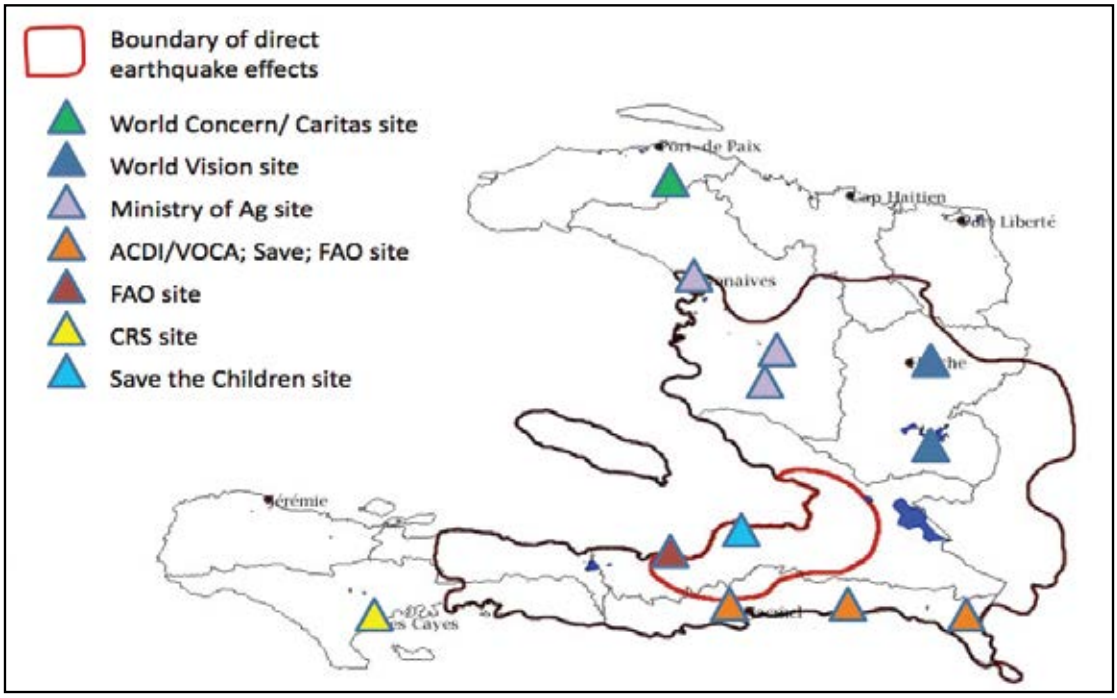
- Key agroecological zones
- Those directly hit by earthquake or not
- Those with many internally displaced persons versus those with a low number of IDPs
- Low agricultural potential versus high potential (including irrigated areas)
- Border versus nonborder areas (to assess seed-related effects of cross-border markets)
- Partner priorities

The 10 sites chosen are presented in Table 5, with Figure 2 showing their relative locations. Three of the sites were located in the direct epicenter for the earthquake: Léogâne, La Vallée de Jacmel and Petit Goave. USAID estimates that 80-90%, 50-60% and 15% of the areas, respectively, were destroyed by the January 12 events. Table 6 summarizes some of the salient features of the 10 sites selected.

Table 5: Zones (commune/section) of Haiti SSSA 2010

COMMUNE	SECTION
Bassin Bleu	La Plate
Chantal	Fond Palmiste
Hinche	Marmont
Lascahobas	Juampas
Verrettes	Belange
Marigot	Fond Jean Noël
Le Petit Goave (plains/hills)	Delatre/ Desplatons
Léogâne	La Petite Rivière
Belle Anse	Pichon
La Vallée de Jacmel	Music

Figure 2. Geographic location of zones in Haiti SSSA 2010



Notes: The epicenter area is outlined in red, with the black outline being a first FAO approximation of agricultural areas affected. In retrospect, all areas had indirect effects as internally displaced persons spread out countrywide.

Table 6: Salient features of the 10 sites selected for SSSA

PARTNER	ZONE	COMMUNE	HIGH POTENTIAL/ LOW POTENTIAL	GENERAL AGROECOL-OGY	EARTHQUAKE IMPACT ZONE	ENVIRON-MENTAL RISK	BORDER?	IDPS	RAINFED / IRRIGATED	MARKET/ INFRA-STRUCTURE
Save	Léogâne	La Petite Rivière	High	Lowlands	Yes – heavy	Flooding	no	Yes – many	rainfed	Passable in dry season
Save	Léogâne	Palmiste à Vin	High	Mountainous	Yes – heavy damage	Landslides	no	Yes – many	rainfed	Passable now but difficult in rainy season
FAO	Petit Goave	Petit Goave	High, medium and low	Highlands and lowlands	Yes – heavy	Flooding	no	yes - many	rainfed	passable roads
CRS	Cayes	Chantal	Average	Humid mountainous	No	Erosion, landslides	no	yes - average	rainfed	passable roads
World Vision	Plateau Central - haut	Hinche	Low	Dry mountainous	No	erosion, deforestation	no	yes - many	rainfed	poor roads
World Vision	Plateau Central - bas	Lascahobas	Average	Dry mountainous; dry lowlands	No	Deforestation	near	yes - many	both	good
World Concern	Port de Paix	Bassin Bleu	Medium	Semiarid mountainous plain semiarid/ plain irrigated	No	Flooding/ Drought	no	yes - average	Irrigated/ rainfed	poor roads; port
ACDI/ VOCA, Save, FAO	La Vallée	La Vallée	High	Humid mountainous	Yes	Flooding, erosion, landslides	No	Yes – average	Rainfed	passable roads, feeds into PaP;
ACDI/ VOCA, Save, FAO	Bel Anse	Belle-Anse	Low	Dry mountainous	No	Flooding, landslides	no, but some cross-border trade	yes - average	Rainfed	Terrible roads
ACDI/ VOCA, Save, FAO	Marigot	Marigot	Medium	Humid mountainous	Partial damage	Flooding (very high)	Close	yes - average	Rainfed	passable roads, some are paved
MARDNR	Antibonite – bas	Verrettes	High	Plains	Modest damage lower areas	No	no	average	Yes	good -more commercial

IV. SEED SYSTEMS IN HAITI: OVERVIEW

Smallholder farmers use multiple channels to procure seed. These channels fall within formal and informal seed systems, the latter sometimes labeled local, traditional or farmer seed systems.

The formal seed system involves a chain of activities leading to certified seed of named varieties. The chain usually starts with plant breeding and promotes materials towards formal variety release. Seed marketing takes place through officially recognized seed outlets, either commercially or by way of national agricultural research systems (Louwaars, 1994). Formal sector seed is also frequently distributed by seed relief agencies.

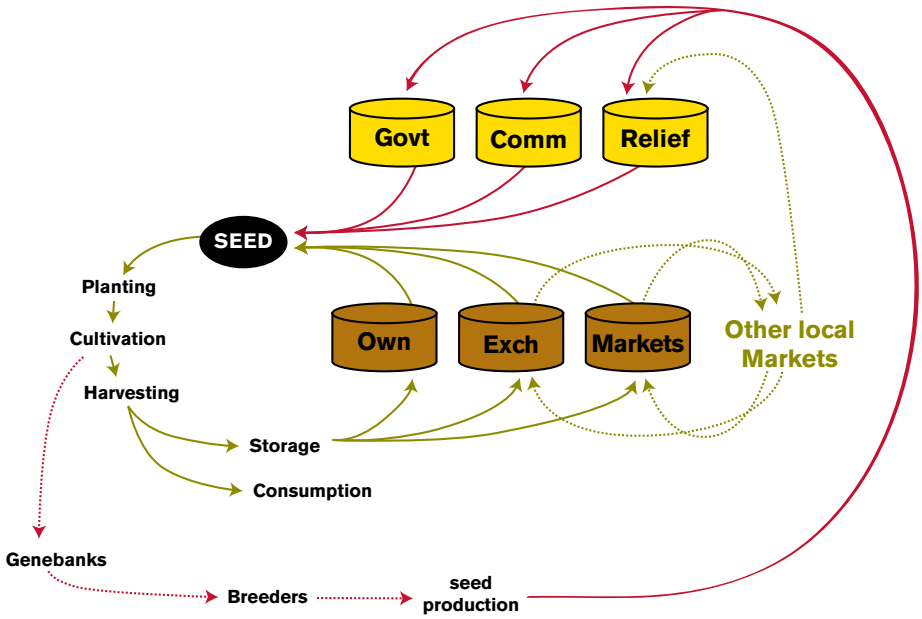
The informal system embraces most of the ways farmers themselves produce, disseminate and procure seed: directly from their own harvest; through gifts and barter among friends, neighbors and relatives; and through local grain markets or traders. Farmers' seed is generally selected from the harvests or grain stocks, rather than produced separately. Local technical knowledge, standards and social structures guide informal seed system performance (McGuire, 2001). In developing countries around the world, somewhere between 80% and 90% of the seed sown comes from the informal seed system (DANAGRO, 1988; FAO, 1998), although this varies by crop and region.

The assessment suggests that in Haiti upwards of 98% of seed comes from informal systems. Formal sector outlets stores are few and farmers seek certified seed elsewhere mainly for rice and horticultural crops. Vegetables are a somewhat special case for use of both modern varieties and certified seed. For vegetables, with the exception of eggplant and leaf amaranth, 100% of temperate vegetable seed is improved, imported lines.

Figure 3 depicts the formal and informal seed systems (and component channels) and how they may interact. In Haiti, links between the two systems certainly need to be strengthened, especially to speed up the flow of modern varieties.

The next section gives more details of the current state and plans for formal plant breeding and seed sector development in Haiti. Insights on current informal sector functioning, with a special focus on local markets, are then presented. General issues linking gender and food/seed security are highlighted at the end.

Figure 3. Channels through which farmers procure seed



Channels are depicted by the cylinders: Own seed stocks, exchange with other farmers, and purchase through local grain markets constitute 'informal' channels, while commercial seed stockists, government or research outlets, and relief supplies constitute formal channels. The arrows indicate the flow of seed in the 'informal' and 'formal' sectors respectively. Adapted from Almekinders and Louwaars (1999).

Formal Plant Breeding in Haiti

Plant breeding activities over the last 20 years have been minimal within Haiti. These have consisted mostly of plant introductions, evaluations and diffusion of germplasm. The National Seed Service (SNS) has conducted some varietal evaluations at their research farm in Damien, occasionally linking to a network of international institutions that help develop and provide new germplasm. Within country, the Organization for the Rehabilitation of the Environment (ORE) has been the only organization to have regularly bred and screened a range of crops (e.g., maize, beans and sorghum). At present, ORE focuses particularly on testing improved lines from elsewhere, including biofortified beans and maize.

Note that the Faculty of Agronomy does have a professor of plant breeding, but no current plant breeding program exists. A project by Développement Économique des Filières (DEFI) is scheduled to start later in 2010 in the Les Cayes area (southern Haiti): it will be led by the MARDNR plant breeder and focus on common beans and maize improvement.

As various organizations have been involved in variety development and introduction at different points, we present their contributions below, linked to specific crop and variety work. The information is organized on four headings: plant breeding within Haiti; germplasm collections; plant introduction (line development); and new variety introduction. This SSSA has been an opportunity for the MARDNR to compile this information into a more systematic format. Several priorities for public sector plant breeding support are suggested at the end of the section.

Some plant breeding has been done locally and in strong collaboration with local and international institutions. It has covered a good range of crops: maize, beans, rice, cassava (manioc) and Irish potatoes. Key examples appear below.

Maize *(Zea mays)*

The NGO ORE, located in Camp Perrin, Southern Haiti, has produced a line of local maize hybrids, Apollon 1 to Apollon 9. These hybrids do outperform local landraces, but their diffusion has not gone forward.

Various lines from the International Maize and Wheat Improvement Center (CIMMYT) have also been introduced, including La Maquina 7822 and COMAYAGUA. These are yellow-seeded, tropically adapted, open-pollinated maize lines and have shown good adaptation to lowland Haitian conditions.

Bean (*Phaseolus vulgaris*)

In the bean sector, ORE has selected a local landrace that has been released as LORE 87. It is a black-seeded line with a good yield, adapted to low soil fertility. It is not, however, resistant to any of the most dangerous bean viruses in Haiti: BGYMV (Bean Golden Yellow Mosaic Virus), BCMV (Bean Common Mosaic Virus), and the necrotic strains of the Bean Common Mosaic Virus (BCMNV).

The Madian-Salagnac Project, a joint activity of the Ministry of Agriculture and French Cooperation, has bred a few bean lines, notably the mottled red line Salagnac 90. This is a cross between Salagnac 86 and Constanza 1, a line originally from the International Center for Tropical Agriculture (CIAT) and introduced

from the Dominican Republic. Another notable line is Salagnac 2000, a black-seeded bean that is resistant to anthracnose and oidium and adapted to acidic and low-fertility soils. A switch of preference from red mottled beans to black beans in the Salagnac area has resulted in Salagnac 90 being almost unavailable. The National Seed Service and the Salagnac Center keep Salagnac 90 alive. Salagnac 2000 is multiplied every year by the Salagnac Center.

Rice (*Oryza sativa*)

The Office of Development of the Artibonite Valley (ODVA) created new rice varieties by crossing Taiwanese variety Chia-Sen 11 with Dawn (Madam Gougousse), an old US variety. The most successful was La Crête à Pierrot (LCAP). The introduction of Empty Head disease led to the withdrawal of the variety LCAP. It was replaced by TCS 10, another Taiwanese line. Sheila, a mutant of Madam Gougousse, is currently being planted in the Artibonite Valley. It seems more tolerant to Empty Head Disease.

Cassava (*Manihot utilissima*)

The Organization for Development of the North (ODN), managed by the Ministry of Agriculture, introduced new cassava clones, including CMC 40 from CIAT.

Irish potatoes (*Solanum tuberosum*)

Various Irish potato lines have been introduced from the International Potato Center (CIP) by the Centre de Recherche et de Documentation Agricoles (CRDA), the research arm of the Ministry of Agriculture. Some of these lines combine tolerance to *Phytophthora* and tolerance to *Ralstonia solanacearum*, as well as good yield potential.

Germplasm collections

Only modest germplasm collections have been assembled within Haiti, and particularly for the bean landraces. Few collections (or reports) seem to exist for other crops.

Collections of local germplasm have been put together by ORE, the Ministry of Agriculture, the Faculty of Agronomy and the Madian-Salagnac Project (located in the highlands of Miragoane). The Madian-Salagnac Project alone has collected more than 50 bean landraces, focusing on Powdery mildew (oïdium) resistance and tolerance to low fertility and acidic soils. A subset of these seeds has been sent to CIAT.

ORE also has a significant collection of black-seeded landraces, the best of which have been released as LORE lines.

The Southeast Consortium for International Development (SECID), a cooperation program in the 1990s, also seems to have made some plant collections, but the SSSA team was unable to secure more detailed information.

Plant introductions

Select plant introductions, working lines, have also evolved in the past five years. ORE has introduced improved lines of common beans and maize from CIAT and CIMMYT. Hugo, a QPM high-lysine corn, has been released.

The Ministry of Agriculture, through its research service, initially called SERA (Service de Recherche Agricole) and later CRDA (Centre de Recherche et de Documentation Agricoles) has introduced various bean,

sorghum, cowpea and cassava lines. The sorghum line M 50009 has been well accepted in the Plaine des Gonaïves. A selection from M 50009, called Dodo 87, obtained by ORE, is distributed in Southern Haiti.

Bean research in the Ministry of Agriculture has been focused on introducing and evaluating lines with multiple virus resistance from CIAT, Guatemala, the University of Puerto Rico (UPR), and the Escuela Agricola Panamericana (Zamorano). Lines with resistance to BGYMV, (Bean Golden Yellow Mosaic Virus), BCMV (Bean Common Mosaic virus) and BCMNV (Bean Common Mosaic Necrotic Virus) have been introduced, tested and are being promoted: ICTA Tamazulapa, and ICTA Ligero from Guatemala, Arifi Wurite (from Honduras), DPC 40 from UPR, and the Dominican Republic, XRAV 40-4 from UPR. All of these lines are highly resistant to BGYMV and BCMV, while XRAV 40-4 and DPC 40 are also resistant to BCMNV. Other varieties like Arroyo Loro Negro and Buena Vista are not virus-resistant.

New variety introductions

In terms of new varieties *per se,* a full list of current varieties recommended for Haiti appears in Annex II. The list covers specific recommendations for 11 staple food crops and some 15 horticultural crops. Below, we signal a few of the more popular and upcoming varieties.

Rice

- TCS 10 has been introduced by the Taiwan Agriculture Mission and basic seed is introduced every year from Taiwan, then increased in the Artibonite Valley and distributed through ODVA.
- Prosequisa 4 and Prosequisa 9 have been introduced from the Dominican Republic. Prosequisa is produced by a branch of the fertilizer company FERQUIDO. Prosequisa is popular in northeastern Haiti and in Torbeck, southern Haiti.
- The NERICA lines have been introduced from WARDA by CRDA, the research service of the Ministry of Agriculture. The first trials have not been successful and should be repeated.
- Rainfed rice varieties will be introduced from Brazil later this year for testing in Fonds des Nègres (Department of Nippes) and mountain areas.

Maize

- Open-pollinated maize lines will be introduced from EMBRAPA for planting in Fonds des Nègres. Desired traits are: high yield, tolerance to achapamiento and/or sorghum downy mildew.
- Open-pollinated maize lines have been introduced from CIMMYT by the Ministry of Agriculture for evaluation for high yield, tolerance to achapamiento, QPM and tolerance/resistance to sorghum downy mildew.
- Open-pollinated and hybrid maize lines have been introduced from CIMMYT by ORE for evaluation for high yield, tolerance to achaparamiento, QPM and tolerance/resistance to sorghum downy mildew.

Beans

- Introduction of improved varieties by ORE and the Ministry of Agriculture will continue. ORE focus will be on BGYMV-resistant lines with improved nutrient availability (iron and zinc) in collaboration with CIAT, while the Ministry will be looking at virus-resistant lines with tolerance to low soil fertility and high soil acidity.

Irish Potato

- New clones will be introduced from CIP by the Ministry of Agriculture and the DEFI project for use in high-altitude mountains.
- The use of botanic seeds of Irish potato is also being planned this year by DEFI as well as the National Seed Service of the Ministry of Agriculture.

True Yams

- Dioscorea alata species with a high level of resistance to the leaf disease anthracnose will be introduced from Vanuatu. Alata yams can be grown at sea level and thus reduce pressure on degraded mountain slopes and watersheds.

Summary and reflections on formal plant breeding

All in all, there are some select new varieties in use or soon coming into use in Haiti. Much of the material, however, is being imported and is not necessarily adapted to the full range of environments in which farmers require new innovations. Haiti has unusually heterogeneous farming conditions.

The SSSA identified a basic need to accelerate variety screening within the country and particularly to set up testing networks able to encompass Haiti's varied agroecological zones. At this point there is no countrywide system of multilocational variety testing. Two key steps are suggested (with more comprehensive recommendations appearing in Chapter VII):

- Multilocational sites might be quickly established for screening 'best bets' from elsewhere. In the current absence of a government-run decentralized testing system, a temporary network of agricultural NGO and universities, coordinated by MARNDR, might be established in key agroecological zones.
- Screening sites for more exploratory germplasm trials should also be established across key agroecological zones, using models that allow for end-user evaluation. Participatory Variety Selection (PVS), mother-baby trials, or garden variety trials are among the well-established variety screening formats that allow for intensive evaluations by farmers and traders.

MARDNR has stated it will ensure introduction of outside germplasm and suggested the following sources:

a. France's Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) for yam
b. CIAT for bean, rice and manioc
c. CIMMYT for maize and sorghum (agreement with the International Crops Research Institute for the Semi-Arid Tropics, ICRISAT, in Latin America and the Caribbean)
d. CIP for Irish potato and sweet potato
e. The International Institute of Tropical Agriculture (IITA) for cowpea

To shape all this work, plant breeding priorities and goals will have to be reflected on and defined more explicitly. Maintaining resistance to disease (as in beans with BCMV and BCMNV), concentrating on climate change (both drought and excess water), and responding to farmers' real planting conditions (e.g., low soil fertility) may be among the overarching themes considered.

The degree to which plant breeding capacity has to be immediately scaled up within Haiti has been debated. Certainly the MARDNR hopes at least one private university/faculty of agronomy can be given support to start its own breeding operations.

Formal Seed Sector in Haiti

The formal sector in Haiti provides very little of the seed that farmers actually use, perhaps less that 2% of the total seed sown. The major exceptions are seed for growing rice and a range of horticultural crops, for which both modern varieties and high-quality seed are readily available.

Current structures of formal sector seed production

At the governmental level, the National Seed Service (SNS) is in charge of the seed sector. However, with only two employees currently, its capacity is extremely limited. The SNS does not have a laboratory or engage in certification activities.

It is the research programs themselves (CRDA, Taiwanese Mission, ORE, National Seed Service, Faculty of Agronomy) which introduce and test improved varieties, and which, in theory, provide the initial breeder seed.

For basic seeds, only the rice programs, linked to the Taiwanese Mission, have access to any sizable seed quantities, and basic seeds are imported every year, especially the variety TCS-10. Except for the Taiwanese Mission, located in the Artibonite Valley and focusing only on rice, the supply of basic seeds is problematic.

Within Haiti, certified seed *per se* is produced only by ORE, although a range of other NGOs, farmers groups, and small companies produce seed of other quality (see section below, Locally based multiplication programs). Overall, about 800-900 MT of seed is produced in decentralized multiplication programs annually.

A full inventory of current seed multipliers in both Haiti and the Dominican Republic is in progress[4]. While there are at least 35 seed production organizations 'on paper', a good number are not functional or economically sustainable. Much of the certified seed used in Haiti comes from the Dominican Republic or elsewhere. For instance, one estimate suggests that 40% of the emergency supplies regularly distributed by FAO within Haiti is imported (with the rest sourced within the country). Different types of formal seed sector models, which would unite Haitian and Dominican Republic strengths, might be worth testing.

History of formal sector seed production

Haiti did have a more complete set of formal seed sector structures in the recent past. The most recent, the Commission Intersectorielle de Production et Distribution de Semences Améliorées (CIPDSA), was disbanded in 2002, due to financial irregularities. Unfortunately, the void has not yet been filled. Landmarks in the history of the formal seed sector are listed below.

4 Comprehensive seed multiplier inventories were in progress at the time of report writing. Within Haiti, the inventories are being organized by the MARDNR; within the Dominican Republic, by FAO.

Formal seed sector history: key events

1970: Creation of the Service d'Etudes et de Recherches Agricoles (SERA), research arm of the then Department of Agriculture. SERA was closed in 1983 and its activities transferred to the Faculty of Agronomy.

1977: Creation of the Service National des Semences Améliorées (SENASA). SENASA had its own (small) seed technology lab with funding from IICA and the French Fonds d'Aide et de Coopération (FAC).

1978: Creation of the Centre de Conditionnement et de Stockage des Semences de Maïs (CECOSAM-Maize). Its mandate was later extended to other improved seeds. It could process 1 ton of maize seed per hour, had storage facilities for 500 metric tons of seed, and had its own seed lab. Poor management of 150 tons of maize seed of the variety Eto Amarillo led to serious financial trouble for CECOSAM. The plant was looted in 1994 and is no longer functioning.

1983: Creation of the Centre de Recherches et de Documentation Agricole (CRDA). CRDA started at the Faculty of Agronomy, then was returned to the Ministry in 1987.

1987: Beginning of ORE seed production activities.

1993: Beginning of CIPDSA.

1993: Various private seed companies, LABSEM and SOGESEP are created to supply seed to CIPDSA and FAO.

1995: Formal legalization of CIPDSA for 5 years.

2002: Creation of National Seed Service.

2002: CIPDSA's mandate is not renewed.

The Commission Intersectorielle de Production et Distribution de Semences Améliorées was a structure encompassing three representatives from the Ministry of Agriculture, two representatives from farmers organizations, two representatives from NGOs, and two representatives from the private sector. Its mission was to:

- Execute activities related to the production, multiplication and distribution of seeds and other agricultural inputs (tools, fertilizers, pesticides);
- Implement specific action plans on basic food seeds, maintain varieties, support technical specifications related to Haitian production systems;
- Support the activities of the Ministry and other public institutions in supplying seeds and other agricultural inputs to the farmers;
- Propose provisional standards and procedures for the production and the marketing of seeds.

For some seven years, CIPDSA contributed to the distribution of important quantities of seed to Haitian farmers. For the first two years it was funded by UNDPN. The European Union later gave financial support to CIPDSA.

Plans for a revitalized formal seed sector are currently being proposed by a number of organizations (e.g., see http://www.haiticonference.org/Haiti_Action_Plan_ENG.pdf).

Informal Seed Sector in Haiti

Overview

For farmers' priority crops – maize, beans, rice, sorghum, peanut, pigeon pea and cowpea – the informal system dominates seed supply, accounting for some 98% of the seed sown. Even for the crops (rice and maize) or sites (Chantal, Verrettes) that attract the most commercial activity, formal commercial channels remain of minor importance, supplying at most 2-6% of seed. Only horticultural crops (commercial fruit and vegetable F1 hybrids) are purchased mainly from formal channels such as agro-dealer shops. This section focuses on the functioning of informal channels in Haiti's seed systems, concentrating on informal markets, the predominant source for most crops.

The informal seed system includes a range of inter-linked channels that produce, disseminate and procure seed. These include farmers' own stocks, other farmers and friends, and local markets. Farmer seed production enterprises, often project-supported, also provide modest amounts of seed to farmers. These latter build on informal channels, but aim also to bring in formal sector expertise and modern varieties.

In Haiti, farmers' own stocks supply roughly 15-20% of all seed sown; they are key for maize and sorghum and (in Lascohabas) for peanuts. Other farmers serve as minor sources of seed for legumes and cereals (2%). Rice is the only crop for which there is significant seed sourcing from family and friends. Yet other farmers are relatively more important as sources of planting material for the vegetatively propagated crops such as yam, banana, sweet potato and manioc. Farmer seed producers *per se a*re among the seed sources least used (<1%), and only have a presence in the Hinche site within the SSSA sites sampled. Informal markets dominate, supplying over 70% of all seed, particularly for beans, peanuts and cowpeas.

These figures are striking. Local markets are used far more than in most other low-income countries, and are *the* most important seed source across nearly all crops and locations. This importance is not a transient effect of the earthquake. Just prior to the quake, 60-88% of farmers in the South Department sourced maize and bean seeds from the market (Walters and Brick, 2010). Similar figures were reported a decade earlier (Shields, 2001). There are several possible reasons for this. While on-farm storage is relatively straightforward for cereals such as sorghum and maize, it is generally more difficult to store large-seeded crops such as beans, cowpeas and peanuts between seasons. Additionally, cash needs, such as for school fees or debt payment, compel many to sell most of the crop at harvest. This helps explain the low availability of seed in stocks or with other farmers. Farmers thus transfer seed storage risks to the market, in the knowledge that they can buy appropriate seed at sowing time. (See Chapter VI for fuller discussion of this issue.)

New channels, new varieties: dynamism in informal seed systems

New varieties are important for introducing dynamism into local seed systems, which, overall, seem to be quite static in Haiti. Community interviews and seed mapping exercises (Chapter VI), indicate that most communities have seen no change in their sources for seed of major crops, or in their relative importance, over the past five to 10 years. This is despite efforts, such as those of NGOs, to promote farmer seed multiplication groups. Similarly, only 14% of farmers have brought a new variety onto their farms in the past five years, with most of these introductions coming from seed aid (see Chapter VI).

A related point is the relative absence of diversity of varieties for major crops. Many of the farmers interviewed during the SSSA named only one or two varieties per major crop grown and the overriding impression was that there is little innovation on farm. Weak extension systems and poor links with research

also mean that informal systems have large information gaps – so any new varieties introduced may not be noted. Yet local systems may not be quite as static as they initially appeared to be. Some of the ways that seed and varieties have moved through the rural sector in Haiti are described briefly below.

Locally based multiplication programs

The general lack of actual plant breeding in Haiti, described earlier in this chapter, means there are few opportunities for farmers to view or access new varieties soon after they become available. This contrasts with the diverse means by which farmers in other countries may discover modern varieties – for instance, via on-farm trials or open days.

Nevertheless, Haitian farmers can obtain good seed, and often new varieties, through a number of decentralized seed production initiatives. Although varied, they together produce only modest amounts of seed, perhaps 800-900 MT yearly, across crops.

ORE (near Cap Perrin) is probably the only organization that multiplies seed to International Seed Testing Association (ISTA) standards. It has long been organizing seed production through a group of contract growers, who re-sell seed to ORE for onward sale or distribution. Double Harvest (Cul de Sac Valley) farms an area of about 100 ha, producing about 185 MT/year of bean, corn and sorghum seed, particularly for NGO clients and MARDNR. The Réseau d'associations pour la commercialisation de la production agricole du Bas Artibonite (RACPABA), seems to be one of the few seed-related organizations geared to the needs of small farmer clients. In 2009, RACPAPA worked with 174 multipliers on 133.5 ha, and eventually sold 229 bags of rice (18.3 MT). This was purchased by small farmers and institutions, respectively at a 70% : 30% ratio. Note that rice seems to be the only crop for which small farmers currently buy significant amounts of high-quality seed. The Organisme pour le Développement de la Vallée de l'Artibonite (ODVA), produced an estimated 300 MT of rice seed in 2009 (using 150-200 contract growers), and sold the bulk of it, albeit at significantly subsidized rates.

A number of smaller, more community-centered organizations also produce seed. Among them are the FAO-stimulated Groupements de Production Artisanale de Semences (GPAS). The Irrigateurs de Dubreuil (AID), located in Torbeck, near Les Cayes, seems to be one of the more successful groups.[5] For instance, AID produced 40 MT of bean seed, for sale to FAO in 2009. An NGO, ACDI/VOCA, working in the Southeast, aimed in 2010 to produce some 20 MT of the highly appreciated bean variety Arifi Wurite. It obtained initial stocks from Double Harvest and then continued multiplication via farmer multipliers starting in August 2008. While this is a nascent activity, farmers and other institutions are showing keen interest in the seed, due to the bean's key varietal characteristics of good yield and high tolerance to the mustia fungus. Note also that ACDI/VOCA is experimenting with an interesting way of getting new varieties to farmers on a noncash basis, via a seed loan system (see Box 2).

5 An official list suggests there may be 12-16 GPAS functioning in Haiti. In 2010, the entire cluster was projected to produce some 200 MT of bean seed alone (P. LeCoent, personal l communication). The assessment team tried to follow up on two GPAS in the lower Artibonite area. Neither could be found nor were they known by other key seed multipliers, suggesting that the GPAS may vary in the degree to which they are productive and sustainable.

BOX 2. SEED LOANS AS A WAY FOR MOVING SEED EVEN AMONG THE VERY POOR?

A seed loan system is potentially a good way to move seed quickly and also to reach all types of farmers. Farmers are given an initial amount of high-quality seed which they are trained to multiply in a clean and efficient manner. At harvest, farmer-multipliers pay back some of the initial loan (at interest) but may also keep some stock — to multiply further, sell or eat. One of the main challenges of loan systems is to ensure that the seed paid being back is really of sowing quality (and not formed of immature or broken grains, or mixed with stones and dirt). Good seed loan systems have been shown to reach 20,000-25,000 farmers in two or three seasons, with some farmers getting seed of new varieties they would not otherwise have been able to afford.

ACDI/VOCA has been experimenting with a multiplication and seed loan system. Here are a few project milestones:

- ACDI/VOCA authentication of farmer land suitability, and expansion of commodity type and quantity of bean, corn, sorghum, manioc and peanut
- ACDI/VOCA authentication of 90% land preparation, and provision of cash grant based on land size, replacing traditional contract with a cash-grant contract.
- Harvest of seed and payback of seed "lent" and cash equivalent only in Anse à Pitre (4 kg, 8 kg or 16 kg by land size).

Such seed loan work has been initiated in all zones of ACDI/VOCA action. Côtes de Fer, Bainet, La Vallée, Belle Anse, Grand Gosier, Thiotte and Anse à Pitre.

There is a long history of efforts in Haiti to develop market-orientated farmer seed enterprises, from the Agricultural Input Boutiques (BIAs) and Artisanal Seed Production Units (UPSAs) in the mid-1990s, to PESA, a seed producers' group in Les Anglais supported by CRS. However, these groups have generally not developed strong links with potential farmer clients, and have tended to decline rapidly in the absence of large institutional buyers (as with most BIAs and UPSAs by 2000; Shields, 2001) (See Box 3). Where these groups continue to be active, they also retain some seed for their own use and thus contribute to the spread of new varieties to their own members, and to others in the community.

Community-based seed multiplication efforts also occur among groups or individuals. Informal farmer associations, which are not organized specifically for seed production, may also help to disseminate varieties. For instance, small groups of farmers in Cavaillon (South) occasionally travel to ORE to purchase new varieties of maize or beans. Though this seed is mainly for the benefit of their own members, these groups also sell seed to neighboring farmers, generally straight from their farms, thus contributing to onward dissemination.

Finally, cooperatives, local development NGOs (e.g., CODE in Camp Perrin), and other farmer groups may also play important roles in seed security. By being able to purchase seed in larger quantities, they can help secure access for their members. Also, cooperatives with grain storage capacity can help ensure a supply of seed for members in times of need.

BOX 3. THE SUBSIDIZED SEED PRODUCTION MODEL: HOW TO BREAK THE TREND?

Small-scale seed production groups, as well as more formal small-scale companies, should be important and sustainable sources of modern crop varieties and of good-quality seed for farmers. Small companies should be able to change their profile of crops and varieties on offer, to quickly respond to small-farmer needs and to tailor selling strategies to their local clientele.

Unfortunately, the history of small seed-producing cooperatives in Haiti reveals an industry that looks up to its donors and organizational buyers rather than forward to its clients. The case shared by the Cooperative d'agriculture au développement de l'industrie (CADI) reveals just how strong the need is for a rethinking of seed business strategy.

CADI, which became a cooperative in 1997, started an input store in 2000 and strongly invested in artisanal seed production from 2002 onward. The group focused on black bean production and particularly on a variety called BAT 304, which has good yields even in dry times and a great taste.

> Everything was fine from about 2004 to 2007. CADI trained farmer multipliers, bought their harvests and then sold to government and international institutions. In 2006, for instance, FAO bought 9 MT of their total 12 MT of seed on offer. One major client, one check, one guaranteed market. But then the organizational contract dropped off and CADI business ground to a halt.

CADI seems to have not yet:

- experimented to reach clients with multiple varieties and innovations;
- courted small farmers as major clients, which means selling varying quantities in many areas;
- set up a real marketing business plan.

It is time for most seed production groups to focus squarely on clients, economic sustainability and outreach. (Multiplying the actual seed is the easy part!)

Seed assistance

Special seed-related assistance has also served to introduce new varieties of different crops, conserve local landraces and provide seed in times of potential seed stress. The following programs have been prominent in this regard.

Seed fairs

Seed fairs, where farmers are given seed vouchers to purchase seed, were started by CRS in Haiti in 2009. Farmers, traders and organized seed production groups bring seed and other inputs to sell at the fair, which is a dedicated venue where voucher holders and potential seed sellers are brought together. Other similar approaches (outside Haiti) give farmers vouchers to purchase seed and other inputs from agro-dealers.

Direct seed distribution

Many NGOS, FAO and the Government of Haiti have been involved in direct seed distribution, particularly in the past five years, and extensively in 2010. These programs sometimes introduce farmers to new vari-

eties. The SSSA shows that 'emergency' seed distribution has been far more important than normal development and extension programs in diffusing new varieties (see Chapter VI, Table 29). While maize and beans have predominated, new varieties of other crops, such as rice and sorghum, have been introduced through emergency programs. It might be seen as unfortunate (and unwise) that emergency programs are being used for variety introduction. Such introductions should be accompanied by honed technical advice and multiseason follow-up. (These are not skills or services that emergency providers necessarily possess or can deliver. See Chapter VI, Box 10.)

Cross-border trade

Some materials find their way across borders, particularly materials from the Dominican Republic. There is extensive cross-border trade involving *Madames Saras*, petty traders and migrants (Caritas Haiti, 2010; Shields, 2001). Some NGOs also purchase popular varieties from there for distribution, such as ICTA Ligero beans, which are produced commercially in the Dominican Republic. Finally, the open trade with the USA does sometimes bring farmers new varieties to use, whether beans or vegetables.

Seed/grain markets – the heart of informal supply in Haiti

As the single most important seed source for Haitian farmers, local markets merit special attention. These markets sell grain and other essentials, and vary from weekly rural markets to more permanent ones in larger centers. They are extensively used by Haitian farmers. The average farmer in the South Department, for example, visits markets 45 times a year, travelling 80 minutes each way by foot (Shields, 2001).

There is a great deal of information about grain markets in Haiti, but how these markets work to buy and sell seed to farmers is still poorly understood. These markets are also often misrepresented, through claims that buyers and sellers never distinguish seed from grain, or statements that farmer seed purchases from local markets are always risky, desperate acts. This negative view of local markets ignores how farmers and some traders treat seed *distinctly* from grain. Specific actions seek to promote variety identity, adaptation and the physical and physiological quality of seed, even in the absence of formal certification (Sperling and McGuire, 2010, summarize cross-country evidence of this). Better understanding of these actions helps to build a more balanced appraisal of the contribution local markets make to seed security in Haiti, and can suggest new approaches to strengthen informal seed systems.

Markets for food and other products involve a network of different actors in Haiti: producers, importers, wholesalers, retailers and *Madames Saras* – intermediaries who buy and sell. These exchanges move products across the country from ports or producer markets to regional assembly markets (e.g., Jacmel, Pont Sondé) and to urban consumer markets, with reverse flows when rural demand increases prices in the hungry season. Rapid assessments, such as those using the Emergency Market Mapping and Analysis (EMMA) methodology, have investigated how these markets function, and how they may be disrupted by crises (USAID, 2010b, USAID, 2010a, Walters and Brick, 2010, Auerbach, 2008; see also FEWS NET). Such studies provide valuable information on the complex workings of Haitian markets, and their impacts on livelihoods and access to food. A dozen different market information systems regularly monitor prices of key food and nonfood products across nearly 100 markets in Haiti, though with varying standards of reporting and analysis (Damais, 2007). However, these information systems do not examine how seed is traded within these markets and do not monitor prices of specific varieties or how potential 'seed' is moved as opposed to 'grain'.

The rest of this section reports on focused study of seed/grain markets in two regions: the South (Les Cayes, Cavaillon, Cance, Camp Perrin, Torbeck and Arniquet) and Upper Artibonite (Gonaïves, Poteaux, Terre Neuve).

It focuses on four major crops: beans and maize in both areas, plus rice in South, sorghum in Artibonite. While not exhaustive, it advances our understanding of how local markets are used for seed supply.

Farmers' practices

Farmers and merchants in both South and Upper Artibonite outlined different ways to distinguish seed from grain when purchasing. These include:

1. Selecting buying location. Some areas are known for good seed, and farmers travel there specifically for seed purchases. For instance, Southern farmers highlighted Camp Perrin and Beaumont (Grande Anse) as good places to buy bean seed. Highland farmers in Terre Neuve (Artibonite) travel to lowland markets in Gonaïves to access a wider choice of seed types. Some farmers travelling to buy seed sell some of their purchases to others back home, further evidence that some regions have a reputation for quality.

2. Choosing sellers. Scale matters, as some sellers are more likely to obtain seed locally and be aware of key variety adaptation issues. Smaller-scale traders (generally farmers themselves), larger farmers (*grands planteurs*), and some farmer associations tend to source locally. Also, certain traders are known to specialize in seed and they carefully source and select their wares (see Box 4, on Darbonne market). Thus some sellers manage seed distinctly – and some farmers recognize this.

3. Questioning vendors about provenance. Farmers are acutely aware of adaption issues between seasons or agroecological zones and seek appropriate varieties where needed. For instance, '*deux mois'* (two months) maize is adapted to the lowlands of Gonaïves and farmers specifically seek it out in the market. Equally, highland farmers in the South avoid bean varieties from the irrigated plains (such as ICTA Ligero) which perform poorly in the mountains. Some vendors indicated that farmers query them about the origin of their stocks, taking this as a key indicator that they were buying seed rather than grain. Farmers often tell vendors when they are buying seed, rather than grain, or otherwise signal to vendors they are purchasing to plant by buying specific quantities (e.g., unusually large amounts of beans, unusually small amounts of maize).

4. Seeking stocks with good appearance. Farmers and merchants agree that lots of a single variety, with contaminants or shrunken grains removed, command higher prices, and are sold as seed *per se.*

5. Buying grain as potential seed, then selecting at home before planting. Some farmers do this because seed *per se* was not available for that crop in that market, or because they did not want to pay a premium price for seed.

These practices raise the chances that farmers will obtain seed of a known and (where relevant) adapted variety, with good germination (see also Box 4, Darbonne specifics). However, some farmers noted that buying seed from markets could still pose risks – particularly if their purchases were urgent (e.g., due to a failed first sowing). Farmers in such situations may have less scope to choose their seller or seed lot, or may have to pay a premium for the best-available seed.

BOX 4. NAVIGATING LOCAL MARKETS AND DISTINGUISHING SEED AND GRAIN:

Example from Darbonne

Buying seed in local markets has a bad image among many organizations and agencies, not just in Haiti but internationally. The assumption is that farmers or local market traders *never* make any distinction between seed (that which could potentially be planted) and grain sold for consumption. Thus, it's concluded that that farmers could face big risks if they buy their seed from local vendors.

However, Haitian farmers do often purchase planting material from local markets–across a large range of crops. Field evidence from Darbonne (Léogâne Commune) shows that farmers are agents, rather than victims, in their use of markets for seed. Buyers and sellers take multiple and diverse actions to distinguish seed from grain.

Farmer Action

The absence of formal certification does not mean that farmers buy seed from just anyone. Some farmers in Darbonne prefer to buy seed from specific vendors they know, who have a reputation for good-quality seed, and who source locally. Others specifically travel to markets in areas known for good production, or for providing particularly desirable varieties.

Darbonne farmers especially distinguish between key varieties of maize and sorghum, and only purchase from vendors selling pure lots of the preferred varieties. Cereal varieties are often kept separate by traders anyway, as different varieties sell for different prices even for food.

Farmers also are prepared to pay more for lots already selected for seed (i.e., grain from which inert material and shrunken or misshapen grains have been removed), and for particular varieties. Prices for seed can be 50% more than for grain being sold at the same time, and in some cases, up to 100% more, for example, for well-selected seed of the fast-maturing maize variety '*deux mois' (*two-months*)*, in Gonaïves.

Traders' practices

Not all traders are the same. Scale in particular affects how different merchants manage seed distinctly from grain (see Box 5 and Figure 4). Generally, those confined to one area or region – part-time traders or rural *Madames Saras* – know the names of key local varieties, areas of adaptation, and planting times. Most traders at this scale are themselves farmers or belong to farming households, and are involved in selecting seed from their harvested grain. For example, a Torbeck trader (South) pointed out that 'Trois mois' (three months) and 'Cinq Mois' (five months) varieties of maize and sorghum could not be planted in her area, and that "*Madames Saras* who bring in from outside do not know the difference. But ... I try to sell the right types for seed." During key sowing periods, locally based traders are more likely to sell seed as a product distinct from grain. They often display such seed in separate containers, and sometimes apply special treatments to it.

BOX 5. SCALE DOES MATTER: DIFFERENTIATING AMONG SEED/GRAIN TRADERS

Not all traders are the same. The scale of a trader's operation and her/his relationships with other parts of the market chain affect how a trader may manage seed versus grain.

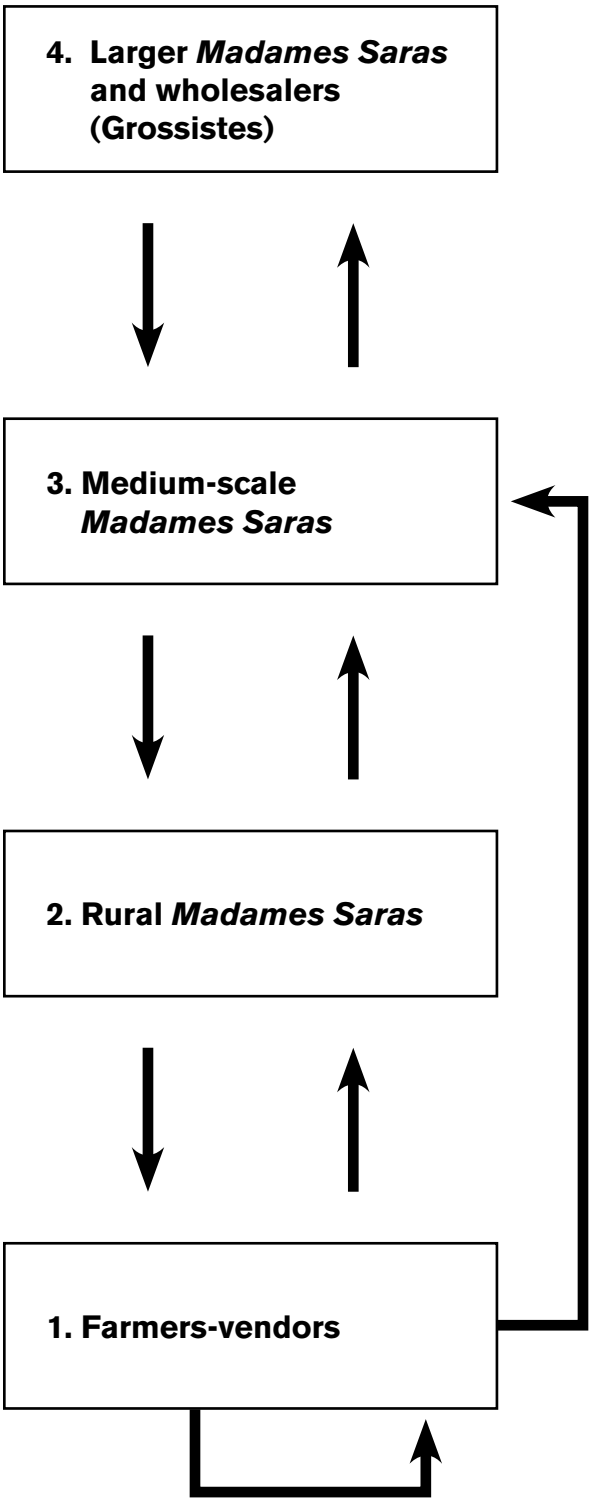
Figure 4 below shows a simplified schema of trader hierarchy, based on examples in the plain of Les Cayes, and in Upper Artibonite (Gonaïves and Terre Neuve Communes). Compared with other studies of market chains (e.g., Caritas Haiti, 2010, USAID, 2010), this schema places less emphasis on the urban retailers and wholesalers, and more on the diversity of vendors who directly interact with farmers, as these latter groups often trade in grain that has potential to be used as seed.

One important factor is that relatively better-off farmers (e.g., *grands planteurs*) are often known as sources for good seed, either selling directly to neighbors or in the market themselves (level 1). Also, 'level 2' traders (rural *Madames Saras*) are often active farmers themselves, or from farming households. They collect from local producers and re-sell in a set number of regional markets. Level 1 and 2 vendors are very aware of seed/grain differences, and of higher prices for selling seed *per se*. They may: have lots of a single variety; select to remove inert material and small or misshapen grains; and actually search for locally desired varieties. Sources at these levels also tend to be relatively local (a single farm, or local region, respectively). Seed *per se* may be a significant proportion of their turnover. One *Madame Sara* reckoned 20% of her sales were seed. Typical seed sales from rural *Madames Saras* are 1-3 tonnes a year. Note that rural *Madames Saras* (level 2) do also buy seed/grain from larger *Madames Saras*, with whom they may have established a relationship. So a portion of their stocks may come from other parts of the country.

Traders at higher levels are much more mobile, and move products between markets following price differences – suggesting their stocks may be more geographically mixed and cared for differently. However, even level 3 traders, medium-sized *Madames Saras* who travel between markets, may lack their own transport despite trading in relatively large volumes (e.g. 1-2.5 MT per week). These traders buy stocks at a single market (often before the market is open to the public, when it serves a wholesale function) and then take these immediately to another location on public transport, to sell. Thus, even at significant volumes, materials can still have a varietal uniformity. Finally, where there are clear differences between preferred varieties (as with maize and sorghum), these crop lots tend to remain unmixed even by larger traders, simply because different varieties command different prices: for food, and, sometimes, for seed as well.

In sum, farmer-vendors and rural *Madames Saras* (levels 1 and 2) are aware of seed/grain differences, and tend to source locally, with some *Madames Saras* even setting out to purchase material from specific sources or from farmers — to sell as seed. Their rural residence also means that 'social certification' is more of an influence: retaining a good local reputation matters and encourages them to be certain of what they are selling as potential seed. The seed/grain distinction is less clear at higher levels of trade, though even here, select traders may shift large quantities from a single agro-ecology and of distinct varieties-, which have potential to be used as seed.

Figure 4. Simplified levels of the seed/grain trade, based on analyses in the Cayes plain, and Upper Artibonite.



- Sell to large urban markets and retailers
- Important source of credit
- Can have own transport, storage
- Relationships with suppliers and outlets key resource

- Travel extensively between sites of production and demand
- Generally do not have own transport
- May not have own storage
- Buy from rural Madames Saras or directly from producers in market

- Usually farms, or from farming household
- Generally work in limited number of local markets
- Sell own production plus buy from neighbors
- May buy from larger Madames Saras to sell on
- Transport generally pack animals, may have basic household-level storage

- Some (particularly grands planteurs) sell seed directly to neighbors, or in local markets themselves
- May sell to rural Madames Saras (collectors) from homestead, or larger Madames Saras in market
- A few are organised collectively for seed production; generally contracts are linked to project purchasers

Price differences also clearly signal that sellers (and buyers) are conscious of the different management of seed from grain. Over and above seasonal price fluctuations, some vendors charge significant price margins (from 20 to 100%) above grain *sold at the same time* for selected stocks and for certain sought-after varieties. Such margins reflect the cost of removing inert material in pre-selection, and the value of pure varieties in some cases. Here are some examples from traders gathered during the SSSA:

- In Torbeck (South), selected 'Chicken corn' maize sold for 100 gourdes/MT and 'Maquina' sold for 60 gourdes at planting time (February), the latter for food only. In August, 'Trois Mois' sorghum sold for 100 gourdes, but 'Cinq Mois' (not sown) cost only 50.
- Another Torbeck trader charges more for selected lots than unselected lots of the same variety: 15-20 gourdes extra per MT for beans, 25 extra for sorghum, and up to 50 extra for maize.
- Farmer-sellers in the lowlands of Gonaïves charge from 50-100% more for selected grain of desired maize, sorghum and bean varieties.
- Farmer associations in Cavaillon (South) sell selected 'Maquina' maize seed for 50-75 gourdes/MT when the grain price is 40 gourdes.
- Clearly for some, there is a distinct profit in managing seed.

Seed flows between locations

Markets in major centers and in the Croix-des-Bossales market in Port-au-Prince are important hubs for buying and selling, and may shape seed flows in surprising ways. People and products in the Croix-des-Bossales market tend to remain in regionally segmented networks, with tight restrictions against crossover to other regional networks; urban traders' relationships with mobile *Madames Saras* help maintain these networks (Auerbach, 2008). This suggests that seed/grain moving from the capital to the regions may actually have originated in these regions. So geographical mixing in Haiti-wide seed flows may be less than anticipated.

As perhaps expected, seed flows in regional local markets are not exclusively local. Movement of seed/grain between highland and lowland areas is common, reflecting complementary harvest periods and inter-regional flows. In Léogâne (Darbonne) sweet potato cuttings move between the highlands and the plain, allowing re-establishment after dry seasons. For remote highland areas like Terre Neuve (Artibonite), farmers may travel to markets on the plain to buy and sell, as the greater accessibility of these markets affords them a wider choice of sellers/buyers. Thus, there can be a number of reasons for seed flows between regions.

How well adapted specific crop varieties are to specific agroecological conditions is an issue for many buyers and sellers of seed, but indirectly. Where this adaptation matters, farmers and traders, particularly locally based ones, say they take care to ensure the provenance and variety purity of what they buy. Highland growers in the South say they avoid beans from irrigated plots. This may be linked to the fact that the 'ICTA Ligero' variety performs poorly in upland areas. However, farmers and traders describe the issue in terms of provenance rather than variety, possibly because this black bean variety is difficult to distinguish from others. In other cases, such as black beans in the lowlands, they assert there are no serious adaptation issues related to seed source.

Seed flows between different agroecological zones are significant for some crops. However, as varieties are rarely well defined, it is difficult to determine how serious adaptation issues may be. The most-cited issue for farmers was season length (and possibly photoperiod sensitivity); other aspects of local adaptation, such as disease resistance or nutrient-use efficiency, are also likely to be significant between agroecological zones, but were generally not flagged by farmers.

A final aspect of seed flows is that of seed availability through markets. Traders in the two regions that were intensively studied – the South (Les Cayes, Cavaillon, Cance, Camp Perrin, Torbeck and Arniquet) and Upper Artibonite (Gonaïves, Poteaux and Terre Neuve) – had up to 40 years' experience in the seed/grain trade. However, *no one* could recall a time when he/she was unable to obtain seed, provided the trader had the funds to do so. When one small trader was asked this, her husband (a farmer) replied: "Of course she could find seed if needed. It's her profession, after all!"

Gender Issues: Food and Seed Security

We end this overview with a few observations about women and gender-related issues surrounding seed systems in Haiti. Seed security assessment and food/seed security interventions are not necessarily gender neutral. The notes below are intended as a reminder that gender concerns should help shape the forms of assessment and subsequent actions taken.

It has been noted that women in developing countries often manage seed system processes, especially storage and exchange of seed (Sperling, 2001). In Haiti there are other issues to be highlighted around women and seed security because so many households are female-headed and because women seem to be the drivers of petty rural commerce, including trade in agricultural products. Here we give an introduction to female-linked seed security and livelihood issues, with the specific seed security results appearing in Chapter VI.

Women's roles and responsibilities in the household and livelihoods

Household structure and processes

In rural Haiti, a high percentage of households are headed by females. Within the assessment sample, 24.5% of households were female-headed, with this varying by locality. In Léogâne, 39% were female-headed; in Hinche, only 11% were female-headed.

Cohabitation without marriage has been reported as fairly common, with the resulting stability of those households varying in terms of how much support men provide to the household (World Bank, 2002). Apparently, the law does not recognize many rights of women living under *plaçage,* or informal marriage, even though the majority of unions are of this type. In Bassin Bleu, roughly one-quarter of the 72 members of the Association des Femmes Vigilantes (one of the women's groups interviewed during the SSSA) were unmarried. They may live as the heads of household, or they may live with partners.

Women interviewees, especially in Léogâne, also claimed that men controlled the household resources but that they, the women, were given portions of it to buy food, seed and other household requirements. Across the assessment sites, women's priority expenditures were, first, food and, second, savings. The third priority varied. Some groups responded that school fees were important; some mentioned soap and other household goods; members of one group noted they would purchase items needed by their husbands. In this regard, women are the face of food security for the household as they make nutritional decisions and are responsible for food purchases and preparation.

Market roles and commerce

Many Haitian women have dual roles, as farmers and as traders of their household's production. In general, women are responsible for selling the harvest and for buying seed for the next year. Women also play a key role as intermediary traders, on several levels. Apart from seed and grain, women engage in "petit commerce" for a range of goods: cosmetics, cigarettes, candy, beverages and foods. Some women also own larger boutiques.

Haiti's informal economy is about 85% of the total economy, and women's commercial activities make up over 80% of this sector (Gardella, 2006). There is a direct link between women's roles and priorities for commerce, and household food security and well-being. As one woman noted, "If you have many children and the land isn't good, you eat your business."

Overview of women in seed and agriculture

Haiti has one of the highest female Economically Active Population (EAP) rates in the developing world, as 62% of women are part of the labor force (World Bank, 2002). Some 33.7% of the agricultural labor force are women, compared with 12% overall in the rest of the Latin America-Caribbean region (*Ibid*). Men and women share agricultural labor, with men taking on some of the more physical production work for certain crops, such as land clearing. Women are generally responsible for storage and marketing of agricultural products.

Access to land

Both female and male heads-of-household own land in Haiti. In general, female-headed households in the SSSA sample had smaller landholdings – 0.87 *karo* versus 1.04 *karo* in male-headed households. Changes in land area under cultivation after the earthquake were not found to be significantly different for female-headed households versus male–headed households.

Some women have access to small plots of land for themselves. They may plant the same crops there as on the household plot, and the harvest becomes part of the overall household harvest. These plots of land are rarely under their names. Even if the woman's parcel is small, it will mostly likely be registered in the husband's name, or even the community's.

Agricultural commerce and seed/grain storage

As noted earlier, there are several layers of women traders in Haiti. Rural and medium-scale *Madame Saras* are key intermediaries in the trade of food commodities and agricultural inputs, including seed, both at local and regional levels. Some also stock seed, grain and other commodities for sale throughout the year.

Seed/grain storage also occurs at the household level. A focus group in Lascahobas estimated that 50-60% of women participate in some kind of grain storage at the household level, either buying and storing grain from the market or storing their own grain, for resale later. There are also traders who buy and amass grain in larger quantities for sale at planting time, including some women's community groups. A women's association in Bassin Bleu, for example, buys, stocks and sells about ten 100-pound sacks of grain per month.

Women's crops

There was no clear indication of "women's crops" from the SSSA data and interviews, although many women tend to cultivate higher-value vegetables. For instance, managers in one of the agro-boutiques in Gonaïves, initiated under USAID's Watershed Initiative for National Natural Environmental Resources (WINNER) Project, suggested that women account for about two-thirds of their clients. Women clients are purported to be more interested in buying vegetable seed for crops like eggplant, but also buy seed for the cash crops in which they trade. Men tend to buy corn and beans, crops for which they do some of the field labor.

In brief, women have multiple roles in the seed system. They are producers of seed alongside their male counterparts. They are also the main conveyors of seed since they select the seed at harvest, store seed/grain in their homes, and bring it to market. Women are also among the major purveyors of agricultural goods in general.

Promising models to support women

There are a number of opportunities for supporting household seed and food security by promoting the women responsible for key production, trade and household well-being. For example, the Mutuelles de Solidarité (known as MUSO) are self-help or self-financing groups that help build capacity and promote innovation even in rural areas. Currently there are more than 3000 MUSOs in Haiti, according to KNFP (the Conseil National de Financement Populaire). Port-au-Prince has over 50 MUSOs with almost 1500 members, and many have already received external credit from microfinance institutions. One week after the earthquake, about 75% of MUSOs continued their normal activities, with attendance rates at 85%. They continued contributing funds and, not surprisingly, took cash from their emergency social funds.

The emphasis on group cohesion and solidarity, as well as continued access to emergency funds and savings, have shown MUSOs to be a significant players in the social and economic responses needed during normal as well as stress periods. MUSOs gives members access to small amounts of capital, either for rebuilding after an emergency or for purchasing agricultural inputs to stimulate economic activities. For instance, ACDI/VOCA has initiated eight groups based on the MUSO approach, including bean seed multipliers in La Vallée and vermiculture producers in Anse à Pitre. These groups are a mix of men and women, though they tend to have slightly more women and are often composed of both traders and producers.

Other kinds of women's groups could also be strengthened. One case is the Association des Femmes Unies de Poulie (AFUP), a dynamic women's group located in Lascahobas, in Plateau Central. This group, which has 50 members, has participated in on-farm trials and tested three pepper varieties provided by an international NGO: piment Habanero, piment cash bonnet, and a local variety, piment bouc. Habanero was successful and was introduced into the community. Madame Lafaille, one of the group leaders, noted that the group made enough profit from the successful trial to be able to buy a small plot of land for the group, as well as a small building for meetings and storage.

Working through agricultural women's groups such as AFUP is an opportunity for programs to both test new varieties and provide income for women. Some support might be needed to increase knowledge of seed-saving since AFUP proved dependent on the NGO for new seed supplies season after season. A program such as AFUP might be also be linked systematically with a larger variety selection and testing program, as well as with some form of savings-led microfinance scheme to help the women build capital for seeds and other inputs.

Formal and informal seed sectors: Summary

True plant breeding activities over the past 20 years in Haiti have been minimal and current internal capacity for breeding and screening resides largely with the Organization for the Rehabilitation of the Environment (ORE). However, important varietal introductions have taken place, largely the result of Haitian collaboration with various international research centers. Formal sector seed structures and capacity are also nearly nonexistent, with the exceptions of those linked to rice and, in particular, supported by the Taiwanese Mission project.

Decentralized seed production groups and organizations do manage to produce about 800-900 MT of seed annually, across a range of crops. However, much of this goes to institutional rather than farmer-client buyers and such enterprises may not be sustainable in the long run. New models of market-oriented seed production and delivery are sorely needed.

Overall, the formal sector currently plays a modest role in diffusing new varieties. Only 14% of farmers have received a new variety in the past five years and the formal sector plays only a modest role in diffusing high-quality seed, amounting to less than 2% of the total seed sown.

The informal seed sector has served an important role across Haiti, providing some 98% of the seed farmers sow, particularly through local seed/grain markets. Although there is not much dynamism in Haitian seed systems, there is clearly potential to build upon informal channels for producing and disseminating varieties and seed. Experience shows that farmers can produce good-quality seed and a preliminary investigation of informal markets shows both farmers and (some) traders strategize in their use of the market to boost quality and manage risks. A number of practices, as well as price and other indicators, clearly signal when 'seed' is being managed distinctly from 'grain'. The need to further strengthen and professionalize the informal seed sector in Haiti is discussed in more detail in Chapters VI and VII.

A final note about women and food seed security. One-quarter of rural households in Haiti are female-headed, and women are heavily involved in seed selection, storage and marketing of a range of crops and agricultural goods. There does not seem to be a set of women's crops *per se,* and such a label would put female efforts into too small a box, as women drive much of the agricultural trade. Women's key roles, in producing and moving crops for both commerce and consumption, suggest that their special needs also might best be reviewed in seed security assessments, especially to help guide the design of subsequent interventions.

The next chapter presents an overview of the fertilizer sector.

V. THE FERTILIZER SECTOR

This chapter reports overview trends in fertilizer supply and demand in Haiti: focusing on mineral inputs, but also reporting insights on organic inputs. More specifically, it aims to understand trends in overall supply of soil-related inputs in different zones; how the supply was used; possible current demand; and accessibility (especially in terms of price). Recommendations appear at the end of this chapter, as well as in Chapter VII.

Agricultural productivity in Haiti has been decreasing over the last three decades due to land degradation and low soil fertility. With a fast growing population (over 2% per year) demand for food has significantly increased and the agricultural sector has not been able to meet needs and earn money from exports. Loss of nutrients due to soil depletion and farming requires the use of some types of soil amendments on a large scale in order to increase crop yields and production.

Government efforts to reduce food insecurity in the country focus on intensification of agriculture with increased use of mineral fertilizer, improved seeds, and rehabilitation of agricultural infrastructures (irrigation systems). Meanwhile, some non-governmental organizations have encouraged the production and use of organic fertilizer at the farm level in order to develop a more environmentally friendly agriculture.

Importance of Fertilizer

Fertilizer is an essential component of food security and increased food production in Haiti. Over the past 10 years, Haiti imported on average 50% of its food (CNSA, 2010). Continuous or frequent cultivation of a soil without restoration of nutrients and organic matter lost during cultivation, as is typical in Haiti, results in soil degradation and loss of productivity. In Les Cayes, the assessment team was told that that one cannot produce rice, maize or beans without fertilizer. One agronomist also stated that when farmers had started farming a new area, they were able to do so organically, but with continued cropping they had to begin using fertilizer and pesticides.

Although it is possible to farm sustainably using traditional practices without fertilizer under shifting cultivation, Haiti does not have sufficient arable land to practice such a system, which requires long fallows that allow natural vegetation to return to its native state. Nye and Greenland (1960), reported that in the super-humid forests of Southeast Asia and Central Africa, one to two years of cropping were normally followed by 10-20 years of fallow, while in savanna and less humid forest, systems with 6-12 years of fallow were “apparently stable”, implying that soil fertility was maintained. Lesser fallows resulted in declines in productivity. Mutsaers (2007), using data from the East Indies by van Beukering (1947), estimated that 13 ha of gross land (assuming 70% cultivable) was required to cultivate 1 ha under shifting cultivation. This is not possible in Haiti, and even land that is referred to as fallow land is often so heavily grazed that there is little plant biomass produced that could contribute to restoration of soil organic matter and fertility. Under these conditions of degraded soils, soil productivity can only be restored through improved soil management, which includes management of soil organic matter and nutrient status. Crop residues should be recycled and other organic by-products, as well as N-fixing legumes, should be utilized wherever possible. However, judicious use of chemical fertilizers will ultimately be necessary to correct inherent soil nutrient deficiencies and to supplement nutrients supplied from other sources.

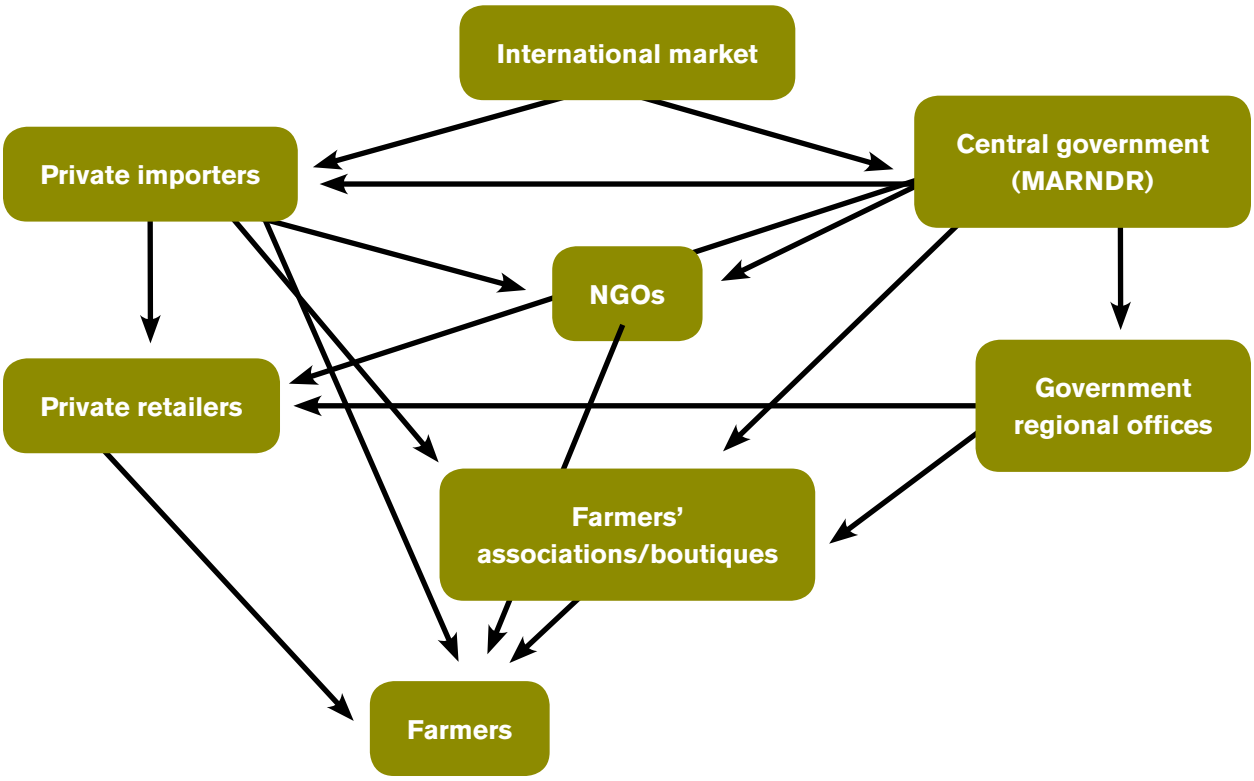
Systems of Fertilizer Distribution

Mineral fertilizer used in Haiti is imported from different countries and regions; the choice of purchase location depends primarily on the buyer and the source of funding. When fertilizer is bought by Haiti, it is usually purchased where it is cheapest, in the Dominican Republic, which is the dominant supplier, or Trinidad and

Tobago. Venezuela donated compound fertilizer from Europe and urea produced in Venezuela. Japanese have in the past stipulated purchase from Japan.

The market chain varies depending upon government policies, especially subsidies. The operators involved in the distribution and use of fertilizer are described in Figure 5. They include government (represented by MARNDR), private importers, NGOs, farmers' associations, private retailers and farmers.

Figure 5. Distribution chain of fertilizer in Haiti



Government distribution

The Ministry of Agriculture has been the major importer of fertilizer over the last 10 years. Despite slight variations in approach and policy, the Ministry has carried out a fertilizer subsidy program during much of this period, aimed at reducing prices in order to stimulate fertilizer use. Until 2004, the program, called KR2, was funded by the government of Japan (about $6 million/year) and the national budget. Since the summer 2008, following riots all over the country consecutive to the generalized food crisis, the government resumed subsidies through its Fertilizer Subsidy Program (FSP). Funding for the FSP comes from three sources: a yearly donation of $6 million dollars and an additional 12,000 MT of fertilizer in July 2009 from Japanese cooperation; about 27,000 MT of fertilizers from the Venezuelan government between July 2008 and January 2009; and $10 million from the Haiti budget in fiscal year 2009-2010 which was available after the January 12 earthquake.

Over the past 10 years, government intervention in the fertilizer sector can be divided into three periods, reflective of different approaches.

Period 1: 2000-2004

In 2000-2001, the government contracted with a local private company to import and store stocks of fertilizers for its distribution. Potential buyers paid the Ministry of Agriculture directly and the delivery was done at the importer facilities upon presentation of a certificate from MARNDR.

In 2002-2003, the stock of fertilizer was directly delivered and stored at an MARNDR warehouse at Damien where the sales took place on a first-come, first-serve basis; during the 2003 season, potential buyers were accredited by the regional offices and agencies of the Ministry of Agriculture (ODVA, DDAS). The clients of the Ministry of Agriculture were NGOs, private dealers and farmers' associations.

Period 2: 2004-2008

From 2004 to 2008, MARNDR withdrew from the distribution of fertilizer upon request of Japanese cooperation and also after an FAO-funded evaluation of the subsidy program. A free market then opened up and private companies imported fertilizer for sale in country on a competitive basis. The rapid and steep increase in fuel prices led to rising fertilizer prices worldwide. Consequently, prices of fertilizer rose sharply in Haiti making fertilizer less accessible to farmers. It is believed that agricultural production was greatly affected by the fertilizer shortage, which aggravated soaring food prices in Haiti.

Period 3: 2008-2010

One of the policy measures carried out by the government to respond to the rising food prices of 2007-2008 was to distribute fertilizer at low prices. In August 2008, it received a gift of 15,000 metric tons of urea from the government of Venezuela to conduct its subsidy program. In 2009, the Japanese government granted $6 million to resume the fertilizer cooperation program with Haiti. The government also brought some public funds into the program. Higher government officials wanted a free distribution of fertilizer throughout the country, but MARNDR managers set a low price equivalent to a subsidy of more than 75% of the FOB price. Currently, MARNDR purchases the stock of fertilizers and contracts with three private agricultural supply companies for storage.

Each Agricultural Departmental Directorate requests a certain amount of fertilizer to be distributed locally. However, the program manager finally decides the amount allocated to each region based on its agricultural production importance and past history of fertilizer use. Authorization to purchase at the MARNDR central office is supposed to be given by the Direction Départementale Agricole (DDA), but some people get around that and purchase their stock in Damien. At the departmental level, the purchase can be done at the Bureau Agricole Communal (BAC) or directly at the DDA facilities.

Private agricultural supply companies

When there is a free market policy, private agricultural supply companies import fertilizer for sale in country. There are three major companies involved in importing fertilizer (COMAG, Agrotechnique and Reimbault). These companies have major infrastructures to store fertilizer. Smaller companies include Darbouco SA, Agrisupply and Semeng. All these private companies import fertilizer from two major producers (FERSAN and FERQUIDO) in the Dominican Republic to distribute in the country. The big companies have significant capacity, allowing them to import larger quantities than the small ones. However, when the government fixes prices, they temporarily stop importing fertilizer, leaving the government as the primary importer. Nevertheless, they buy directly from MARNDR to distribute in different regions in the country.

Different opinions were expressed on the role of government and private sector in fertilizer distribution and subsidies. Some people felt that government should set policy and that the private sector should handle distribution. Others believe the government should control distribution as well, in order to ensure that the fertilizer gets into the right hands. It should be pointed out that that strategy does not appear to work very effectively now.

Government intervention in imports and distribution of fertilizer is not sustainable because of its dependence on foreign aid, mainly the Japanese program (KR2). An effort has been made during the fiscal year 2009-2010 to include $10 million in the budget for fertilizer. However, this effort can be linked to the engagement of the President of the Republic to support national agricultural production. Since politics plays a greater role in this decision, it is uncertain whether the effort will continue over time.

Non-governmental organizations

Some NGOs have been involved in fertilizer imports in recent years. In the past, NGOs such as SOCODEVI, ASSODLO and FLM imported a certain amount of fertilizer by obtaining a franchise from MARNDR. During the last cropping season, other organizations — Earth Institute, Oxfam, USAID/WINNER, the Taiwan rice project and FAO — were also involved in the import of fertilizer. These institutions granted their stocks to farmers' associations to which they provived technical support.

Since 2008, some institutions (NGOs and FAO) have been distributing fertilizers and seeds to farmers in direct response to the food crisis that provoked riots in different parts of the country. FAO, in its emergency relief program, distributed about 32 MT of fertilizer each harvest season to groups of farmers involved in seed production in selected areas in the country.

Local distributors

The local distributors are private retailers and/or farmers' associations which stock up via private importers and the government. These merchants are found in many urban and larger town areas, especially in irrigated areas. In Les Cayes for instance, the local distributors are Agroservice, Gerly, AIW, AID and four or five private individuals. Farmers' associations usually follow donors and MARNDR guidance to set fertilizer prices.

Farmers

Subsistence farmers are the end of the distribution chain. According to some estimates, there are about 800,000 small farms in Haiti. Official records suggest that a farmer cultivates on average 1.8 ha under various land tenure arrangements (MARNDR and BID, 2005). A small number of farmers operating in areas where water is available (irrigated areas, humid hillsides) use mineral fertilizers that they buy at a farmers' association boutique or from a private local merchant. Farmers' use of fertilizer may be limited by their lack of knowledge, availability and costs of the product, and the profitability of the investment. Lack of credit was repeatedly mentioned as one reason for low utilization of fertilizers by farmers. (Chapter VI addresses findings on farmer fertilizer use more closely.)

Mineral Fertilizer Availability and Use

Import and consumption of mineral fertilizer

Fertilizer imports between 2000 and 2010 ranged from a low of 12,526 tons in 2003 to a high of 35,000 in 2009, with total imports in 2010 projected to be as high as 50,000 tons (Table 7).

Table 7: Amount of fertilizer available in Haiti, 2000-2010

YEAR	AMOUNT OF FERTILIZER IMPORTED (MT)
2000	18780
2001	13674
2002	25297
2003	12526
2004	15000
2005	15000
2006	15000
2007	15000
2008	27000
2009	35000
2010	35000+
Average	**20666**

(Source: Bellande and Damais, 2004, and Jacques Alix, personal communication, 2010)

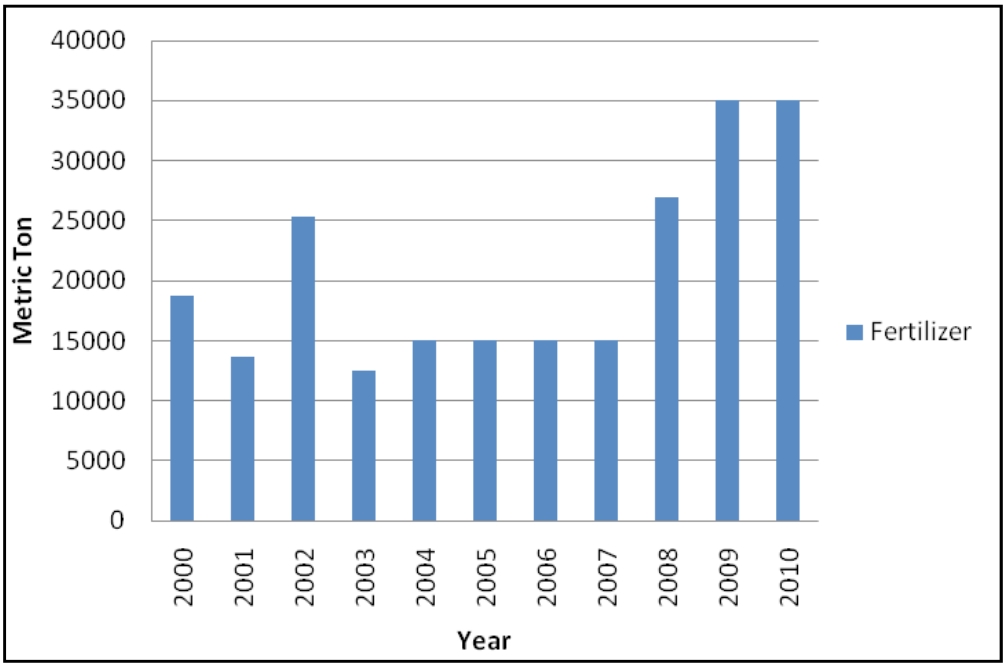
The amount of fertilizer imported in Haiti fluctuated between 2000 and 2003 to a peak of 25,297 metric tons in 2002 (Figure 6). During that period, MARNDR, private companies and NGOs imported and distributed fertilizers. From 2004 to 2008, the amount of fertilizer imported seemed to stabilize around 15,000 MT when private agricultural input companies were the primary importers. Since 2008, when the government resumed its subsidy program, the amount of fertilizer imported has greatly increased to reach 35,000 metric tons in June 2010.

In addition to government imports and distribution, several NGOs imported a certain amount of fertilizer during the cropping season 2009-2010. The WINNER project purchased about 2000 MT of fertilizers (15-15-15; urea and superphosphate) that it granted to 35 farmers' associations in Gonaïves, Plateau Central, Arcahaie, Kenscoff and Plaine du Cul-de-Sac. The project purchased directly from two local agro-dealers who import from the Dominican Republic. Associations have to sell the fertilizer to individual farmers at the price set by the govern-

ment. The amount purchased depends of the number of hectares that the project intends to cover in its areas of intervention. For the spring season, the objective was to cover 10,000 ha. The number of hectares is expected to increase over the next few years.

In the South, the Taiwan project makes available about 18 MT of fertilizer to a number of farmers they support. The amount of fertilizer purchased is based on the number of hectares the project plans to cover. The purchase will increase by about 18 MT each year over the next five years. The project may purchase from the government subsidy program; but given the type of fertilizer recommended (20-5-20-4S), the stock is directly purchased from the Dominican Republic.

Figure 6. Fertilizer imports to Haiti between 2000 and 2010



Consumption of fertilizer has shown an upward trend for the last two years to reach 35000 MT in June 2010. According to MARNDR, fertilizer consumption is expected to reach 50000 MT by the end of 2010 and 100000 MT over the next 10 years. Other agronomists suggest that the fertilizer market will be around 120000-125000 MT for the next 10 years. However, this growth is contingent to investments in irrigation systems, affordable prices of fertilizers to the small scale farmers, crop prices.

Areas of fertilizer distribution

The amount of fertilizer distributed in selected areas depends on their agroecological importance, the type of importer, and the presence of NGOs. The current Haitian government controls in some measure where fertilizers are made available throughout the country. Fertilizer distribution by agricultural Department is as follow (Table 8). The priority is for irrigated areas, followed by humid areas with vegetable production. Grand'Anse is considered an organic production area and little fertilizer is used there. The Northeast and Northwest also received negligible amounts of fertilizer.

Table 8: Distribution of fertilizer by agricultural region in Haiti

AGRICULTURAL DEPARTMENT	PERCENTAGE	MAIN CROPS	MAIN LOCALITIES
Artibonite Valley (ODVA)	45%	Rice, vegetables	Mainly the Artibonite Valley
West	15%	Vegetables, plantain	Kenscoff, Pine Forest, Furcy, Arcahaie, Cul-de-Sac Plain
South	10%	Rice, beans, maize, leafy vegetables	All the plain of Les Cayes, Saint-Louis du Sud
Southeast	8%	Coffee, vegetables	Thiotte, Cap-Rouge
Nippes	5%	Vegetables, rice	Rochelois Plateau, Abraham, Anse-à-Veau
Plateau Central	4%	Coffee, vegetables	Baptiste, Belladere, Mirebalais
North	4%	Rice, vegetables	Saint-Raphael, Grison Garde, Camp-Louise
Other (Northeast, Northwest, Grand'Anse, Upper Artibonite region	About 10%	Rice, vegetables, beans, coffee	Maribaroux (NE), Saint-Louis, Anse-à-Foleur (NW), Beaumont (GA), Gonaïves, Ennery, etc. (Artibonite)

Source: Jacques Alix and authors

MARNDR fertilizer policy strongly favors the Artibonite Valley over all other regions, and irrigated land, to the exclusion of rainfed agriculture with exception of high-elevation humid zones where vegetable production predominates. Estimates of quantities of fertilizer required currently or in future are based solely upon areas under irrigation or having potential for irrigation. Rainfed agriculture and sloping land are ignored. However, Bossa *et al.* (2005b) showed strong fertilizer responses at three rainfed sites, two of which were on slopes of 20-30%. Fertilization with P promotes root growth (Brady and Weil, 2002), which increases a plant's ability to withstand drought.

It appears that rice is the main crop being fertilized in the country. The Artibonite region receives the largest amount of fertilizer consumed in Haiti (40-45% of the total fertilizer available in the country). This fertilizer is mainly distributed in the Artibonite Valley where rice is the major crop. Rice is also produced in more than 10 other locations where MARNDR distributes a certain amount of fertilizer through its local agencies. Rice production covers more than 50,000 hectares throughout the country (Bayard, 2007).

Shortages of fertilizer are a common and continuous problem. When asked how often there are shortages, several respondents in the Les Cayes area answered that shortages occur several times per year. This happens because of the irregularity of imports and insufficient fertilizer allocations to Departments. When the government imports fertilizers, it takes two to four months, sometimes more, before the product is made available to farmers; when the purchase is made from the cooperation funds, the government has to receive the donor

approval and then go through a process of seller selection, disbursement and payment. These procedures can take more than four months. When the private sector orders the fertilizer in the Dominican Republic, it takes less than one month for it to be available to farmers.

Both government and NGO employees in Southern Haiti complained that the amount of fertilizer sent to the South by the MARNDR central office was inadequate to meet the demand. These interruptions in supply lead to speculation, which further exacerbates shortages. Speculation exists despite efforts on the part of Ministry departmental staff to control it. Businesses hoard fertilizer until a shortage and then sell at 20% above the government price, or even double or triple the government price. Some people argue that fertilizer is readily available when imports and distribution are carried out by the private sector. However, prices always exceed most farmers' reach.

In discussing fertilizer shortages, some agronomists believe that a fertilizer mixing plant should be established in order to increase fertilizer availability as well as the range of fertilizers available. At least two attempts in the past were not successful. Opinions vary on whether a fertilizer mixing factory is needed in Haiti. The current fertilizer market is dominated by two firms in the Dominican Republic. Many believe that success would require participation or acquiescence of manufacturers in that country.

Despite complaints about shortage of fertilizer in several areas, some suggest that a certain amount of fertilizer available in Haiti crosses the border illegally to be sold in the Dominican Republic. Exchanges of agricultural commodities and inputs commonly take place at the border between Haitians and Dominicans. In 2007, when fertilizer was sold in a more competitive market in Haiti, it was observed that farmers in the Maribaroux area (Northeast) purchased fertilizer in cash or credit in the Dominican Republic to grow rice (Bayard, 2007). Today, with a lower price for fertilizer in Haiti, Haitians have more incentive to sell fertilizer in the Dominican Republic. The size of the illegal flow of fertilizer into the Dominican Republic is not known. According to one estimate, about 10% of the stock available in Haiti goes back to the Dominican Republic to be sold at higher prices. It was not possible to check that claim; however, there exist conditions that may facilitate such deals:

- Price differences between the two countries. Given that fertilizer is currently highly subsidized in Haiti in contrast to the situation in the Dominican Republic, the price is lower in the former than in the latter. Therefore, some dealers may try to cross the border with stocks of fertilizer to make a profit.
- Delays in the distribution of fertilizer. When the stock arrives too late during the cropping season, on-farm use may be reduced. Given the lack of storage facilities, merchants are going to try to sell at a favorable price in the Dominican Republic.
- Fertilizer distribution in areas of limited consumption such as the border regions of Northeast, Southeast and Central Plateau. If stocks received by these regions are greater than what they can consume, and given the delivery delays that have often occurred in the distribution system, sufficient conditions exist for trade to take place at the border especially when there is a major price gap.

Types of fertilizers available

The fertilizers most commonly available are 20-20-10 and urea. Sometimes the compound fertilizer 12-12-20 (N-P2O5-K2O) is available instead, and sometimes ammonium sulfate is available instead of urea or in addition to urea, as a nitrogen source. Other fertilizers sometimes available include 16-10-20, 12-24-24. The government once provided 16-16-16. The reason given for choice of fertilizer purchased by the government was generally price and availability, although in the past it has also been influenced by the donor. For example, when Japan donated money for fertilizer, they required that it be bought in Japan, and when Venezuela was the donor, it was Venezuela that purchased the fertilizer.

Sometimes other organizations have themselves purchased and imported fertilizer types that they considered important for the area in which they were working. The WINNER project recently included superphosphate (most likely triple superphosphate) in a stock of fertilizer it purchased. The Taiwan rice project in Torbeck in the South of Haiti imported 20-5-20-4S from the Dominican Republic. And the agricultural supply company, Darbouco, imported 20-20-20 foliar spray for vegetable and ornamental nurseries.

Agronomists complain of a lack of choice in the fertilizers available. One cannot always find the most appropriate fertilizer for particular crops or soil conditions. The importation of only two types of fertilizer does not account for regional differences in nutrient deficiencies. For example, several agronomists working in the Plaine des Cayes reported K deficiency and indicated that they could not obtain a compound fertilizer with a higher proportion of K, such as 12-12-20. The Taiwan rice project also reported apparent S deficiency, and to address these two problems imported their own fertilizer. Another complaint was that ammonium sulfate was preferable to urea on rice grown on alkaline soils in the Artibonite Valley but that it was seldom available. Apart from urea or ammonium sulfate, single-element fertilizers are generally unavailable, which means that if one wants to more closely follow recommendations based upon soil tests, one cannot adjust the rates for P or K without affecting the other nutrient.

Prices of mineral fertilizer

Chemical fertilizer has become a critical input in agricultural production, especially in rice-producing areas such as the Artibonite Valley. Price has always been a major issue in the fertilizer sector in Haiti. Hence, the government often intervenes on the market to set fertilizer prices. Over the years the Haitian government has alternated between subsidizing fertilizer prices and leaving prices to fluctuate with the market. The evolution of fertilizer prices is reported in Table 9 and Figure 7.

Table 9: Evolution of fertilizer nominal prices in Haiti, 2000-2010, in gourdes

YEAR	SULFATE	UREA	20-20-10	12-12-20	10-10-20	12-24-24	20-5-20-4-S
2000	75	107.5	107.5	95	95		
2001	0	150	150	135	135		
2002	100	155	155	140	140	180	
2003	160	265	230	225	225	280	
2004	825	800	735	280	280	320	
2005	939	854	753				
2006	858	820	563				
2007	949	994	726				
2008	1631	1278	1290				
2009	500	500	500				500
2010	500	500	500				500

Sources: Bellande & Damais, 2004; CNSA, 2010; Jacques Alix

Two approaches have been used to set the prices of fertilizer in the country: free market, where supply and demand guide decision making, and government control. Until the end of 2003, fertilizer prices were relatively low varying from 75-160 gourdes per 100 lb bag for sulfate, and 107.5-230 gourdes per bag of urea. The prices were set by MARNDR to make fertilizer more affordable to farmers. At the end of 2003, the government fertilizer subsidy represented more than 40% of the actual costs. Prices were set according to the type of fertilizer. The marketing margin was calculated for distributors to reflect location difference. Therefore, farmers paid slightly different prices depending on their locations.

From 2004 to 2008, prices skyrocketed, varying from 800 gourdes to 1278 gourdes per bag of urea when the distribution was carried out by the private sector (Figure 9). These prices reflected the real costs of importing and distributing the products within the country. In the absence of government intervention, the law of supply and demand determines prices. Prices of fertilizer largely exceeded those of crops. Consequently, few farmers could afford to buy even a small amount of fertilizer. As one agronomist observed, farmers stop buying fertilizers when prices reach a certain level. Although farmers complained about the high prices, they acknowledged the availability on the market during that period.

Currently, the price of all types of fertilizer is about 500 gourdes everywhere in the country. This corresponds to a subsidy of 80% of the actual costs. Upon its return in the fertilizer sector in 2008, the government set a maximum retail price at 500 gourdes per bag for all types of fertilizer. All operators must apply this policy. Although the current price is set at 500 gourdes per bag for the farmer, in actual fact the government sells bulk quantities at cheaper rates. Between July 2008 and August 2009, the MARNDR selling price varied based upon the quantity purchased, as follows:

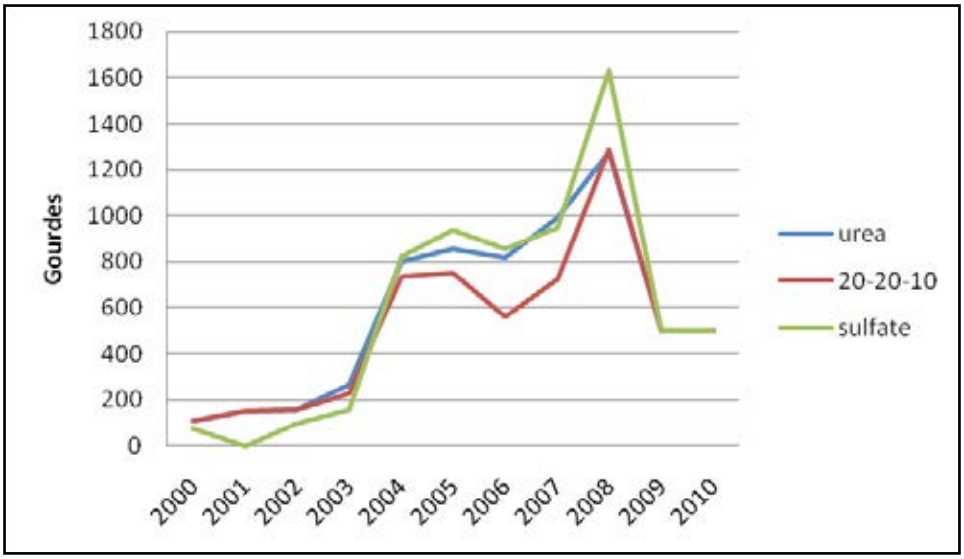
< 200 bags –	375 gourdes	200-999 bags –	350 gourdes
1000 – 4999 bags –	325 gourdes	≥ 5000 bags –	300 gourdes

Since 2009, MARNDR has been selling fertilizer to intermediaries at 350 gourdes per bag regardless of the quantity sold. The price differential between the wholesale and retail price is intended to allow the local suppliers to cover transportation costs and make a small profit. We did hear reports that fertilizer was being hoarded to be resold at double and triple the government price.

MARNDR officials worry about how they will pay for subsidies once aid funds have been spent. The Cabinet's current policy is to slowly wean farmers off subsidies over five years. Recent fluctuations in prices and demand suggest that demand is highly elastic. A decrease in subsidies will likely lower demand and, as a consequence, lower agricultural production unless it is accompanied by increases in agricultural prices and/or profit.

There is widespread belief that fertilizer subsidies are essential for food security in Haiti. The amount of fertilizer consumed in Haiti appears to be highly dependent upon price. There is wide agreement among agronomists that most farmers lack resources to pay market prices for fertilizer. The inability of Haitian farmers to afford inputs is linked to low prices of food commodities. While it is not desirable for government to involve itself in markets, it is hard to argue that Haitians should not subsidize fertilizer when the domestic market is flooded with imported commodities, some of which are themselves subsidized.

Figure 7. Evolution of fertilizer prices in Haiti, 2000-2010, in gourdes



Research and Fertilizer Recommendations

Soil characterizations

It is important to point out that soil characterization can be done for different purposes and using different methodologies. Soil characterization for "type" of soil involves examining the horizons in a soil profile and assessing physical and chemical properties in the field and laboratory. This assessment is used to assign a soil to a particular taxonomic class, family, etc., and when done in conjunction with soil mapping, the soil is assigned to a soil series and mapping unit. To our knowledge, soil maps and soil series have never been developed for Haiti. This is highly specialized work that can only be done by a pedologist, soil morphologist or professional soil classifier. To further complicate matters, different soil classification systems are in use around the world. The most important for Haiti would be Soil Taxonomy, developed in the United States, the French system, and the FAO system.

The only documented soil descriptions and classifications that we had access to were conducted by Auburn University. Pedologist Richard Guthrie (Guthrie and Shannon, 2004) described and classified nine profiles during the 1990s using Soil Taxonomy at seven locations used in the experiments conducted by the PLUS and Soil Management CRSP projects of USAID. The authors noted very low P, possible nutrient imbalances, and micronutrient deficiencies associated with high pH and high Ca on some soils. On the other hand, most soils have high cation exchange capacity and high organic matter which are favorable with respect to fertilization with P and minor elements. An earlier publication (Guthrie *et al.*, 1990) contains profile descriptions and classifications from 30 sites around Haiti. It is likely that several profile descriptions were done in the Salagnac area in the early 1980s in conjunction with the French cooperation, but we did not have access to this information.

Professor Hans Guillaume at FAMV reported that he had carried out soil assessments in Cul-de-Sac and 15 profiles in the Plaine des Cayes, but he was unable to produce the reports. He reported that lack of drainage was a problem in Cul-de-Sac, resulting in high salinity. Louissaint and Duvivier (2005) assessed chemical properties and soil texture at 0-30 cm and 30-60 cm depth in 50 soils in the Artibonite Valley in order to assess soil fertility status of rice-producing areas. Although the results gave some general information on soil fertility, they were not used to develop fertilizer recommendations.

Soil description and classification cannot on their own be used to generate fertilizer recommendations, but do indicate general soil chemical and physical characteristics that affect availability of plant nutrients and the response to fertilizer application. Soil fertility is greatly affected by parent material, as well as the degree of weathering of soils. In Haiti, soils may be grouped according to limestone and basalt parent material, which have very different properties affecting nutrient availability to plants. However, one also encounters dark red soils, suggesting weathering of clay minerals, especially at high elevations, as well as acid soils at a few locations. If soil classification and mapping could be carried out in major agricultural areas and in conjunction with fertilizer response trials, this would enable researchers to better categorize soils from different areas in order to yield better recommendations. Fertilizer recommendations can best be made based upon soil tests that have been correlated with field responses in fertilizer trials on soils that have similar properties. Thus, the usefulness of soil classification is to enable grouping of soils that are likely to respond similarly to fertilizer applications.

Research on fertilizer

Lack of funding for agricultural research and extension has been a serious issue in Haiti for decades. Government and donors have not placed a high priority on agricultural research, and consequently research has declined over the past three decades. Research on crop fertilization is very rare in Haiti. There have been some studies conducted on the use of mineral fertilizer in the 1990s and in recent years.

Clermont-Dauphin (1998) surveyed farmers in the Kenscoff and Artibonite areas and, based upon fertilizer history, calculated linear regressions yields on quantity of 16-10-20 applied. In Kenscoff, the survey was conducted in Fort Jacques and Furcy where the soils are calcareous in the former and basalt in the latter. Effects of fertilizer were assessed mainly for cabbage and potato. Data for each locality was grouped by soil type or by use of manure or compost. Results of the study indicate a positive relationship between amount of fertilizer applied and crop yield in most instances, but the relationship was stronger in the absence of organic amendments. In the Artibonite Valley, where soils may vary from one location to another, the focus was on rice. She found that the effectiveness of fertilization of rice was related to the drainage of the soil. On well drained sites, there was a strong response to N. She recommended a maximum of 200 kg N ha^{-1} with 30% coming from 20-20-10.

Bossa *et al.* (2005b) conducted P and K fertilizer response trials in maize on calcareous soils at Bergeau and Pernier, basaltic soil at St. Georges, and a high-elevation soil at Salagnac, also over limestone. Treatments of leucaena prunings without fertilizer and with mid-levels of P and K were also included. Significant responses to P and K were observed; however, the responses were very different on different soils. At Bergeau, K application gave a strong response, but P applied alone had no effect on maize yield. At high levels of K application, there was a modest response to P. At St. Georges, fertilizer responses were more complex with a very strong P X K interaction. Phosphorus applied in absence of K depressed yield, but in combination with potassium increased yields. Potassium at low rates increased yield independent of P application, but at high rates it only increased yield in the presence of P. At all three locations, the application of prunings from leucaena significantly increased maize yield. This indicates that soils differ in their nutrient requirements. The basalt soil at St. Georges was deficient in K. The calcareous soil at Bergeau appeared to fix P fertilizer and P appeared to affect yield only at high rates. In the absence of knowledge, it is safe to say that P and K should both be applied, but the relative proportions of each should be determined by soil tests. Application of prunings significantly increased soil P and K over three seasons.

Duvivier *et al.* (2006) carried out a fertilizer trial on rice at Mauger experiment station in the Artibonite Valley. They varied rates of P and K using 20-20-10, while using urea (46-0-0) to maintain the N rate constant at 115 kg N ha-1. There were no significant differences in yield due to fertilizer rates. It is likely that there was high

residual P and K from past fertilization. Similar trials carried out by the Programme d'Intensifcation Agricole (PIA, 2006) on farms in six areas of the Artibonite Valley also gave nonsignificant results. In a follow-on study, four rates of N (0, 50,75 and 100 kg N ha-1) and two rates of K (0, 30 kg K ha-1) were tested in 12 on-farm trials. Fertilization with N increased yield, but K had no effect. The authors used the LSD for means separation, which showed no significant differences between the 50 and 100 kg N ha-1 rates; however a plot of the data suggests a linear response with highest yield at 100 kg N ha-1.

The Taiwan project tested rates of fertilizer for rice in South. Although they did not publish their data, they reported potassium deficiencies in the Plaine des Cayes, as well as response to S. Eliassaint Magloire also indicated that he found K deficiencies in studies he carried out in Plaine des Cayes.

On-farm fertilizer recommendations

There are no official recommendations on fertilizer use. Agronomists in the field generally advise farmers based upon rates established over time for specific crops. NGOs also provide guidance. Although there is logic based upon crop differences, there is generally no consideration for the existing fertility conditions of specific fields.

Fertilizer used is generally expressed in number of bags (100 lbs or 45.45 kg) or kg/ha. Bellande and Damais (2004) reported the amount of fertilizer used on farms for selected crops in different regions (Table 10).

Table 10: On-farm use of fertilizer in 2004

AREA	CROPS	DOSAGE (KG/HA)
Artibonite	Rice (irrigation)	400
Les Cayes	Maize (irrigation)	300
	Beans (irrigation)	250
Rochelois Plateau (Salagnac)	Cabbage/Carrot	450
Furcy/Kenscoff	Leek	800
Thiotte	Coffee	250

Source: Bellande & Damais, 2004.

Interviews with agronomists and review of the documentation indicate various amounts of fertilizer for different crops in selected areas. Amounts used on vegetables in Forêt des Pins range from 10-15 bags ha-1. At Salagnac, yam, carrot and cabbage are fertilized with 600-800 kg of fertilizer with the addition of manure (chicken litter, rabbit and horse waste) when available. Beans receive about 300 kg 12-12-20. GRAMIR suggested 500 kg/ha compound fertilizer on beans in Nippes, 600-700 kg / ha of Urea + compound fertilizer on rice. On cabbage, 100 kg /800 m2 = 125 kg/ha compound fertilizer. On the Plaine des Cayes, fertilizer is used on rice, vegetables, maize, tobacco and beans. On rice, farmers use four bags urea and five bags 20-20-10. On maize, four sacks of each are applied. The Taiwan rice project recommends 450-500 kg fertilizer per hectare on rice. They recommend 10 sacks of fertilizer with 20 X 20 cm spacing and under best management with 25 X 25 cm spacing, 11-12 sacks of which four sacks of urea. They recommend four applications (1/3, 1/3,

16%, 16%) beginning with basal doses of complete fertilizer. Arsène Similien at SEED Minstries in Les Cayes estimates that 120 kg N ha is needed on rice and 100 kg N ha on maize. 30% of N may come from compost. Most farmers only use urea. Compound fertilizer is applied only in alternative seasons.

Oxfam recommends the use of compound fertilizer for cassava, a crop produced mainly in dry areas. They recommend about 19 bags (of 100 lb) of mineral fertilizer per ha. Mineral fertilizer should be applied at the time of planting and 50 days later. They stress the importance of water for fertilizer use.

Some agronomists have proposed an amount of fertilizer specifically for rice, but it is not clear if these recommendations were followed. Duvivier *et al.* (2006), concluded that 115 kg N ha-1 + 27 kg P2O5 ha-1 + 13 kg K2O ha-1 was sufficient to obtain a rice yield of 6 tons per hectare based upon research conducted on rice in the Artibonite. This was approximately half of the P and K fertilizer utilized by farmers in the same area. In another document the Programme d'Intensification Agricole (PIA, 2006) recommended 75 kg/ha of N, 30 kg/ha P2O5 and 14 kg/ha K2O, equivalent to approximately four bags of 20-20-10 and two bags of urea. The residual fertilizer would benefit vegetables in the rotation. Clermont-Dauphin (1998) cited a recommendation by Messaien (1975) not to exceed 1000 kg ha-1 of 16-10-20 or 800 kg ha-1 20-10-20 for vegetable production in Kenscoff.

There is little scientific support to guide fertilizer application at the field level. The soil testing laboratory at FAMV lacks basic supplies (chemicals) and lacks resources to maintain equipment. Cost also limits choice of reactants used. When there is a request for an analysis, chemicals must sometimes first be ordered from the US. Therefore, test results cannot be furnished on a timely basis. Often, those needing soil analysis simply send the samples to the Dominican Republic for testing. Because there is not sufficient demand for such service, the lab cannot maintain stocks of supplies. So there is a vicious circle that must be broken.

Fertilizer recommendations based upon soil tests are apparently not based upon correlations between soil test values and yield carried out on Haitian soils. Apparently soil test interpretations are based upon correlations done on US or French soils. For example, Louissaint and Duvivier (2005) cited a French source in assessing P and K values. Some fertilizer response trials have been conducted, but not systematically around the country. Some fertilizer response studies did not use single-nutrient fertilizers, with the result that P and K or N, P and K were confounded. Lack of availability of triple superphosphate and muriate of potash in Haiti was given as the reason.

Fertilizer response studies coupled with soil testing could lead to a more rational fertilization program. Studies by PIA (2006) suggest that too much N, P and K is being applied on rice in Artibonite. Given the long history of fertilization in certain rice and vegetable growing areas, it is highly possible that P rates should be decreased because of a possible build-up of P in these soils. Although the rates reported above seem reasonable, Clermont-Dauphin (1998) reported high and sometimes extremely high rates of fertilizer, some reaching 2700 kg 16-10-20 ha-1 applied to cabbage and potato at Fort Jacques and Furcy. Some of these farmers also applied manure or other organic fertilizer, further increasing nutrient applications. High rates of fertilizer and manure application on potatoes in the Forêt des Pins have also been recorded (ATPPF, 1998). Although Clermont-Dauphin (1998) concluded that fertilizer application on vegetables was profitable, such high rates of fertilization are probably not economic and could lead to environmental pollution. Hence there is a need to develop more rational fertilizer recommendations based upon research.

Alternative Sources of Plant Nutrients

The Ministry of Agriculture has not encouraged the production and use of organic fertilizer. Some suggest that pressure on the land for food production militates in favor of mineral fertilizer in order to obtain quick results. In

most parts of the country, soil fertility is maintained by the recycling of organic matter and crop rotations. Tree cuttings and the resulting soil erosion and overgrazing of the land leave little organic materials able to restore the fertility. In areas where water is adequately available (irrigated regions, humid mountains), and high-value crops are produced (rice, vegetables), mineral fertilizers are used in large amounts.

Alternative sources of nutrients from organic and biological sources have not been widely utilized, although some NGOs are actively promoting solutions such as composting market refuse or bagasse. Animal manure, primarily from the poultry industry, has been a source in the past but availability has considerably decreased with the decline in domestic poultry production. Some NGOs provide technical support to farmers in preparation and use of compost. Materials used for the compost include crop residues, market wastes, and animal dung (from cows and horses). This practice is known throughout the country, but it is not well documented. Farmers in different regions of the country have received advice and training from NGOs to use compost. Oxfam, for instance, recommends the use of 62 bags of well decomposed compost per hectare of cassava. Others suggest 36 bags of compost per hectare for rice. Some organizations are also promoting vermiculture, where the worm castings are used for fertilizing crops and the worms are fed to chickens. All of these nutrient sources have low concentrations of nutrients compared with fertilizer, and the cost of transporting these materials long distances can be an issue. Also, the volume of compost and manure is likely to be small relative to land areas under cultivation. As a result, these nutrient sources are most likely to be used on high-value crops or on crops close to the production areas.

It seems very little thought is being given to herbaceous and tree legumes as sources of N and organic matter. These sources could reduce but not eliminate the need for fertilizers. Magloire reported that ORE successfully introduced the use of velvet bean (*Mucuna* spp.) as a cover crop in sorghum cultivation in Formond. The sorghum is planted without tillage into the velvet bean residues from the previous season. He believes that this practice is still in use. Jean René Bossa carried out experiments in the 1990s with the legume *Canavalia ensiformis* interplanted with maize in a system that has been promoted by CIMMYT (personal communication, 1997).

One plant that has a lot of potential as a source of N is leucaena (*Leucaena leucocephala*). This N-fixing legume tree has been widely planted in many parts of Haiti as contour hedgerows for soil conservation. When these trees are pruned and the prunings applied to the soil as mulch, they provide significant amounts of N and recycle P and K, as well as secondary and micronutrients that benefit crops planted in the alleys between the hedgerows. Isaac *et al.* (2004) measured 81-145 kg N ha-1 per season in prunings during four seasons in an alley cropping study in Pernier, Haiti. Soil application of leucaena prunings increased maize yield by 157%. Bossa *et al.* (2005a) reported that a single application of 3.5 kg ha-1 of dry leucaena biomass released 4.9 kg P and 35.4 kg K ha -1 within 32 weeks of decay. Alley cropping has been shown to sustain maize yields over 17 seasons of continuous cropping without N or K fertilizer and for 14 seasons without any fertilizer at all (Shannon *et al.*, 2003). Soil application of hedgerow prunings has been shown to increase soil C and N, important soil quality parameters (Isaac *et al.*, 2003). At high elevation, *Acacia angustissima* is a good substitute for leucaena (Isaac *et al.*, 2006).

These results, all from Haiti, demonstrate that N-fixing legumes reduce the need for fertilizers containing N, especially urea and ammonium sulfate, whose prices are highly dependent upon the price of oil. In addition, K and to a lesser extent P, contained in the leaves and stems, could reduce the amount of P and K required in the fertilizer. Carlin Prosper of the Taiwan Rice Project reported that leucaena leaves applied to rice decreased fertilizer requirement by for to six bags.

Bossa(2005b) reported that net returns were highest when leucaena prunings were applied to maize without fertilizer than when fertilizer was applied. This points out the importance of fertilizer cost and crop value in influencing Haitian grower behavior. Fertilizers are more readily used on high-value crops than

on lower-value crops. Policies that suppress food prices will also suppress fertilizer use and, in consequence, lower yields.

Any practice involving major changes to the farming system will not be adopted without significant investment in extension and education of farmers, as well as research to address issues constraining adoption within the farming systems. Use of leucaena hedgerows as a soil amendment competes with its use as fodder for ruminants. Legume cover crops, such as velvet bean, compete with space for crops, and also serve as fodder. Bayard *et al.* (2007) reported problems with adoption and maintenance of alley cropping in the South of Haiti. Nevertheless, a visit to Bannate, where alley cropping was introduced in the early 1990s and where some initial studies were carried out, confirms that the hedgerows are still in use for soil conservation and crop production.

Fertilizer Summary and Recommendations

Fertilizers have received much attention by the agricultural sector in Haiti. The government has been subsidizing fertilizer for more than a decade in an effort to reduce poverty and hunger. While subsidies make the product more affordable to farmers by setting prices below that of a free competitive market, subsidies have resulted in difficulty in distributing fertilizer to farmers on time, frequent stock disruptions, dependence on foreign aid, and pressure on a national budget already supported by donor agencies at more than 60%, leading to distortions of the market. Government intervention has not been successful in raising food production in the country.

Although some studies point out high and possibly excessive application rates of fertilizers on rice and vegetables in selected areas, on-farm use of fertilizer is limited due to lack of financial and technical support, and due to market liberalization that depresses agricultural commodity prices. Only limited use is made of organic fertilizer and legumes. Lack of research limits the ability of extension services to advise on judicious and appropriate use of fertilizers and organic soil amendments. The following measures are recommended to stimulate a better distribution and use of fertilizer in Haiti:

1. Fertilizer use should not be considered independently of the overall value chain, from distribution of inputs to marketing of final products. Low market prices for farmers are a disincentive to the use of fertilizers, especially in a free market. Policies that suppress food prices will discourage investment in agriculture in general and in fertilizers and other inputs. In short, efficient distribution and use of fertilizer in Haiti should be placed within the context of a well developed agricultural policy.
2. Credit should be made available at a reasonable cost for purchase of fertilizer and other inputs.
3. Fertilizer purchases and distributions should be well planned to ensure sustainable availability. The private sector may do a better job in procuring and distributing fertilizers in a timely fashion, but government should maintain subsidies in the short term to keep fertilizer within the reach of farmers. The long-term goal should be to increase on-farm revenue so that farmers will more readily invest in fertilizers and other agricultural inputs.
4. Clearly defined policies are needed with respect to subsidies and the government's role in fertilizer distribution. Agribusinesses need to know the environment in which they are operating if they are to commit resources.
5. Fertilizer supply should be increased to accommodate the needs of farmers outside Artibonite Valley. Although it is logical to invest greater resources on irrigated land, it should not be to the neglect of rainfed agriculture. There are areas of rainfed agriculture that have potential and which are not irrigated or do not have vegetables, but could benefit from fertilizer applications.

6. A greater range of fertilizer types should be made available on the market to allow farmers to apply fertilizer based upon specific requirements of soils and crops.
7. At least one functioning and equipped soil testing laboratory should be made available for providing soil testing services to Haitian farmers.
8. Further study is needed as to the feasibility and viability of installing a fertilizer mixing plant in Haiti to increase the quantity and diversity of fertilizers available on the market.
9. Fertilization should be viewed in the context of improvements in soil quality, and soil conservation and environmental protection. Soil and water conservation and soil quality improvement should be promoted in tandem with fertilizer use.
10. Greater use should be made of organic sources of nutrients, where they are available, both for the nutrient and soil quality benefits they provide, and to reduce dependence on imported fertilizers. Opportunities exist to utilize waste products from industrial processes, urban waste, animal manure, vermiculture, etc. The carbon in organic amendments helps to improve soil physical properties, such as soil structure, aggregate stability and porosity, factors that enhance aeration, water infiltration and retention and ultimately improved crop growth.
11. Greater use should be made of herbaceous and tree N-fixing legumes to supply N to crops. This would reduce the need for urea on some crops, especially on hillsides. Alley cropping, with its dual role of soil conservation and enhancement of soil fertility, should be encouraged, as well as cover crops such as velvet bean where they fit into the cropping system.
12. Fertilizer distribution should not be treated as an end in itself but as a component of an integrated policy of research and extension, where fertilizer imports and recommendations are based on research results on different soils in each region.
13. A sustained effort should be made to increase soil research related to soil characterization and fertility. Fertilizer response studies involving single-nutrient fertilizers should be conducted on different soils and using different crops in order to determine appropriate fertilizer rates for each region, soil type and major crops. This research should be accompanied by soil laboratory analyses using different extraction methods in order to correlate soil test results with fertilizer responses and to identify extraction methods that provide the best correlation with crop response. This will be extremely useful in developing future fertilizer recommendations. This research can also serve to train future soil scientists in the fields of soil fertility, soil chemistry, pedology and production economics. Scholarships should be given to qualified candidates for graduate degrees involving field research conducted in Haiti.
14. Education of extension workers and farmers on soil fertility and fertilizer use is also essential to developing science-based agriculture. The extension system in Haiti must be reinvigorated and strengthened.

VI: FIELD FINDINGS: ACROSS SITES

This chapter reviews the field findings across the 10 assessment sites: these include sections in Bassin Bleu, Chantal, Hinche, Lascahobas, Verrettes, Marigot, Léogâne, Belle Anse and La Vallée de Jacmel[6]. The choice of locales offers good coverage of typical Haitian smallholder agricultural regions and gives insight into the variable areas in which humanitarian and developmental aid unfolds. In terms of agroecology, the sites range from the better-off irrigated areas of Verrettes to some of the drought-prone zones of Bassin Bleu, and include a range of mountainous and lowland locales (see Table 6, Chapter III). Further, Léogâne, La Vallée de Jacmel and Petite Goave were located directly in the epicenter area of the earthquake and can be compared with the other seven sites scattered across the country. As described in Chapter III, sites were chosen so as to cover: key agroecological zones; areas hit directly, or not, by the earthquake; areas with many/few internally displaced persons; zones of high/low agricultural potential; border/nonborder areas (to trace seed flows); partner organizations' priorities.

This assessment situated seed security issues within the larger agricultural and rural economy context and aimed to distinguish between changes tied to the earthquake *per se* and those linked to other kinds of stresses and opportunities. It is important to remember that the earthquake directly hit a circumscribed area in the southern region of Haiti, and that the seasons framing the earthquake were marked by excessive rain and drought in some areas.

The assessment was organized around three major themes. The first was the impact of the January 12 earthquake on households and agricultural livelihoods, including possible changes in assets, food consumption, land holdings, labor availability, income-generation activities, crop profiles and seed use. Second, the SSSA examined possible acute seed security issues, monitoring farmers' immediate seed procurement strategies, and examining the effects of any aid given. As a third thrust, the SSSA focused on possible chronic seed security problems, including homing in on seed/grain markets, agricultural product transformation, and access to modern varieties. Hence the foci included 'very short-term', as well as short- and medium- term issues.

Findings are indicated below along these three major themes: a) immediate effects of earthquake on households and agriculture; b) acute seed security issues; and c) chronic seed system concerns.

Note that overview tables are presented in the main text to indicate the trends across sites, that is nationwide. The complete set of site-by-site tables is presented in Annex III (some 117 tables). Occasionally, findings by site are presented below to highlight differences among regions and, in particular, to contrast epicenter versus non-epicenter areas.

Immediate Effects of the Earthquake: Overview

Households

The most dramatic and direct effects of the earthquake on rural families were changes in the number of people per household and in food consumption. Household size expanded immediately after the earthquake, largely due the influx of internally displaced persons (IDPs), especially those fleeing the devastation of Port-au-Prince. Overall, household size expanded from an average of 6.44 persons to 8.68 in the weeks after the earthquake, or an increase of more than two mouths to feed. Expansion was noted in all sites, including in the epicenter

6 Site-specific reports are available from some partners. Site-by-site quantitative data are posted in Annex III.

areas. Within the epicenter areas, there was modest expansion in Léogâne and the plains of Petit Goave, and more significant increases in the hills of Petit Goave and La Vallée de Jacmel. However, across sites, Bassin Bleu, Chantal and Hinche experienced the greatest changes (Table 11).

At the time of the assessment, May-June 2010, average household size had already significantly dropped, to a mean household size of 7.18 overall, which amounts to but a 10.44% increase over pre-earthquake levels. Across sites, household size was stabilizing quickly. However, it is noteworthy that a subset of households still reported a marked increase in occupancy rates (31.5% over the norm) four to five months after the event.

While the additional IDP burdens were not as high as anticipated in June 2010, it is interesting that male-headed households remained slightly more swelled than female-headed ones: 7.34 per household versus 6.63 (Table 12). This figure does not necessarily indicate gender-linked burden in itself as extensive interviews suggest that in both male- and female-headed households, the task of welcoming IDPs falls largely on women, as they are responsible in the household for ensuring people have clothing and food.

Table 11: Effects of earthquake on household (HH) size, site by site

EFFECT (H: HOUSEHOLDS)	UNIT	BASSIN BLEU	BELLE ANSE	CHANTAL	HINCHE	LASCAHOBAS	LÉOGÂNE	MARIGOT	LE PETIT GOAVE		VERRETTES	JACMEL	ALL SITES
									PLAINS	HILLS			
	N	110	102	107	61	72	100	100	85	45	100	100	983
HH citing change in # occupants	%	82	58	66	62	53	29	59	51	62	31	71	**57**
	n	90	59	71	38	38	29	59	43	28	31	72	**558**
Persons pre-earthquake, all HH	mean	7.91	6.15	6.96	5.79	6.00	6.66	6.51	6.09	5.83	6.10	5.79	**6.44**
Persons post-earthquake, all HH	mean	11.67*	7.86*	9.96*	8.30*	7.97*	6.86	9.46*	6.79*	9.24*	7.10*	9.16*	**8.68***
Persons in June 2010, all HH	mean	9.44*	7.36*	8.09*	7.36*	6.84*	8.83	7.31*	6.07	5.98	6.62	6.53	**7.19***
% change pre- & post-earthquake, all HH	mean	47.93	25.98	31.07	39.41	20.99	7.90	34.41	27.56	28.20	11.06	54.18	**30.10**
% change pre- & post-earthquake, HH w changes	mean	58.59	43.73	45.74	62.84	42.60	26.34	58.32	54.48	55.18	35.33	75.24	**53.21**
% change pre-earthquake & June 2010, all HH	mean	18.35	20.35	7.67	28.70	10.00	0.46	7.49	3.73	-0.22	5.00	10.14	**10.44**
% change pre-earthquake & June 2010, HH w changes	mean	32.49	47.48	52.38	67.98	33.11	16.67	25.58	11.61	-0.62	27.52	24.48	**31.50**

** Difference relative to before the earthquake is statistically significant at <5%.*

Table 12: Effects of earthquake on household (HH) size, by sex of household head, all sites

SEX OF HOUSEHOLD HEAD		HOUSEHOLD HEAD		TOTAL
		MALE	FEMALE	
	N	**723**	**234**	**957+**
Farmers citing change in number of persons living in household	%	57.4	62.0	**57**
All farmers citing change	N	415	145	558
Persons before, all farmers	Mean	6.45	6.29	**6.44**
Persons after, all farmers	Mean	8.68	8.48	**8.68***
Persons in June 2010, all farmers	Mean	7.34	6.63	**7.18***
% change before and June 2010, all farmers				**10.44**
% change before and June 2010, farmers citing change				**31.50**

+ 983 is the total sample. Gender of HH head was missing in 26 cases.

Tied to increases in household size, steep drops in food consumption were reported by almost half of households (48%) — from 2.48 to 1.59 meals/day directly after the earthquake, or basically a full meal less. Almost half of the farmers also indicated that they were eating less preferred foods since the earthquake, although few attributed this to the earthquake itself. Together, these data indicate increased stresses on already high food insecurity.

Table 13: Earthquake effects on food consumption

EFFECT	UNIT	ALL SITES
	n	**983**
Farmers citing fewer meals consumed since earthquake	%	**48**
All farmers citing fewer meals	n	468
Meals consumed before, farmers citing change	mean	**2.48**
Meals consumed after, farmers citing change	mean	**1.59***
Farmers citing changes in types of food consumed	%	50
All farmers citing changes in types of food	n	488

** Difference relative to before the earthquake is statistically significant at <5%*

Other key household indicators showed no clear trends across sites, although some regions experienced change. For instance, across sites off-farm labor remained stable, but in Bassin Bleu and Chantal (non-epicenter areas), the number of family members working off-farm actually increased (*Annex III.1, Table 3*). Access to credit and lending did not veer from normal, nor apparently did the scale of livestock trade, or sale or purchase of household assets and farm equipment. Table 14 documents the magnitude and direction of purchases and sales in the immediate four- to five-month period post-earthquake among the households monitored. More livestock were sold than purchased, but even purchases were on an important scale. Only 11% and 7% of households, respectively, had transactions in farm equipment and household goods, with the lion's share being purchasing rather than selling. Farm equipment purchased included hoes, machetes, rakes and shovels. Household goods purchased included kitchen utensils, pots and dishes. What is key here is that many farmers reported such transactions had nothing to do with the earthquake.

Table 14: Post-earthquake purchases and sales, January to June 2010 (N = 983 households)

ITEM	% HH SELLING OR BUYING	# SOLD	# BOUGHT
Livestock	**27**	202	104
Farm Equipment	**11**	6	55
Household goods	**7**	2	53
	69% **not** attributed to earthquake		

It is important to emphasize that these are dynamic systems, albeit stressed ones, and that rural households regularly respond to opportunities as well as constraints. Interesting is the range of income-generating activities that were added in the months between January and June 2010 (Table 15).

Table 15: Income-generating activities added and dropped between January 12 and June 2010

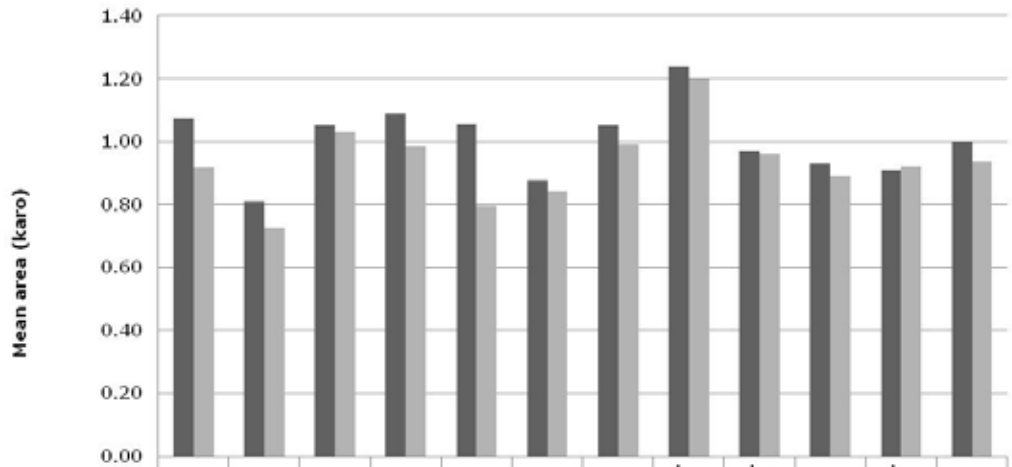
INCOME-GENERATING ACTIVITIES ADDED											
							LE PETIT GOAVE				
BASSIN BLEU	BELLE ANSE	CHANTAL	HINCHE	LASCAHOBAS	LÉOGÂNE	MARIGOT	PLAINS	HILLS	VERRETTES	LA VALLÉE	ALL SITES
charcoal herding masonry mechanic trade	charcoal trade	borlette coffin sales masonry plumbing restaurant telephone card sales	charcoal	charcoal trade	butrcher clothing sales construction day laborer digging wells & latrines driving fishing masonry mechanic trade	driving trade wood/ charcoal	bread sales carpentry construction furniture sales herding masonry trade	clothing sales lottery sales	bread sales commerce sewing taxi motorcycle trade	de Jacmel salt sales trade	borlette bread sales butcher charcoal clothing sales coffin sales construction day laborer digging wells & latrines driving fishing furniture sales herding masonry motorcycle taxi plumbing salt sales sewing telephone card sales trade
INCOME-GENERATING ACTIVITIES DROPPED											
sewing trade					masonry sales of cosmetics	gaguerre	car demolition rice & beans sales				sewing trade masonry sales of cosmetics gaguerre car demolition rice & beans sales

Agriculture

The assessment also focused on some possible areas of broader change in agriculture, examining issues such as: household land area under cultivation, crop profiles, agricultural labor availability, and input use.

Changes in household land area varied in frequency and direction among sites but, overall, the percentage change was small, a negative 3.13% (Figure 8). In some sites, land use changes are directly linked to the earthquake, especially in Léogâne, Marigot and Verrettes, but in almost half of the reported cases (94 of 205 observations) land use shifts were not tied to the earthquake. Note that in Léogâne, the hardest hit area in the epicenter, household land area under cultivation decreased only slightly as farmers sought to open land also in the hills areas.

Figure 8. Changes in land cultivated after Haiti earthquake



	Bassin Bleu	Belle Anse	Chantal	Hinche	Lascahobas	Leogane	Marigot	Le Petit Goave plains	Le Petit Goave hills	Verettes	La Vallee de Jacmel	All sites
Area before, all farmers (karo)	1.07	0.81	1.05	1.09	1.05	0.88	1.05	1.24	0.97	0.93	0.91	1.00
Area after, all farmers (karo)	0.92	0.73	1.03	0.98	0.80	0.84	0.99	1.20	0.96	0.89	0.92	0.94

Total % change: -3.13%

Slightly over one-quarter of households (27%) also cited some change in labor availability, but the overall change was modest, a negative 0.30% (Table 16). For the majority of sites, this change is negative, with farmers indicating this reflects increased labor prices and households' inability to afford it. Chantal and Verrettes are exceptions, as they indicated increases in available labor (*Annex III. 2, Table 12*).

Table 16: Changes in labor available for agriculture after the earthquake

EFFECT	UNIT	
	N	**983**
Farmers citing changed labor availability	%	**27**
All farmers citing changed labor availability	N	261
Direction of change		
Increased	N	98
Decreased	N	135
No explanation provided	N	31
Persons available before, farmers citing changes	Mean*	8.13*
Persons available after, farmers citing changes	Mean	7.10
Percentage change, all farmers	Mean	**-0.30**

**Statistical tests: paired t-tests comparing labor availability before and after the earthquake indicate significant differences below 5% using a one-tailed test. Note: 'Labor' refers to household + hired labor*

Few households reported adding (9%) or dropping (7%) crops altogether. More farmers reported shifts in land area for given crops, but with no clear directional trends. Bassin Bleu, Lascahobas, Léogâne and Verrettes all showed market dynamism in shifting crop profiles to meet normal needs. (*Annex III.2, Table 11*).

Changes in input use were modest, and most were in the direction of increases as mineral fertilizer became relatively more available with the scaling up of humanitarian and developmental aid inputs. In Léogâne and Verrettes respectively, 23% and 62% of farmers reported increases in input use post- earthquake (*Annex III.2, Table 13*).

Petty commerce: focus on women

It was in gathering information on petty commerce in rural areas that the assessment revealed some of the sharper effects of the earthquake on agriculture and livelihoods. In two separate focus group discussions, women traders reported that their petty commercial activities had been abandoned, at least temporarily in 91-92% of cases, directly due to processes catalyzed by the earthquake (Table 17). Even those remaining in commerce in June 2010 reported changes in levels of activity. For instance, the only woman still engaged in business in La Vallée de Jacmel, specialized in making banana fritters (bananes pesées) saw her sales drop from about 1000 gourdes/day to 300 gourdes/day, post-earthquake.

Table 17: Women's groups reporting changes in petty commerce activity among their members, post-earthquake

GROUP LOCATION	TOTAL MEMBERS	# IN PETTY COMMERCE PRE 12 JAN/10	# IN PETTY COMMERCE POST 12 JAN/10	PERCENTAGE CHANGE
Dade (La Vallée de Jacmel)*	24	19	2	-91%
Belanger (Bas-Artibonite)	25	10	1	- 90%

Multiple reasons were cited by women for the decrease in rural petty commerce:

1. Insecurity. Insecurity in Port-au-Prince has deterred traders from buying and selling their goods there, thus depressing commerce (see Box 6).
2. Reduced demand. A decrease in cash post-earthquake means that consumers see reduced purchasing power, and traders see reduced demand.
3. Supply failures. Women traders reported supply ruptures, as stores in Port-au-Prince, where they source their stocks, were damaged or destroyed.
4. Decreased access to credit. About 12.8% of female-headed households noted that they were less able to obtain credit (compared with a similar 9.9% of male-headed households) after the earthquake. Some also noted a change in interest rates. One focus group in Artibonite claimed that their local bank used to charge interest at 10% (100 for 1000 gourdes) for one month, but now demanded rates of 25% per month (250 for 1000 gourdes).

BOX 6: MRS. X'S CASE: BALANCING FOOD NEEDS WITH TRADING OPTIONS POST-EARTHQUAKE

Mrs. X is a 36-year-old farmer and trader. She lives in Poulie, in Lascahobas, and grows a variety of different crops, including multiple varieties of bananas, and black beans and peanuts.

Normally her household consists of six people, but it increased to 17 immediately following the earthquake, after friends and family came from Port-au-Prince (PaP). Due to the excess expenses, she has not been able to grow peppers and cabbage, which she usually grows especially for income. With her peppers alone, she routinely makes between 20,000 and 25,000 gourdes per season. Her family often eats some of the cabbage she sells the rest, about 3,500 gourdes worth. This year all such revenue has been lost.

Also, as a trader, Mrs X regularly buys produce from other local farmers and transports it to PaP by truck. Unaware of the reality in PaP following the earthquake, Mrs. X followed her normal pattern and brought bananas and sacks of maize to PaP to sell. All of her stock was stolen in the city--- so she has temporarily discontinued such trade.

Now, over four months later, there are still 11 extra people in Mrs. X's household. They have reduced their number of meals from three to two per day. She has had to sell six of her animals, as well as a table and four chairs, to make some additional money to support the enlarged household.

While most Haitian households have stabilized, the lingering stress suffered by some families should not be forgotten.

Women's focus groups, in commenting on the decline, emphasize that possibilities for both on-farm and off-farm income need to be better promoted. Specific requests of the women's group in La Vallée might signal areas to be explored more broadly in supporting women's roles as important drivers in food and livelihood stability:

- On the commerce side, women requested easier access to credit, and on better terms, plus training and skill building in marketing, packaging and labeling.
- In terms of short-term employment via aid schemes, they ask for equal access to Cash for Work (CFW) opportunities and estimate that only 40% of such slots currently go to women in their particular community.
- Foremost, many feel they have much more capacity to work. As one older woman remarked, "I would love to have work. Even if I were sick, I would then be healed."

Summary: immediate effects of the earthquake

The immediate stress on farming households directly due to the earthquake was formidable, especially increases in household size and sharp drops in family food consumption. However, rural household sizes had largely normalized by May-June 2010, with about a 10% increase over normal sizes.

Key indicators show other direct earthquake effects to be minimal or stabilizing: land area under cultivation has decreased by a mere 3.13% since January 12 and labor available for agriculture decreased by 0.30%, across all households. One important lingering effect centers on rural petty commerce. Managed principally by

women, petty commerce has decreased by up to 91% in the cases monitored in May-June 2010. This anecdotal evidence merits closer follow-up.

Acute Seed Security Findings

Issues of possible acute seed security were also centrally examined: how and where did farmers obtain seed post-earthquake? Did they plant as 'normal' in terms of quantity and quality (as compared with the same season during a stable year)? Two seasons were closely followed so as to gauge immediate effects and resilience in farming systems. The assessment labels them as first season post-earthquake and second season post-earthquake, as the exact planting dates varied by region, crop, and farmer management strategy. Most commonly, 'first season' sowing fell in the period March to April, with 'second season' sowing starting in the months June, July and August.

First season post-earthquake: sources and quantities of seed farmers planted

Figure 9 and Table 18 show the sources and quantities of seed actually planted by farmers during the first season post-earthquake. Information is given in the form of both graph and table so as to make highly visible the relative use of sources and the exact scale (quantity) of seed use. Several features are of note.

Figure 9. Percentage of seed quantities by source and crop used by farmers first season post-earthquake – all sites

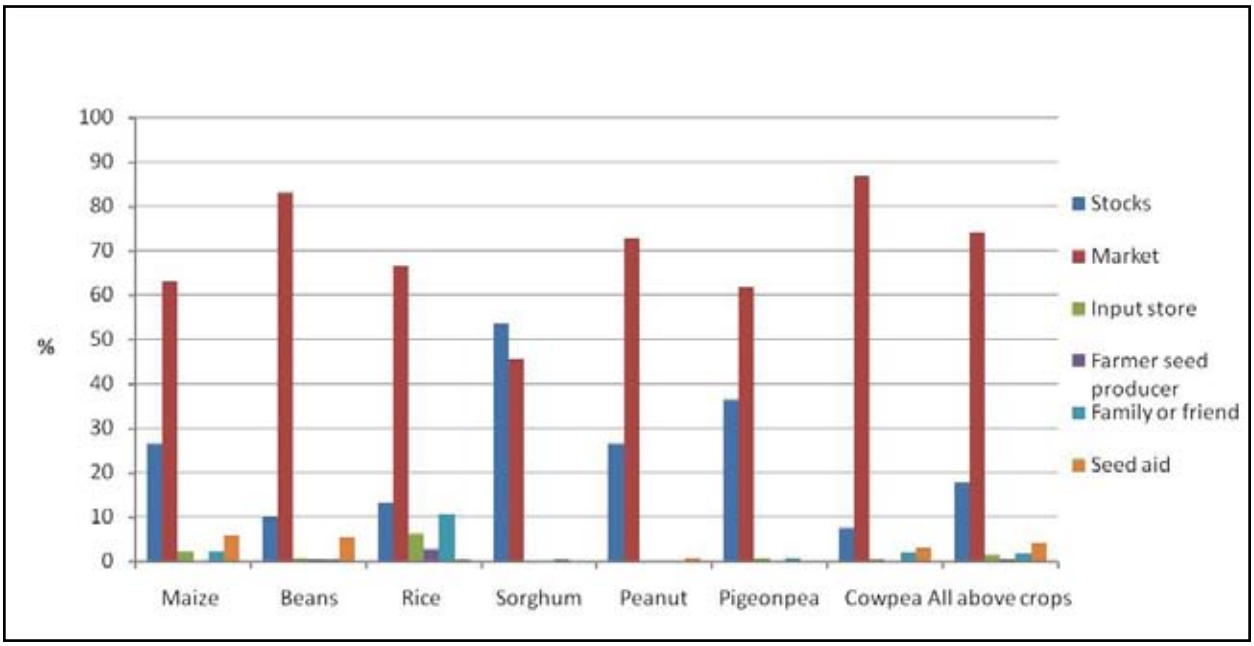


Table 18: First season post-earthquake: quantities of seed sown by source and crop (%), all sites

		PERCENTAGE DISTRIBUTION						
	TOTAL KG	STOCKS	INPUT STORE	MARKET	FARMER SEED PRODUCER	FAMILY OR FRIEND	SEED AID	TOTAL
Maize	8497.4	26.5	2.2	63.0	0.0	2.3	6.0	100.0
Beans	19780.9	9.9	0.7	83.1	0.4	0.5	5.5	100.0
Rice	3883.8	13.3	6.2	66.4	2.8	10.8	0.5	100.0
Sorghum	1155.3	53.5	0.2	45.7	0.0	0.5	0.0	100.0
Peanut	4700.0	26.6	0.0	72.8	0.0	0.0	0.6	100.0
Pigeon pea	1406.4	36.6	0.6	61.8	0.0	0.7	0.3	100.0
Cowpea	644.2	7.5	0.6	86.8	0.0	1.9	3.2	100.0
All above crops	**40068.0**	**17.8**	**1.5**	**74.2**	**0.5**	**1.9**	**4.2**	**100.0**

n of seed sources = 3583, includes 3 priority crops per household; 983 households

Across sites, farmers relied heavily on **market purchase** to obtain seed for a wide range of crops. This varied slightly from site to site. For instance, Lascahobas has a higher rate of seed use from home stocks *(Annex III.3, Table 31)* but, overall, 75% of seed for the crops cited derived from purchases in local markets. Common bean seed, in particular, was purchased in large quantity, with farmer interviews suggesting this happens season after season. The overwhelming reliance on markets is costly and not without risk. While Chapter IV explored how both traders and farmers distinguish between seed and grain within local market channels, product variability is likely the norm. Certainly strengthening the seed quality associated with these local markets could be an important entry point for raising seed quality across a large number of crops, with the strategy having potential to reach a large majority of farmers (if not all).

During the first season post-earthquake, **developmental and commercial channels** provided very small portions of the seed farmers sowed. Only 1.5% of the seed sown came from formal input stores (agro-dealers) and most of this was associated with rice purchases, especially in Verrettes, where a good deal of rice production takes place in irrigated areas and has potential to be commercially marketed at a larger scale. At this point, it is hard to know whether low agro-dealer use is due to: a) price; b) product quality; or c) access to agro-dealer shops. Farmers in places like Petit Goave signaled that agro-dealer outlets for obtaining quality seed are based 2 ½ hours away (in this case, in Port-au-Prince). Novel efforts to catalyze more rural agro-dealer input shops, such as those initiated by WINNER, bear close monitoring (Box 7).

BOX 7. NEW CHANNELS FOR SEED: FARMER INPUT BOUTIQUES

Haitian farmers have poor access to new varieties, and standard agro-dealer input shops provide only 1-2% of the total seed sown nationally. The promotion of rural enterprises to supply new varieties thus addresses an important gap. USAID's new WINNER project is supporting the development of "Farmer Boutiques" in Artibonite and West Departments; in the Gonaïves area alone, there are 10 such boutiques. They receive seed and inputs (fertilizer, pesticides, backpack sprayers) free of charge from WINNER, for sale to local farmers. While farmer (i.e., unimproved) varieties of maize and sorghum are also sold, the Boutiques promote F1 maize hybrids and several types of vegetable seed. The maize hybrid varieties originate from a high-profile gift by Monsanto in March, and are conventional (not genetically transformed). While the vegetable varieties have been grown in Haiti in the past, the three maize hybrids seem new to the country.

As an effort to develop enterprises, this program is particularly interesting. The boutiques are situated in farming communities, in some cases rejuvenating defunct local shops, and run by farmers' associations with representative councils. Besides inputs, WINNER provides business advice to help boutiques become sustainable enterprises. Also, packet sizes are not fixed, so farmers can purchase the quantities they want, allowing for flexibility and gradual adoption. Boutiques publicly display unit prices for seed, which are fixed by WINNER and relatively low, at least for the first season. Hybrid maize will be sold at 35.50 gourdes / marmite, compared with 100 gourdes or more for local maize varieties in local markets. Finally, all buyers will receive close technical support in managing these new varieties from WINNER-employed agronomists.

This initiative aims to reach 10,000 farmers this year, and merits close follow-up. For these Boutiques to become sustainable enterprises, a key challenge will be to stimulate local demand and the value of these new varieties, particularly as prices increase towards full (unsubsidized) levels. A second challenge will be to maintain the quality of seed provision. Some of the local seed sold early in 2010, for example, had poor germination. A third challenge will be to develop management packages and ensure accompanying technical support, particularly for hybrid maize varieties which are new to most small farmers in Haiti.

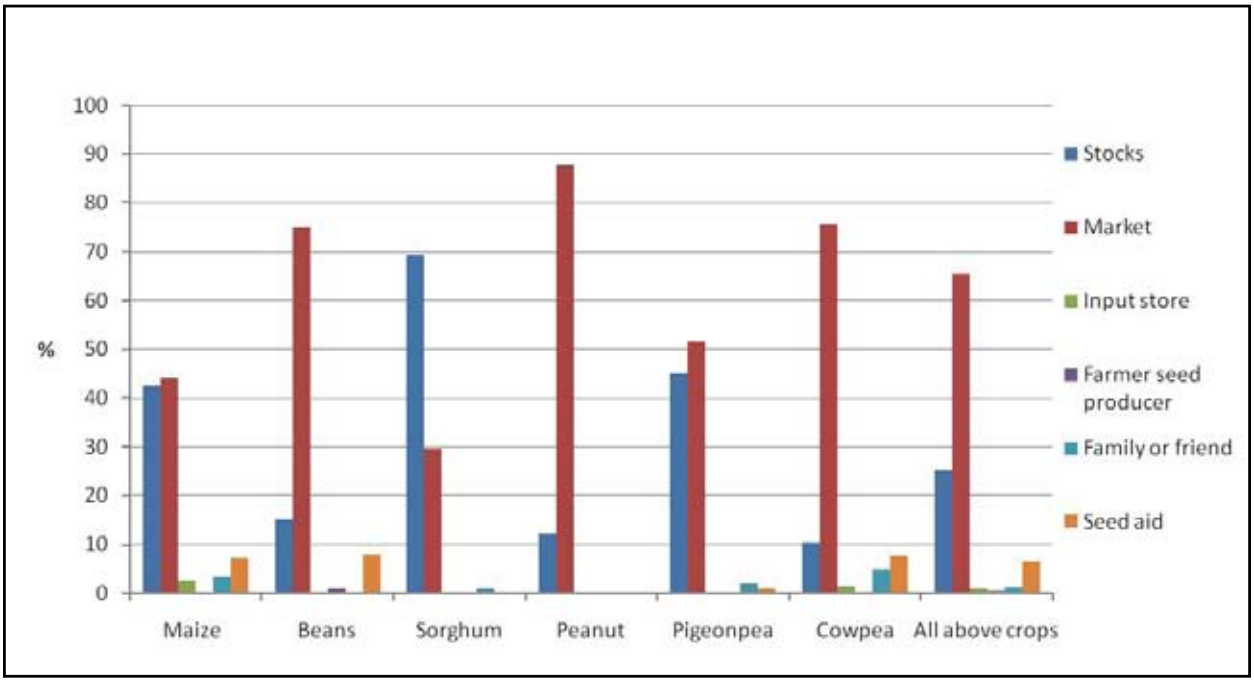
Finally, Boutiques might consider expanding the range of products on offer, offering not only multiple varieties to reflect farmers' diverse needs, but also other goods such as cement and roofing (a practice already tested in northern Haiti). More diversified goods on offer could broaden the range of potential customers. For example, a visit to buy roofing tin, could lead to a major maize purchase.

Farmer seed producers, those groups most often mobilized by the Ministry of Agriculture, FAO and certain development projects, provided but 0.5% of the seed sown, with this again being associated with rice, especially in the area of Chantal. The rationale and current capacity of farmer seed producers has been addressed in Chapter IV. Ultimately such seed producers will become viable only if their seed production is tied to an explicit marketing strategy and if the varieties on offer remain desired by farmers, traders and agroenterprises.

Unusually, **gift giving** of seed via family and friends was particularly low in the season monitored, especially in reference to normal rural practice elsewhere. Seed gifts and exchange seem to be important only for the vegetatively propagated crops, which do not easily move via local markets.

Finally, **seed aid**, which here includes both developmental aid as well as emergency aid, compromised slightly over 4% of the seed sown post-earthquake. This was at a time when the aid community was organizing substantial emergency distributions. Even in the epicenter areas, where emergency aid was concentrated, seed donations made a relatively minor contribution among the varied seed sources used. Figure 10 shows seed sources of the three sites clustered together in the epicenter area. Trends are the same as for the whole 10-site group: high use of markets, low importance of formal shops, near-nil acquisition of seed from seed-producer groups and gift giving; and modest importance of seed aid. The analysis combined developmental and emergency seed aid given under the single rubric of 'seed aid' as farmers themselves could not reliably distinguish between the two. Both developmental and emergency programs unfolded in the epicenter areas.

Figure 10. Percentage of seed quantities by source and crop used by farmers first season post-earthquake – epicenter sites Léogâne, Le Petit Goave and La Vallée



Of special note is that there were multiple farmer comments about the seed aid given in areas of Petit Goave and Hinche, both because of the variety type and possible issues with germination. Minimally, any seed given has to have an assured performance. Also, in some areas, agro-dealers and agricultural businesses complained about the very use of direct seed distribution, suggesting that such free aid undermined their business and prospects for future recovery (Box 8). CRS used a seed voucher and fair system in the southwest (near Les Cayes) to respond to farmers' purchasing constraints during the first season post-earthquake. This effort drew seed from the local seed/grain trader network as well as from the more formal ORE seed providers. Agro-dealers in Léogâne suggest such efforts might be usefully employed elsewhere in emergencies and perhaps even developmental initiatives.

BOX 8. AID, VOUCHERS AND AGRO-DEALERS: WHY NOT IN LÉOGÂNE?

Léogâne was at the epicenter of the earthquake: irrigation canals were damaged, salt water covered large portions of fields, and bean, sugar cane and mango crops were particularly affected. Léogâne was also a central area where direct distributions of seed aid took place, mostly of maize, beans, cowpeas and vegetables, all coming from outside Haiti, especially the Dominican Republic.

Seed producers and agro-dealer suppliers also took quite a hit from the earthquake: some had their storage sheds damaged and some had supplies trapped. But there have also been two other big post-earthquake hits.

First, the number of farmer customers has gone way down: money is scarce, real demand has tumbled.

Second, free seed aid is compromising whatever hopes for customers they may have had. "Aid Agencies are undermining our business. Maybe they give this year, but what will farmers do next year, when there are no free seed gifts? "

Mr. LeB, an agro-dealer entrepreneur, has 3 MT of maize he still needs to sell. He asks: "Why can't these important agencies actively support, rather than undermine our business. Give farmers coupons [vouchers] and give *us* the business."

At this point Mr. LeB says his only recourse is to give lots of credit — to 200 or 300 people. Otherwise his revenue from his lingering stocks will be totally lost.

First season post-earthquake: magnitude of seed use versus normal use

How did the quantities of seed sown relate to amounts planted during a normal season (comparable to same time of year). Beyond inquiring if farmers are using their routine sources in periods of stress, one also has to monitor actual quantities planted. Table 19 shows that during the first season post-earthquake, farmers experienced significant stress. Over all 10 sites and various crops, farmers sowed 15.9% less seed than normal, with nearly half of farmers experiencing some reductions in seed use.

Table 19: Farmers' seed use, first-season post-earthquake, across sites, compared with normal use

CROP	N	PERCENT OF FARMERS GROWING THIS CROP			TOTAL	MEAN % CHANGE ACROSS SITES (+ SE)
		USED MORE SEED	USED LESS SEED	NO CHANGE		
Maize	888	6.6	50.1	43.2	100.0	-18.0 (1.3)
Bean	594	8.6	55.6	35.9	100.0	-16.4 (1.9)
Pigeon pea	279	6.5	43.7	49.8	100.0	-16.0 (2.4)
S potato	201	6.5	40.8	52.7	100.0	-12.6 (4.0)
Sorghum	176	2.3	34.1	63.6	100.0	-13.9 (3.2)
Banana	153	5.9	47.7	46.4	100.0	-13.4 (3.4)
Peanut	102	5.9	55.9	38.2	100.0	-19.1 (3.6)
Rice	95	5.3	31.6	63.2	100.0	-8.1 (3.2)
Manioc	94	9.6	53.2	37.2	100.0	-13.0 (6.6)
Cowpea	93	1.1	46.2	52.7	100.0	-20.6 (3.0)
Yam	38	5.3	42.1	52.6	100.0	-11.8 (4.9)
Cabbage	23	0.0	30.4	69.6	100.0	-16.0 (5.3)
Carrot	17	0.0	29.4	70.6	100.0	-12.0 (5.0)
All crops	**2815**	**6.5**	**47.8**	**45.7**	**100.0**	**-15.9 (0.8)**

Several site-specific tables shed insight into how patterns of seed use declined region by region. In Léogâne, the area most directly hit by the earthquake, reduction in seed use across crops amounted to 13.3 %. However, the greatest reductions in seed use were in Bassin Bleu, the site farthest from the epicenter. There farmers sowed 35.8% less than normal, due to the late onset of the rains and continuing drought (S*ee also Annex III.5, Tables 44-66.)*

Table 20: Léogâne – Farmers' seed use, first season post-earthquake, compared with normal use

CROP	USE MORE SEED	USE LESS SEED	NO CHANGE	MEAN CHANGE (%) FOR ALL GROWING CROP
	N	N	N	
Banana	1	4	8	-4.4 (7.0)
Beans	2	20	35	-9.4 (2.3)
Maize	3	38	45	-21.2 (3.3)
Manioc	4	4	4	**11.5 (17.5)**
S Potato	4	13	21	-11.3 (4.9)
Pigeon pea	1	4	10	-6.3 (9.9)
Cowpea	0	7	16	-15.7 (5.4)
All crops	**15**	**95**	**149**	**-13.3 (1.9)**

Notes: In many cases the median change was zero: the majority of farmers did not change the amounts sowed. A negative mean change means that a greater number of farmers reduced rather than increased their sowing amounts. With manioc, those who increased did so to a greater extent than those who decreased, leading to an overall positive mean change (though median is zero for this crop as well).

Table 21: Bassin Bleu – Farmers' seed use, first season post-earthquake, across sites, compared with normal use (area farthest from epicenter)

CROP	USE MORE SEED		USE LESS SEED		NO CHANGE	MEAN CHANGE (%) FOR ALL GROWING CROP
	N	MEAN CHANGE	N	MEAN CHANGE	N	
Banana	1	75.0	25	-46.4 (4.8)	7	-32.9 (6.0)
Bean	4	32.7 (12.0)	47	-47.1 (3.0)	6	-36.6 (4.1)
Maize	1	33.3	75	-47.5 (2.0)	13	-39.7 (2.6)
Manioc	2	83.4 (16.6)	33	-49.6 (3.2)	3	-38.7 (5.9)
S Potato	0		19	-44.9 (3.0)	4	-37.1 (4.9)
Pigeon pea	5	85.0 (31.2)	37	-49.4 (2.7)	6	-29.2 (7.1)
Cowpea	0		10	-42.1 (6.1)	5	-28.1 (6.6)
Pois souche	0		14	-50.5 (6.0)	3	-41.6 (6.8)
All crops	**14**	**62.9 (12.7)**	**263**	**-47.6 (1.1)**	**47**	**-35.8 (1.8)**

Notes: The amount of reduction was large – nearly reducing amounts sown by half across all crops, which is greater than seen in other sites. Reasons are linked to drought and labor availability.

The reasons for decreased seed use immediately post-earthquake are presented in further detail in Table 22, which summarizes a large qualitative data set (1237 responses). Problems with household finances (less cash, credit) were, by far, the most important reason that farmers sowed less just after the earthquake (51+% of responses). Concerns about land tenure changes and drought each accounted for about 10% of responses. Of particular interest is that 'seed not being available' and 'high seed prices' were both relatively unimportant factors in shaping reduced seed use (representing about 4% of responses each). These latter reasons (particularly the lack of availability of seed) are the most common rationales given for launching emergency seed aid programs. and were used as a prime justification for the February-March 2010 distributions.

Table 22: Reasons farmers used less (or more) seed first season post-earthquake

	HOUSEHOLD FINANCES HOUSEHOLD FINANCES	SEED ASSISTANCE	SEED CONSUMED	SEED NOT AVAILABLE	SEED PRICE, COST	SEED PUT ASIDE FOR ANOTHER SEASON	SEED STOCK LOW/HIGH FROM LAST HARVEST	SEED DAMAGED BY INSECTS OR DISEASE	LABOR ACCESS	LAND USE AND TENURE CHANGES	"EARTHQUAKE"	ILLNESS, DEATH, OLD AGE, DISCOURAGEMENT	DROUGHT, CYCLONE, RAINFALL, LACK OF IRRIGATION	TOTAL
USED LESS														
Bassin Bleu	147	0	1	4	14	0	2	5	13	2	1	15	44	248
Belle Anse	63	1	0	9	10	0	3	3	1	3	1	4	14	112
Chantal	102	0	1	2	1	0	1	0	14	20	0	3	16	160
Hinche	31	0	0	0	3	0	3	0	4	6	0	9	14	70
Lascashobas	89	0	0	12	6	0	3	0	7	7	0	1	2	127
Léogâne	31	0	0	5	0	0	4	0	3	29	6	4	4	86
Marigot	78	0	0	6	7	0	10	0	12	4	11	17	4	149
Le Petit Goave (plains)	13	0	0	2	1	1	2	1	2	15	1	11	26	75
Le Petit Goave (hills)	11	0	0	2	1	2	0	2	5	2	2	10	6	43
Verrette	26	0	0	0	0	0	0	2	1	26	1	2	2	60
Vallée de Jacmel	47	0	3	9	6	1	7	0	11	10	0	10	3	107
Total	638	1	5	51	49	4	35	13	73	124	23	86	135	1237
Percent of all responses	51.58	0.08	0.40	4.12	3.96	0.32	2.83	1.05	5.90	10.02	1.86	6.95	10.90	100.00
USED MORE														
Bassin Bleu	2	0					0		0	4	0	1	7	14
Belle Anse	7	0					0		0	1	0	0	0	8
Chantal	9	0					0		1	10	0	0	0	20
Hinche	7	0					0		0	1	0	0	1	9
Lascashobas	8	0					0		0	8	1	0	0	17
Léogâne	4	0					0		1	6	0	0	0	11
Marigot	14	1					0		1	4	0	1	2	23
Le Petit Goave (plains)	2	0					1		0	9	0	1	1	14
Le Petit Goave (hills)	2	0					2		0	0	0	1	0	5
Verrette	1	0					0		0	10	0	0	0	11
Vallée de Jacmel	10	8					0		0	6	0	0	2	26
Total	66	9					3		3	59	1	4	13	158
Percent of all responses	**41.77**	**5.70**	**0.00**	**0.00**	**0.00**	**0.00**	**1.90**	**0.00**	**1.90**	**37.34**	**0.63**	**2.53**	**8.23**	**100.00**

Under "used less," household finances, farmers reported lack of means, money, or economic hardship.

Under "used more," household finances, farmers reported a desire to innovate, make more money, take advantage of high demand, or advance economically.

Land use and tenure changes involve changing crop areas, changing tenure patterns, and generally not destruction of fields by the earthquake.

Labor refers most often to scarcity and price. Lack of household labor is generally reflected in the illness, death, or old age category.

Under "used more," when the earthquake or rainfall was mentioned, these were often in connection with greater needs to be met, and thus more effort.

In Léogâne, several farmers opened fields in the hills when their lowland fields were destroyed by saltwater and sand.

First season post-earthquake: seed quality and varieties sown

Quality

Farmers also commented on the quality of seed sown, first season post-earthquake. For all crops but beans, seed sown was generally deemed acceptable or even good. Of particular note is that, despite some cases of poor bean seed quality, farmers are still aiming to re-sow what they have in hand, perhaps indicating that there are few choices for finding other planting material.

In terms of variety quality *per se*, farmers generally had difficulty reporting whether they were using modern varieties or local ones, as most had never been exposed to modern options (see section below, Chronic Seed System Concerns).

In terms of modern varieties, there was no maize hybrid use reported within the sample, either for the season immediately after the earthquake, or the subsequent one. Also for maize, only 26 of the 1022 seed lots sown, 3%, were claimed to be improved and named (Hugo, BR 106, TLOA) the first season. Overall, for both seasons, only 1.8% were named improved varieties.

Surprisingly, farmers differentiated very little even among their local varieties, sometimes not reporting distinct names. When specific varieties were noted, names like Trois Mois (three months) and Cinq Mois (Five Months) were offered.

Table 23: Farmers' assessment of quality of seed sown first season post-earthquake

	WHAT WILL BE THE RESULT THE VARIETY PLANTED THIS SEASON? (%)					WILL YOU SOW THIS VARIETY AGAIN? (%)	
CROP	GOOD	ACCEPTABLE	POOR	I DON'T KNOW	TOTAL	YES	NO
Peanuts	56	23	2	18	100	100	0
Banana	63	23	2	13	100	98	2
Cabbage	67	23	7	3	100	93	7
Bean	28	34	34	4	100	92	8
Yam	25	44	2	29	100	100	0
Manioc	54	29	4	13	100	94	6
Sweet potato	42	38	8	13	100	90	10
Pigeon pea	48	25	4	24	100	94	6
Cowpea	36	33	1	31	100	97	3
Rice	75	15	4	5	100	99	1
Sorghum	40	34	2	24	100	97	3
All crops	**42**	**32**	**13**	**13**	**100**	**95**	**5**

Second season post-earthquake: Sources and quantities of seed farmers planted

To understand system resilience, that is, whether farmers are recovering or not, it is always wise to assess agricultural trends several seasons in a row. Hence, the assessment asked farmers what crops they would sow the next season, and the precise quantities and sources of seed. (Because of the timing of the SSSA, some of responses were based on actual sowing and some on projections.) As shown in Figure 11 and Table 24, sources for the second season parallel those actually used in the first season post-earthquake, except that farmers are counting on less seed aid being given free. Markets remain the driving source for seed, although home stock use gains slightly in importance.

Figure 11. Seed quantities (%) farmers sow (or plan to sow) second season post-earthquake by source and crop – all sites

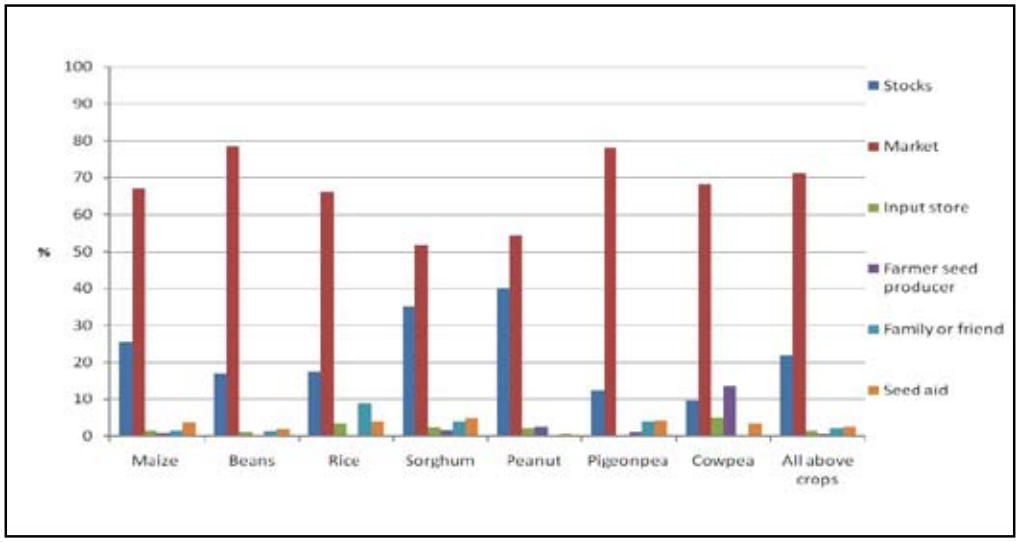


Table 24: Quantities of seed (kg) farmers sow (or plan to sow) second season post-earthquake, by source and crop (%), all sites

		PERCENTAGE DISTRIBUTION						
CROP	TOTAL KG	STOCKS	INPUT STORE	MARKET	FARMER SEED PRODUCER	FAMILY OR FRIEND	SEED AID	TOTAL
Maize	6307.0	25.4	1.5	67.0	0.9	1.6	3.6	100.0
Beans	18202.9	17.0	1.2	78.5	0.0	1.3	2.0	100.0
Rice	3871.3	17.4	3.4	66.1	0.0	9.0	4.1	100.0
Sorghum	1122.2	35.2	2.5	51.7	1.8	4.0	4.9	100.0
Peanut	4153.4	40.2	2.1	54.3	2.5	0.2	0.6	100.0
Pigeon pea	697.1	12.4	0.0	78.1	1.1	4.1	4.3	100.0
Cowpea	295.0	9.7	5.1	68.2	13.6	0.0	3.4	100.0
All above crops	**34648.8**	**21.8**	**1.6**	**71.1**	**0.7**	**2.2**	**2.5**	**100.0**

n of seed sources = 2975, includes 3 priority crops per household; 983 households

Second season post-earthquake: magnitude of seed use versus normal use

The really unexpected results came when examining quantities to be used compared with a normal comparable season. Farmers are sowing (or intend to sow) significantly more than normal, + 15.3% overall. Seed *access* for the poor (i.e., cash shortage for market purchase) may be an issue here for the legumes (but is unlikely for sorghum). As Table 25 shows, projected declines are modest for those crops which do show dips. Farmers stated they are making a push to re-start stressed agriculture. Even, in Léogâne, an area battered by the earthquake, projected declines are a modest -2.8% overall (Table 26).

Table 25: Farmers' seed use second season post-earthquake, across sites, compared with normal use

CROP	N	% OF FARMERS GROWING THIS CROP			TOTAL	MEAN % CHANGE ACROSS SITES (+ SE)
		USED MORE SEED	USED LESS SEED	NO CHANGE		
Maize	559	11.1	32.6	56.4	100.0	**+10.0 (10.8)**
Bean	546	11.4	38.3	50.4	100.0	-1.9 (5.1)
Pigeon pea	93	7.5	39.8	52.7	100.0	-4.9 (6.0)
SPotato	328	9.5	32.3	58.2	100.0	**+83.9 (56.7)**
Sorghum	132	8.3	28.8	62.9	100.0	-1.5 (5.5)
Banana	108	16.7	39.8	43.5	100.0	-1.1 (10.4)
Peanut	100	13.0	37.0	50.0	100.0	-6.0 (5.1)
Rice	100	7.0	28.0	65.0	100.0	-4.9 (3.8)
Manioc	126	7.1	27.8	65.1	100.0	-10.0 (2.3)
Cowpea	40	15.0	20.0	65.0	100.0	**+8.6 (10.1)**
Yam	14	21.4	42.9	35.7	100.0	-3.3 (20.1)
Cabbage	28	10.7	25.0	64.3	100.0	**+5.2 (9.8)**
Carrot	21	4.8	9.5	85.7	100.0	**+8.3 (10.3)**
All crops	**2284**	**10.7**	**33.7**	**55.6**	**100.0**	**+15.3 (8.9)**

Note. The final column shows shifts at the margin, sometimes affected by a few individual decisions one way or the other. Median changes were zero for most crops, including maize, beans and potatoes.

Table 26: Léogâne – Farmers' seed use, second season post-earthquake, compared with normal

CROP	USE MORE SEED	USE LESS SEED	USE SAME AMOUNT	MEAN CHANGE (%) FOR ALL GROWING CROP
	N	N	N	
Banana	7	7	7	0.0
Beans	11	11	19	-2.0 (1.5)
Maize	13	17	20	-7.0 (4.1)
Manioc	4	1	9	0.0
Sweet Potato	11	9	23	-0.7 (0.7)
Pigeon pea	0	2	3	0.0
Cowpea	2	2	6	-7.1 (7.1)
All crops	**57**	**57**	**94**	**-2.8 (1.2)**

Summary: Acute Seed Security Findings

In the season immediately after the earthquake, farmers overall sowed less seed than normal, a drop of 15.9% across crops and regions. This reduction was largely due to financial constraints but also linked to land tenure concerns, routine health problems, and acute stresses such as drought. In fact, the highest seed use drop occurred in drought-stricken areas of the Northwest (declines of 35.9% in Bassin Bleu) and not in the epicenter of earthquake impact (declines of 13.3% in Léogâne). Seed availability did not emerge as an important cause of declining seed use (only 4% of 1237 responses).

For the second season post-earthquake, which is staggered by crop and region, farmers plan to increase the amounts they sow (15.3% above normal), across sites sampled. There is a heavy orientation to re-stimulating the agriculture sector and especially to focus on income-generating opportunities. The epicenter areas are also showing considerable rebound; for example, in Léogâne seed use is projected to be only 2.8% below normal. Overall, acute seed security issues are minimal, aside from those important ones associated with a general drop in purchasing power.

Analysis of the seed sources used in two consecutive seasons (representing routine trends) shows that farmers depend heavily on local markets, from which they access about 75% of their seed across crops. Their own stocks provide 15-20% of seed sown, with other potential sources — input shops, farmer seed producers, gifts via family and friends, and seed aid — providing negligible amounts. Immediately after the earthquake, seed aid (including both developmental and emergency aid) provided about 4% of the total seed sown.

Chronic Seed System Concerns

We now examine more systemic trends in Haitian agricultural and seed security. Community-level assessments were done in all 10 sites and involved a range of methods: community meetings, special focus groups with women, key informant interviews (with local leaders, shopkeepers, NGO staff), and formal interviews with individual farmers. The varied methods allowed for considerable cross-verification. They also opened possibilities for assessing longer-term trends and gaining insight into enduring constraints or emerging opportunities.

Crop diversification and value-added products

Communities were asked to give an overview of all major crops sown in their area, and to rate them in terms of their importance for immediate food consumption and for income. Information was also sought on whether communities transformed some of the raw agricultural goods into value-added products geared to increasing their revenue. As examples, Tables 27 and 28 sketch out the results of two community meetings in the general zone of Petit Goave, contrasting plains versus mountain areas (lowland and upland).

An impressive range of crops is grown in each zone and a good number are routinely sold to generate income, especially beans, sugar cane and banana. However, there are very low levels of crop transformation within communities, although a number of major crops could potentially be further processed into saleable products. Flours, candy, sugar cane syrup and peanut butter products were noted, but not much more. Similar trends of having high crop diversity, major sales of crops, and low levels of processing were found across all 10 sites. One of the few realms in which dynamism was noted was in the area of horticultural production. Communities increasingly regard the growing of vegetables as a way to generate cash in a reliable way. Some communities, such as Moyette (Table 28), are investing in the production of a range of horticultural crops.

Table 27: Community assessment of crop portfolios: La Madeline, Petit Goave (plains)

CROP	FOOD	INCOME	TRANSFORMATION?
Sorghum	H	M	Flour
Maize	H	M	Flour
Cowpea	H	M	
Peanut	M	L	Candy
Cassava	M	L	Flour
Banana	H	H	
Mango			
Sugar cane			Syrup
Beans	M	H	

H, M and L stand for high, medium and low importance.

Table 28: Community assessment of crop portfolios: Moyette, Petit Goave (mountains)

CROP	FOOD	INCOME	TRANSFORMATION
Beans	H	H	
Maize	H	H	Flour
Yam	H	H	
Peanut	L	H	Paste
Cowpea	H	M	
Lima bean	H	M	
Sorghum	H	M	
Manioc	L	M	
Cabbage	H	H	
Horticultural crops	H		
Peppers		H	
Carrots		M	
Eggplants		M	
Leeks		M	
Banana	H	H	
Sweet potato			

H, M and L stand for high, medium and low importance.

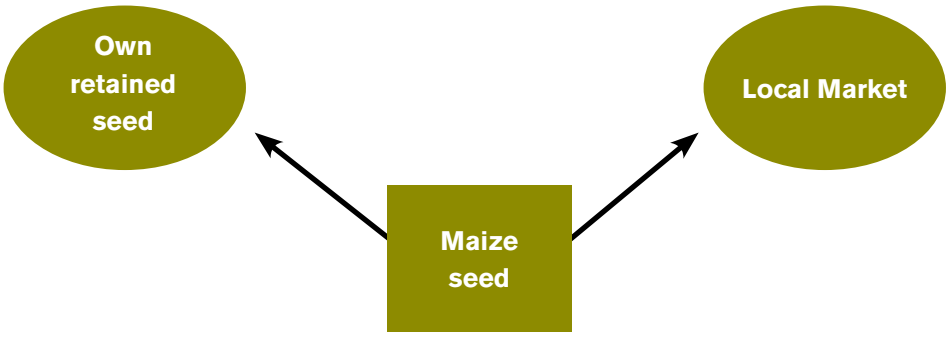
Seed maps

Community mapping of seed sources also served to trace general trends in seed source strategies. Community groups worked together to map the seed sources for a particular crop, comparing the range of current sources with those used during the previous 5 to 10 years. Several seed-mapping samples appear below, with remarkably similar patters found at all 10 sites.

Mapping of maize seed sources in the La Vallée community of Dada shows that maize seed is obtained either from farmers' own stocks or from the local market, and that there has been no change in the last five years. Both channels are local ones. Bean seed is also obtained from these two main channels, although a development project, ACDI/VOCA, has started to give seed of several new varieties.

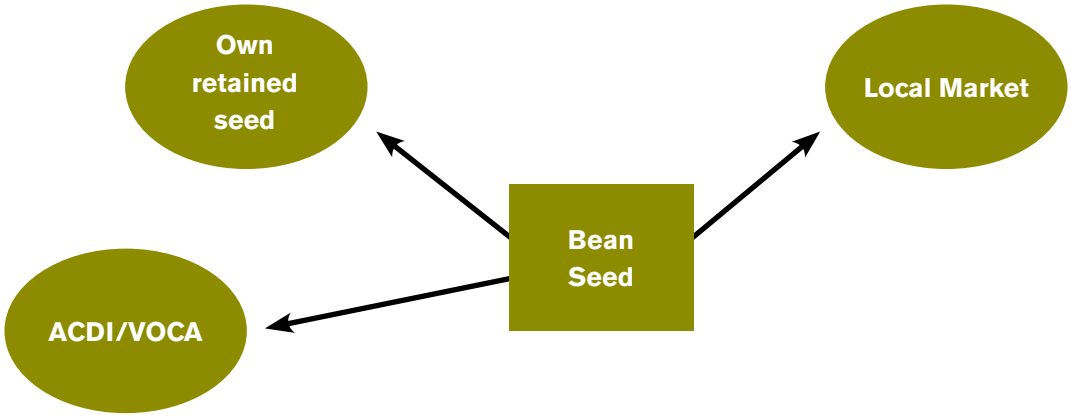
Figure 12: Maize seed mapping in La Vallée: Dada

2010

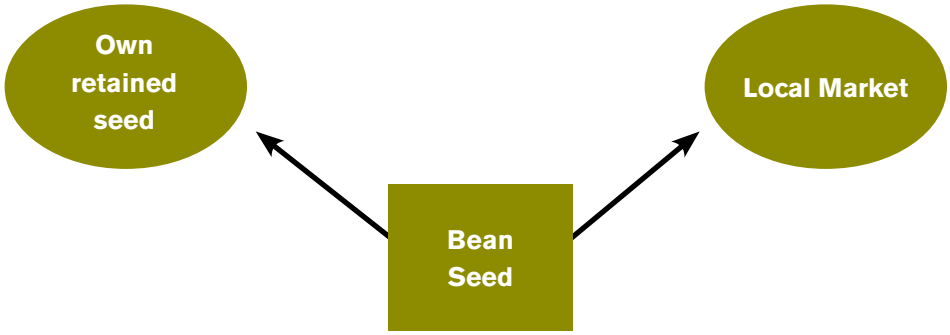


2005 **IDEM**

2010



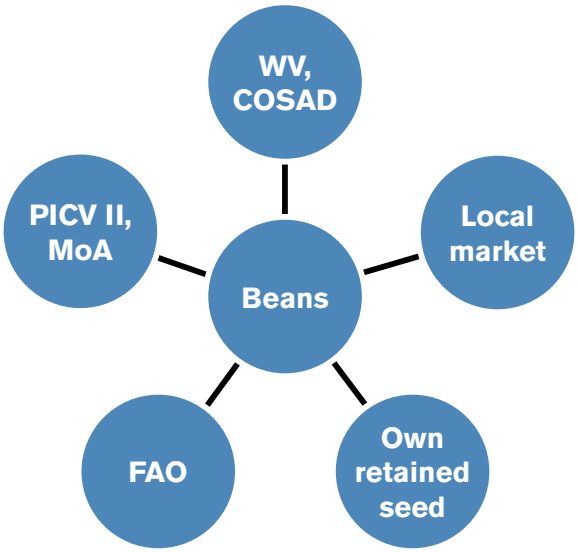
2005



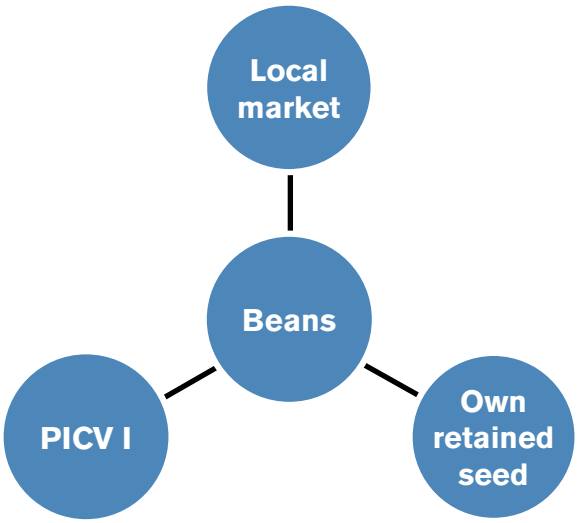
Mapping of bean seed acquisition in Poulie, Laschobas, shows local markets and farmers' own stocks are still cores of bean seed acquisition, with several current development projects or government interventions giving new varieties and seed donations. The pattern was the same 10 years ago, but with a single government project intervention operational (PICV, Projet d'Intensification des Cultures Vivrières, Phases I and II).

Figure 13: Bean Seed Mapping in Lascahobas: Poulie

2010



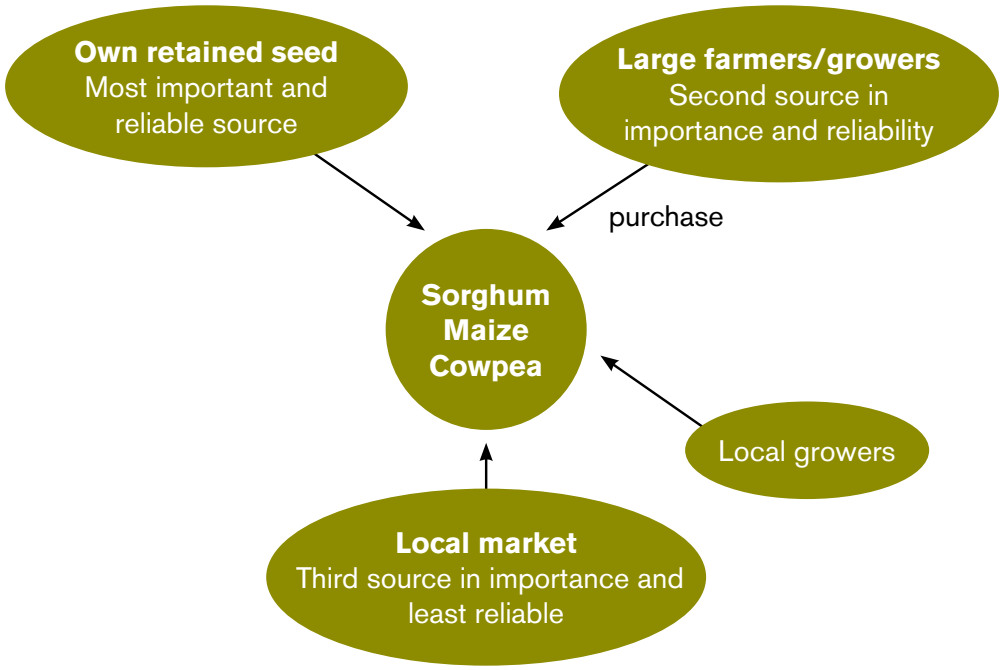
2000



Community mapping in Moyette, Petit Goave, gives further insight into how one community values the diverse channels, across the range of informal sector possibilities. Many trust their own seed stocks most, followed by seed bought from some of the larger growers. Farmers may use the local markets to obtain important quantities of seed, but they see the quality of such planting material as variable: local market use may be one norm, but use of this channel does demand some skill and involves some risk.

Figure 14: Cross-crop mapping in Petit Goave: Moyette

2010



Allied with the community discussions on seed sources, the issue was raised of why there is so little seed storage. Why are there such high rates of 'eating all of one's seed' or 'selling all of one's seed'? Certainly issues of financial exigency came to the forefront: for instance, a bean harvest is equivalent to a stash of cash, especially when large sums are required (e.g., for school fees or to pay important medical bills). Eating and selling of one's seed are the norm for many, and not at all a signal of stress (see Box 9). However, more harvest storage could potentially be created, especially for crops such as cowpea and peanut, were more effective storage techniques known, available and relatively cheap. While high sales and purchases of seed will likely remain a core farmer practice in Haiti for years to come, storage advances could help some families enjoy significant economies.

BOX 9. IS EATING SEED REALLY A SIGN OF STRESS?

Is eating seed a sign of stress? Not according to farmers in Biré who eat their bean stocks year after year. In Biré, a small community outside of Léogâne, farmers sow beans only one season annually and keeping their seed just doesn't make sense. Beans stored many months often fail to germinate and chemicals for keeping insects away are often unavailable and costly. Besides, the local market can easily provide the varieties routinely used.

So farmers eat their own stocks and, smartly, shift the risk of storage to others — the local and regional seed/grain traders.

In summary, seed systems have remained relatively static for years. The informal channels of farmers' own stocks and local markets remain the key sources for planting materials. Government or development projects occasionally give free seed or introduce new varieties, but these interventions tend to be one-off. Quantitative dimensions of this issue are pursued in the next section.

New varieties, new information and seed aid

Within the context of assessing seed security, it is especially important to consider access to new varieties, as new varieties (here equated with modern varieties) represent an economical way to increase production quickly and potentially across a broad range of farmers. Table 29 presents the results of new variety use recorded by the SSSA, which encompassed a countrywide sample across crops and ecological zones.

It is striking that only 14% of Haitian farmers have obtained any new variety in the past five years. Further, 83.1 % of new introductions have come via seed aid (207 of 249 observations) (Table 30). Seed aid this year alone provided 56% of all the new variety introductions recalled for the past five years, with most being linked to emergency distributions. Some 79% of the new aid-linked varieties were maize or beans.

Table 29: Farmers (%) obtaining a new variety in the past five years, and source – all sites

SITE	N	YES	NO	TOTAL
Bassin Bleu	110	6	94	100
Belle Anse	102	12	88	100
Chantal	107	10	90	100
Hinche	61	31	69	100
Lascahobas	72	15	85	100
Léogâne	100	2	98	100
Marigot	100	4	96	100
Petit Goave Plains	85	45	55	100
Petit Goave Hills	45	29	71	100
Verrettes	100	5	95	100
La Vallée de Jacmel	101	30	70	100
Total	**983**	**14**	**86**	**100**

Table 30: Source of new variety and frequency of seed aid in the past five years

		SOURCE OF NEW VARIETY (COUNT)					FREQUENCY OF SEED AID
SITE	N	SEED AID	INPUT STORE	LOCAL MARKET	SEED PRODUCER ASSOCIATION	FAMILY OR FRIENDS	PAST 5 YEARS
Bassin Bleu	9	7	1	0	0	1	0.60
Belle Anse	24	20	2	0	2	0	0.63
Chantal	21	16	0	0	2	3	0.81
Hinche	30	30	0	0	0	0	0.11
Lascahobas	13	13	0	0	0	0	0.19
Léogâne	2	2	0	0	0	0	0.07
Marigot	10	10	0	0	0	0	0.38
Petit Goave Plains	62	49	4	4	3	2	0.38
Petit Goave Hills	24	15	1	1	4	3	0.49
Verrettes	7	3	0	0	4	0	0.03
La Vallée de Jacmel	47	42	0	0	2	3	0.10
Total	**249**	**207**	**8**	**5**	**17**	**12**	**0.38***

**If all farmers had received every year in the past five, the figure would be 5.0, if all did, but only for one year, it would be 1.0.*

Overall, farmers' accessing of new varieties has been very limited. At this point, emergency aid seems to have been more important than routine research and development (R&D) work in exposing farmers to novel crops and varieties, even though this aid has been quite restricted (with each farmer having received aid less than one year in five).

This trend of using emergency aid as the vehicle for variety innovation can be partially understood given the limited resources available to MARDNR and other government agencies for R&D over the last five years for circulating in rural areas. However, it might be questioned whether emergency initiatives should make novel introductions at all, as emergency personnel might not be able to provide farmers with the much needed technical advice and multi-season follow-up. Also, there risks in introducing new varieties in crisis periods (see Box 10).

More generally, farmers throughout the assessment zones lamented the lack of access to: new varieties, novel agronomic techniques, technical information, or even advertisements alerting them that certain products exist. Many farmers could not even remember the last time they had seen a government agronomist on the ground. The need to revitalize rural information networks, including two-way communication systems, seems just as great as the need to move specific varieties or other inputs.

BOX 10. INTRODUCING NEW VARIETIES IN CRISIS PERIODS?

Advice on reducing risks and maximizing positive gains

Regardless of the potential for improving smallholder productivity through the introduction of new varieties, it is important to start by questioning the legitimacy of such introductions during crises. In periods of emergency and prolonged stress, small farmers are already at levels of increased risk. They are generally poorer, having lost household assets, livestock or crops in the field, and they cannot afford to waste any land or labor, which may already be scarce. Further, they need to have some confidence that the next planting season will yield better than the present, stressed one.

Outside aid, minimally, should put on offer products or processes at least as good as those already in farmers' hands. While formal sector varieties are referred to as 'improved' and the quality of the seed is certified, these varieties sometimes yield poorly in smallholder cropping systems. They may not be adapted to the local agroecological conditions or farmers may not possess the management inputs (for example, fertilizers and pesticides) crucial for their growth. So an 'improved' variety does not mean that performance is guaranteed.

If new variety introduction is being considered during a period of stress, a number of well-defined steps might best be followed:

1. Work with farm communities and other informed personnel to choose possible new varieties.

   Is there sufficient prior evidence that varieties:

   - Are adapted to the specific agroecological zones?
   - Meet farmers' acceptability criteria (harvest + postharvest for subsistence + market use)?
   - Can be successfully used under farmers' own management conditions (e.g. without fertilizer)?
2. Design introductions so as to minimize risk and maximize farmers' informed choice.
   - Offer 'test size' packets: introductions should be small-scale.
   - Give farmers choices: to use the variety or not. And if possible, put several varieties on offer.
   - Provide sufficient accompanying information to allow farmers to make variety choices and management decisions (planting time, levels of input use, crop associations).
3. Build in explicit monitoring and evaluation of new varieties: are they performing? For whom? Where?
4. Count on a multi-year process.
   - Can the new introductions be successfully integrated into stressed farming systems?
   - If yes, is further fine-tuning needed?

(Source: Sperling et al., 2006)

In terms of inputs *per se*, only a small amount of new variety seed was purchased from formal input stores and local markets (N = 13) and this consisted mostly of vegetable (horticultural) seed. Innovative ways to reach farmers with seed material might be usefully considered. This might include expanding the geographic placement of current formal agro-dealer stores, as well as setting up distinctly rural agro-dealer community-run shops such as WINNER is doing (see Box 7). Government, development projects and NGOs might also consider building on the seed channels farmers routinely use to obtain seed: e.g., via the local open markets and *Madame Saras*. Packing seed in small quantities and making it easily accessible in venues where farmers routinely purchase household supplies could potentially give thousands of farmers easy access to much needed new varieties and quality seed.

BOX 11. SELLING WHERE FARMERS ROUTINELY GET THEIR SEED STOCKS: OPEN MARKETS

Commercial company standard practice is to package certified seed in minimum quantities 2 kg and to sell in specialized agro-input shops, mainly concentrated in medium- and higher-potential areas, where more commercial farmers congregate. Smallholder farmers have been reluctant to buy such seed, as the cost may be two to four times that local seed.

The small pack approach (100 g or less) has been successfully tested in many countries, especially in Africa. Farmers are usually interested in the new varieties, and have been ready to pay for small, risk-free amounts of certified seed. This novel marketing tool has solved a number of challenges: how to make new varieties and high-quality seed available to farmers; how to make them affordable, and how to make them geographically accessible. The concept has also been taken up by a number of commercial companies which are expanding profits by greatly expanding their customer base.

Seed is generally sold from the back of a truck, or through vendors in open markets, where farmers routinely buy food and seed supplies. Local country stores also put the small packs on offer.

Fertilizer and Compost Use

As nonseed inputs, fertilizer and compost use were also assessed across the 10 sites.

Given the scarcity of agricultural innovations, the relatively high use of soil amendments was somewhat unexpected. Overall, 37.8% of the farmers interviewed have used mineral fertilizer at some point in their agricultural practice, with 27.1% using it the season of the assessment. Even more, 38.7%, used compost immediately post-earthquake.

Figure 15. Fertilizer and compost use, by site, first season post earthquake

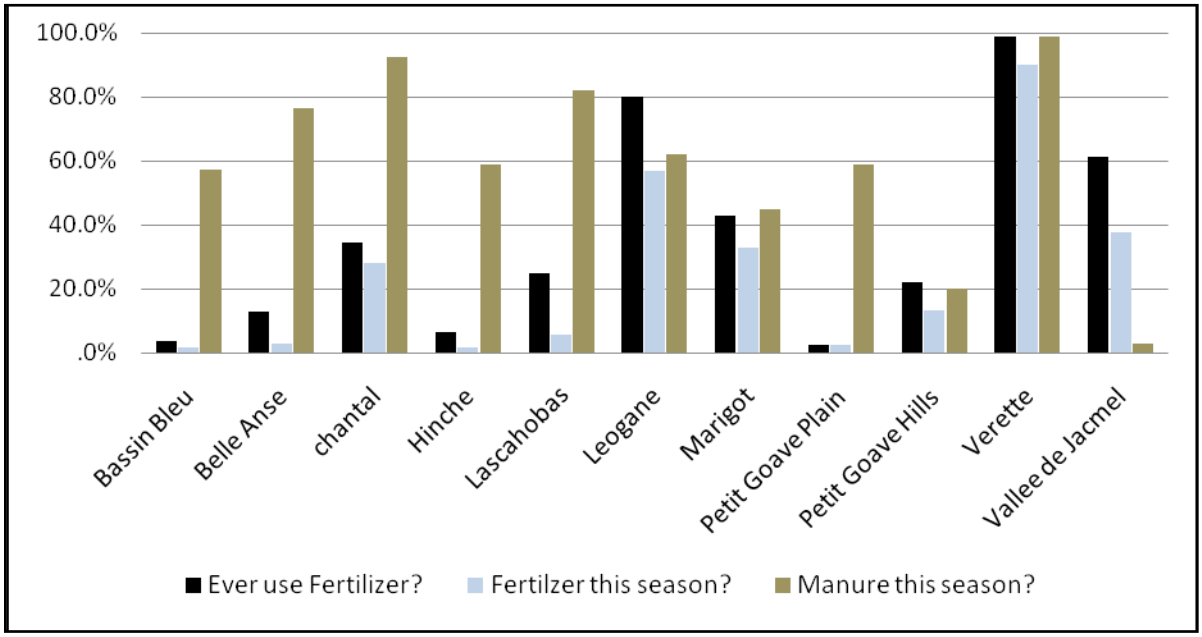


Figure 15 suggests some dramatic differences between locations for fertilizer and compost use. Chemical fertilizer has been used by many farmers in Léogâne, La Vallée, Marigot, and especially Verrettes. However, usage is much lower in other sites, particularly Hinche, Bassin Bleu, Belle Anse and the lowlands of Petit Goave. Interestingly, manure (or compost) use is high in some of the same sites where fertilizer use is low: Hinche, Bassin Bleu, Belle Anse the lowlands of Petit Goave, Lascahobas, and Chantal. Only Léogâne and Verrettes have high proportions of farmers using both fertilizer and manure.

The types of mineral fertilizer usage fell into three categories: complete, urea, and urea and complete. Complete dominates, although this may represent different mixes of NPK (as this level of product detail could not be captured via survey). Not surprisingly, cost stood out as the major reason for farmers never having used fertilizer (35% of responses) with unavailability also being a major constraint (12% of responses). However, 19% of farmers did not assess mineral fertilizer use as necessary. (S*ee Annex III.8, Table 114 for a fuller account.*)

The types of organic input used included straw, field residues, and horse, pig, cattle and chicken manure. In practice, most organic inputs are manure, mixed with straw.

Crop emphasis

The crops receiving either fertilizer or manure compost most often are maize, beans, rice and bananas. These four crops alone account for two-thirds of instances. Hence, fertilizer use has been concentrated on maize and the market-oriented food crops.

Table 31: Crops that have received either fertilizer or manure/compost in the past five years

CROP	FERTILIZER N	% OF ALL FERTILIZER CASES	MANURE N	% OF ALL MANURE CASES
Maize	247	32.1	230	28.4
Beans	142	18.5	196	24.2
Rice	109	14.2	1	0.1
Bananas	42	5.5	84	10.4
Sugarcane	59	7.7	22	2.7
Sorghum	8	1.0	60	7.4
Pigeon pea	14	1.8	39	4.8
Potatoes	26	3.4	22	2.7
Yam	14	1.8	36	4.4
Cabbage	24	3.1	20	2.5
Peanuts	12	1.6	17	2.1
Carrots	18	2.3	6	0.7
Peppers	10	1.3	13	1.6
Tomatoes	4	0.5	12	1.5
Cowpea	0	0.0	14	1.7
Manioc	5	0.7	10	1.2
Leeks	10	1.3	4	0.5
Gombo	9	1.2	4	0.5
TOTAL	**769**	**100.0**	**810**	**100.0**

Sources of fertilizer

Fertilizer was generally purchased, not traded. Fertilizer was purchased mainly in local markets (two-thirds of sales) but also from input shops (about one-quarter of sales).

Table 32: Where farmers sourced their fertilizer, first season post-earthquake

SOURCE	FREQUENCY	PERCENT
Local market	342	62.2%
Input shop	152	27.6%
NGO	15	2.7%
Community seed producers' association	15	2.7%
Family /neighbors/ friends	10	1.8%
Government	6	1.1%
Reserves / stocks	5	0.9%
Other	4	0.7%
Inter-governmental	1	0.2%
TOTAL	**550**	**100.0%**

Gender, fertilizer and manure

The SSSA also sought to distinguish possible gender-related issues related to fertilizer use. During the season of assessment, female-headed households employed fertilizers and compost at a frequency comparable to that among male-headed households, although more women than men use compost. Also, fewer women than men use chemical fertilizers. Some 173 female-headed households (73.9%) have utilized fertilizers over the past five years, as compared with 578 male-headed households (79.9%). Some 185 female-headed households (79.1%) have utilized compost or manure in the past five years, as compared with 609 male-headed households (84.2%) (Table 33). Such figures should dispel any myths about women not being as open to commercial inputs as men.

Table 33: Use of fertilizer and manure/compost by male- and female-headed households

CROP	HOUSEHOLD HEAD	FERTILIZER USE LAST 5 YEARS	MANURE/COMPOST USE LAST FIVE YEARS
Maize	**Male**	183	177
	female	59	51
Beans	**Male**	115	145
	female	27	50
Rice	**Male**	78	1
	female	25	0
Bananas	**Male**	31	55
	female	11	25
Sugarcane	**Male**	37	12
	female	22	9
Sorghum	**Male**	7	49
	female	1	9
Pigeon pea	**Male**	8	30
	female	6	9
Potatoes	**Male**	20	15
	female	4	6
Yam	**Male**	11	29
	female	2	7
Cabbage	**Male**	21	16
	female	3	3
Peanuts	**Male**	8	14
	female	3	3
All Crops	**Male**	**578 (79.9%)**	**609 (84.2%)**
	female	**173 (73.9%)**	**185 (79.1))**

Overall, fertilizer use especially was greater than anticipated (at least from key informant accounts), including women's use and access to fertilizer. Doses and timing of applications and blends could not be monitored during the SSSA, so the assessment was not able to comment of the effectiveness of such use.

Cost of Seed

As a final issue related to possible chronic seed security, the cost of seed merited some closer scrutiny. Given that 75% of seed is bought, and on an annual basis, the recurrent costs of routine production inputs for small farmers would seem to be formidable.

Table 34 reports actual cases from the raw data sets for 107 households in Chantal. It summarizes seed purchases by three farmers for their two or three major crops. 'Guyl' was the household head among those with the lowest expenditures on seed while 'Etienne Lebonheur' was the top spender, with Louisa 'Louisa Devil', who bought 45 kg of seed for two crops alone, in the middle. Farmers in Chantal generally grow an array of crops: maize, beans, pigeon peas, cowpeas, rice, sorghum, manioc and sweet potato. While the vegetatively propagated crops (e.g., manioc and sweet potato) are among the only crops regularly accessed through neighbors and friends (Figure 16), the rest are purchased mainly in local markets.

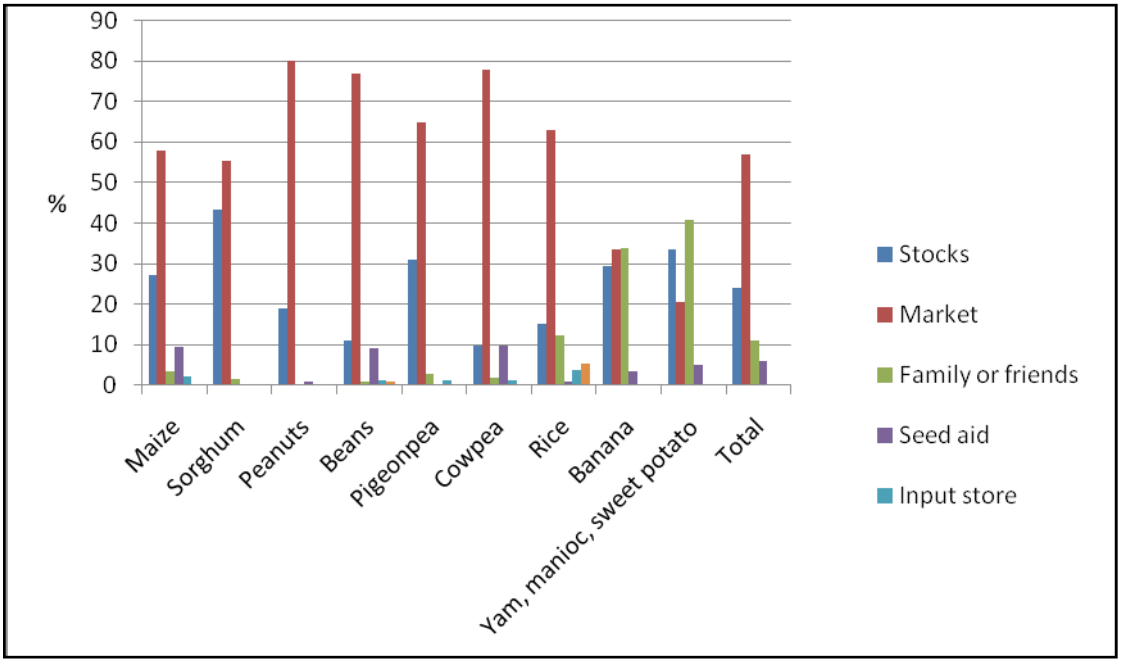
We reflected on costs as follows: If Louisa Devil spends the equivalent of US$30 for just two crops per season, she undoubtedly spends upwards of US$60-70 to meet her full sowing needs each growing period. With an average yearly income of $600-700, and at least two seasons of sowing, someone like Louisa might allot 20% of her income or more to routine local seed purchases. Some of her seed could potentially be obtained through noncash transfers, such as her rendering land preparation or weeding services to a neighbor (the equivalent of seed for work). Some seed she might also obtain via exchange. However, in all cases these seed costs are remarkable and undoubtedly raise important issues. The routine economics of farmer seed acquisition in Haiti deserves much closer examination.

Table 34: Examples of seed quantities sown for select crops, and costs, Chantal first season post-earthquake

EXAMPLES	QUANTITIES (KG)	PRICE (USD / KG)	CASH OUTLAY	NAME
Close to the minimum				Guyl
Pigeon pea	5	1.50	7.50	
Maize	2.5	1.00	2.50	
Total convertible to kg	**7.5**		**$10.00**	
Mode				Louisa Devil
Maize	20	1.00	20.00	
Beans	5	2.00	10.00	
Total convertible to kg	**25**		**$30.00**	
Maximum				Etienne Lebonheur
Maize	77.5	1.00	77.50	
Peanut	125	1.00	125.00	
Beans	37.5	2.00	75.00	
No other crops				
Total convertible to kg	**240**		**$277.5**	

For completeness, Figure 16 presents sources of planting material for crops whose 'seed' was hard to quantify in discrete units. It basically shows that for crops such as banana, manioc and sweet potato, family and friends can be important sources of planting material. Even for vegetatively propagated crops, however, markets and farmers' own stocks remain prime sources for planting material.

Figure 16. Percentage of times farmers used seed source, by crop, all sites, first season post-earthquake



Summary: Chronic Seed Security Findings

The large majority of seed security constraints identified are deeply chronic ones. Unlike nearly everywhere else in the world, "eating one's seed" or "selling all of one's seed" are not signals of distress in Haiti. They are normal practices, particularly for crops such as beans. Farmers routinely buy some 75% of their seed from local markets, a considerable expense for the many already hovering at the poverty line. Further, farmers generally cannot access new varieties, an array of other needed inputs, or even regular technical advice. Only 14% of farming households have had access to *any* new variety over the last five years. The February/March 2010 emergency distribution alone provided 53% of these introductions.

There is virtually no dynamism in seed systems across major crops, with few new sources supplying seed to farmers (rice is an exception), and little agricultural transformation. One growing area of agricultural innovation is horticultural crops, which are especially important for income generation. Fertilizer use also has been documented at a higher than expected rate; 28% farmers used some mineral fertilizer this season, a rate perhaps reflecting the improved availability of inputs, especially due to aid interventions. Women use soil amendments (fertilizer and compost) in equal proportions to men, with higher relative use in areas with a stronger commercial orientation.

Overall, small farmer systems have been static for years and new variety introduction is minimal. Farmers' current heavy reliance on markets for seed raises particular concerns about the economics of routine seed use: the average farmer spends at least $US60-70 per season. Markets could provide a vibrant entry point into strengthening seed

systems, but they need to be linked strategically to a range of quality and information innovations.

Review of Seed Security Problems: prime realms for intervention

Now, having reviewed the full results of this seed security assessment, we come back to the analysis of broad realms of possible seed security-related options in the short and medium term (Table 35).

Table 35: Seed security problems and broadly appropriate responses, Haiti SSSA 2010

PARAMETER	ACUTE	CHRONIC
Unavailability of seed	**Direct distribution of seed**	(Happens rarely or never)
Farmers lack access to seed	**Vouchers and cash (sometimes with seed fairs)**	**Income-generation activity** **Agroenterprise development**
Poor seed quality • **poor varieties** • **unhealthy seed**	***Limited* introductions new varieties**	**Introduce new varieties and give technical support** **Variety selection / breeding** **Development of seed enterprises linked to new varieties and other quality enhancements**

(Shaded areas suggesting points of intervention.)

The SSSA found that the overriding problem surrounding seed security and the functioning of seed systems in the wake of the earthquake in Haiti has little to do with seed *per se*. Rather, immediate and key constraints revolve around decreased purchasing power: rural households have lost assets, are recuperating from having had many mouths to feed, and may have less income due to the sharp drop in rural petty commerce.

The SSSA also identified an abundance of chronic seed security problems (as well as opportunities) facing farmers. These start at the beginning of the seed chain. Plant breeding structures and processes need to accelerate varietal screening, sustainable decentralized enterprises must be catalyzed, and delivery systems have to be designed to give farmers access to seed, information and market-related skill building opportunities. Haitian farmers need and deserve high-performing agricultural technologies, access to inputs and information, and opportunities to add value and even transform a range of rural enterprises.

We end this chapter by re-emphasizing the two overarching findings of the SSSA:

- Haitian farmers have not experienced a seed security emergency, aside from those important problems linked to finances and purchasing power. In the very short term, ways to increase farmers' access to goods and services should be explored but, in general**, there should be a move away from the emergency focus in agriculture.**
- Short- to medium-term developmental actions now need major attention. The SSSA **recommends a move towards significant investment in small-farmer-driven variety, seed, and agricultural marketing systems.**

The next chapter recommends a set of concrete, doable, urgent actions.

VII: RECOMMENDATIONS: ACROSS SITES

The SSSA encompassed diverse and representative regions of the Haiti. While evaluating the immediate effects of the earthquake, it also assessed comprehensive farmer seed security trends countrywide and over the longer term, for a period of 5 to 10 years.

In terms of acute stress, in the season immediately after the earthquake farmers overall sowed less seed than normal — a drop of 15.9% across crops and regions. This was largely due to financial constraints but also linked to stresses such as drought. In fact, the biggest drops in seed use occurred in drought-stricken areas of the North (a decline of 35.9% in Bassin Bleu) and not in the epicenter of earthquake impact (a decline of 13.3% in Léogâne). For the second season post-earthquake (which is staggered by crop and region) farmers plan to increase the amounts they sow (15.3% above normal) across sites sampled.

Other key indicators show direct earthquake effects to be minimal or are stabilizing. Land area under cultivation has decreased by a mere 3.13% since January 12 and labor available for agriculture decreased by only 0.30%, across all households. One important lingering effect centers on decreased rural petty commerce, which has especially affected women, who are important rural traders.

This does not mean that Haitian farmers are not stressed. They have lost assets; they are supporting a 10% increase in household size (i.e., more mouths to feed); and their agriculture remains vulnerable to the vagaries of weather and household finances. However, acute seed security issues are minimal, aside from those important ones associated with a general drop in purchasing power.

The large majority of seed security constraints identified are deeply chronic ones. Unlike nearly everywhere else in the world, "eating or selling one's seed' are not distress signals in Haiti. They are normal practices, particularly for crops such as beans. Farmers routinely buy some 75% of their seed from local markets, with seed costs raising particular concerns about the economics of routine seed use: the average farmer spends at least US$60-70 per season. Further, farmers generally cannot access new varieties, an array of other needed inputs, or even regular technical advice. For instance, only 14% of farming households have had access to *any* new variety over the last five years, and the February/March 2010 emergency distribution alone provided 53% of these introductions.

Below we make a set of recommendation linked to emergency response and to more developmental opportunities. Perhaps this acute stress, the earthquake, will serve as the catalyst to jumpstart the development of seed systems which can serve the real needs of Haitian farmers.

Recommendations

I. EMERGENCY SEED AID

Emergency seed aid responses need to be honed. In February/March 2010, several regions in which farmers and authorities had reported no direct ill effects of the earthquake on agriculture (e.g., Petit Goave) nevertheless received seed aid. Further, seed of variable quality was given in multiple direct seed distributions (with germination problems for maize and bean seed in particular). Most important, the type of aid response often did not match the seed security problem at hand. The immediate problem was clearly one of financial stress, which can lead to problems in accessing a range of goods, including seed. Direct seed availability was not identified as a significant constraint.

To shape more effective seed aid practice immediately, the following recommendations are made:

1. Emergency seed aid should be used only to address urgent problems, and those in which seed security is a specific problem. Note that current farmer projections for August/September 2010 suggest that farmers are able to access the seed they need.

2. Any seeds made available to farmers through aid interventions have to shown to a) be adapted to local conditions, b) fit well with farmers' preferences, and c) be of a quality 'at least as good' as what farmers normally use.

    1.1 One should **never introduce varieties in an emergency context which have not been tested in the given agroecological site and under farmers' management conditions.**

    1.2 Seed quality, both varietal and phytosanitary quality, has to be farmer-acceptable in all seed aid transfers, with specific germination tests to be conducted whenever possible.

3. Certain problems were observed in the quality of seed aid given in February/March 2010 (with most of the comments coming from Petit Goave and Hinche). To learn from such mistakes, future seed aid interventions should build in a monitoring and evaluation component, including direct field visits. Delivering seeds that do not germinate makes stressed farmers even more vulnerable.

4. Targeted seed aid approaches, whereby responses are matched to specific seed security problems, should guide future initiatives.

    1.1 Direct Seed Distribution (DSD) is best used when there are problems of seed availabilit Several agro-dealers in Léogâne indicated they had substantial supplies of maize seed unsold while free seed aid was being delivered. Business was being compromised at the critical moment it needed to be strengthened. While Léogâne may be unique in currently having an input dealer network, such outlets will likely become more numerous in the near future. These should be supported, not undermined.

    1.2 The use of vouchers should be considered where problems of access to seed are identified. Voucher use might be considered through seed fairs, linked to farmer producer groups, or through established agro-dealers. In all cases, preconditions need to be met: a) the seeds that traders and agro-dealers put on offer must be farmer-preferred varieties; b) traders and agro-dealers must be located within reasonable proximity of the farming community; and c) supplies should to be sufficient to cover the voucher amounts distributed.

    1.3 The capacity of humanitarian organizations to use a range of seed security-related response approaches needs to be built, with training explicitly programmed. Many have good experience with DSD, but have less (or no) capacity to implement seed fairs, voucher schemes, or cash transfer programs.

5. Novel improved varieties should generally not be introduced to a broad population in the context of an emergency distribution. Rather, new varieties should be tested and promoted within the framework of a longer-term development program where technical advice and clear monitoring can be ensured. If new varieties are to be distributed in a humanitarian response, better practices should be respected: a) farmers should have a choice between using the new variety or using an established one; b) small quantities should be sown; c) follow-up in the field should be scheduled – during the season and post-harvest.

6. In zones where emergency seed aid is being implemented repeatedly (a good signal is aid giving three seasons in a row), decision makers (donors, ministry, partners) should program a formal review to assess its continued rationale and efficacy.

II. VARIETY INTRODUCTION

There is a generalized need, across Haiti, to develop and identify varieties that are adapted to local conditions, meet farmer preferences, and respond to dynamic market needs.

Various steps might be considered in the process of identifying productive and accepted varieties.

7. Concerted efforts should be made to scale up the multiplication and distribution of 'proven varieties' (such as Arifi Wurite in the irrigated lowlands).

8. Multilocational sites might be quickly established for screening 'best bets' from elsewhere. In the current absence of a government decentralized testing system, a temporary network of agricultural NGO and universities, coordinated by the MARNDR, might be established across the country, to cover key agroecological zones.

9. Screening sites for more exploratory germplasm trials should also be established (across key agroecological zones), using models that allow for end-user evaluation. Participatory Variety Selection (PVS), mother-baby trials, or garden variety trials are among the well established variety screening formats that allow for intensive farmer and trader evaluations.

10. Decentralized screening might best be tied to decentralized seed producer groups. These can help spur immediate, wider multiplication, once acceptable varieties have been identified.

Key is that a) local adaptation be confirmed; b) farming communities be engaged to ensure performance and cooking/taste acceptability; and c) traders/dealers be involved to anticipate market acceptance. Top-down models, which fail to stimulate local innovation, should be avoided.

In keeping with recommendation 5 above, new varieties should be introduced in a developmental context. Introductions should be made only if close follow-up is ensured over several seasons. More complicated technologies, such as hybrids, will require comparatively longer monitoring.

III. SUSTAINABLE DECENTRALIZED SEED PRODUCTION MODELS

Current decentralized seed production is limited, heavily subsidized, and not effectively reaching smallholder farmers. Sustainable decentralized production models need to be confirmed.

12. The range of current decentralized seed multiplication programs should be evaluated for their cost-effectiveness. The main ones are the Groupements de Production Artisanale de Semences (GPAS), small-scale businesses, and community-based multiplication programs. (Most current programs are tied to providing seed to institutional clients, developmental and relief agencies).

    Seed multiplication programs should only be promoted if they are:

    - geared to meeting farmer-client needs;
    - tied to continuing new sources of germplasm;
    - contain an explicit delivery (and, where appropriate, marketing) component; and
    - are economically viable for the producers involved in such enterprises.

    Linked to the above:

13. As there will be challenges in developing profitable, seed production and delivery programs for many of the staple crops, donors and implementers should, at a minimum, aim for break-even models.

14. Multiplication groups should be encouraged to produce crops only if clear markets have been identified, and general agroenterprise/marketing skills are enhanced.

15. Links have to be catalyzed for feeding farmer-acceptable and market-preferred crops into seed production initiatives. Efforts such as Farmer Field Schools (FFS), or the end-user evaluation mechanisms above (#9) might all help to raise awareness of and access to new needed varietal materials.

16. Production of foundation seed has to be intensified across a range of noncommercial crops, to form the base of an extensive, decentralized seed production system. The production of such foundation seed should rest squarely with the national research institution, MARNDR. (This is not a sustainable function for an NGO alone, however effective ORE actions have been.)

17. Improved storage methods should be investigated and promoted, particularly to deal with storage constraints of crops such as groundnut and cowpea. (For the latter, triple bagging options might prove effective.)

    In brief, we are recommending the development of a market-driven decentralized seed production system, which scales up foundation seed and then decentralizes seed production in multiple zones countrywide. Supply has to respond to demand, meaning that hard-to-produce crops (e.g., groundnut and manioc) and new desired varieties have to drive the production process.

IV. FORMAL/INFORMAL OUTLETS AND LOCAL MARKETS FOR AGRICULTURAL INPUTS

Farmers need regular access to outlets that can provide them with the varieties and quality seed they desire. Current outlets (aside from those selling horticultural crop inputs) are few and far between, and often not located in client-friendly venues.

18. As a first overall planning instrument, GIS mapping of potential rural clientele might be useful to guide placement of input outlets which maximize coverage for smallholder farmers.

Specialized formal outlets

19. Well established agro-dealer networks are currently concentrated in cities and larger towns. (For instance, farmers in Petit Goave have to travel to Port-au-Prince, 2½ hours away, in order to obtain certain inputs). Larger suppliers might require temporary incentives to test placement of sub-outlets closer to communities.

20. 'Farmer boutiques' that specialize in seed, fertilizer and other agrochemicals are a recent development (catalyzed by USAID/WINNER). Special efforts should be made to assess their social reach (who buys?) and economic feasibility.

Expansion of informal and integrated outlets

Most farmers continue to obtain a large proportion of their seed from various types of local markets. We recommend that creative initiatives be taken to tie the supply of new varieties and quality seed to the multiple venues where farmers routinely make purchases. More specifically:

21. Trials might be initiated for selling new varieties and high quality seed through more integrated stores. Two options merit consideration: a) making seed available in general delivery stores, and b) expanding the range of goods available at agricultural stores, to include items such as roofing materials and cement (as has been tested formerly in northern Haiti). In both cases, venders would have to be trained to provide farmers with the technical advice needed to guide informed seed choices and management.

22. *Madames Saras,* the women traders who normally deal in seed and grain, might be usefully engaged to sell seed of new varieties on a trial basis.

23. Seed fairs, whether in the context of emergency aid or development programs, might be systematically linked to sources of new varieties and quality seed.

24. Seed loan schemes that allow farmers to obtain seed of new varieties on credit should be tested and include monitoring mechanisms to determine the quality of the seed returned by farmers and their real repayment rates.

    Seed sales through the above-mentioned informal outlets can be facilitated if high-quality seed is sold in small quantities in sealed plastic packs. Experience elsewhere suggests this should be done in quantities acceptable to farmers (perhaps 100-200 g) and with labels reporting basic varietal characteristics.

25. Farmer-focused, small-pack sales models might be tested in the range of venues where farmers routinely buy seed and other goods. (See recommendations 20-22.)

If done smartly, these suggestions for broadening seed sale venues and sale formats should stimulate the creation of a broad customer base, focusing directly on producers (small-scale farmers) and reducing reliance on large institutional buyers. As the above suggestions build on the varied local market channels that Haitian farmers already regularly use, their transaction costs would be minimized.

V. FERTILIZER AND ORGANIC AMENDMENT USE

Fertilizer and organic amendment use also formed part of the Seed System Security Assessment as the targeted use of such inputs can help to stabilize small-farmer systems and make them more productive.

About 28% and 39% of farmers used mineral fertilizer and compost, respectively, during the season of the SSSA. It is hard to assess the effectiveness of such use. Lack of research limits the ability of extension services to advise on judicious and appropriate application guidelines.

Chapter V of this report focuses on the overall fertilizer supply and demand patterns in Haiti. Here we list as recommendations an abbreviated set of those presented in that chapter. The aim of these recommendations is to stimulate a better distribution and use of fertilizer and organic amendments in Haiti.

26. Fertilizer use should not be considered independently of entire value chain, from distribution of inputs to market of final products. Low market prices for farmers are a disincentive to use of fertilizers, especially in a free market.

27. Credit should be made available at a reasonable cost for purchase of fertilizer and other inputs.

28. Fertilizer purchases and distributions should be well planned to ensure sustainable availability. The private sector may do a better job of procuring and distributing fertilizers in a timely fashion, but government should maintain subsidies in the short term to keep fertilizer within reach of farmers.

29. Clearly defined policies are needed with respect to subsidies and the government role in fertilizer distribution. Agribusinesses need to know the environment in which they are operating if they are to commit resources.

30. Fertilizer supply should be increased to accommodate the needs of farmers outside Artibonite Valley. Although it is logical to invest greater resources on irrigated land, it should not be to the neglect of rainfed agriculture. There are areas of rainfed agriculture that have potential and which are not irrigated or do not have vegetables, but could benefit from fertilizer applications.

31. A greater range of fertilizer types should be made available on the market to allow farmers to apply fertilizer based upon specific requirements of soils and crops.

32. A sustained effort should be made to increase soil research related to soil characterization and fertility. Fertilizer response studies involving single-nutrient fertilizers should be conducted on different soils and using different crops in order to determine appropriate fertilizer rates for each region, soil type and major crops. This research should be accompanied by soil laboratory analyses using different extraction methods that provide the best correlation with crop response. This will be extremely useful in developing future fertilizer recommendations.

33. At least one functioning and equipped soil testing laboratory should be made available for providing soil testing services to Haitian farmers.

34. Greater use should be made of organic sources of nutrients, where they are available, both for the nutrient and soil quality benefits they provide, and to reduce dependence on imported fertilizers. Opportunities exist to utilize waste products from industrial processes, urban waste, animal manure, vermiculture, etc.

Overall, we suggest that the promotion of fertilizer use and fertilizer distribution not be treated as an end in itself but be viewed as a component of an integrated policy of research and extension, where fertilizer imports and recommendations are based on research results on different soils in each region.

VI. INFORMATION INNOVATIONS: RAISING AWARENESS AND RAISING DEMAND

Haitian farmers currently receive little information about improved techniques for sustainable and profitable agricultural production. Emergency aid campaigns – the main intervention in which farmers access novel agricultural products – are generally conducted in the absence of supporting technical personnel or information.

There is currently little formal extension in Haiti. (Many of the farmers interviewed during the assessment could not remember the last time they interacted with a trained agronomist.) The Bureau Agricole Communale (BAC) have to serve large geographic areas, with few financial resources. The decentralization of these government entities also poses challenges for communication and coordination. Some initiatives do exist in rural areas by which authorities transmit information (on seed aid, for example) via megaphones in communities — but such channels tend to be localized and reach limited numbers of people. Radio programs could be used as an enhanced component of information flow, in addition to other traditional methods such as poster campaigns and community information fairs. However, two-way communication methods should be emphasized as well.

The focus of the following recommendations is to enable small farmers to draw on badly needed innovations and to make more informed choices among multiple options.

35. Mobile systems that exploit the omnipresence of cell phones among Haitians should be explored. An SMS-based alert network could promote the transfer of critical information on a variety of topics, in particular:
    a. New varieties: characteristics, planting tips, and locations where available
    b. Market prices of various crops in different localities (see also # 31.2)
    c. Fertilizer and other input availability constraints
    d. Other business development services (BDS).

Services such as FrontlineSMS (for SMS alerts) and Esoko (for market information) have been deemed useful elsewhere and could be explored for possible use in Haiti.

36. Farmers in several sites, especially Verrettes, actively asked for more formal extension services. An extension network needs to be stimulated to provide continuing guidance to farmers and to feed back their concerns to relevant fora. (Non-governmental coalitions could be catalyzed to meet this need quickly.)

VII. MARKET CHAINS

Seed security in Haiti, as well as food and livelihood security generally, are linked to the financial capacity of farmers. Rural agroenterprises are mechanisms of potential impact that are currently severely underdeveloped. Farmers are selling their agricultural produce in raw form, or only slightly modified, as in the sale of fried bananas or as flour in the case of maize and manioc.

Significant market chain prospecting needs to be carried out. Current interesting bets are the marketing of coffee, mangoes, avocados and vegetables. Production of mango soft drinks, using Haitian mango pulp, also seems to be in the offing. Agroenterprises and agroenterprise development need to be strengthened at the local, regional and national levels, focusing on markets for food security and higher-value crops. More generally, the development of agroenterprises which link farmers to domestic and international markets needs to be pursued with vigor but through processes that reduce the risk farmers face (such as ensuring the use of transparent pricing and payment mechanisms).

In this vein, we recommend the following measures:

37. Profitable business models that serve local markets with good-quality produce, especially in collaboration with existing formal and informal market actors (e.g., *Madames Saras), need to be catalyzed.*

38. Market information needs to be shaped to become more timely and trustworthy, providing information on volumes, prices and products at a national and regional scale. This can be facilitated through the use of radio and cell phone information systems. If done well, actors all along the market chain will be able to make better decisions based on more complete or up-to-date information. In addition, there should be a general reduction in the costs actors bear for discovering new information (see also #35).

39. Insurance schemes should be tested as a way to offset climate-related production risk.

40. Specific leadership roles for women and women's organizations need to be developed, reinforcing their roles as economic actors in the market chain through service provision (and going beyond employment generation for women in processing/sorting) (see also section VIII below).

Also, as a guiding principle, we suggest a perspective which focuses on development of the entire market chain. This encompasses smallholder production, local value addition and processing, physical market access,

the development and support of buyers willing to provide support services (technical, organizational or financial), and the fostering of enabling public policies.

VIII. RURAL WOMEN AND COMMERCE: ECONOMIC STIMULUS

Women play critical roles in the seed production and market system, as well as in household food security and well-being. They are often responsible for seed and grain storage at the household level, and, as traders, move seed and grain from producers to markets, and even across regions (as in the case of *Madame Saras*). Multiple women's focus groups reported the sharp drop in rural petty commerce after the earthquake: special efforts should be made to revitalize livelihood options for women. Here are four specific recommendations:

41. Women's groups that were contacted during the SSSA carry out a range of activities such as providing seed storage during critical postharvest periods, conducting participatory variety selection, managing plant nurseries, and acting as seed multipliers. Such groups, rather than individuals, should be considered an important entry point for development and investment support. Precedents such as the Mutuelles de Solidarité (MUSOs) suggest a group entry point is effective.

42. Sustainable models of agroenterprise for women's groups should be explored. An entry point could be internal savings and lending schemes to help strengthen women's group cohesion, and provide access to small amounts of capital through savings. These groups may form the foundation for agroenterprises, other income-generation schemes, and skills building, and also enable women to protect and grow their assets.

43. Women small traders seek enhanced business skills and marketing skills, as well as greater access to credit to conduct their commercial trade. Women should, on a large scale, have access to training in business, marketing and group and financial management, and should be encouraged to build on their existing innovations (see also #40).

44. Little research has been carried out on gender dynamics in Haiti's agricultural systems and rural economy. The government and development organizations should invest in a focused study on women's participation in agricultural activities to determine appropriate entry points for women in key value chains, seed security, and food security initiatives.

Overall, the SSSA recommends a move away from an emergency focus in rural interventions. It is high time to make significant and strategic investments, across Haiti, in small-farmer-driven variety, seed and agricultural marketing systems.

REFERENCES

Almekinders, C.J.M., and Louwaars, N.P. 1999. *Farmers' seed production: New approaches and practices. London:* Intermediate Technology Publications. 291 pp.

Association Internationale de Développement. 1990. Gestion des Ressources Naturelles en vue d'un développement durable en Haiti. Report BDPA/SCETAGRI.ED.90015.

ATPPF. 1998. Aide-Mémoire: Enquête menée dans les zones tampons des Parcs et Forêts par l'Equipe CRDA – Assistance Technique SECID. Report prepared for the World Bank project Projet d'Assistance Technique pour la Protection des Parcs et de la Forêt.

Auerbach, A. 2008. Emergency Market Mapping and Analysis (EMMA) Pilot Test 3, Haiti: Key Findings and Recommendations. London: Practical Action, with ACDI / VOCA, Croix-Rouge Haitienne, Canadian Red Cross and Oxfam GB.

Bayard, B. 2007. La filière riz en Haiti: Diagnostic global et perspectives. Port-au-Prince: ANDAH. 96 pp.

Bayard, B., Jolly, C.M., and Shannon, D.A. 2007. The economics of adoption and management of alley cropping in Haiti. *Journal of Environmental Management. 84: 62-70.*

Bellande, A., and Damais, G. 2004. Évaluation de l'impact de la gestion des engrais chimiques par le Ministère de l'Agriculture et propositions de relance de la filière sur une base concurrentielle. Port-au-Prince.

van Beukering, J.A. 1947. *Het ladangvraagstuk, een bedrijfs-* en social economisch problem. Mededeelingen van het Departement van Econommische Zaken in Nederlandsch-Indië, No. 9. The Hague.

Bossa, J.R., Adams, J.F., Shannon, D.A., and Mullins, G.L. 2005a. Phosphorus and potassium release from leucaena leaves in three environments in Haiti. *Nutrient Cycling in Agroecosystems.* 73: 25-35.

Bossa, J.R., Shannon, D.A., Adams, J.F., Mullins, G.L., and van Santen, E. 2005b. Phosphorus, potassium and leucaena pruning interactions on corn in Haiti. Nutrient Cycling in Agroecosystems. 73: 37-47.

Brady, N.C., and Weil, R.R. 2002. The Nature and Property of Soils, 13th Edition. Upper Saddle River, N.J.: Prentice Hall.

Catholic Relief Services (CRS). 2002 *Seed Vouchers and Fairs: a Manual for Seed-Based Agricultural Recovery in Africa.* Catholic Relief Services, developed in collaboration with the International Crops Research Institute for the Semi-Arid Tropics and Overseas Development Institute. Nairobi, Kenya.

Caritas Haiti. 2010. DRAFT Report of CRS study of markets in NE Department, esp. Ouanaminthe. Port-au-Prince: Caritas and CRS.

CIA. 2007. The World Factbook. https://www.cia.gov/library/publications/the-world-factbook/geos/ha.html

CNSA. 2010. Rapid post-earthquake emergency food security assessment. Port-au-Prince: Coordination Nationale de la Sécurité Alimentaire, 72 pp.

Correia, M. 2002. A Review of Gender Issues in Dominican Republic, Haiti and Jamaica. Washington: World Bank. Report No. 21866-LAC.

Damais, G. 2007. Haiti: A Rapid Assessment of Market Information Systems: A special report by the Famine Early Warning Systems Network (FEWS NET). Washington, D.C.: USAID. 79 pp.

DANAGRO. 1988. SADCC Reproduction and supply project, main report (vol. 1A) and Country Reports (vol. 2A-2J).

Dauphin-Clermont, C. 1998. Étude socio-économique sur l'utilisation d'engrais chimiques à Kenscoff et dans l'Artibonite.

Duvivier, P., Louissaint, J., and Sampeur, U. 2006. Réponse de trois variétés de riz (*Oriza sativa, L.)* [Bogapote, Malaïka et TCS10] à la fertilisation phosphatée et potassique dans la Vallée de l'Artibonite, Haïti. *RED*. 1 (3): 22-25.

FAO. 1998. Proceedings of the International Workshop on Developing Institutional Agreements and Capacity to Assist Farmers in Disaster Situations to Restore Agricultural Systems and Seed Security Activities. FAO Plant Production and Protection Paper No. 150. Rome: Food and Agriculture Organization.

FAO. 2009. FAO Country Profile: Food Security Indicators. <http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Haiti_E.pdf >

FAOSTAT. <http://faostat.fao.org/site/342/default.aspx>.

FEWSNET. 2009. Production and Trade Flow Maps: HAITI BEANS. <http://www.fews.net/docs/Publications/ht_fullmap_beans_norm.pdf>

Gardella, A. 2006. Gender Assessment. Haiti: USAID. <http://pdf.usaid.gov/pdf_docs/PDACH597.pdf>

Government of the Republic of Haiti. 2010. Action Plan for National Recovery and Development of Haiti: immediate key initiatives for the future. <http://www.haiticonference.org/Haiti_Action_Plan_ENG.pdf>

Guthrie, R.L., and Shannon, D.A. 2004. Soil Profile Descriptions for Steepland Research Sites in Haiti United States Agency for International Development, Soil Management Collaborative Research Support Program, Auburn University Technical Bulletin 2004-01. 24 pp.

Guthrie, R.L., Rosseau, P.M., Hunter, G.A., and Enilorac, M.P. 1990. Soil profile descriptions for selected sites in Haiti. USAID Haiti: SECID/Auburn Agroforestry Report No. 16.

Isaac, L., Wood, C.W., and Shannon, D.A. 2003. Pruning management effects on soil carbon and nitrogen in contour-hedgerow cropping with *Leucaena leucocephala* (Lam.) De Wit on sloping land in Haiti. *Nutrient Cycling in Agroecosystems.* 65: 253-263.

Isaac, L., Wood, C.W., and Shannon, D.A. 2004. Hedgerow pruning management effects on maize yield and nitrogen uptake in alley cropping. *Agronomy Journal.* 96: 1632-1640.

Isaac, L., Shannon, D.A., Wood, C.W., and Bernard, C.R. 2006. Promising tree species as hedgerows for alley cropping in different environments in Haiti. Washington, D.C.: United States Agency for International Development, Soil Management Collaborative Research Support Program. Auburn University Technical Bulletin 2006-1. 29 pp.

Louissaint, J., and Duvivier, P. 2005. Principales caractéristiques physico-chimiques des terres rizicoles de la Vallée de l'Artibonite (Haiti) et disponibilités réelles en éléments majeurs. RED. 2 (1): 32-36.

Louwaars, N.P. 1994. Seed supply systems in the tropics: international course on seed production and seed technology. Wageningen: International Agricultural Centre.

MARNDR, and BID. 2005. Identification de créneaux potentiels dans les filières agricoles haïtiennes. Port-au-Prince: MARDNR. Rapport de synthèse.

McGuire, S.J. 2001. Analysing Farmers' Seed Systems: Some conceptual components. L. Sperling (ed.). Targeted Seed Aid and Seed System Interventions: Strengthening small farmer seed systems in East *and* Central Africa. Proceedings of a workshop in Kampala, 21-24 June 2000. June 2000. PRGA, CIAT, and IDRC. pp. 1-8.

Mutsaers, H.J.W. 2007. *Peasant Farmers and Scientists: A Chronicle of Tropical Agricultural Science in the Twentieth Century.* Dordrecht, The Netherlands: Springer. 607 pp.

N'Zengou-Tayo, M. 1998. Fanm Se Poto Mitan: Haitian Woman, the Pillar of Society. Feminist Review. 59 (Summer): 118-142.

Ng, F., and Aksoy, M.A. 2008. Who are the net food importing countries? Washington, D.C.: World Bank. Policy Research Working Paper No. 4457. <http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2008/01/02/000158349_20080102095804/Rendered/PDF/wps4457.pdf>

Nye, P.H., and Greenland, D.J. 1960. *The Soil under Shifting Cultivation.* Technical Communication No. 51. Harpenden, UK: Commonwealth Agricultural Bureaux.

PIA. 2006. Étude de la Fertilisation des sols de la Vallée de l'Artibonite. Rapport Final Essais de Fertilisation. Port-au-Prince: MARNDR/BID Programme d'Intensification Agricole (PIA).

Remington, T., Maroko, J., Walsh, S., Omanga, P., and Charles, E. 2002. Getting off the Seeds-and-Tools Treadmill with CRS Seed Vouchers and Fairs. *Disasters.* 26 (4): 316-328.

Shannon, D.A., Isaac, L., Bernard, C.R., and Wood, C.W. 2003. Long-term effects of soil conservation barriers on crop yield on a tropical steepland in Haiti. Washington, D.C.: United States Agency for International Development Soil Management Collaborative Research Support Program. Auburn University Technical Bulletin No. 2003-01. 40 pp.

Shields, W.H. 2001. A Subsector Analysis of the Improved Bean Market in Haiti. Agricultural Economics, Michigan State U, East Lansing, MI. 100 pp.

Sperling, L., and McGuire, S.J. 2010. Understanding and strengthening informal seed markets. Experimental Agriculture. 46 (2): 119-136.

Sperling, L., Cooper, H.D., and Remington, T. 2008. Moving towards more effective seed aid. Journal of Development Studies. 44 (4): 586-612.

Sperling, L. 2008. When Disaster Strikes: a guide to assessing seed system security. Cali, Colombia: International Center for Tropical Agriculture.

Sperling, L. and Remington, T. with Haugen, J.M. 2006. Using seed aid to give farmers access to seed of new varieties. Practice Brief No. 5. In: Seed aid for seed security: advice for practitioners. Practice Briefs 1-10. Rome, Italy: International Center for Tropical Agriculture and Catholic Relief Services.

Sperling, L. ed. 2001. *Targeting seed aid and seed system interventions: Strengthening small farmer seed systems in East and Central Africa*. Proceedings of a Workshop, Kampala, Uganda, 21–24 June 2000. Kampala, Uganda: International Center for Tropical Agriculture.

Taft-Morales, M., and Drummer, D. 2007. Haiti's Development Needs and a Statistical Overview of Conditions of Poverty, Congressional Research Service. <http://pdf.usaid.gov/pdf_docs/PCAAB593.pdf >

UNCTAD. 2006. The Least Developed Countries Report. Geneva: United Nations. 73-175 pp. <http://www.unctad.org/en/docs/ldc2006p2ch4_en.pdf>.

UNICEF. 2007. State of the World's Children. Geneva: United Nations.

USAID. 2010a. Emergency Market Mapping and Analysis: The Market for Agricultural Labor in Sud-Est Department of Haiti. microREPORT. Washington, D.C.: USAID.

USAID. 2010b. Emergency Market Mapping and Analysis: The Market for Beans in Sud-Est Department of Haiti. microREPORT. Washington, D.C.: USAID.

Walters, E., and Brick, D. 2010. A Rapid Seed Assessment in the Southern Department of Haiti: An examination of the impact of the January 12 earthquake on seed systems. Washington, D.C.: CRS. 53 pp.

World Bank, 2002. A Review of Gender Issues in Dominican Republic, Haiti and Jamaica. December 2002.

WFP. 2008. WFP feeds thousands displaced by Hurricane Gustav. World Food Programme. <http://www.wfp.org/node/149>