TCP/RLA/3101

Assistance to Improve Local Agricultural Emergency Preparedness in Caribbean Countries Highly Prone to Hurricane Related Disasters

Good Practices for Hazard Risk Management in Agriculture

Summary Report Haiti
Project Phase I

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Jointly implemented by

The Food and Agriculture Organization of the United Nations, and
The Ministry of Agriculture, Natural Resources and Rural Development (MARNDR), Haiti

Environment, Climate Change and Bioenergy Division, FAO

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Upper left: Hurricane Jeanne impacts in Gonaives in 2004, Credits: FAO/Marmelade;
Upper right: Flood in the South in 2006, Credits: FAO Emergency Unit;
Down left: Improved Contour Canal at Marmelade, Credits of FAO/Marmelade;
Down right: gully plugs in Marmelade, Credits FAO/Marmelade.

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EXECUTIVE SUMMARY

Haiti is an agro-based economy whose general livelihood systems have been seriously affected by recurrent onslaught of weather-related disasters resulting in 18,441 killed, 4,708 injured and 131,968 homeless, 6,376,536 affected and economic damages for 4.6 billion US $ over the 21^{st} century. Particular physiographic characteristics - semiarid tropical climate, rough and mountainous terrain - and the combined interplay of environmental degradation with extreme socio-economic conditions in the form of poverty, illiteracy, inefficient land use systems and governance problems, have made the country increasingly vulnerable. In 2004 alone, a very active cyclonic year, hurricanes Ivan and Jeanne resulted in 320,852 affected, of which 2,757 killed, as well as heavy material losses. Such extensive damages combined with the vulnerability of small farmers, lessons learnt from a number of FAO emergency and rehabilitation projects and critical gaps in disaster and risk management strategies eventually oriented FAO towards a more proactive approach.

Within this framework, the FAO funded the regional TCP "Assistance to improve Local Agricultural Emergency Preparedness in Caribbean countries highly prone to hurricane related disasters" in Cuba, Grenada, Haiti and Jamaica to "assist governments of participating countries to support the food security of small farmers operating in the most hazard prone areas by improving institutional frameworks and technical options for hurricane-related disaster preparedness, emergency response and post-emergency agricultural assistance". The proposed approach was to use a Participatory Rural Appraisal - PRA/based qualitative research paradigm.

The current section summarizes the project implementation outcome in Haiti during phase I, June 2006 - January 2007.

I. DRM Framework Linkage Improvement

A relatively new concept in Haiti, Disaster and Risk Management has been topical from 1998 when, in response to Hurricane George, the government initiated a program to reinforce national capacities with emphasis on disaster response and preparedness. With the formulation of the National Plan for Disaster and Risk Management institutionally supported by UNDP, a rather sound national framework was developed for this sector. Projects realized so far have known mixed successes, owing to planning deficit, lack of well-trained local evaluators, an emphasis on response rather than rehabilitation, lack of synergy between actors, inadequacy of scope of the programs versus the many needs of disaster-stricken communities and relatively weak links binding DRM to other national strategic activity sectors, particularly the important socio-economic agriculture sector.

The following recommendations, likely to improve the national DRM framework and initiate a stronger DRM–Ag interface, emanated from farmers, farm extension officers, agriculture and/or DRM national experts:

1. Collection of additional information, based on relationships between the DRM and the agriculture sectors,
2. A more participative and egalitarian approach should underlie the relationships between executives, stakeholders, beneficiaries, and actors in the two sectors at all levels;

3. A better planning is needed between the institutions to design joint action plans to reduce risks and be more efficient in delivering disaster relief to farmers;
4. There is a need for an effective decentralization of government decisions to lower administrative levels in both sectors;
5. Small stipends (seed money) should eventually be provided to DRM local committee members for them to be more involved and efficient in the execution of their duties;
6. The MoA DRM sector committee needs to be activated, with mandate to elaborate and execute agriculture sector-wide contingency plans related to DRM issues;
7. A better timing is needed for the undertaken DRM activities (e.g. real time delivery of early warning messages, in time delivery of relief to disaster stricken communities);
8. Both sectors should shift their global vision of DRM from the current passive disaster-management-dominated approach to a more proactive risk-management-based approach.

II. Pilot site selection and profiling

The basic criteria used to select the two pilot sites of *Bassin Magnan* and *Lavanneau* are, among others:

a) the vulnerability to hydro-meteorological hazards and multi-hazard exposure, frequency of hazards within the last 5 years,

b) evidence of local risk mitigation capacity, existence of local knowledge perceived as DRM good practice,

c) evidence of ongoing farm activities,

d) relatively high dependence on agriculture for a livelihood.

Bassin Magnan is a 9 km^2 rural farming area, with about 2,500 inhabitants located on a very dry, deforested plateau 160/300 m above sea level and is part of the very dry tropical forest life zone. Bassin Magnan is part of a leeward region and is prone to extensive droughts which combined with extreme deforestation of surrounding hills rendered inapt to farming activities exacerbate the vulnerability of the local population, ultimately compelled to burn charcoal and excavate the bed of local rivers for gravel, sand and stones for a living. Coping strategies include: good practices for drought/water management, migration, selling of farm labor, informal local credit system, sharecropping, cattle herding, etc.

Bassin Magnan farmers consider FAO the number one local contributor to post-disaster rehabilitation efforts, while the Ministry of Agriculture is regarded as the object of the poorest performance. Lavanneau farmers, on the other hand, perceived the Haitian Red Cross as the most effective local contributor, and the Ministry of Agriculture as the worst.

Lavanneau is a fairly deforested peri-urban farming area of about 6.5 km^2, with 2,000 inhabitants. It includes two distinct zones, Beaudouin at 40 metres above sea level and Romage at 350 m above sea level, part of the dry tropical forest life zone. Lavanneau is prone to floods in its lower part and vulnerable to wind and water erosion in its higher part characterized by steep slopes and exposition to local dominant winds. Local residents resort to mesquite charcoal burning, migration, farm labor selling, sharecropping, cattle herding, and informal extra-farm activities such as motorcycle-taxi riding as livelihood coping strategies. The presence of high value crops such as mandarin and plantain makes living standards apparently higher at Lavanneau compared to Bassin Magnan, where local farmers, whose houses mostly have thatched roofs, are compelled to prioritize drought resistant and low-market value crops such as sorghum and millet.

Similarities between the two pilot sites include: proximity to a departmental city; under-development; presence of a small-scale irrigation system; proneness to hurricanes; marked absence of state-led farm extension services; social stratification in three farmer classes; relatively degraded state of natural resources and priority holding by a minority of farmers; active presence of numerous NGOs filling up for the absence of the State; relative strength of local associative movement, etc.

III. Good practice assessment and prioritization

Twenty six good practices were identified on the field during PRA-based surveys. Sixteen were further documented for their relative higher relevance and effectiveness to disaster and risk management. Soil conservation related practices were the most frequently used by the respondents to address DRM issues, tree pruning, however, received the highest scores for feasibility, sustainability, efficiency, and replicability, the criteria according to which the Haiti workshop participants prioritized them, in descending order of importance:

1. Tree Pruning
2. Removing livestock from low lying areas to higher and more secure grounds
3. Appropriate selection of cropping seasons and cultivars
4. Tree Planting
5. Land tiling
6. Soil Conservation practices package
7. Building a traditional granary "*Colombier*" to store the harvest
8. Banana plantation management package

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CONVERSION UNITS

The main unit for land measurement in Haiti is the "carreau"
1 Carreau (Cx) = 1.29 hectare = 12,900 m^2
1 Carreau (Cx) = 3.18765966 acres
1 hectare = 2.471054 acres = 10,000 m^2

- The official exchange rate in October 2006 in Port-Au-Prince, Haiti was 1 US $/39.75 Haitian Gourdes

LIST OF ACRONYMS

ACDI	Agence Canadienne de Développement International
ASSODLO	Association Haïtienne pour la Maîtrise des Eaux et des Sols
BAC	Bureau Agricole Communal
BRH	Banque de la République d'Haïti
CARE-Haiti	Cooperative for American Relief Everywhere-Haiti
CASEC	Conseil d'Administration de la Section Communale
CBO	Community Based Organization
CDERA	Caribbean Disaster for Emergency Response Agency
CEPAL	Comission Economique Pour l'Amérique Latine
CIDA	Canadian International Development Agency
CIDPSA	Comission Inter-Départemental de Production des Semences Artisanales
CNSA	Centre National de la Sécurité Alimentaire
CRH	Croix Rouge Haïtienne
CROSE	Coordination Régionale des Organisations du Sud'Est
CRS	Catholic Relief Service
DDA Sud'Est	Direction Départementale Agricole
DDAA	Direction Départementale Agricole de l'Artibonite
DPC/U. Européenne	Département de la Protection Civile/Union Européenne
DRM	Disaster Risk Management
ECHO	European Community Humanitarian Aid Department
ECLAC	Economic Commission for Latin America and the Caribbean
EU	European Union
FACN	Caféière Native Haïtienne
FAMV/UEH	Faculté d'Agronomie et de Médecine Vétérinaire/Université d'Etat d'Haïti
FAO	Food and Agricultural Organization of the United Nations
FIC	Frères de l'Instruction Chrétienne
HGRP	Hurricane Georges Recovery Program
HTG	Haitian Gourde
IDB	International Development Bank
IMF	International Monetary Fund
IPM	Integrated Pest Management
KPSL	Komite Pwoteksyon Sivil Lokal
MARNDR	Ministère de l'Agriculture des Ressources Naturelles et du Développement Rural
MDE	Ministère de l'Environnement
MED	Ministére de l'economie et des finances
MICT	Ministère de l'Intérieur et des Collectivités Territoriales
MoA	Ministry of Agriculture
NGO	Non Governmental Organization
OPDES	Organisation Pré-Désastres et de Secours
ORE	Organisation pour la Réhabilitation de l'Environnement
OXFAM	Oxford Committee for Famine Relief

PADF	Pan American Development Foundation
PAE	Plan d'Action pour l'Environnement, Action Plan for the Environment
PIA	Programme d'Intensification Agricole
PNGRD	Plan National de la Gestion des Risques et Désastres
PRODEVA	Association Haitienne pour la Promotion d'un Developpement Autonome
S/DDA	Sous- Direction Départementale Agricole
SNRE	Service National des Ressources en Eau
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WFP	World Food Program

1. Study Background

The small islands of the Caribbean have seen very active hurricane seasons during the last 10 years As a result, countries of the Caribbean region experienced devastating effects which posed serious threats to human lives, human settlements, and the productive sectors. The agriculture sectors of various Caribbean countries have been affected to varying degrees by these hurricanes. The reports of the damage assessment conducted has included damage or complete destruction of cash crops, livestock and poultry production, farm land and farm infrastructure and the fisheries sector. A lot of emergency response was provided for the agriculture sector, including assistance for fisher folk, small scale farmers, and their livelihood. Different types of intervention were provided also by FAO which focused on reducing the vulnerability of persons affected by these meteorological events. The assistance which helped beneficiaries to regain self sufficiency and supported governments' efforts to improve disaster response capabilities included,

(i) Emergency distribution of agricultural inputs to the most affected communities to get ready for the next agricultural campaign;

(ii) Technical assistance to governments to strengthen national institutional frameworks for early warning;

(iii) Technical assistance to exchange and share information and best practices in the region.

However, the devastating effects of the strong hurricane seasons of 2004 and 2005 highlighted again the limited long-term impact of emergency response for sustainable development and the establishment of a more comprehensive disaster risk management approach. In particular, the Governments of Cuba, Jamaica, Haiti and Grenada, among the worst affected countries during the 2004/05 seasons, stressed that more emphasis should be placed on addressing "preparedness" for mitigating the impact of these unforeseen events and implementing better and efficient emergency responses and rehabilitation work in the agriculture and livestock sector. In response to the request of these 4 countries, in particular and recognizing the importance of agricultural production in the economies of these countries against the background of the high vulnerability to meteorological hazards, FAO was asked to design a project which takes cognizance of past and ongoing DRM work done in the Caribbean region with a view to addressing the problem in a more permanent way, applying FAOs agricultural perspective as entry point.

In this framework, the FAO launched the regional TCP "Assistance to improve Local Agricultural Emergency Preparedness in Caribbean countries highly prone to hurricane related disasters" which has subcomponents in Cuba, Grenada, Haiti, and Jamaica,

The project acknowledges that all four countries have their own Disaster and Risk Management (DRM) frameworks which address preparedness issues to different extents and through various types of interventions; that there are also many players involved in DRM in the Caribbean (i.e. UNDP, USAID, the Caribbean Disaster Emergency Response Agency (CDERA), etc). However, in spite of the above, it build on the assessment that there is still a shortcoming in linking long term development planning within the agricultural sectors to the reality of recurrent natural hazards and improving prevention and preparedness measures. With a view on agriculture and livestock sectors, DRM is addressed mainly at regional and national levels, with insufficient links with the communities and farm levels. In addition, there is a gap between immediate emergency agriculture response (such as input supply) and recovery-rehabilitation work that should deal with sustainable land and water management in order to mitigate the effect of natural hazards on the fragile ecosystems of most Caribbean countries.

The project objective was therefore formulated as "to assist governments of participating countries to support the food security of small farmers operating in the most hazard prone areas by improving institutional frameworks and technical options for hurricane-related disaster preparedness, emergency response and post-emergency agricultural assistance" (FAO, 2006), more specifically the project will contribute to the improvement of disaster preparedness in the agricultural sector and strengthen inter-sectoral linkages and coordination. It aims at concrete recommendations for improving the institutional frameworks and technical options in the agriculture sector for hurricane related disaster preparedness, emergency response and post-emergency agricultural assistance. The project will produce three main outputs addressing specific target audiences.

(i) Local communities/small scale farmers: Identification, demonstration and replication of locally adapted good practices for response preparedness and assessment of demand responsive training related to innovative preparedness activities.

(ii) Local Government Departments: Inputs to local action plans for timely, efficient and demand responsive emergency operations to minimize adverse effects of hurricane related disaster on the agricultural sector and integration of agricultural issues into local level contingency planning.

(iii) Government and relevant ministries (rural and agricultural ministries) and international community: Recommendations and best practice examples to enhance national and local preparedness in national and international post-emergency agricultural rehabilitation programmes.

In Haiti, specifically, the project recognizes and builds on the fact that many FAO-sponsored projects such as the OSRO/HAI/401/CAN[1] (as well as projects sponsored by other donors), initiated in response to Hurricane Jeanne were typical emergency-assistance projects, consistent with the stated objective to reduce the vulnerability of farmers living in areas affected by extreme weather conditions. In spite of being successful in re-gaining food security in the affected countries the projects proved to be limited in terms of efficiently addressing any of the underlying vulnerabilities which caused the devastating size of the impacts observed over the 2004-2005 cyclonic year. This eventually led FAO to also support a paradigm shift in Haiti oriented towards a more proactive, holistic and preparedness-based approach to cope with hurricanes and other weather-related disasters (FAO, 2005).

This report presents the project implementation outcome in Haiti during phase 1 (June 2006 - January 2007). Project implementation is done in close collaboration with government DRM programs, other agriculture and livelihood emergency and development operations; the project is jointly executed by the Ministry of Agriculture and FAO.

[1] Other projects of this same type include OSRO/HAI/403/NZE, TCP/HAI/3004, OSRO/HAI/502/EC.

1.1 NATIONAL HAZARD RISK CONTEXT

Haiti is a republic constituted by the westernmost third of an eponym Island[2] whose Dominican Republic, on the Eastern side, occupies the remaining two thirds of the total land area. This island which is located in the Indies archipelago at the entrance of the Mexican gulf, is the second largest in size (after Cuba) among the four West Indies, and is surrounded by Cuba to the North-West, Jamaica to the West, and Puerto Rico to the East (Refer to Figure1).

Spatially, Haiti covers 27,500 square kilometres and extends itself between 18.02^o N and 20.09^o N of latitude, and between 71.61^o W and 74.48^o W of longitude. It is politically and administratively divided into ten departments[3] which each is subdivided into communes themselves individually further subdivided into communal sections (Refer to Figure 1).

Figure 1 Geographic location of the Republic of Haiti within the Caribbean region

Source: the Author

1.1.1 Framework conditions shaping the vulnerability to natural hazards

Haiti is ranked among the poorest countries in the World and is considered the poorest of the Western/American Hemisphere: the national per capita Gross Domestic Product, GDP amounts to US $332.00 and is the lowest of the Caribbean region. Additionally, high inflation rates contribute to a constant decrease of the purchasing power of the consumers (MARNDR, 2007). Ca. 4,000,000 Haitians, about 55% of the total population (MARNDR, 2007) live below the US $1.00 a day poverty line and 76% below US $2.00 a day poverty line. Poverty is mainly a rural phenomenon with an incidence of 69% and 86% for the US $1.00 and US $2.00 poverty lines respectively in rural areas (IMF, 2007). By contrast, 23% of the Port-Au-Prince Metropolitan area population and 57% of the other cities residents live below the US $1.00/capita/day poverty line (MARNDR, 2007).

[3] Actually and by the year 2003, the Haitian authorities decided to create a tenth department, the Nippes, by splitting the Grande Anse area into two approximately equal-size departments. The available geographic dataset used to design the presented maps has not been updated yet to incorporate the mentioned changes.

The following points flag some of the structural problems and features of Haiti, which in combination with the natural hazard context, negatively impact on poverty, development and food security in the country.

- **Population growth** According to the Haitian Institute for Statistics and Informatics (IHSI) 2000 census results, Haiti had 7,959,000 inhabitants, divided into 52 females and 48 males out of every 100 individuals. The approximate annual growth rate is 2.3%[4]. With 69.7% of its population aged less than 30, Haiti has one of the youngest populations in the World; life expectancy (53.7 years), however, is the lowest in the Caribbean region[5]. Furthermore, with about 300 inhabitants/km^2 Haiti is the second most densely populated country in the region (behind Barbados); and around 2/3 of the population is rural (MARNDR, 2007). Black people of African descent are 95%, dominating the total population, made up for the rest of mulatto and white people[6].
- **Governance**
- **Unemployment** Crucial issue since the total labor force accounts for 41.1% of the population of which 54.40% is aged between 15 and 64 years (IHSI, 2003). The occupation rate is 65%, with 82.1% of informal self employed and 12.75% private and public sectors employees (MEF, 2005). The public sector contributes a mere 0.6% of overall employment (IMF, 2005), while agriculture employs two-thirds of the work force, the service: sector 25%, and industry 9% (CDERA, 2003).
- **High dependence on agriculture** Agriculture is the leading economic activity employing 46% of the existing labor force, thus sustaining 70% of the population (CDERA, 2003) and contributing up to 27.58% of the GDP (MEF, 2005). Despite a downward drift in its contribution to the GDP from 47% to 24% over the 1970-1996 period, and to 27.58% in 2005, (Smucker et al, 2000; MEF, 2005), it still provides a third of the commodity exports[7]. According to IHSI (2005), agricultural land covers 59% of total surface area with a rate of cultivation of 90%. On average, 80% of the rural households have access to 1.8 parcels of land, which they own in 80% of the cases; average size in ha is 0.99 ha (IHSI, 2005). A limiting factor for Haiti's agriculture is that it depends on the use of predominantly mountainous, rough terrain characterized by generally steep slopes (CDERA, 2003) ; 57% of the agricultural land is located on smooth to steep slopes[8], and is to a large extent (60%) exposed to medium to high [water] erosion risks[9].
- **Land degradation** In spite of its originally rich natural resource endowment, the agricultural sector has become increasingly vulnerable during the last decades due to the combined negative interplay of increasing population pressure, environmental degradation, inefficient land use systems, poverty, overall governance problems in the country [10] and the high exposure to recurrent natural hazards. Recent data indicate, that 85% of the country's watersheds are either critically or totally deforested (MARNDR, 2007); the national dense cover forest accounts merely for 1 to 3% (OXFAM-Québec, 2003; IHSI, 2005; MARNDR, 2007); and the annual soil lost is estimated to 36.6 million

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[4]That is: 200,000 people are being added each year to the national population which in 2007 may account for about 9,000,000 people. Using 2000 as a reference year, the Haitian population is expected to double in 29 years.

[5] Source: ECLAC, LC/CAR/G.600 (2000) at http://www.eclac.cl/publicaciones/xml/3/9933/carg0600.pdf

[6] Source: Central Intelligence Agency (CIA) 2003 at https://www.cia.gov/cia/publications/factbook/geos/ha.html

[7] Source: Inter-American Bank of Development, 1998.

[8] 63% of Haiti have slopes higher than 20% and 40% of the hillside cultivated land has slopes higher than 50% (ANDAH, 1999)

[9] The most water erosion vulnerable lands are also located in the lowland areas of the South East department where one of the two selected pilot site, Lavanneau, is located.

metric tons equivalent to 12,000 ha eroded on 20 cm deep/year (FAO, 1995

- **Wide spread illiteracy** The country's global literacy rate of 53% (CDERA, 2003) masks important discrepancies between genders (60% of men against 48.6% of women), and residence places (82% of the Port-Au-Prince metropolitan area residents, and 71.8% of the other cities' residents against only 38.6% of the rural area residents claiming to be literate (IHSI, 2005). This national literacy rate is also lower as compared to neighbouring Caribbean countries such as Jamaica (86.9%) and Dominican Republic (83.7%).[11]
- **Language barriers** Though it is officially claimed that two languages are spoken in Haiti, Creole is actually the dominant language spoken by 100% of the population, while French is only used by highly educated people. This situation constitutes a further discrepancy between non-educated and educated Haitians. Furthermore, since Haiti is mainly surrounded by Spanish and English countries, due to linguistic barriers it tends to be virtually isolated from its neighbours as far as cultural exchanges are concerned.

1.1.2 Natural hazards and disasters

As a consequence of its geographic location in the hurricane belt and its geological features, Haiti is exposed to many natural risks such as hurricanes, droughts, landslides, earthquakes and tidal waves. From 1909 to 2006, Haiti has faced 63 internationally recognized disasters mostly caused by climatic events, including 25 hurricanes and storms, 32 flood events and 7 droughts. Over the 20th century (actually in less than 100 years) these disasters killed 18,447 people and more than 6 million were affected (see Table1).

Hurricanes, landslides and droughts have had the biggest negative impacts on agriculture and livestock. The most severe disasters were caused by devastating windstorms and hurricanes, generally accompanied by heavy rainfalls followed by severe droughts (CDERA, 2003).

Hurricanes and other wet systems

During the period spanning 1909 - 2004, 47 windstorms and hurricanes hit Haiti, of which 19 major climatic events (FAO, 2005), while over the last two years six windstorms hit the country, and a hurricane or tropical depression sweeps through the country every two years, from June to November. Overall these events killed more than 14,500, affected 3,600,000 and caused extensive economic damages for US $4.4 billion. Flora (1963), Gilbert (1988), Gordon (1994), George (1998), and (Jeanne, 2004) were unarguably the most deadly, devastating and economically costly natural disasters to strike Haiti (see Table 2).

According to ECLAC (2005a), the passage of Hurricane Jeanne in 2004 almost completely wiped out the majority of the crops -e.g. sorghum, maize, eggplant, beans, and banana- on 7,767 ha in the Haut Artibonite and the eastern North West areas exploited by about 12,900 farm households and resulting in 843,440,409 HTG (Haitian Gourdes) of financial losses. Wild flooding waters also washed away 25,800 heads of cattle and poultry amounting for 20,918,844 HTG while extensively damaging important hydro-agricultural infrastructures for about 478,191,726 HTG on over 4,000 ha. The global damages to the agricultural sector amounted to US $37.0 million (ECLAC, 2005a). Jeanne and Ivan, the two most damaging windstorms of 2004, significantly affected the farm infrastructures in all departments resulting in capital losses equivalent of 5% of the GDP whose growth rate consecutively decreased from 0.5% to -3.8% in (BRH, 2004).

[11] Source: Institut de Statistique de l'UNESCO, Estimations du taux d'analphabétisme et de la population analphabète âgée de 15 ans et plus par pays, 1970-20015, Révision de Juillet 2002.

Floods

Torrential rains and flooding often come in the wake of other hydrological events like hurricanes and tropical storms. From 1959 to 2006 multiple flood events occurred, of which 32 particularly damaging to the production systems, including agriculture (See Table 3).

In Haiti, devastating impacts of flooding have been historically exacerbated as a result of soil erosion, itself a combined consequence of deforestation[12], inadequate land use systems, poverty, institutional inadequacies, and illiteracy.

Landslides

Due to the unevenness of Haiti's landscapes, its geology of permeable rocks and substrates and erosion, landslides sometimes extend to hectares of agricultural lands. According to OXFAM-Québec, these disaster events manifest themselves in three ways: moving of entire hillside panes, riverbank slide/erosion, and more or less long-distance land sliding. However, being rather localized, they are not extensively recorded. Landslides often have serious economic impacts, as they may for instance cause a river bed to deviate preventing drainage and irrigation infrastructure to work, or completely burying a town under layers of mud. Areas prone to this type of disaster include watershed systems in the South East and North departments where during the rainy seasons torrential waters mixed with eroded soils may flow down the hills, sweep away plants and livestock and cause heavy damages to agricultural fields and irrigation structures downstream.

The plains next to the riverbanks, mainly in basalt-originated soils, are prone to erosion caused by heavy rains. Tons of extirpated arable soils are carried along in swelling rivers to cause important farm-related damages to downstream crops and livestock.

Droughts

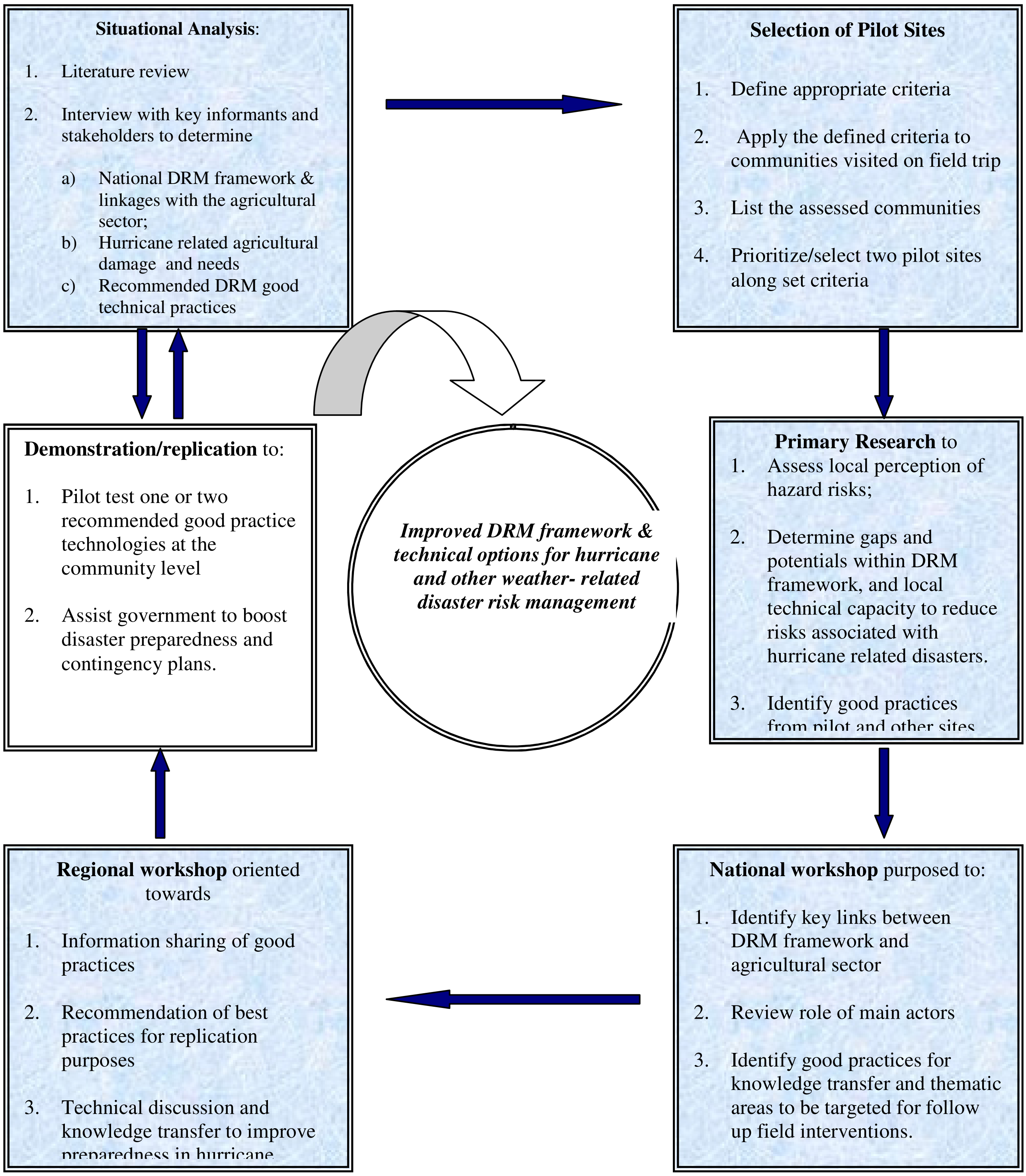
More and more areas in Haiti are now prone to drought, because of the degradation of the environment and the subsequent desertification process. The area hit by droughts is usually limited, however large areas are affected every 5 to 7 years, sometimes with nation-wide impacts. From 1968 to 2000 10 major droughts were recorded, affecting more than 1.5 million people (UNDP, 2005) (see Table 4). Furthermore, the Artibonite department hosts the sadly famous "Savanne désolée", the largest desert area of the country, constantly dry all year round. Cropping activities are a challenge in this area of Haiti and the population only survives thanks to food aid programs led by a number of NGOs.

[12] Only 1.5% of Haiti's natural forest remains and 25 out of the 30 national main watersheds are denuded (CIA, Fact Book, 2003 at http://www.cia.gov/cia/publications/factbook/geos/ha.html).

2. STUDY METHODOLOGY

The overall project implementation framework is presented in Figure 2. According to its design, the project is implemented in two phases: phase 1, which corresponds to this report, focuses on situations analysis in selected field sites; data collection on (a) national institutional set up for disaster risk.

Figure 2 Summary of the project cycle



The boxes in Figure 2 corresponding to Phase 1 are shaded in blue. The second phase will concentrate on the replication and dissemination of good practices on farmers' fields in participating pilot management, and (b) existing good practices for disaster risk management in agricultural sectors; and the preparation for inter regional learning exchange among implementation partner communities. During phase 1 three main tasks were addressed using different methodologies as presented in the following:

2.1 Literature review/situational analysis

Information was collected[13] from NGOs working in DRM and informal interviews with national experts, agronomists, and other professionals working in the DRM and agriculture sectors. Among the institutions contacted were the Ministry of Agriculture Natural Resources and Rural Development, CNSA, the National Center for Food Security, the Ministry of Interior and Territorial Collectivity, the Civil Protection Direction, UNDP, FAO, a number of international organizations and NGOs among which PADF, CARE-Haiti, Oxfam-GB, CARITAS, CRS, etc.

2.2 Selection of Pilot Sites

Two sites were selected for field implementation through field visits in each of the targeted zones.[14] The following set of pre-defined criteria was applied to evaluate the visited sites:

1. Evidence of ongoing activities in community due to prior FAO assistance or NGOs' interventions.
2. Vulnerability to hydro-meteorological hazards and multi-hazard exposure;
3. Frequency, impact and intensity of hazards in the last 5 years;
4. Presence of different agricultural production system (e.g. cash crop, subsistence and mixed farming);
5. Evidence of local capacity to respond and mitigate hydro-meteorological hazard risks - local knowledge peculiar to this area that is perceived as good practice;
6. Size of population at risk;
7. Relatively high dependence of local farmers on agriculture for their livelihood;
8. Level of cooperation with Ministry of Agriculture;
9. Presence of a groups and collaborative mechanisms at farm level.

2.3 Primary field research at pilot sites

A two-stage process was applied that included a transect-based observation of the site landscape followed by PRA-based semi-structured interviews realized with key informants, farmer focus groups, and individual farmers. A questionnaire for the focus group meetings and one for individual farmers were prepared. 10% of the 100 to 200 farmers participating in each focus

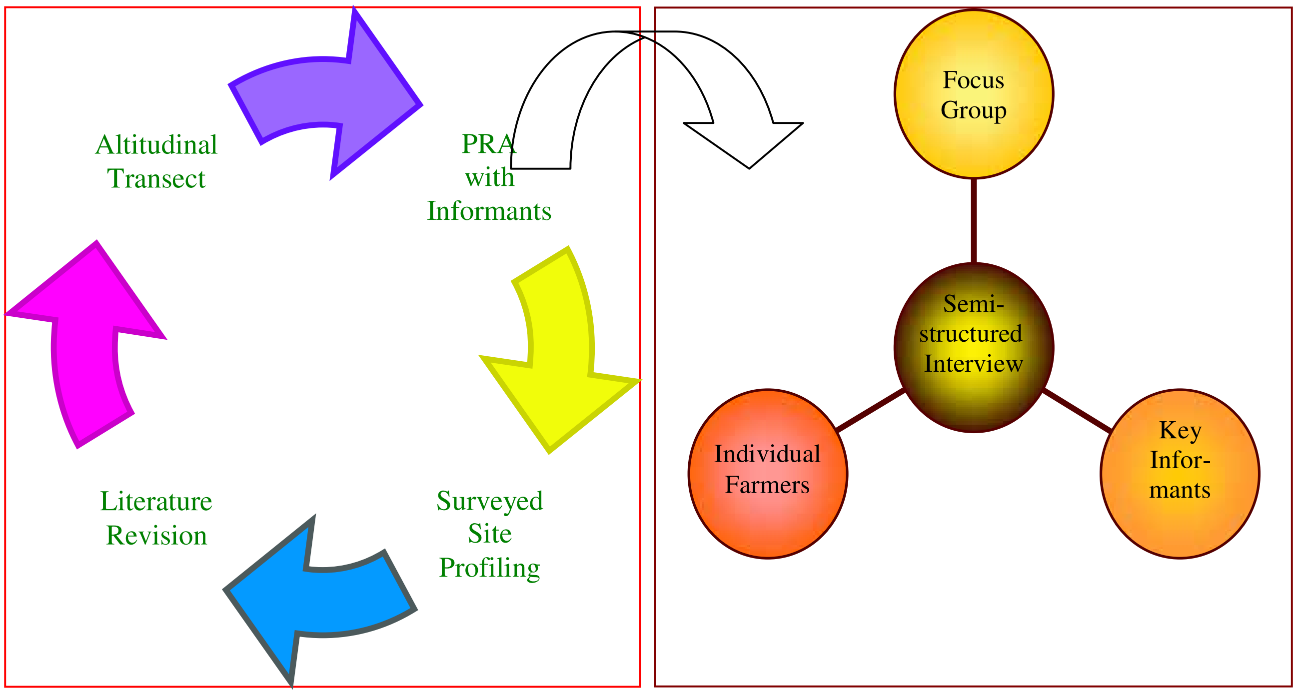
[13] Actually the data describing the Haitian DRM framework were initially collected by L. Charlestra (a former consultant on the project). Those were then evaluated, revised and completed by the current author.
[14] Visited zones were suggested through the literature reviewing and from recommendations of institutions working in the DRM and Agriculture sectors (such as CNSA, OXFAM-GB, the MARNDR, etc.).

group discussion meeting were individually interviewed, preferentially targeting household heads.

In total, 40 individual farmers were interviewed, and at least four focus group meetings held (one per surveyed site) throughout the study area. Completed questionnaires were cleared, cleaned, processed and analyzed. The main observed parameters, e.g. the descriptors for each listed good practice such as origin, implementation costs, etc., were tabulated in an appropriate matrix and arranged in series per pilot site from which the modal values and/or dominant trends were retained.

Furthermore, local risk, vulnerability and available resources were initially mapped using traditional mapping techniques and then moved to Map Info 7.0 software to make them more readily exploitable. Operating DRM framework and linkages with agriculture were determined through diagrams supporting semi-structured interviews from focus groups and/or individual informants. Livelihood profiling was outlined through general transect observation/information, focus group / community-level PRA sessions, key informant and site-level semi-structured interviews with individual farmers. DRM related good agricultural practice examples were documented in pilot and other sites using semi-structured questionnaires administered to individual farmers.

Figure 3 Diagram showing the PRA-based sequential method of data collection



Size of the surveyed population sample = 10% of group focus participants

3. STRUCTURE OF THE DRM SECTOR IN HAITI

3.1 The DRM institutional framework

Haitian authorities have been working on the possibility to establish an institution for Disaster Risk Management since 1983, when an organization for disaster prevention and relief (OPDES) was created to initiate response in case of disaster emergencies. The May 31, 1986 decree put OPDES under the Ministry of Interior (MICT). In 1997, the government created the Civil Protection Division (DPC) within the MICT, to coordinate response actions to disasters and manage risks. After Hurricane Georges in September 1998, Haitian authorities and international organizations committed themselves to draw a national plan for DRM (PNGRD) along with a more effective intervention system, to which UNDP provided active general support. The plan was presented and validated in February 2001 (UNDP, 2004) with the main objectives of:

(1) Acting on the risk causes and factors in order to reduce the negative impacts of disasters;

(2) Reinforcing response capacity at central, departmental, and communal/local levels.

Integrative part of a central action plan for the environment (PAE) the PNGRD was meant to tackle issues as diverse as: urbanization standards, territory planning, map analysis of vulnerability, decentralization and integration of the DRM thematic, and natural resources management (UNDP, 2004). In practice this concept is formalized through the coordination structure of the DRM national system.

3.1.1 The DRM National System

Components of the Disaster and Risk Management National System operating at a centralized level and their functions are the following:

National Committee for Disaster and Risk Management (CNGRD): is the central body of the DRM national system, including high-ranking government officials from each ministry or their representatives and the president of the Haitian Red Cross, its mission is to:

- Define the global DRM government policy
- Lead, coordinate and evaluate the implementation of the National Plan programs
- Promote regional integration of DRM issues.

Permanent Secretary Office for DRM is in charge of technical coordination of the DRM national system and includes representatives of all ministries. Its key responsibilities are*;*

- Convey the top orientations and decisions of the National Committee for DRM;
- Coordinate and implement the DRM National Plan

The Emergency Operation Center (COU*)* is an ad-hoc and representative entity activated in case of imminent disaster. It includes the representatives of all concerned ministries and of the Haitian Red Cross. Its overall mission is to promote, plan, maintain and coordinate disaster response operations at all levels.

The Civil Direction Protection (DPC) acts as the executive secretary office for both CNGRD and the Permanent Secretary Office, it is based on an administrative arm, a disaster coordination arm, and a risk coordination arm, and coordinates the entire DRM system;

Institutional and sectoral committees / thematic committees: Each governmental institution/ ministry is required to elaborate its specific sector DRM plan and to constitute its own committee which may eventually merge with others to form inter-institutional committees to work on particular thematic axes (e.g. urbanism and building codes, land planning and development, vulnerability and risk mapping, etc.). NB: the MoA contrarily to some other government institutions has not yet elaborated its DRM sectoral plan.

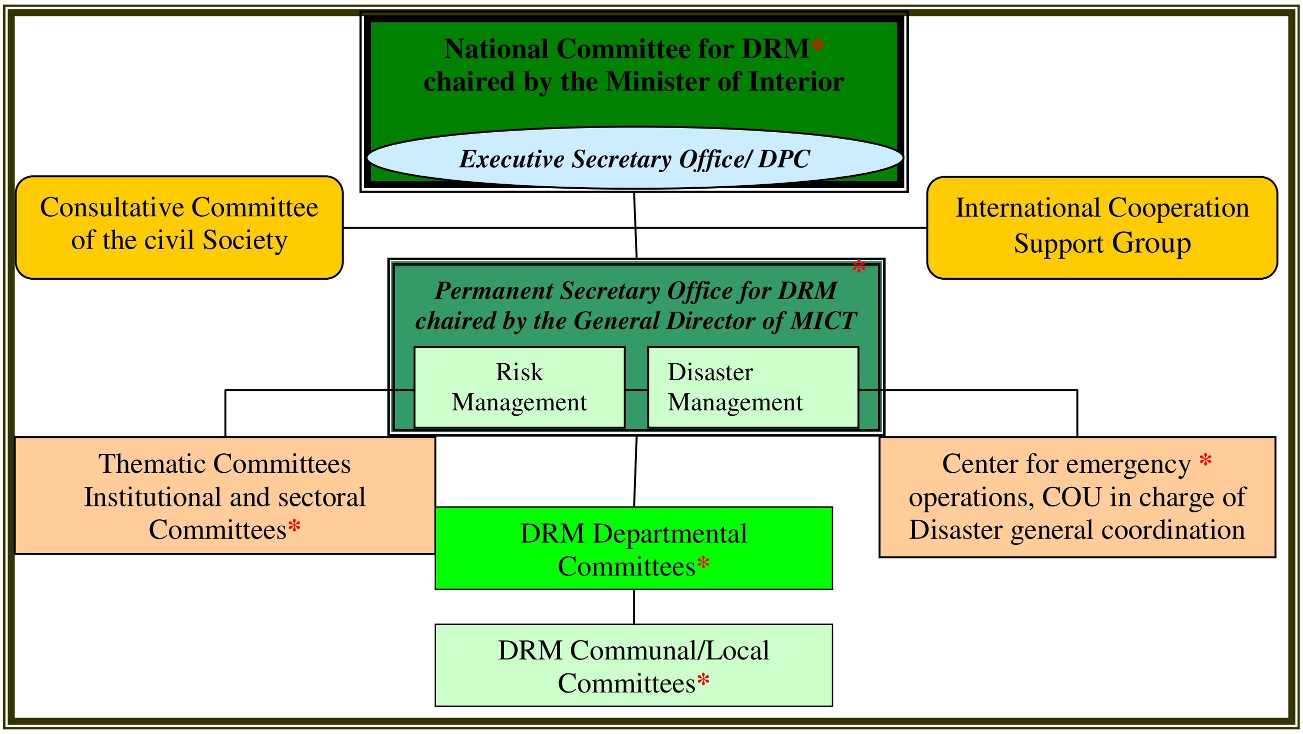
Consultative Committee of the Civil Society: Including individuals from all primary national sectors, its mission is the overall support the DRM process.

The International Cooperation Support group: Including a number of international agencies and NGOs operating in Haiti, its mission is to back up the DRM National System.

Departmental and communal structures: Operating at a more decentralized level, these structures' objective is the implementation of prevention and response actions. Under the supervision of the departmental or municipal representatives of the central government, they include the local mayor's offices, the other government departmental or municipal structures, Haitian Red Cross, NGOs, local community based organizations, and private sector institutions operating in the area.

The departmental and communal committees are responsible for preparing specific local-level action plans to effectively address the needs of the related population as far as DRM is concerned. They also participate in the disaster response coordination. State and autonomous institutions are represented in the DRM structure at all administrative levels but are often less committed in terms of active participation once the level of big cities.

Figure 4 The Haiti DRM National System organization chart[15]



[15] *Source: UNDP Haïti, 2004; Key: a red asterisk indicates where the MoA is directly represented*

3.1.2 Disaster preparedness and mitigation programs in Haiti

Disaster Risk management was hardly included in programs designed over the last 20 years. However, all the stakeholders agree on the complex interrelationships between sustainable development and DRM. According to OXFAM GB in 2001 agriculture and environment constitute the favourite domains of intervention and support for most local, national, and international institutions working for socio-economic development in Haiti. About 69% of the surveyed institutions were working in DRM and 50% were simultaneously involved in prevention and rehabilitation phases. Currently, most of the institutions working in DRM pursue the following objectives:

- Capacity building of institutions;
- Economic empowerment of marginalized populations
- Vulnerability mitigation through the promotion of sustainable use of natural resources.

3.1.3 DRM-based activities undertaken in the agriculture sector

Due to its unpredictable characteristics, DRM in the agriculture sector has historically been a rather secondary topic in Haiti's development programs. Institutions operating in agriculture and environment do not necessarily directly work in the DRM-Ag sector, preferring to address related humanitarian issues such as drinking water supply, relief food and medicine distribution during the response phase. Nevertheless, some actions are taken in the agriculture sector.

When disaster occurs, rapid assessments of needs are carried out by the government through the DPC structures and by local and international institutions and NGOs. Disaster assessment data are generally used to elaborate appropriate disaster relief projects to be submitted to the international and national communities. In this setting, FAO has historically been at the forefront in cooperating with the Ministry of Agriculture and other entities during the response and rehabilitation phases, using disaster damage assessment data it collected to write its own projects for funding FAO then generally executes the project jointly with the MoA. FAO/Haiti has implemented projects contributing to:

- Permanently assess disaster farm needs in collaboration with the Ministry of Agriculture;
- Provide stakeholders with statistical and technical information
- Provide farm inputs to affected farmers through community-based organizations.

In September 1998, after the devastating effects of hurricane Georges on localities in the South, the PADF launched the USAID funded Hurricane Georges Recovery Program which successfully:

- Raised awareness of disaster management and helped 22 communities to develop disaster mitigation, preparedness, and response plans.
- Introduced and distributed 463 tons of improved seed varieties to farmers;
- Implemented 27 subprojects, including the rehabilitation of two roads, seven irrigation systems and eight soil conservation projects);
- Increased ORE's capacity to improve the germ plasm and produce corn, bean and sorghum seeds to be distributed to farmers.

The Haitian NGO ASSODLO undertook a DRM project funded by Helpage International and ECHO in the highly vulnerable town of Fonds-Verrettes, repeatedly swept away by flooding. Among the project's achievements were:

- Community awareness raising;
- Community-based mechanisms and structures for disasters response;
- Mitigation of disaster impacts through reforestation.

After the May 2004 flooding and hurricane Jeanne in September 2004 OXFAM-GB targeted women-headed households in a food security program, which provided seeds and tools in rural areas around Gonaives. In Mapou staff and local counterparts revitalized the local economy by calculating the amount of seeds, tools and livestock required by the population, and allocating vouchers to beneficiaries for use in local fairs promoted on community radios, and through posters and banners. The sellers then redeemed the cost of the voucher from an OXFAM-GB funded local committee.

Following a severe drought in the North-West in 2002, CARE-Haiti distributed seed to 10,000 families in the most heavily stricken municipalities. Program strategies were discussed with the departmental representatives of the MARNDR. The seeds were inspected by CIDPSA, the controlling commission of the MARNDR, before delivery. After hurricane Jeanne, CARE launched a rehabilitation program in the Artibonite and North-West departments, centred on agriculture and livestock. The activities included road rehabilitation, cleaning and repair of damaged irrigation structure on 1,200 hectares of irrigated land, and soil conservation.

The NGOs CRS and CARITAS are about to implement an "Emergency, Disaster and Risk Management Project" funded by the World Bank aiming to reduce disaster vulnerability in 28 communes of the Grande-Anse and South departments. Activities will focus essentially on:

- creation and reactivation of DRM local and communal committees;
- designing of DRM sub-projects;
- revitalization of coordination platforms created in the departments.

Project achievements will be monitored and evaluated, and CRS will share information about results and lessons learned with counterparts.

Table 1 Activities undertaken by some institutions in agriculture and livestock related DRM

Institution	Intervention area	Activities
MARNDR	Country wide	• Damages and needs assessments • Coordination of activities carried out in the sector through the DDAs and S/DDAs
FAO	Country Wide	• Damages and needs assessments • Input distributions (seeds, tools, livestock) • Livestock vaccination campaigns • Rehabilitation of irrigation structures
PADF	Aquin, Vieux Bourg, Chantal, Ducis, Camp-Perrin	• Creation of communal and local DRM committees • Training of committee members on DRM themes • Raising public awareness about disaster preparedness and mitigation • Improved seed and tools production and distribution • Rehabilitation of irrigation systems • Soil and water conservation projects
ASSODLO	Fonds-Verrettes (West)	• Raising public awareness about DRM; strengthening relationships between communities and DPC structures • Creation of disaster preparedness committees • Reforestation projects
CARITAS	Country wide	• Seeds and tools distribution • Restocking (related to pig farming) • Rehabilitation of irrigation systems
Action-Aid	North-West, South-East, West	• Provision of credit (in kind) to farmers • Seeds, tools and livestock distribution • Capacity building in conservation & agro-forestry
OXFAM-GB	Cap-Haitian, Gonaïves, South-East	• Raising public awareness about DRM Seeds, tools and livestock distribution • Soil and water conservation
CARE-Haiti	NorthWest, Artibonite	• Raising public awareness about DRM Emergency preparedness planning • Seed distribution • Poultry restocking • Soil and water conservation • Rehabilitation of irrigation canals
CRS	South, Grande Anse, North, North-West	• Creation of communal and local DRM committees • Development of mitigation projects

Sources: Adapted from Charlestra (2006, unpublished) and others

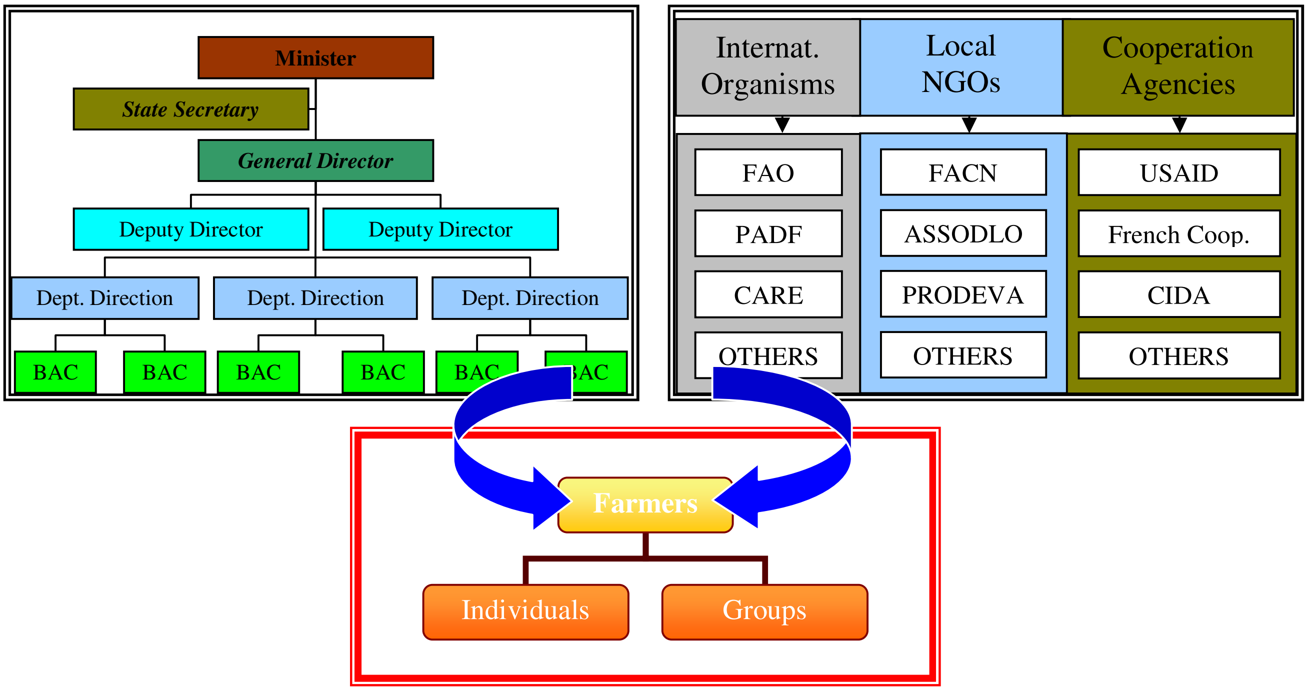
3.2 The Agriculture Institutional Framework

3.2.1 Characteristics of the farm sector in Haiti

The Haitian farm extension system is supported on the one hand by the Ministry of Agriculture and on the other by international organisms, local NGOs, and international cooperation agencies under the Ministry of Planning and External Cooperation umbrella. Those two parties work separately or jointly with individuals and/or grouped farmers to whom they provide technical training and farm inputs such as tools, seeds, fertilizers, etc (see Figure 5), generally free of charge except for the seeds for which small contributions may sometimes be requested. Support provided to farmers is generally not DRM-related. However, after weather-related disasters, relief is delivered to the farmers, including farm-related material. The projects operating within the DRM-Agriculture interface are generally meant to address post-disaster farm issues rather than preparing the farmers to cope with disaster impacts in advance.

The extensive assistance Haitian farmers are used to receiving is likely to negatively affect their creativity and ingenuity, while constituting bad heritage for upcoming programs based on sensitization and motivation to trigger positive behavioural changes).

Figure 5 The Haiti agriculture national framework organization chart



3.2.2 Representation of the Agriculture sector within the National DRM system and existing links

The agriculture sector is directly represented at different levels of the National DRM system by the MoA, though its presence is more perceptible at a decentralized level. The MoA has not designed its intra-institutional DRM sectoral contingency plan yet, so it does not presently cover a leadership position within the DRM national system, and is left to support the DPC/MICT-led decisions in times of disaster.

Present links between the DRM system and the Agriculture sector include: (a) methodical organization of the planned activities), (b) exchange of all relevant data, (c) projects implementation, (d) monitoring, and (e) evaluation. In general, these links are weak, however, they tend to become more effective during the response phase when relief is being rush-delivered to the disaster-stricken as the DPC needs to collect information related to damages at farm-level to prepare damage assessment reports which will ultimately be submitted to donors for emergency relief request.

Moreover, DRM programs in Haiti have historically evolved at a two-fold level to formally include an agriculture-dedicated component on one hand, and on the other to encompass all phases of a disaster instead of being limited to the response phase

as happened in the past. This positive change dates back to Hurricane Georges in 1998, when multi-phase agriculture-based DRM projects were officially designed as the way forward to sustainability in the sector. Though response is still prevailingly the phase addressed DRM related programs implemented in Haiti also address:

- Preparedness, by raising the public awareness and capacity building of committees at different levels (training).
- Response, through input distributions (seeds, tools, livestock)
- Mitigation, through actions to protect the environment (soil conservation, reforestation)
- Rehabilitation, through road repair and rehabilitation of irrigation infrastructures.

The strength of the DRM system is the partnership between the DPC, national and international agencies, NGOs, the civil society and local communities. Moreover, the integrated creation and strengthening of municipal and local DRM committees is important in committing communities and making the process effective. Finally, training and mitigation actions such as soil conservation, roads and farm infrastructures rehabilitation undertaken in most recent DRM projects constitute invaluable investments for longer-term development in the concerned areas.

On the other hand, however, gaps and weaknesses characterize past and ongoing programs, among which:

- Lack of well-trained local evaluators;
- Weakness in the evaluation approach in the agriculture and livestock sector;
- Too much emphasis on response actions rather than on prevention and mitigation on one side, and rehabilitation and reconstruction on the other;
- Lack of cash and inadequate inputs such as improved seeds to disaster-stricken farmers;
- Lack of synergy between actors and consequent tendency to duplication;
- Lack of full involvement of targeted populations in the DRM process.
- Insufficient scope of programs and failure to meet the multiple needs of stricken communities;
- Once needs are established, distribution is undertaken on an equal footing; as such, those beneficiaries who have lost more than others feel that the distribution process is not equitable. In extreme cases, relief was granted to individuals who had not been affected by the disaster;

3.3 The DRM-Agriculture interface: some recommendations for improvements

The following is proposed:

1. The resolutions and provisions decided in the Haitian DRM National Plan which provides a good framework for local issues should be applied by initiating assessments and updating drills;
2. The generally top-down relationship existing between the Ag and the DRM sectors needs to evolve towards a more participative, dynamic, productive, and permanent type and a participative and egalitarian approach should shape the relationships between all stakeholders of the two sectors at all levels;
3. An effective decentralization to the lower administrative levels is recommended, since MoA local representatives is often hampered and remains inefficient since not being authorized to take quick decisions without first reporting to a senior officer or to headquarters, stopping or slowing down the scheduled activities;
4. Local DRM committees created under the impulse of the DPC and the Haitian Red Cross (and dedicated to coordinating training, information sharing, and emergency relief delivery to benefit the population at the local/rural level) should be permanently activated, and trained. Small stipends paid to committee members may ensure an overall better performance
5. It is recommended that the DRM inter-institutional committee dedicated to coordinating DRM sectoral committees be activated;
6. It is recommended that the MoA DRM sectoral committee be activated with mandate to ultimately elaborate, validate and execute agriculture sector-wide contingency plans related to DRM issues at any phase. It should eventually be turned into an autonomous DRM direction provided with adequate resources in view of timely achievement of the scheduled agriculture-related DRM tasks decided in the DRM National Plan;
7. Future watershed management projects, of which the MoA is in charge, should link to disaster and risk management priority framework;
8. Timeliness of early warning and of relief coordination efforts must be prioritized as a key to the success of DRM efforts.

Table 2 Links between DRM & Agriculture sectors and improvement recommendations

Administrative level of action	**DRM phase**	**Links**	**Recommendations**
Central	Before Disaster	Information Planning Execution	➢ Independent direction of DRM sectoral committee at the level of the MoA for a greater efficiency ➢ Finalization of the inter institutional plan for DRM by the DPC/Permanent secretary's office for DRM
	During Disaster	Information Planning Execution	➢ None
	After Disaster	Planning Information Execution Monitoring Evaluation	➢ Preparation and implementation by the DPC of the scheduled sectional response plan with actions and initiatives to undertake in the aftermath of a disaster
	All phases	Planning Information Execution Monitoring Evaluation	➢ More efficient coordination and clearer definition of responsibilities between the DPC and the Permanent secretary's office for disaster and risks management and the other concerned branches of the executive power ➢ Greater involvement of the Ag sector in DRM
Departmental	Before Disaster	Planning Information	➢ A clear definition of the roles and responsibilities of each sector as well as of the links between them is recommended within the existing departmental-level contingency plan; ➢ Involvement of the Ag sector in the design of the DPC funded hurricane related warning messages.

Level	DRM phases	Links	Recommendations
Departmental	During Disaster	Planning Information Execution	➢ Availability of adequate resources to the Agriculture sector for the timely collection, processing and dissemination of natural hazard related early warnings
	After Disaster	Planning Information Execution Monitoring Evaluation	➢ Involvement of the agriculture sector representatives in the DPC post-hurricane season evaluation.
	All phases	Planning Information Execution Monitoring Evaluation	➢ Direct participation and attendance of senior executives from the agriculture departmental direction to scheduled meetings would be recommended;
Communal/Local	Before Disaster	Information	➢ Promotion and implementation of DRM based good practices to help reduce risks likely to occur in the farming system while reinforcing its overall production capacities ➢ Risk assessment as an integral part of the design and implementation process of the selected appropriate practices ➢ Appropriate training of MoA local representatives
	During Disaster	Planning Information Execution	➢ Availability of personnel from both sectors

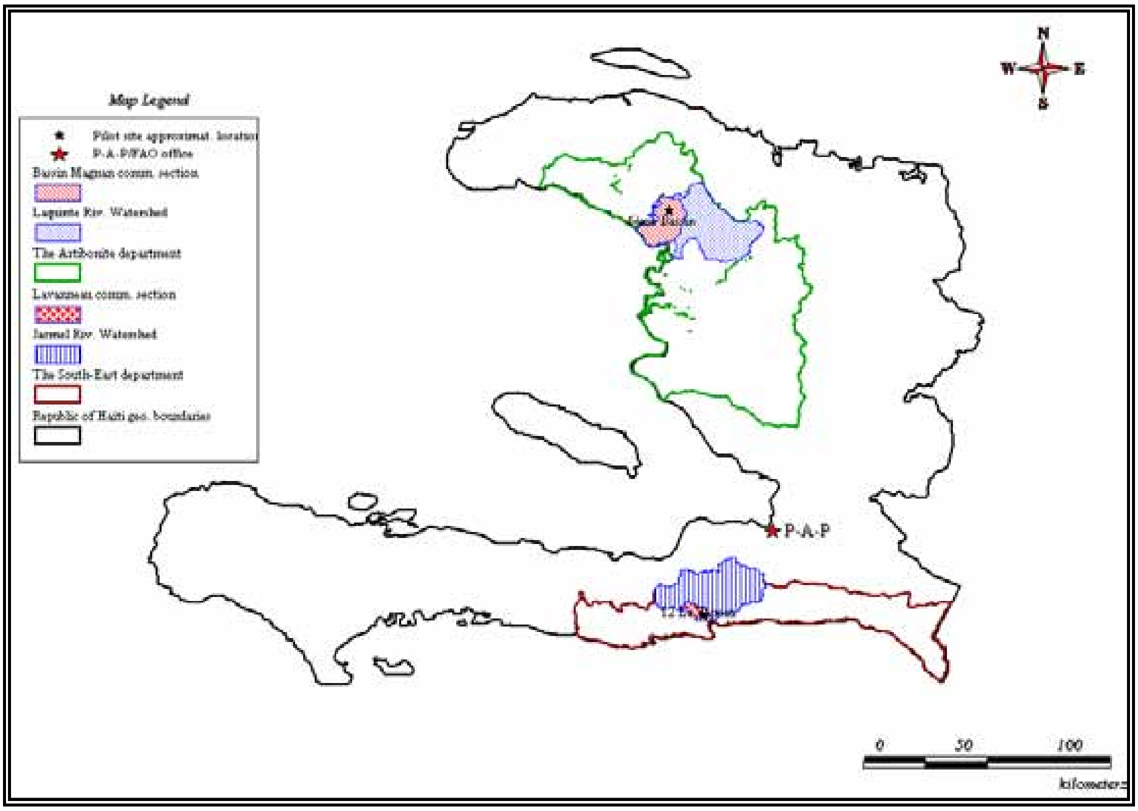
Level	DRM phases	Links	Recommendations
All levels	All phases	Planning Information Execution Monitoring Evaluation	➢ Anticipation to January of the hurricane season related prevention activity campaign ➢ Focus on complementarities between risk management and disaster management within the DRM cycle;

4. PILOT SITE PROFILING

The field research process was administered in the two selected pilot sites and to have a basis for comparison, it was determined that some other sites would also be surveyed. Two of them, Belle-Anse and Marmelade, were selected based on the following criteria:

1. Previous existence of DRM related agricultural good practices;
2. Evidence of FAO and/or other agriculture and/or DRM related NGOs ongoing activities;
3. Request from NGO partners of FAO in DRM to address agriculture and DRM related issues in their operation zones.

Figure 6 Location map of the study area



Source: the Author

Table 3 General characteristics of the selected pilot sites

Name	Geographic area	Agro-ecological zone	Vulnerability to Hazards
Bassin Magnan	Gonaives/Artibonite	Tropical very dry forest / Dry and irrigated plateau	Hurricane, Drought, Landslide
Lavanneau	Jacmel/South-East	Tropical dry forest / Irrigated flood plain and hillsides	Hurricane, Flood, and Wind

4.1 The *Bassin Magnan* pilot site

4.1.1 Location and physiographic features

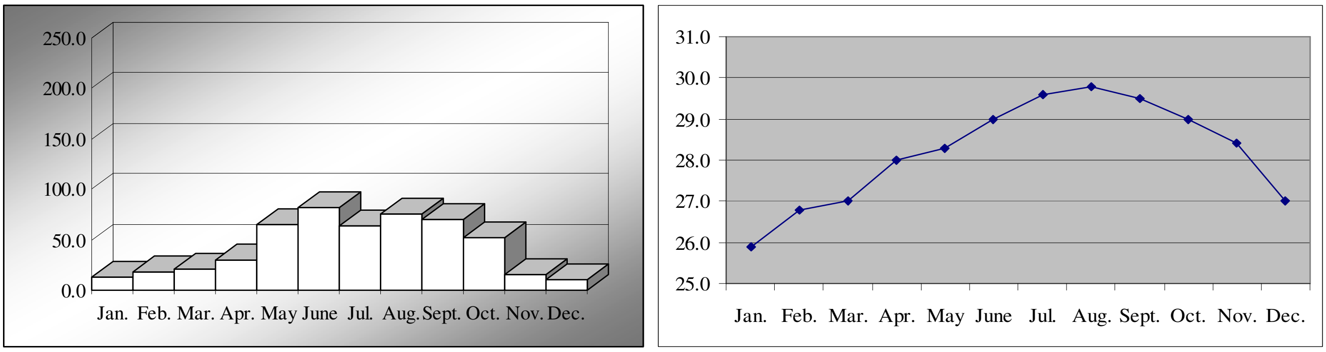
Bassin Magnan is a small rural community of the interior with an extension of 9 km^2 within the municipal section of the same name, located 12 km from Gonaives, the capital and main departmental city of the Artibonite. It is situated on a plateau between 160 and 300 m above sea level, steep-sided between the two medium-altitude mountain ranges François, to the North, and Depot/Marie Colas, to the South. These west – east oriented mountains are crucially deforested with less than 1% of dense forest cover. The community is partly located in the "*Deux Bassins*"ravine basin and partly in the SEDRENN river basin both pertaining to the La Quinte River watershed, the main surface water drainage system of the Gonaives and Terre-Neuve area (see Annex 1). Here the land slopes, ranging between 5 and 10%, do not constitute a problem, except in the surrounding hills which are anyway too degraded for farming".

Climate

In line with the lower Artibonite area pluviometry, *Bassin Magnan* is a leeward and arid zone with hardly 522.5 mm of annual mean rainfall (2 times less than the national average of 1,500 mm). The rainfall curve is almost bell-shaped with two distinct seasons: a wet (or less dry) one from May to October, with a slight dip in July, and a drier one: extending from November to April. The monthly mean pluviometry is no more than 43.5 mm (See Figure 7).

The site temperature increases from January to August and then decreases until December, showing monthly mean value of 28.2°C. Agro-ecologically the pilot site belongs to the tropical very dry forest life zone[16].

Figure 7 Monthly mean rainfall (a) and temperature (b) at *Bassin Magnan*, Gonaives



(a) Monthly mean Rainfall (mm) *(b) Monthly mean temperature (°C)*

Source: FIC, SNRE

Demography

About 45,000 inhabitants live in the entire *Bassin Magnan* communal section of which 52% women and 48% men (Higazi, 2006). 40% of the population is less than 15 years old, of which 15% is less than 5 years old. Moreover 55% was estimated to be labour-active. The pilot site considered very densely populated and the respondents of the PRA field session estimate the total population, though no census data are currently available[17].

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[16] Based on the Holdridge's (1967) two-parameter ecosystem classification, the tropical very dry forest life zone is defined by mean annual temperature >24°C and mean annual precipitation between 500mm and 1,000 mm.

[17] Of note that the Bassin Magnan pilot site cover a mere 3.93% of the communal section total land area.

Social stratification

A conspicuous indicator of social stratification is that the roof of houses in Declin, the dry fringe, is mostly thatched while those in Cinq Carreaux, the central part of the communal section, are generally made of corrugated iron or concrete. At Declin, animals predominantly raised are free ranging goats and poultry whereas cows and pigs are mostly raised in the irrigated zone. Moreover, the PRA-based community meeting session at *Bassin Magnan* proposed the classification of the local farmers in the following three categories; based on area of land exploited, land tenure and access to paid labour:[18]

1. Wealthy farmers exploiting up to 8 ha of mostly privately owned land located in the irrigated zone; they use salaried farm labor and generally possess fields of mesquite they sell to small farmers or coalmen;
2. Medium-class farmers exploiting about 2.5 ha of land partly accessed through ownership, partly through renting and/or sharecropping; needed farm labor is provided by the household members, and partly paid; most of the land is located in the non irrigated zone;
3. Small farmers who exploit at most 0.75 ha generally accessed through sharecropping; the farm labour used is strictly family-provided and the parcels are situated within the dry zone.

History

The biggest changes in the community took place in 1952 when SEDRENN opened a copper extraction plant at Mémé, 5 km from the pilot site. The jobs created through the blazing of a communal/departmental road to Terre-Neuve and the good financial momentum it triggered in the community hardly compensated the ecological disaster caused by the mining and the transformation of landless farmers turned down by SEDRENN into desperate coalmen who cut down all remaining trees to make charcoal. Probably due to the presence of SEDRENN, a baby boom was also observed in the community around 1971.

A community clinic/hospital started to serve the community in 2003 and a small power plant was inaugurated in 2005 in Cinq Carreaux.

4.1.2 Natural resources base

Despite great degradation, the pilot site encompasses most basic natural resources :

Natural forest: Fuel wood lots are important assets in *Bassin Magnan*, belonging to the richest local farmers who eventually "sell" their products to poorer farmers/coalmen who make charcoal from that for a living. The main tree species are mesquite, (*Prosopis juliflora*) and lignum vitae (*Guaiacum officinale*) used for charcoal making. The situation is characterized by an unsustainable exploitation policy, since the intensively harvested trees are not being replaced by new plantations, with the dire prospect of witnessing the disappearance of all trees from the entire area in the mid to long run.

Soils/Land: Soils are prevailingly of the brown vertic/calcic type originated from limestone parent rock. Such impermeable soils are typical of deep valleys plateaus under dry climates, characterized by slightly acid to neutral pH, and high CEC values, 80

meq/100g. Very often affected by active limestone, they are generally fertile; their main problem being water unavailability (GRET-FAMV, 1991).
A typical farm household will exploit 1.56 ha scattered over 3 plots located in different places. The best and most fertile soils within the pilot site, exploited by the wealthiest local farmers, are in the irrigated zone, smaller in size than parcels in the non irrigated zone that smaller and poorer farmers are compelled to exploit.

Water: Irrigation water is provided through a combined system of pumped and river surface water covering a 230 ha total surface irrigated area of which about 80% falls within the pilot site borders. This water is inaccessible to smaller and poorer farmers, generally prevented from exploiting irrigated land for lack of economical means, while about 78% of the 270 of the most fortunate local farm households are able to use it. Drinking water is provided from 7 different springs and water wells. Tap water comes from a single spring and is accessible to 15 - 20% of the total pilot site population, but no private home-delivered services of water supply exist within the pilot site. Moreover, people in the drier fringe are confronting huge problems as far as drinking water supply is concerned, being compelled to use water of doubious quality to satisfy their daily needs.[19]

4.1.3 Other socio-economic resources

Access to credit: farm credit from private or state-owned banks is inexistent in the pilot site, as is crops insurance. Informal cash credit systems include:

- "Ponya"; a cash credit with monthly interest rate as high as 30% of the capital;
- "Sol/Sabotaj": in which participants democratically bound by specific rules regularly save a fixed amount of money at predefined times; on a rolling basis the total amount collected is advanced to a different member of the group until everyone has received the totality of his financial contributions once (Higazi, 2006);
- "Plane" of the land: a kind of pawn-broking in which a farmer in urgent need for money "mortgages" his parcel of land for a period of time during which the "pawnbroker" is entitled to exploit the land until complete reimbursement (Higazi, 2006).

Farming extension services and structures: The farmers complain of the remarked absence of \ government farm services and structures, which are indeed quasi inexistent in the area. Local farm extension is generally the work of international organizations such as FAO, and NGOs such as Hands of Love. Farmers also denounced an implicit clientelism system with the extension agents tending to assist the better off farmers instead of supporting the small needy ones.

Development organisms and local CBOs: Particularly active in the pilot site are FAO (farm infrastructures and inputs), Hands of Love (irrigation water pumping, power supply), AME (Hospital "*Bon Berger*" / health care). No less than 15 associations and CBOs operate with goals as diverse as environmental protection, farm credit, road repairing, animal health, and disaster management.

[19] According to some participants to the PRA session at Bassin Magnan some springs of "drinking water" for human consumption are interchangeably used to water cattle while being located close to open public latrines.

4.1.4 Farming activity at *Bassin Magnan*

As in most of the country, agriculture is the main economic activity at *Bassin Magnan.* Represented subsystems are cropping, livestock and forestry.

Crops

In descending order of market value, main cultivated crops are common beans, vegetables, corn, banana, cassava, pigeon peas, sorghum, millet, sorghum dodo47[20]. While the first three crops are mostly marketed (Higazi, 2006), the latter mentioned are mainly used for household self-consumption. In terms of cultivated land surface area, sorghum is definitely the most important crop in the area, while common beans are cultivated only in the irrigated area and only once a year despite a very short cropping cycle. There are three cropping seasons over a 12-month calendar year, with some crops straddling the next cropping year as far as harvest time is concerned (Refer to Table 8).

In general, the farming tools used, such as machete and hand hoe are anachronistic as well as insufficient in number, resulting in a very labor-intensive activity. Crop yields are very small and far inferior to the invested labor force (Higazi, 2006).

Needed labor force is provided through family labor, paid labor, and mutual aid labor system such as *combit*, based on , volunteer participation, and *colonne*, a more structured system in which a limited number of related workers help each other on a rolling basis and eventually sell labor to others in soil preparation tasks. Through these strategies the difficulties associated with ever skyrocketing costs and locally prevailing scarcity of farm labor may be bypassed.

Chemical fertilizers are not commonly used in *Bassin Magnan* due to their high costs and to inadequate availability of water.

Livestock

Dominant species raised are goats (*Capra hircus*), a species particularly adapted to dry environment, followed by cows and pigs. A single cattle breeder may handle about 4 goats and one cow either directly owned or indirectly tended. Pig farming faces the huge difficulty of food supply due too high prices, while cattle or goats can easily feed on crop residues. Mass deaths, probably due to New Castle disease, once or twice a year tend to discourage farmers from traditional poultry farming that is otherwise very widespread.

Forestry

Forest exploitation is scarcely contrasted through small-scale and scattered reforestation projects undertaken in some strategic and vulnerable spots partly through the volunteer effort of local community based organization (CBO), and partly through formal funds, while farmers are not used to participate in farm-level individual reforestation efforts.

Figure 8 Typical cropping calendar in *Bassin Magnan*, Gonaives, Haiti

		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
First cropping season	Corn				Sowing				Harvest							
	Sorghum					Sowing								Harvest		
	Millet				Sowing			Harvest								
	Sorghumd47				Sowing				Harvest							
	Pigeon peas				Sowing								Harvest			
	Cassava				Sowing								Harvest			→
	Banana						Sowing									→
Second cropping season	Banana								Sowing							→
	Cassava								Sowing							Harvest
	Corn								Sowing				Harvest			
	Sorghum47								Sowing				Harvest			
Third cropping season	Com. beans												Sowing		Harvest	
	S. cassava												Sowing			→
	Sorghum dodo47												Sowing			→
	Banana												Sowing			→

Legend

Sowing	*Sowing time*	Harvest	*Harvesting time*	→	*Harvest time overlapping the next cropping year*

4.1.5 Characteristics of Livelihoods

Access to irrigated land is a challenge at *Bassin Magnan*, where the vast majority of the land is constantly under extended periods of drought. The lucky farmers to exploit irrigated parcels generally don't pay any water fees for the river-bank pointed system, whereas fees as high as 125.00 HTG/hour[21] are reported to be paid by farmers using the pump based system. Anachronistic tools and quantitatively inadequate equipment, difficult access to capital, skyrocketing prices of salaried farm labor are just a few of the limitations facing the local farm households. Cash credit is available to some local farmers through the initiative of a local NGO supporting a locally operating cooperative. Loans are granted at a 2% monthly rate but only for emergency situations such as death and severe illnesses involving the 300 members. The majority of farmers in need are compelled to resort to the informal credit system, in which loans are reluctantly granted at monthly rates as high as 20 to 30% (Higazi, 2006). Sometimes, farmers may mortgage or rent their parcels of land or become members of a *Sòl*, or another informal credit system. A number of NGOs executing farm-based projects supply farm extension and training services. Since 1993 an improved seed bank program managed by OPUDB has been operating in *Bassin Magnan,* focused on managing seeds availability and benefiting from FAO technical and material support. An FAO funded improved goat breed distribution and restocking program as a particularly relevant long-term response to livestock related damages brought about by Hurricane Jeanne. A few fortunate farmers own the prized mesquite woodlots which they

[21] Source: Higazi, 2006

sometimes lease to poorer farmers for charcoal-making. The vast majority of farmers are concerned by the downward trend of availability of farm assets. Understandably, since the site experienced major and recurrent weather-related disasters in the past three years farmers adaptation strategies to sustain a living are growing more and more refined.

Table 4 Coping strategies adopted by local farmers of the *Bassin Magnan* pilot site

Coping strategy	Rationale	Categories of farmers involved	DRM related
Migration	Poverty, insecurity, disaster occurrence, unemployment	Smaller and medium class farmers	Yes
Charcoal burning	Poverty, landlessness	Small and medium class farmers	Yes
Informal cash credit (*Ponya*, *Sòl*, *Plane terre*, *Location*, *Affermage*)	Absence of formal credit from banks and other institutions	Small and medium class farmers	Yes
Request for disaster aid	Damage from natural disasters	Farmers from all categories/classes	Yes
Seasonal farm work	Poverty, landlessness, unemployment	Small farmers	Yes
Excavating river sand/gravel	Poverty, extended drought	Smaller farmers	Yes
Farm and food product commercialization	crop system risks/uncertainties	Women prevailingly	No
Improved farming techniques	Water management in drought conditions	Farmers in dry areas	Yes
Selection of appropriate varieties	Drought, hurricanes	All farmers	Yes
Share cropping	Poverty, landlessness	Small and medium-class farmers	No
Scattering of parcels	Weather uncertainty impact mitigation	High and medium class farmers	Yes
Farm crop diversification	Weather uncertainty impact mitigation	All farmers	Yes
Cultural rotation	Soil fertility management	Farmers in the irrigated zones	No
Livestock selection	Poverty, drought and hurricane prone environment	Prevailingly medium and high class farmers	Yes
Herding	Farm asset management	All farmers	Yes
Agro-pastoralism	Soil fertility and farm asset management	Medium and high class farmers	No

4.1.6 DRM Issues at *Bassin Magnan*

Local perception of natural disaster at *Bassin Magnan*

The *Bassin Magnan* respondents identified three dominant weather-related phenomena which fully deserve the label "natural disaster" based on their respective and specifically destructive impacts on all local activity sectors, and their recurrence, listed and defined in descending order of perceived impacts, causes, consequences, and correcting measures as follows:

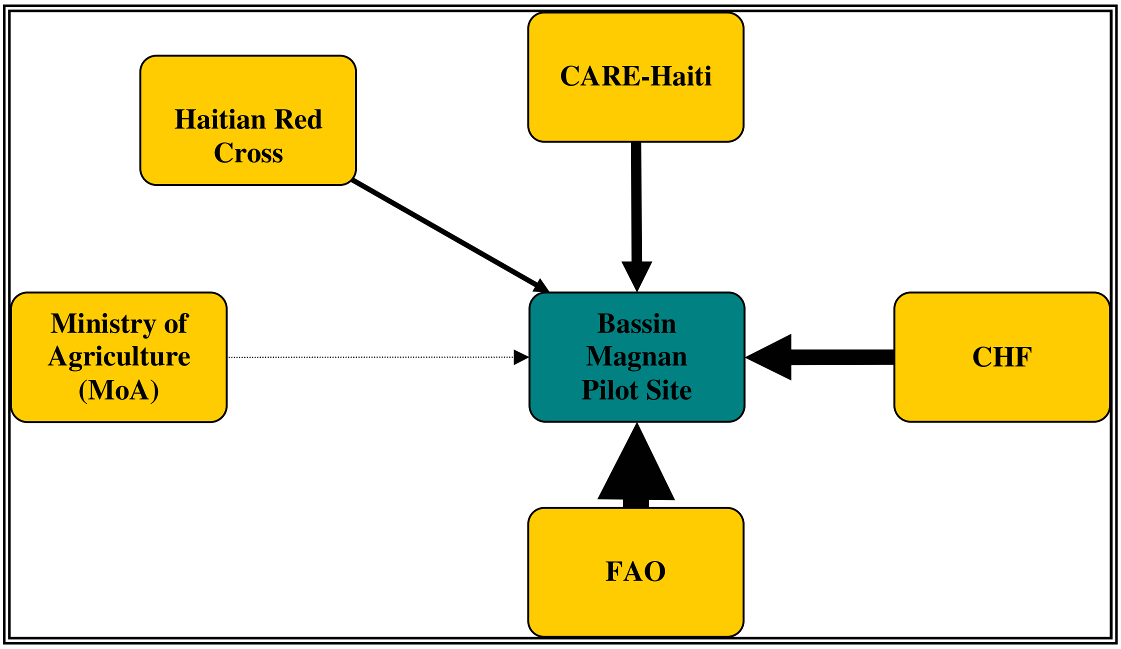
- Hurricane: a devastating weather-related phenomenon with unknown causes but very destructive to the parcels and crops, livestock, human lives, and infrastructures. It may be addressed through soil conservation and reforestation;

- Flood: a phenomenon by which rivers' banks overflow due to a combination of heavy rains, low soil infiltration and excessive run-off, resulting in soil erosion and fertility decrease, losses of crops and human and animal lives. May be mitigated through soil conservation";
- Drought: extreme scarcity of rains due to deforestation and wind resulting in delayed farming cycles and cattle abortion. Drilling water wells is considered a corrective measure;

Furthermore, all social categories within the area only have access to hurricane-related early warning information, generally clearly disseminated in Creole. However, very limited economic means can prevent the farmers to fully take heed of the anti-hurricane recommendations conveyed through the early warning messages. The respondents also observed that not many institutions are actually present to support them in time of disasters and their contribution to disaster alleviation and reconstruction was found to be wanting. Of the mentioned institutions, FAO was ranked highest for projects for the recovery farm infrastructures and other farm inputs implemented in the area shortly after hurricane Jeanne. The Ministry of Agriculture, in contrast, is thought to be insufficiently present in the farm related response and recovery effort (See Figure 9).

Furthermore, DRM pre and post-disaster related training is only available to a few local community leaders.

Figure 9 *Bassin Magnan* farmers' perception of the contribution of local and national institutions to disaster response and recovery efforts



Key: The length and width/thickness of the arrows are a direct function of perceived "proximity" and contribution of concerned actors to disaster response and recovery effort

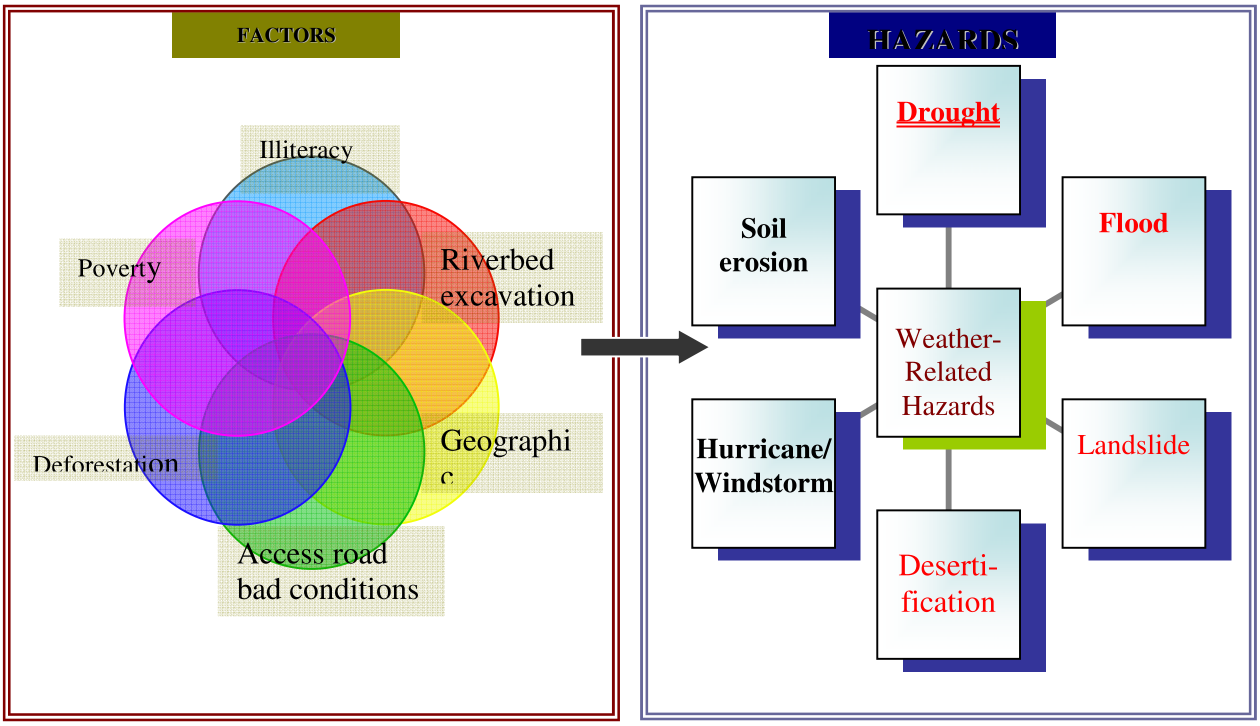
The vulnerability context

Main sources/factors of vulnerability at *Bassin Magnan* are represented by poverty (a historical and pervasive phenomenon in Haiti and in *Bassin Magnan* which prevents the farmers to take heed of most recommendations[22] related to disaster prevention), geographic location (it is part of a leeward area recently revealed as prone to hurricanes); road access conditions: the main communication local road is a dust, unpaved tract which crosses several forded sections of the site's three rivers, making traffic particularly dangerous during rainy and hurricane seasons; illiteracy characterizing the major part of the local population, deforestation (through which the remaining (mesquite and lignum vitae) trees yet accessible are being actively removed for charcoal making); absence or precarity of general and farm-based infrastructures. An additional crucial anthropogenic vulnerability factor is represented by excavation of the nearby by poor and desperate riparians for send, gravel and stones which are sold as house building material for a living. Since the road crosses the river at the mentioned spots, by undermining the riverbed this digging activity may cause the road to collapse while increasing the risk of riverbank slide.

The above-mentioned factors are in turn considered a cause of vulnerability to the following hazards, in descending order: hurricanes, drought, flood, landslide, soil hydric erosion, and desertification (See Figure 10)

Hurricanes have been particularly damaging in the past ten years, with Georges in 1998 and Jeanne in 2004 the two major events. This is rather unusual since hurricanes seem to be shifting their traditional North-North West path to a more transversal one dangerously crossing the Artibonite area. Soil hydric erosion is pervasive due to an extensive level of deforestation. Those two hazards were not mapped out through the focus group meeting since they hit the entire zone with similar intensity and frequency.

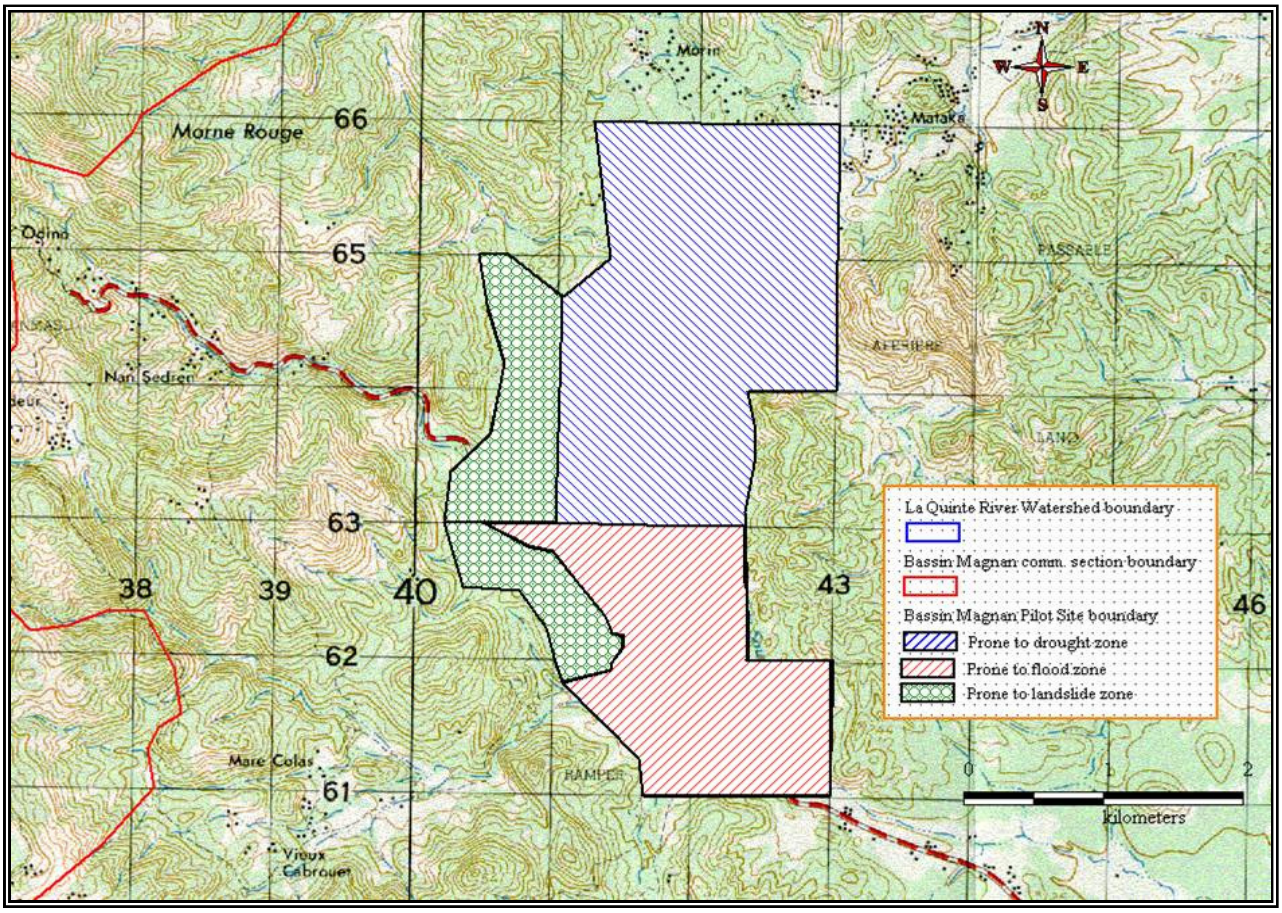
Figure 10 **Vulnerability factors and hazards' exposition at *Bassin Magnan***



Key: In descending order of pervasiveness and/or devastating damages potentials, the vulnerability hazards are symbolized by the following types: underlined and bold, bold and regular. hurricane/ windstorm and Soil **erosion (in black) were not mapped out.**

[22] Building code, for instance is either inexistent or non enforced anywhere in Haiti (hence in the pilot site) and allow the farmers to build and live in any makeshift hovels/houses.

Figure 11 Rough vulnerability map of the *Bassin Magnan* Pilot Site, Gonaives, Haiti



Source: the Author

4.2 The *Lavanneau* Pilot Site

4.2.1 Location and physiographic features

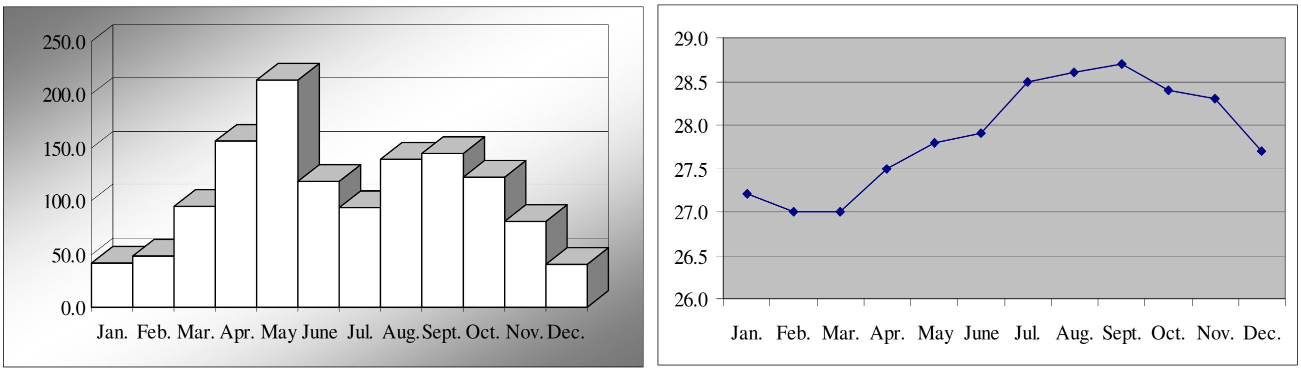
Lavanneau is a small rural community part of a municipal section 6 km to Jacmel in the South East department, the department's main city which is accessible through a dust road network but only during the dry season. The pilot site is divided in two distinct zones: the Beaudouin area in the lower part, 40 m above sea level, located within the flood plain of the area's main river system; and the Romage area, around 350 meters above sea level). The greater part of the site is located on mid-altitude hillsides exposed to the East and affected by winds blowing in a South/South East – North West direction. Slope is prevailingly between 30 and 40%, and altitude ranges from 40 to 540 m above sea level. The Lavanneau site surface waters mostly empty in the *Rivière Gauche*, itself a tributary of the Jacmel River, draining the Jacmel River regional watershed system (See Annex 3). Due to the proximity of the Rivière Gauche to the mouth and to its erratic bank overflowing patterns and banks, an issue of environmental degradation, part of the surface waters empty directly in the area's regional drainage system, the Jacmel river.

Climate

Lavanneau is characterized by 1295.6 mm mean annual rainfall distributed following a bimodal pattern, with two rain seasons, one from March to June) and the other distributed from August to October. The Lavanneau/Jacmel annual rain pattern seems inconsistent with the country's pluviometry, with June generally drier than July, and October rather than September the wettest autumn month.

In Jacmel the mean annual temperature is 27.8°C. Ecologically, the Lavanneau pilot site belongs to the tropical dry forest lifezone [23].

Figure 12: Monthly mean rainfall (a) and temperature (b) at Lavanneau, Jacmel



(a) Monthly mean Rainfall (mm) *(b) Monthly mean temperature (°C)*

Source: FIC, SNRE

Demography

About 11,500 inhabitants live in the entire Lavanneau communal section of which 55% women and 45% men. 60% of the population is less than 15 years old, 30% is between 15 and 65, and 10% is above 65 years old. Moreover 55% of that population was estimated to be labor-active. The pilot site considered very densely populated, and though no data are currently available, the PRA session respondents agreed on estimating around 2,000 inhabitants.

Social stratification

Wealthier Lavanneau inhabitants tend to move to the close by Jacmel, so social stratification is not that apparent within the site. No house has a thatched roof, while most roofs are of corrugated iron and there are 5% houses of concrete.

Moreover, the PRA-based survey classified local farmers in the following four categories, based on area of land exploited, land tenure, and access to paid farm labor:

1. Wealthy farmers representing 10% of the local population, who exploit around 2.5 ha of mostly privately owned land located in the lower and irrigated zone; they generally

[23] Based on the Holdridge's (1967) two-parameter ecosystem classification, the tropical dry forest lifezone is associated with mean annual temperature >24°C and mean annual precipitation between 1,000mm and 2,000 mm.

use salaried farm labor and own upland small groves/orchards of mesquite and mandarin whose harvesting is sold or leased to poorer farmers;

2. Medium-class farmers who generally exploit 1 ha of mostly hillside land accessed partly through ownership, partly through renting and/or sharecropping; needed farm labor is provided by the household and partly paid;
3. Small farmers representing 60% of all local farmers, and exploiting at most 0.65 ha of land generally accessed through sharecropping; farm labor is strictly family-provided and parcels are situated in marginal areas;
4. Landless farmers who account for 5% of the local community; they are generally seasonal migrant farm workers with no access to land.

History

Apparently no marked socio-economic changes occurred in the community over the last 30 years. However, the respondents emphasized a net increase in: (a) percentage of children in full-time education, (b) access to telephone communication, (c) forest clearing for the purpose of fruit tree plantations, (d) number of voodoo temples and churches, (e) number of political organizations and/or community based organizations, (f) number of school buildings, and (g) consumption of imported farm products. On the other hand, the number of children per family, school dropout rates, the number of individuals involved in farm activity, tobacco cropping, global farm production were constantly decreasing. These observed changes were considered to be linked to NGOs' intense activity, providing general support to family planning, and child primary education, as well as the presence of a regional mobile communication carrier, and the preference of young farmers for extra-agricultural activities such as motorcycle taxi driving.

4.2.2 Natural resources base

Fairly degraded, the basic natural resources at Lavanneau are:

<u>Natural forest</u>: dominated by fuel wood (mesquite (*Prosopis juliflora*) is the dominant species used for charcoal burning), fruit trees (mango (*Mangifera indica)*, avocado (*Persea americana*), mandarin (*Citrus reticulata*), bread fruit (*Artocarpus altilis*)), and some off-forest timbers (Haitian oak (*Catalpa longissima*), Spanish cedar (*Cedrela odorata*), Simarouba (*Simarouba glauca*)). Bread fruit is a relatively abundant valuable tree crop growing in the lower part of the site. The intensively harvested trees are hardly replaced by new plantations, mainly mandarin and some high value timber species planted thanks to reforestation projects distributing seedling.

<u>Soils/Land</u>: Soils at Lavanneau are of two dominant types of limestone parent rock:

(1): alluvial very deep and permeable soils in the lower part with neutral to alkaline pH, high CEC, 2 to 6% of organic matter content, and relatively high potassium (K) content (Cabidoche, 1984) favoring the cultivation of banana, the highest value local crop;

(2): white rendzine and calcic brown soils on the hillsides, with normal organic matter content; inadequately assimilated iron causing whitening of the crops, presence of active limestone which makes them very alkaline (pH between 7.5 and 9.0), general deficiency of phosphorus (P), potassium (K), magnesium (Mg), and nitrogen (N) (GRET-FAMV, 1991).

A typical farm household exploits 1.53 ha of land distributed over 3 to 4 scattered plots. The most fertile and coveted soils are in the lower part are banana plots and smaller than those in the mountainous zone.

Water: Drinking water is provided through 2 small tap water systems located in Beaudouin and Romage respectively. Supposedly the water supply system is freely distributed to residents through a network of public fountains and wash houses, but a few politically and/or economically dominant farmers derive their private water supply from it. In spite of distribution problems associated to the system's general deficient maintenance, tap water supply is acceptable within the area.

Irrigation water is river-bank pointed in Beaudouin and spring-collected in Romage. These two small-scale systems irrigate at most 1/3 of the site's irrigable land surface. About 120 water users are registered for about 0.32 to 0.62 ha each. Irrigation water usage fees of 500 HTG per year are actually too expensive and never paid, resulting in huge maintenance and expansion problems associated to the local irrigation systems.

4.2.3 Other socio-economic resources:

Access to credit: Despite half a dozen banks and financial institutions operating in Jacmel, access to credit is a crucial issue in Lavanneau. Presently farm credit or crop insurance is not supported by any private or state-owned institution[24]. An informal cash credit system includes: *Ponya*, *Sol* and mutual loans among close friends and relatives. However, the credit obtained is never nominally supposed to support local farm activities, considered too risky.

Farming extension services and structures: A veterinarian, paid by the MoA is the sole state representative for farm extension. Several NGOs and IOs operating agriculture-based projects in the area, compensate for the scarce government presence in the sector.

Development organisms and local CBOs: About a dozen NGOs and CBOs are active in the pilot site where they operate in sectors as diverse as education, general infrastructure rehabilitation, AIDS and MST prevention, beside agriculture. Among the most active NGOs in Lavanneau are PLAN International (education, [25] farm inputs supply, latrines), Canadian Funds (road maintenance, irrigation system rehabilitation), FAO (seeds), PADF (tools equipment, and seeds distribution), POCHEP (tap drinking water system implementation), CARITAS (farm training and inputs) etc.

4.2.4 Farming activity at Lavanneau

Agriculture is the main economic activity. Despite being relatively close to the ocean, fishery is not practiced, and the represented subsystems are cropping, livestock, and forestry.

[24] Between 2000 and 2004, FONKOZE, a national NGO granted all-purpose credits to the local households who used it for small business and commercialization rather than farm activities. In the early 1980s, Banque de Crédit Agricole, a nationwide state-owned bank granted farm credits which were then used for other purpose,s including direct consumption, commercialization, etc. The recovery rates were so low that BCA ultimately ran bankrupt and had to stop all operations throughout the country and in the pilot site.

[25] Tuition fees are fully covered by PLAN linked international sponsors to benefit children of farmers participating in the projects

Crops

Main cultivated crops include, in descending order of market value: banana, common beans, vegetables, pigeon peas, corn, sweet cassava, bitter cassava, and sorghum. Apart from sorghum and pigeon peas, used for household self consumption, all these crops are commercialized on the local market. Sorghum is the largest crop in terms of cultivated area. Common beans are cultivated in both the lower and hilly zones of the site, but at different periods. There are three cropping seasons, with some crops straddling the next cropping year as far as harvest time is concerned. As in *Bassin Magnan,* in Lavanneau too tools are generally outdated and inadequate. Deficient training and general farm support results in an inadequate exploitation of the available farm resources bases, particularly in the upper part of the site where the lack of basic training in gravity irrigation water management in mountainous sites results in inefficient utilization of the water resources with no positive impacts on crop yields. The crop production subsystem is therefore very labor intensive with very low invested capital rate of return and ultimately resulting in more and more farmers abandoning farm activities for extra-farm ones. Needed labor force is paid to salaried workers, provided by household members, or obtained through the *combit* system. In the latter case, only activities like planting/sowing and harvesting are included, being also occasions for the farmers to socialize. The labor intensive activities, such as soil preparation, weed removal, are generally realized through paid or family labor.

Despite water availability, use of chemical fertilizers is not widespread due to high costs.

Livestock

Dominant animal species are represented by domestic pigs (*Sus scrofa*), followed by cows (*Bos taurus*) and goats (*Capra hircus*). Traditional poultry farming is widespread but unfortunately prone to recurrent occurrence of mass deaths, probably due to New Castle disease. As each single local farm household raises at least 8 hens (*Gallus domesticus*), poultry diseases affecting the community about twice a year are a huge concern there.

The diversified cropping system prevailing in the site allows for more or less normal pig farming despite the food-intensive characteristics of this activity. The average 5 heads of cattle herded by local individual farmers is generally accessed through indirect tenure. Veterinarian services for no less than 100.00 HTG per farmer are delivered on an on-demand basis. The community considers these service costs too expensive, seeing that the veterinarian agent is actually a salaried employee of the MoA.

Forestry

No systematic tree planting initiatives compensate the overexploitation of scarce forest resources. Trees, mainly mesquite, are mainly harvested for charcoal making purposes. Breadfruit (*Artocarpus altilis*), and timbers such as Haitian oak (*Catalpa longissima*), Spanish cedar (*Cedrela odorata*), and West Indian sabicu (*Lysiloma sabicu* Benth) are likely spared, but not actually planted and raised, by local farmers for their global economic importance, and so is the high value Mandarin tree, of which generally only wealthy farmers possess some scattered productive trees, or rarely small orchards which they may lease or sell to small farmers. One mandarin tree has a single year harvest and may be leased at 1,250.000HTG per year. In the past small-scale reforestation activities were tried through very short-lived projects which have left no visible mark. Every now and then local farmers participate in farm-level reforestation efforts promoted by NGOs with only superficial success since only fruit and high value timber species meet the expectations of farmers, as opposed to the fast-growing multipurpose and nitrogen-fixing species actively promoted by reforestation projects.

Figure 13: Typical cropping calendar at Lavanneau, Jacmel, Haiti

Season	Crop	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
First cropping season	Corn				Sowing				Harvest							
	Com. beans				Sowing			Harvest								
	Sorghum				Sowing									Harvest		
	Pigeon peas				Sowing								Harvest			
	Cassava				Sowing											Harvest
	S. cassava*				Sowing							Harvest				
	Banana			Sowing	Sowing											Harvest
Second cropping season	Banana						Sowing		Sowing							⇨
	S. cassava*								Sowing							Harvest
	Corn								Sowing				Harvest			
	Sorghum								Sowing	Sowing				Harvest		
Third cropping season	Com. beans												Sowing		Harvest	
	Corn												Sowing			Harvest
	Tomato												Sowing		Harvest	
	S. cassava												Sowing			⇨
	Lima beans												Sowing			Harvest
	Banana												Sowing			⇨

Legend

Sowing	*Sowing time*	Harvest	*Harvesting time*	⇨	*Harvest time overlapping the next cropping year*

*S. cassava: sweet cassava

4.2.5 Characteristics of Livelihoods

Access to land is more or less easy, though access to irrigation remains a true challenge. The annual fees for two hours a day irrigation of 0.32 to 0.50 ha is ranked high and hard to afford by the average farmer. Needed labor is generally internal and provided by the farmer's family as the minimum 125.00 HTG unit amount fees for a person/day of salaried labor is too high for a poor farmer to afford. Credit is available on a selective basis, and a farmer owning producing mandarin trees has easier access to cash credit from his friends or relatives than a poorer farmer.
Farm extension and training is available through the activity of numerous NGOs executing farm-based projects filling in for state institutions whose presence and general contribution are qualitatively and quantitatively insufficient. Improved seeds are supplied on a small scale by NGOs or international organizations such as PADF, and FAO Beneficiaries of pig restocking programs are generally medium and high-class farmers, due to the huge food supply challenges associated with pig farming.
A few farmers have access to direct forest product exploitation through the lease of mandarin trees and of mesquite woodlots used for charcoal burning. Availability of those basic farm assets fluctuates through time, with greater scarcity observed in periods of greater need, further exasperated by the occurrence of weather-related disaster particularly hurricanes.

Figure 14 : Coping strategies adopted by local farmers of the Lavanneau pilot site

Coping strategy	Rationale	% involved	DRM related
Migration	Poverty, insecurity, disaster occurrence, unemployment	Medium and low class farmers	Yes
Charcoal burning	Poverty, landlessness	Medium and low class farmers	Yes
Informal credit : (*Ponya*, *Sôl,* land renting)	Absence of formal farm credit from banks and other institutions	Medium and low class farmers	Yes
Request of disaster aid	Damages from natural disasters	All farmers	Yes
Seasonal farm work	Poverty, landlessness, unemployment	Small farmers	Yes
Extra-farm activities	Crop system risks/uncertainties	Women prevailingly	No
Improved farming techniques	Management of disaster risks (floods, hurricanes)	Farmers in dry areas	Yes
Selection of appropriate varieties	Drought, hurricanes	All farmers	Yes
Share cropping	Poverty, landlessness	Medium and low class farmers	No
Farm crop diversification	Weather uncertainty management, small size of land holdings	All farmers	Yes
Cultural rotation	Soil fertility management	All farmers	No
Livestock types/species selection	Poverty, challenges associated with food supply	Medium and low class farmers	Yes
Herding	Poverty, farm asset management and investment risk minimization	All farmers	Yes
Agro-pastoralism	Soil fertility and farm asset management	All farmers	No

4.2.6 DRM issues at Lavanneau

Local perception of natural disaster at Lavanneau

The Lavanneau farmers named four dominant weather-related phenomena ranked as natural disasters based on their destructive impacts, and their recurrence. They are described in their causes, consequences, and eventual correcting measures and listed in descending order of perceived socio-economic impacts :

- Hurricane: God's power manifestation, takes the form of strong winds and heavy rains, probably due to the crossing between a warm and a cold ocean. Very devastating to crops, livestock and human lives, building, and infrastructures, it cannot be prevented, or mitigated;
- Flood: high waters washing away everything they overcome. Probably caused by the degradation of the environment, and there are no effective or definitive remedies to it, other than timely escape after having secured important assets;
- Wind: an excess of air of divine or unknown origins damaging crops and trees, causing outbreak of livestock disease and degradation of soil quality and retention capacity. No efficient anti-wind measures are known of;

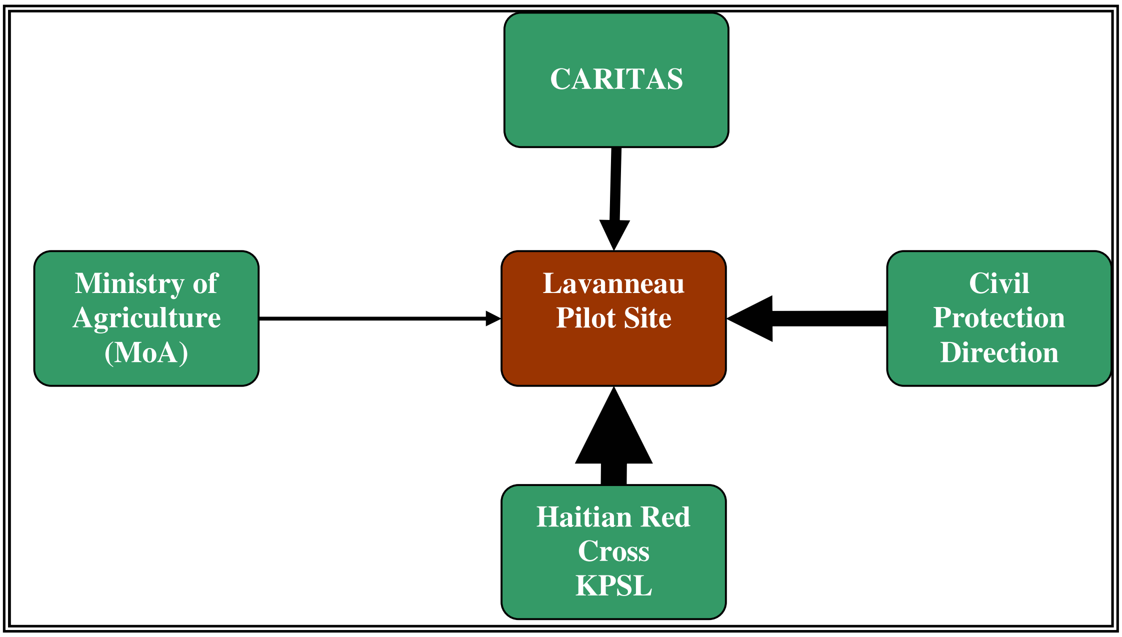
- Drought: extreme scarcity of rains associated with extreme heat due to deforestation and resulting in starvation, massive livestock death and crop loss. No corrective measures are recognized or practiced.

Access to early warning information available only for hurricane related issues is granted to all social categories and is generally clearly broadcasted in Creole; though limited economic means very often prevent local farmers to fully apply the anti-hurricane recommendations conveyed through the early warning messages.

The Lavanneau respondents found that the Ministry of Agriculture participates in the disaster response and recovery local efforts only indirectly by requesting disaster relief from international and or local organization and NGOs operating in the Jacmel area and ranked it poorly as far as the disaster response and recovery efforts are concerned. The Haitian Red Cross, by contrast is the most highly ranked since its staff is generally present on the field to bring first medical aid to the victims while supporting a more or less active network of first-aid agents who are fairly close to the local communities (See Figure 15).

DRM training is available to a few local community leaders including the active members of the the local committee for civil protection, supported by the departmental delegation office or by the Haitian Red Cross local office. The community members have had a limited access to post-disaster emergency relief such as the rehabilitation of the Beaudouin irrigation system after Hurricane Georges in 1998. However, no significant disaster related assistance was distributed in the area over the last 7 years which in fact were cyclonically very active.

Figure 15: Lavanneau farmers' perception of the contribution of local/national institutions to disaster response and recovery efforts.



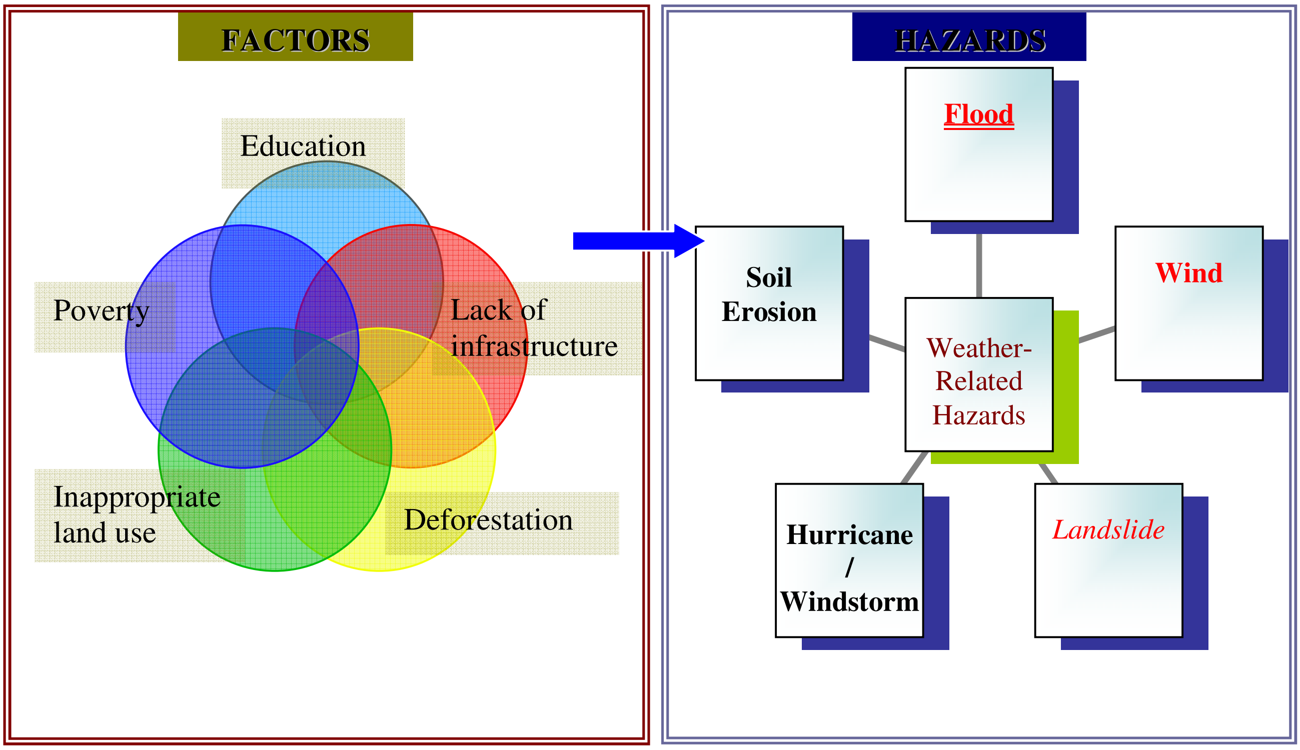
Key: The size of the arrows and their thickness is a direct function of the percieved proximity of institutions as far as DRM relief support is concerned.

Vulnerability context

The following interrelated factors come into play to shape disaster vulnerability in the Lavanneau pilot site:

- most of the residents in the community are very poor farmers;
- lack of general infrastructure, and particularly a deficient road system with no bridges crossing the river and torrential flow and high waters in rainy seasons;
- widespread illiteracy of the local population
- Deforestation, which makes the system environmentally less resilient while exacerbating the negative effects of any adverse phenomenon.
- Inadequate land use systems; population in the lower zone continue to live and intensify cropping activities into the very river bed that is very prone to recurrent flood events. In the higher zone on the other hand, land with steep slopes is cultivated in the absence of any soil conservation correcting measure.

Figure 16 **Perceived vulnerability factors and exposure to hazards' at Lavanneau**

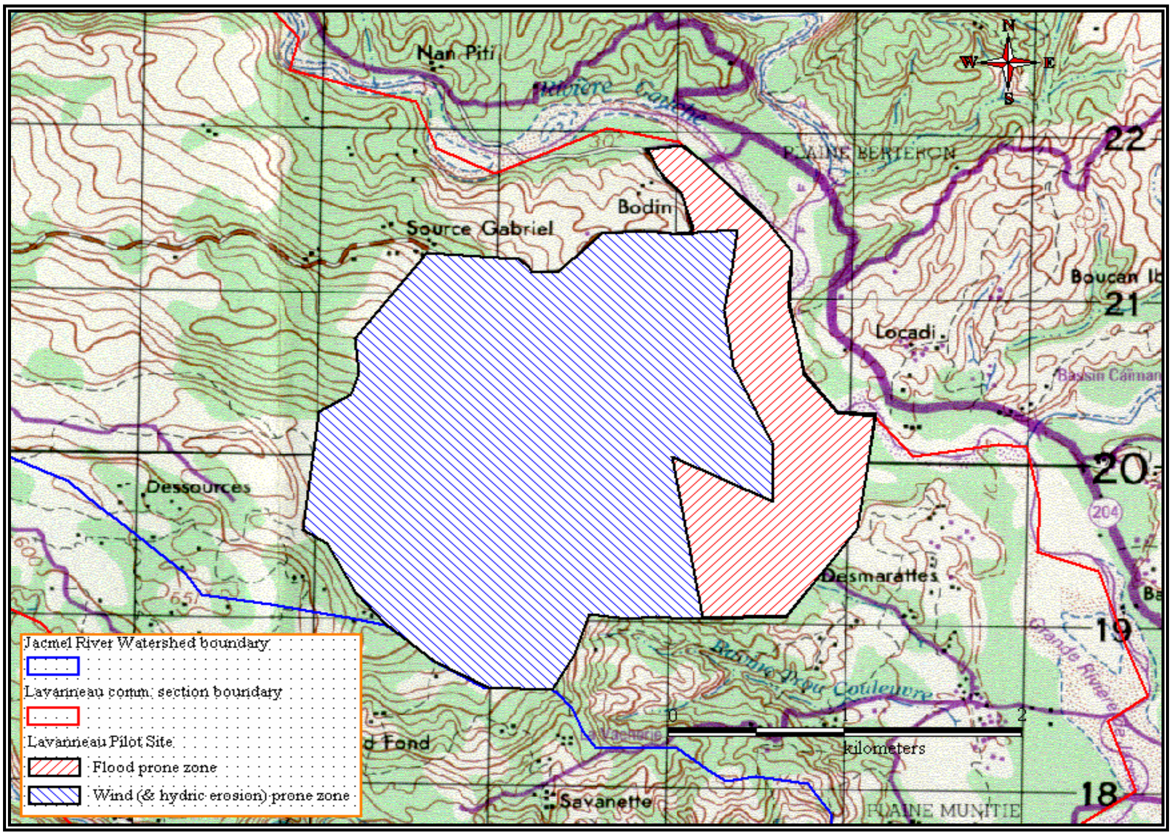


Key: In a descending order of pervasiveness and/or devastating damages potentials, the vulnerability hazards are symbolized by the following types: **underlined and bold**, **bold**, regular, and *italic*. Hurricane/windstorm and Soil erosion (in black) were not mapped out.

The local river system in rainy seasons is likely to flood the entire lower part of the site, systematically affecting the local population and making floods the most pervasive and recurrent hazard. Despite repeated warnings from the authorities and recurrent disasters with a high rate of casualties, the local population has always declined the proposed plans for total evacuation. In spring and fall high waters can make the site inaccessible, since no bridges cross the principal local river system. In the upper part, recurrent winds cause extensive damages to the farm system, rendered yet more fragile by the weak local farming extension system. Landslide occasionally strikes the hilly and friable area overhanging the Beaudoin piedmont zone of Lavanneau in times of hurricanes and heavy rains.

Hydric erosion further contributes to the site's vulnerability, since no soil conservation measures are applied by farmers on a regular basis to address this adverse phenomenon. Hurricanes, which in recent years have been hitting the area yearly, are the first cause of loss of farm assets, resources bases, and productive capacities of the local communities. The community, hit by recurrent hurricanes and inadequately prepared, developed a defeatist and fatalistic behavior and mentality, considering hurricanes "the will of God, for which no human being has solutions or mitigation measures.

Figure 17: Rough vulnerability map of the Lavanneau Pilot Site



Source: Author

5 Identified Good Practices for Disaster Risk Management in Agriculture

5.1 General considerations

The good agricultural practices for DRM applied by farmers primarily address the three most common and dangerous disasters in Haiti, hurricanes/storms, flood, and droughts. Respondents proposed twenty six traditional practices currently used to address one or more phases of weather-related disasters, of which sixteen were found to be efficient DRM measures consequently documented, and eventually grouped under specific technical packages such as Soil conservation, and Banana tree management.

Typology of the identified good practices

Table 5 Good DRM related farming practices

Good DRM related farming practices	**Categories**	**Pilote Sites**			**Other Sites**
		Bassin Magnan	***Lavanneau***	***Belle-Anse***	***Marmelade***
1. Land tiling	Cropping subsystem	√	√		
2. Appropriate selection of cropping time and cultivars		√			
3. Post-harvest conservation of seeds in a calabash			√		
4. Construction of shelter in the garden to temporarily store the harvest			√	√	
5. Construction of a traditional granary “colombier” to store the harvest		√			
6. Closing down water irrigation system from stream/primary channels			√		
7. Banana tree leaf removal		√			
8. Clearing stones from the land after flooding		√			
9. Early harvesting of all marketable / mature crops		√	√		
10. Replanting after inundation		√			
11. Sowing in alternate rows		√			
12. Staking banana trees		√	√		
13. Building gully plugs in the ravines	Soil Conservatio n	√	√		√
14. Construction of improved contour canals					√
15. Building diversion ditches			√		
16. Construction of stone wall			√		√
17. Construction of mulch hedges			√		
18. Planting candelabra along the ravine banks			√		
19. Planting vetiver on the edges of the plot		√			
20. Construction of shelter for gravid livestock	Livestock subsystem		√	√	
21. Removing livestock to more secure grounds		√	√	√	√
22. Transhumance					√
23. Tree pruning and routine management	Forestry subsystem	√	√		√
24. Tree planting		√	√		√
25. Low intensity marketing to support agricultural production	Other	√			
26. Repairing the family house and outbuildings		√			

5.2 The documented good practices list

In terms of their importance and DRM relevance and effectiveness, the following eight good practices or packages were considered as worthy of in depth documentation: (See Annex 2)

1. Tree Pruning
2. Removing livestock from low lying areas to higher and more secure grounds
3. Appropriate selection of cropping seasons and cultivars
4. Tree Planting
5. Land tiling
6. Soil Conservation practices package
    - (improved contour canal,
    - stone wall,
    - gully plug,
    - river bank protection with vetiver,
    - river bank protection with candelabra,
    - diversion ditches,
    - construction of mulch hedges
7. Building a traditional granary "*Colombier*" to store the harvest
8. Banana plantation management package (leaf removal, staking of the banana tree, anticipated harvesting, further banana management practices)

Figure 18 Global Typology of the field identified Good Practice

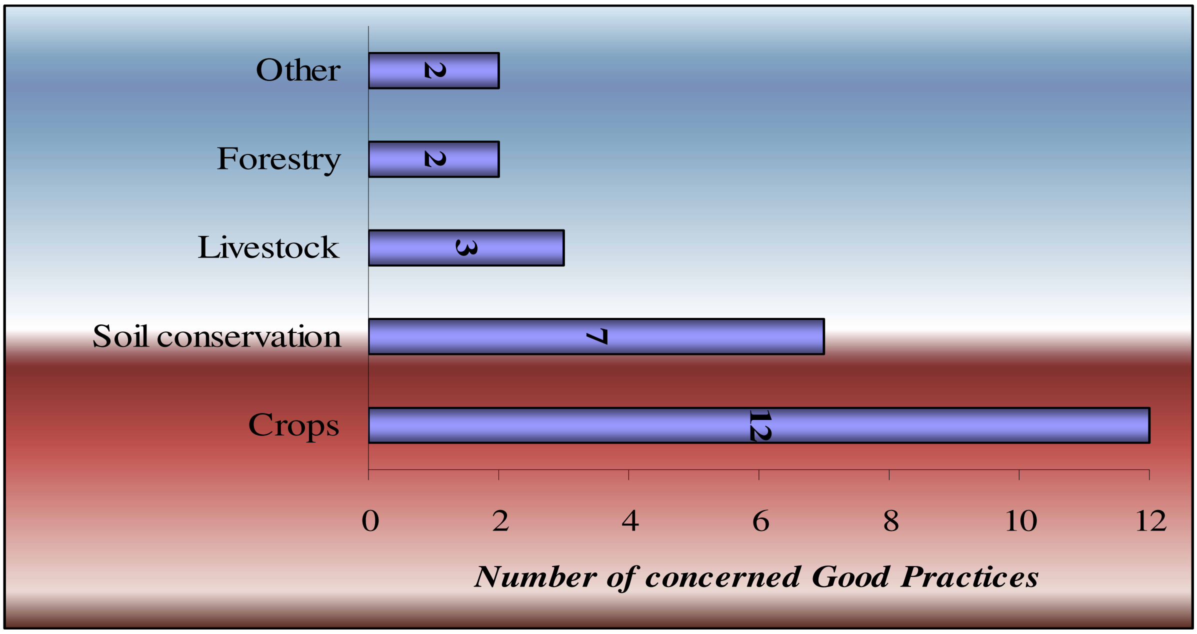


Table 6 Selected DRM Good practices and their suitability related to different natural hazards

Hazards/ DRM stages	Agric. sub-sectors	*Cropping*	*Livestock*	*Agroforestry /forestry*
Flood	Impact prevention	Building a traditional colombier	Removing livestock to more secure ground	Tree Pruning
		Appropriate selection of cropping seasons and cultivars	Soil Conservation package	
		Soil Conservation package		
		Banana Management Package		
	Impact Mitigation	Building a traditional colombier	Soil Conservation package	
		Soil Conservation package		
	Preparedness	Building a traditional colombier	Soil Conservation package	Tree Planting
		Soil Conservation package		
		Banana Management Package		
Windstorm / Hurricane	Impact prevention	Soil Conservation package	Removing livestock to more secure ground	Tree Pruning
			Soil Conservation package	
	Impact Mitigation	Soil Conservation package	Soil Conservation package	
	Preparedness		Soil Conservation package	Tree Planting
		Soil Conservation package		
		Tree Planting		
Drought	Impact Prevention	Land Tiling	Soil Conservation package	Tree Planting
		Appropriate selection of cropping seasons and cultivars		
		Soil Conservation package		
		Tree Planting		
	Impact Mitigation		Soil Conservation package	
		Soil Conservation package		
		Land Tiling		
	Preparedness	Tree Planting	Soil Conservation package	Tree Planting
		Land Tiling		
		Appropriate selection of cropping seasons and cultivars		
		Soil Conservation package		

6 National Workshop to validate Good Practices in Disaster Risk Management

The Haiti national workshop was convened to: Discuss with key stakeholders strengths and weaknesses of the Haiti DRM system and its links to the Agriculture sector; identify and propose strategies for improvement; evaluate agriculture-based good practices for disaster risk management traditionally applied by the Haitian farmers in the surveyed sites; select the best DRM agricultural-based practices for the regional workshop; point out relevant operational implications related to the implementation of good practices.

Two working group/plenary sessions were held during the workshop. One was dedicated to discuss the links existing between the agriculture and the DRM sectors in Haiti; and the second addressed the evaluation, prioritization and selection of the good practices. To rank and select the best DRM related practices from the proposed pool, the audience adopted a 4-criterion based scoring system. The criteria and their associated respective maximum score (in parenthesis) were set as follows: Doability: (2), Durability/sustainability: (2), Efficiency: (3), Replicability: (3). For each evaluated good practice, the individual scores gained from each criterion were added up to yield 10, the maximum total score a practice can get through the evaluation process. Finally the evaluated good practices were ranked using the total score in a descending order.

Workshop conclusions and recommendations

Through its global objectives and implementation strategies, the TCP/RLA/3101 project as designed and executed is rather innovating and quite challenging in Haiti where farm related development projects have historically included substantial and direct material and financial support to farmers. There is a need for an effective partnership in project phase two between the project's stakeholders: FAO and the MARNDR on one side, and the beneficiary farmers on the other- based on a close relationship and clear and effective communication. In the same way, a closer relationship between FAO and the MARNDR based on effective integration of the latter institution into the project's activity is recommended.

The Haitian DRM framework is conceptually sound, supported by well-defined objectives, a solid structural organization, and clearly expected outcomes. Nevertheless limited success and a certain degree of inefficiency is associated to DRM projects in Haiti. Operational link between the DRM and the Agriculture sector remain weak. A better integration of the two sectors is a prerequisite for successful disaster risk management on all scales. Such integration would envisages a shift from the current top-down approach characterizing the DRM – Agriculture interface to a more dynamic, more participative approach based with e common goals defined for managing risks rather than responding to disasters.

The two pilot sites have many characteristics in common such as prevalence of extreme vulnerability and limited capacity of managing risks and disasters, extreme agro-dependence of local communities, cropping calendar and kind of cultivated crops, exposition and extreme vulnerability to hurricanes, uncertain presence of state-led farming institutions, presence of an almost totally costless water irrigation system, the presence of mesquite[26], and proximity to the main departmental city associated with under-development. These similarities on many levels

[26] Mesquite existence in an area generally indicates the propensity or tendency by the local riparians to be more or less intensively involved in charcoal burning activity

support the use of a similar strategic approach in both sites as far as farm extension is concerned. The dominant types of weather-related hazards prevailing locally -drought in Bassin Magnan, and flood in Lavanneau- are however different, and the farmers' socio-economic levels and life standards seem to be higher in Lavanneau. It is therefore advisable that the good practices to be replicated during the project's phase II relate to drought in Bassin Magnan and flood in Lavanneau.

The twenty six good practices were identified were integrally elicited from farmers operating within and outside the study site and are all techniques used by Haitian farmers to address weather-related hazards. In Bassin Magnan, where the overall agro-climatic conditions are worse than in Lavanneau a lower range of adaptation practices could be identified. This is explained by the high number of soil conservation practices applied in Lavanneau, which is mostly a mountainous and hilly area.

Haitian farmers have traditionally been granted free material and financial support to participate in most agriculture-based development projects, so the second phase of the current project might face some constraints from this heritage.

Due to lack of training and the precarious economic situation, many of the Haitian small farmers design their farm production systems on the rational of gaining for short-term revenues, while paying little attention to environmental protection or disaster risk management. Project interventions can only lead to sustainable impacts, if issues such as the need improve land tenure security (e.g. land distribution by the government), and improved access of farm households to tailor made financial services responding to the needs of small farmers (e.g. farm credit programs, crops and livestock insurance, etc) will also be addressed;

The fact that most of the practices used by the Haitian farmers are not monitored/evaluated through any institutional requirements, suggests the perception that such techniques can be easily promoted in a formal project implementation framework. On the other hand however, it may highlight the institutional weakness associated to the overall farming framework in Haiti which needs to be accordingly addressed.

Contributions of FAO in the context of good practice replication in pahse two of the project should try to include provisions for farming tools needed to perform the field activities, since many households lacks them; further, for a better manageability, it would be better to spatially downscale the current pilot sites since they are relatively too large (particularly that at Bassin Magnan); The conceptual approach of the project for the second phase of the project (replication of good practices) should be further specified and clear definitions of key parameters included e.g. what exactly is perceived as good practices and by whom, to prevent misconception and misunderstanding among stakeholders, actors and beneficiaries;

A good way to provide corrections for a project of this kind in the future is associated with a third-party evaluation system in place and fully operational throughout the project's life cycle to periodically and punctually monitor individual performance partner. This presupposes the prior existence and clear definition of agreed-upon evaluation criteria and calendar.

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ANNEX 1

Natural disasters in Haiti

Natural disasters in Haiti from 1909 to 2006

	No of Events	Killed	Injured	Homeless	Total Affected	Damage (US $000)
Drought	7	0	0	0	2,305,217	1,000
Earthquake	1	N/A	N/A	N/A	N/A	20,000
Flood	32	3,716	1,060	26,970	503,723	959
Slides	2	262	60	1,000	1,060	N/A
Windstorms/Hurricanes	25	14,463	3,588	103,998	3,563,612	442,286[27]
Total	67	18447	4708	131968	6373612	464245

Source: Adapted from the CRED website at www.cred.net

Major Hurricanes and tropical storms in Haiti 1909 - 2006

Date	Name	Departments hit	Killed	Home-less	Damages US $000	Affected
06-26-06	Ernesto	Grande-Anse, Artibonite	5			15000
10-24-06	Alpha	Grande-Anse, West, South-East	12			2175
10-24-06	Wilma	South	12			
10-05	Stan	Artibonite	1			10000
7-7-05	Dennis	Grande-Anse, South, South-East	40			15000
9-18-04	Jeanne	Artibonite, North West	2754	14048	21000000	298926
9-13-04	Ivan	North, South	3	2500		4000
10-6-03	???	West	26	150		
9-20-98	Georges[28]	Contry wide	190		80000000	12000
10-23-96	???	Artibonite, North West	40	115		
11-15-94	Gordon	Contry wide	1122	87000		1500000
9-11-88	Gilbert	Grande-Anse, South, South-East	54		91286000	870000
8-5-80	Allen	South-West, West	300		40000000	330000
9-29-66	Inez	South, West, South-East	480		20000000	67000
8-24-64	Cleo	South	100		10000000	80000
10-4-63	Flora	South, South-East	5000		180000000	
10-18-54	Hazel	South,Grande-Anse, West	410			250000
10-21-35	No name	South, South-East, Grande-Anse	2150			
8-12-15	No name	South Peninsula	1600			
11-12-09	No name	West	150			

[27] Money costs of damages were assessed and/or reported for only seven (7) of all of the documented hurricanes.
[28] Other sources like CDERA (2003) suggested that Hurricane Georges damages to crops, infrastructure and housing in Haiti accounted for US $180 million. They also reported an approximated number of 400 deaths.

Source: Adapted from CRED, 2007

Principal flood events in Haiti 1959 - 2006

Dates	Departments hit	Killed	Injured	Affected
30-Jul-06	Artibonite			4,690
28-Nov-06	Grande Anse, North West	11	10	20,000
Oct-05	West	11		11,500
23-May-04	West, South East	2,665	153	31,130
20-Dec-03	North, North West	38		150,000
29-Aug-03	Artibonite	24	70	12,000
23-May-02	Grande Anse, South	31		38,335
16-May-01	Artibonite	26	11	5,070
Dec-00	Grande Anse	12		1,200
9-Feb. 1996	Noth West	19		2,250
1996	North West	54		2,000
11-Nov-93	???	13		5,000
22-29-Oct. 90	South	13		3,615
23-Feb-89	West			24,725
30-Sep-88	West	12		200
20-Jun-88	Artibonite			2,500
27-Jan-88	North West	15	1	1,000
Dec-87	South			3,000
10-Jul-87	West	33	150	5,000
23-Oct-86	West	69		45,000
1-Jun-86	South	79	660	85,000
20-May-72	South	78	40,000	>40,000
14-Nov-63	North	500	???	>500
Apr-59	???	50	???	???

Source: Adapted from Charlestra (2006, unpublished), CRED (2007), and OXFAM-Québec (2003)

Principal Droughts in Haiti 1968 - 2000[29]

Duration	Location/department	Affected people
2/1/2003 to 2004	North West, South	35,000
2000-2000	Countrywide	???
1996-1997	North, North-East, North West	???
8/1/1993 to 1993	Artibonite region	???
4/1/1992 to 1992	Country wide	1,000,000
1990-1991	Country wide	Thousands
1986-1987	Country wide	Thousands
1984	North-West	45,000
1980 to 1983	Southwest	103,000
5/1/1977 to 1977	Country-wide	450,000
11/1/1974 to 1974	North West Peninsula	507,000
1/1/1968 to 1968	North West Peninsula	210,217

[29] Combined sources include UNDP (2005), CRED (2007), and FAO (2006).

ANNEX 2

Identified Good Practices for DRM

Tree Pruning

Among the many consequences of hurricane-related disasters that recurrently hit Haiti are the damages caused when strong winds tear bulky branches from trees and shrubs, causing them to fall on underlying cultivated crops. The traditional practice of pruning, adopted in different localities throughout the island, copes with this danger by preventively cutting dense tree tops. Pruning has the additional benefit of contributing to soil fertility, if the prunings and tree cuttings are left to decompose on the soil. This technique also allows light and sun penetration to benefit the crops, resulting in positive yield fallouts.

Tree pruning is a traditionally used technique which did not undergo specific changes. Practiced in all agro-ecological zones, it may be applied to parcels with a more or less dense shaded tree cover. It is a good practice for disaster preparedness implemented before the disaster actually occurs, and whose simplicity makes it applicable by all socio-economic categories and at any spatial scale. It makes use of traditional farm tools such as a machete, axe and any sort of pruning knife. Generally the farmers personally climb the trees to be pruned, and this is quite time consuming, besides exposing them to the concrete risk of sometimes deadly falls.

The practice consists in removing all shrubs likely to fall damaging crops, and banana trees in particular, in times of strong winds and/or hurricanes. Similarly, when already fallen, the low branches of large trees are removed with caution in order to avoid harming existing crops. In some instances a farmer will agree to damage a negligible part of his parcel resulting from pruning a large tree’s heavy branches whose wind-induced falling would cause the crops three fold damage.

If performed using family labour, installation costs are free. Otherwise, paid labour can amount to up to 100.00HTG per person a day. A person can prune forty shrubs or ten medium to large trees a day. No institutional requirements or maintenance costs are involved in the process, except the eventual sharpening of utilized farming tools.

The agriculture sub-sectors concerned by this practice are crops, whose protection is guaranteed as well as eventual yield increases, and forestry, in the sense that tree harvesting and/or silvicultural tree processing is involved. The livestock sub-sector may also be concerned if the pruned trees are used to feed raised farm animals.

Drawbacks associated to this technique are all related to the need to train its users in efficient tree pruning techniques to prevent them from destroying rather than effectively protecting the crops.

Improvements required concern the system’s need for appropriate and adequate training, and more effective and modern tree pruning tools, e.g. long stick pruning shears, allowing to pruning the trees from the ground, and accessory pruning material such as special filler anti-pathogen, etc.

Removing the livestock from low lying areas to higher and more secure grounds

This widespread traditional disaster prevention practice consists in removing livestock from low lying areas when a natural disaster is about to strike to save it from being drowned in floods or swept away by hurricanes. It is extremely important to have established an efficient early warning system to help animal owners implement this practice more effectively. Participants to a national workshop evaluating collected good agricultural practices judged this disaster prevention technique to be highly practicable, sustainable, efficient and replicable.

This practice may only be applied in an environment that includes safe and secure spots against winds, wild overflowing waters, and is free of large trees whose falling branches may negatively interfere with the safety of the sheltered cattle. It is recommended against flood, heavy rains, and hurricanes and may be applied by any informed farmer of all socio-economic classes.

This is a common-sense traditional technique has not undergone specific implementation technique changes, except in some areas, like Belle-Anse for instance, where farmers value cattle so highly that evacuated animals are moved inside the family farm house.

Implementation material is easily available: a knife or machete and a rope are all that is needed, besides the aforementioned availability of relevant early warning information. The practice consists in reaching the pasture spots where the cattle are tied fairly in advance of the disasters' occurrence, untie them and carry them either to the family house backyard or to a secure spot in nearby exploited parcels. In the latter case the selected spot should be easily accessible for effective monitoring of the cattle at all times, even at night. In case of a longer confinement period, the overall planning should necessarily include an on-site food/fodder supply aspect.

No installation costs are generally involved except in case of extended confinement period, when approximately 40.00 HTG/cattle head (bovine, equine and caprine species) will be spent for fodder supply each day. No institutional requirements for operation and no maintenance fees are involved. Concerned subsystems are crops, livestock, and forestry.

Improvement recommendations associated to this technique are:

- existing natural pastures and installation of artificial pastures should be encouraged;
- Fodder management and conservation techniques should be promoted;
- Promotion of agro-sylvo-pastoral systems of land management including soil conservation practices (hedgerow, improved contour canal) applied in appropriate environment;
- Back-up of existing early warning programs and/or implementation of new ones to favour more efficient forecast and timely delivery of early warning information

Removing cattle from low lying areas to more secure grounds: Yoked and tied mule an pig inside the farm house backyard (up) and donkey and cow in a close to the farm house spot (down) have been brought and secured there through their removal from low lying and riverside dangerous areas. Credits: the Author.

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Appropriate selection of cropping seasons and cultivars

This traditional technique has not changed through time and space. It consists in avoiding the overlap of critical farming moments with expected adverse natural phenomena such as drought, inundations and hurricanes. It is therefore practiced in environments prone to seasonal floods and/or to more or less extended drought periods and is suitable to all socio-economic conditions and at any spatial scale.

It consists in delaying the beginning of the farming campaigns after the weather-related disaster has struck, or in growing an agronomical short-cycle species, thereby bypassing the negative climatic event.

For example, a farmer is likely to wait till the end of the high water season in the fall before growing his crops in a plot located in a flood plain zone which will then only be used to grow a very limited number of crops, mainly those with a short farming cycle.

Applicable before and after disasters, it requires no implementation material or fees, since it is simply a decision taken by farmers. Its main limitation lies in the fact that farmers cannot indefinitely delay their cropping campaign, and could end up starting the growing season at random in the absence of information coming from an early warning system.

The following basic recommendations are likely to improve this technique's efficiency:

- Availability of a sound early warning climate and weather information system associated with a timely delivery global strategy;
- Qualitative and quantitative availability of the needed crop varieties and cultivars;
- Availability of sound seed conservation structures/facilities in case of extended delay associated with beginning of the cropping season or campaign;
- Irrigation water and drainage facility availability.

Tree Planting

The locally implemented practice of planting trees along the border or at the centre of a plot is a soil conservation strategy accruing multiple benefits such as protecting underlying crops, enhancing soil structure and soil resistance to erosion, favoring water infiltration and reducing wind erosion. Besides, it also provides farmers with diversified income possibilities and guarantees food security.

As a farm practice tree planting is very traditional. It is associated with a remote past, when it mainly consisted in letting the wild shrubs spontaneously grow on the parcel rather than planting and raising them.

This practice may be applied in any environment suitable to regular cultivation of crops in order to mitigate the impacts of all weather-related disasters, hurricanes included. The perceived benefits are multiple, among which taller trees' protection of the co-located or under-story crops against strong winds; trees cushioning the impact of raindrops on the soil, thus reducing rain-splash erosion; roots binding the soil, further mitigating erosion processes; by shading the soil, trees also reduce soil temperature and diminish the amount of water that evaporates into the air, they break the wind, reducing the amount of wind erosion; they recycle nutrients from deep in the soil, and leguminous trees fix nitrogen that can benefit food crops. Besides all this, trees provide further economic and social benefit if high value or domestic consumption or fodder crops are planted.

Considered a long-run investment, this activity is more easily - or less reluctantly - practiced by farmers exploiting privately-owned land parcels, which need to be appropriately sized. The number of trees planted by a single farmer varies according to size of the holding, land tenure and available tree material. Fruit and timber species are more widely accepted and planted than the fast growing species traditionally promoted in the reforestation projects and initiatives prevailing in Haiti.

Materials for implementation are traditional farming tools such as spade, pickaxe, hand hoe, seedlings, which are generally received as a gift, and manure and compost if available.

Based on farmers' statements, the procedure of planting trees is the following:

Dig a 20cm deep and 15/20 cm wide hole. Remove a first and superficially excavated layer (5/10 cm) of soil and place it to the right of the hole,and a second and deeper layer to its left. If available, mix manure and compost with the first layer and then pour it back into the hole. If potted, extract the seedling and place it on the first soil layer. Finally add the second excavated soil layer and dig a small pit to store rain water to the benefit of the seedling. Eventually place stakes all around the seedling to serve as a protection indicator.

Installation costs and fees amount to 10.00 HTG/planted seedlings, with no institutional requirement or maintenance costs and fees involved in the process. Since the planted trees are generally installed in parcels traditionally used for crops, they may profit from the overall soil preparation tasks related to the cropping campaign for no extra charges.

Crops, forestry as well as livestock are the subsystems involved. Large-scale application of this technique by farmers has to face the almost insurmountable difficulty of the required seedling supply. Presently, motivated farmers have no other choice but to wait for occasional donors – specifically NGOs involved in reforestation projects - or for occasions such as the 1st of May and Agriculture day, when they receive reforestation trees as gifts.

For a wider and more efficient application of this practice, valuable for Disaster Risk Management and for agro forestry purposes too, the following recommendations for improvement should be taken into account:

- Appropriate training and sensitization of local farmers to integrate tree plantation in their day-to-day farming behaviour and activity
- Promotion and material/financial support for the production of the required reforestation seedlings in different types of nurseries (central/business-oriented, community-based, and single farmer/household nurseries);
- The related seedling production should be flexible enough to allow for an equal number of three basic types of seedlings: nitrogen-fixing fast growing trees, fruit trees and high-market value timber species. This would allow farmers to freely select their favourite tree species type, based on technically sound advice from the extension team;
- The distribution of incentive bonuses to farmers whose planted trees reach 50% minimum survival rate after 3 years (long-range project strategy).

Tree planting activity within the study site showing a small local nursery (upper left), Casuarina equisetifolia (upper right) and Ficus spp. (down left) planted seedlings aged between 1 and 2 years at Bassin Magnan. Two indicator tree species: Citrus reticulata (center right) and Prosopis juliflora (down right) representing Bassin Magnan and Lavanneau ecological respective conditions are also presented in the sketch. Credit: the Author.

Land tiling

Land tiling is a traditional technique, which may be traced back to a rather remote past. It is particularly fit for a dry environment, either rainfed or irrigated, where the shortage of water makes its management problematic, and addresses the adverse impacts of droughts / drying winds on cultivated crops. Practiced at any stage of disaster, land tiling can accommodate the needs of all farmer categories operating in a relatively flat land area. Direct benefits felt by farmers practicing the technique are related to global improvement of soil fertility and better crop yields, assumingly due to greater humidity of the soil.

Land tiling in the Haitian farming community of *Bassin Magnan* went through some slight technical changes e.g. the section of the tile decreased from 3 X 1.50m2 to 2 X 1m2 in the irrigated plains areas as compared to the dry/rainfed area, where this initial size is unchanged.

The utilization scale may vary with available economical means. ¼ Cx is the optimal land surface area that a single farmer can efficiently handle over a cropping campaign, if needed labour is to be self-provided. Implementation material includes traditional farming tools such as hand hoe, shovel, pickaxe, and manure and compost if available.

To implement this practice, the parcel's land is pickaxed to about 30cm deep, and eventually manure/compost is added to the soil. The pickaxed soil is overturned and fixed into tiles that are 2m long by 1m wide. In irrigated areas these are bordered by 30-cm-high dykes, delimiting furrows for water circulation. In dry/rainfed farm areas by contrast, rainwater is trapped and blocked on the 3 X 1.50m2 tiles' four sides to augment infiltration and prevent runoff.

Land tiling is practiced in November in irrigated areas, in preparation of the common beans' annual campaign, and in March in the drier/rainfed area.

Installation costs and fees may be as high as 75.00 HTG/person/day, and forty six persons a day are required to appropriately tile a hectare of land.

Institutional requirements for the operation are inexistent, but maintenance unit fees of about 75.00 HTG/person/day are usual and a hectare of land may be processed by twelve persons a day.

The main agricultural sub-sector concerned by the practice is cropping. Livestock, however, is sometimes concerned as well. when land tiling is extended to include the cultivation of Guinea grass (Pennisetum purpureum) on the parcel's edge to assumingly act as windbreakers for the common beans that are being grown. Wind is particularly harmful to blossoming common beans in December, when it may cause extensive flower falling associated with significant yield reduction.

Inappropriate implementation may lead to temporary water excess in upstream irrigated parcel soil, causing cultivated common beans and shallot to rot while, on the other hand, downstream water users might face increasingly frequent water shortages.

The following improvements would be recommended:

- Appropriate training in irrigation water management to benefit farmers;
- Material support in terms of more appropriate tools and high value crops;
- Promotion of lessons learnt from past and current FAO projects related to improved seed selection and multiplication techniques;
- Institutional strengthening of local associations to improve solidarity links encouraging mutual aid relationships in order to better address the labour-intensive characteristics of this

practice.

Land tiling before planting common beans in irrigated area (up), and tile planted with growing common beans at Bassin Magnan. Credits: the Author.

Soil Conservation Package

Soil conservation as a package of techniques practiced before disasters in erosion-stricken and gullied environments within watersheds to control negative impacts of water induced soil erosion, flood, and hurricanes was presumably introduced as late as 1986.. They are generally more suitable to medium and high-class farmers, since they are very labor-intensive and imply long term cash return on investments. The techniques are suitable for advanced gullying in the thalweg/ravines - gully plug- and more or less eroded hillsides -stone wall, improved contour canal, etc. Implementation material includes traditional farm tools such as shovel, pickaxe, occasionally wheelbarrow; and various building material. No institutional requirements are associated with installation of this package. Soil conservation techniques are not primarily dedicated to address disaster risk management but related to environmental protection and soil fertility increase, themselves closely tied to the farmers' main objective of increasing farm revenues. Cropping is the main agriculture subsector concerned, though sometimes livestock and forestry are also concerned. Installation fees vary according to the installed techniques while maintenance fees are either negligible or amount at most to 50% of the installation expenses.

<u>*Gully plugs*</u>

This technique is meant to address gullying in ravines no more than 2 meters wide located within farmers' cultivated parcels. Its associated changes are those related to gabionage (in case of over-sized ravines which eventually are processed through formally funded soil conservation projects operating in the area and generally based on job creation and high intensity labor initiatives) The plug may be made of biological material such as cuttings of candelabra and other species, poles, sticks, twigs and leaves, or mechanical material such as plastic bags filled with sandy dust, or most typically stones. To install a gully plug the needed stones are gathered and a 50-cm deep and 75-cm wide foundation channel is dug in which stones are carefully placed without any binding agent. on top of one another perpendicularly to the direction of the flow. The gully plugs may reach 1 to 2 meters height above ground, and are placed counter-slope wise at a 10-meter average interval in the ravine, based on the relative steepness of the slope. During the installation process single large stones placed at the bottom are preferred to round ones, giving more stability to the overall structure.

This technique is among the most labor and cost intensive soil conservation techniques. Related installation fees are approximately 600.00HTG for one single 2.5m wide and 1.5m high gully plug. As stones are removed, space is available for the cultivation of higher value crops such as tubers. Additional felt benefits are a reduction of the gullying process and an increase in fertility and yield.

Gully plugs in the ravines

Contour canal

Construction of improved contour canals is a technique related to a remote past presumably introduced by NGOs working in the soil conservation sector. Major technical implementation changes are the incorporation of graminaceae species and pineapple observed in Marmelade to increase economic value as well as technical effectiveness. It is a hillside-designed practice suitable for deep soil environments preferably free of stones, which are protected against overflowing waters, strong/heavy rains, and hurricanes. Utilization scale is proportional to the economic and financial means available to households of economically well off farmers with self-owned or direct land tenure parcels. Implementation materials includes spade, shovel, pickaxe and graminaceae cuttings (elephant grass, sugar cane) and/or pineapple seedlings/suckers, etc.

Implementation technique comprises the following steps

a) Staking using an A-frame to delineate contour lines where the structures will be placed;

b) Digging the ground 40cm deep and 30cm wide at each delineated contour. The excavated soil should be placed downslope.

c) Planting of graminaceae, sugar cane, and pineapple seedlings downslope and upslope the canal with a 50-cm distance between them.

Installation fees are 25.00HTG/meter, including 15.00HTG and 10.00HTG for labor and vegetal material respectively. A person is paid 75.00HTG a day to build 5 linear meters of structure. Maintenance fees amount to ⅓ of the installation costs.

Felt benefits: protection of the parcel against wild overflowing waters; soil fertility increase; and fodder availability. The technique is limited to coarse textured soils as it is hard to implement with fine textured soils in wet and clayey environments.

Further Improvements suggested: Based on global rainfall and average slope of the parcel a clear choice should be made before the structure is installed between building a diversion structure with an internal slope greater than 0% and an absorption structure with a slope of 0% ; Similarly, the overall size of the structure should be directly proportional to slope steepness and upstream drainage surface extent. Canals should preferably be installed in an environment of limestone parent rock rather than basalt. Parallel lines of cuttings upstream and downstream of the canal are technically redundant and economically inefficient, since vegetal cuttings account for 2/5 of the contour line total costs. A single cutting line will save up to 1/5 of the total costs with an approximately equal degree of effectiveness of the structure.

Contour canal (upper left); Improved Contour Canal (right)

<u>*Diversion ditch*</u>

This is a very old practice apparently only introduced in *Lavanneau* in the year 2000 as an adaptation of the contour canals practiced in some other areas of the country. It s currently concerns hillside parcels affected by an active gullying process, with one or several dry ravines carving the plot. All social categories may use this practice to address torrential overflow, heavy rain, and hurricane consequences. Shovels and pickaxes are currently used for to implement the technique as follows:

From the highest elevation point a slope-wise oriented diversion ditch is dug on average 30 cm wide and 40 cm deep to drain down slope water in excess. With time the initial depth is likely to increase due to the ongoing erosion processes

Installation fees are currently about 40.00 HTG/meter, though the number of meters/hectare is variable, with half the amount allocated to maintenance activities. Properly installed, the structure positively impacts the cropping and livestock subsectors by effectively diverting the incoming devastating waters from the parcel bounds. However, according to respondents long-term benefits will depend on Mother Nature’s whims.

Diverted overflowing waters may harm crops and animals located downstream, so this practice is in fact not a definitive solution to the problem, and it will only work if practiced by a group of neighbouring farmers digging a main primary drainage channel to collect water coming from all the concerned parcels to a common outlet.

Stone wall

Stone walls were introduced in a remote past on hillsides, where stones are abundant, apparently an adaptation of the gully plugs/check dams technique practiced in the ravines, to date no changes have been observed.

Installed before the occurrence of overflowing waters, heavy rains, flood, windstorm, and hurricane, this practice may be afforded by any socio-economic category; though the optimum utilization scale ranges from 0.16 to 0.32 ha of treated plot size. Traditional farming tools such as pickaxe, hand hoe, wheel barrow and stones are used to build this structure as follows:

After initial staking based on A-frame measurements and digging of an horizontal channel 40 cm deep and 40 cm wide, with 0% internal slope, the collected stones are carefully placed one on the top of the other from the base of the channel to the top. The stone walls are erected counter slope wise and at about 5 to 10 meters distance on the hillsides, according to the relative steepness of the slope. The height of each structure varies from 50 cm to 1 m, according to slope steepness and the availability of stones. Long-shaped ones are generally preferred to round or globular, since they provide greater overall stability to the structure.

Installation fees practiced locally may reach 35.00HTG/meter, or 35.000.00 HTG/hectare, while a person is paid about 125.00HTG a day).Maintenance, a normal part of the soil preparation process can amount to up to ⅓ of the installation fees.

The main subsector concerned is crops and felt benefits are protection of soil against water erosion, soil fertility improvement and hence, crop yield increase.

It is a labor intensive practice which is sometimes implemented just to clear the parcel from stones preventing the cultivation of soil; in this case the stones are lined up counter slope wise at more or less regular distance in the middle of the parcel, without any specific considerations for technical standards).

Stone walls on the hillsides

Construction of mulch hedges

Mulch hedge is a pre-disaster technique introduced at Lavanneau in 1990 and designed to address overflowing waters, rain, erosion impact in hilly environment.
Definitely one of the least expensive local soil conservation measures, it is affordable to all farmer categories on an optimal size of 0.19 ha. The main difficulty is not labor-intensity but scarcity of necessary straw to implement it

Machete, pickaxe, shovel, hand hoe and mulch, including green and dead leaves, straw, etc. are used to install the structure, based on the following steps:

a) Staking using an A-frame to delineate the contour lines, stakes are placed at a distance of 20 cm;

b) Digging the ground along the delineated contour line 15-20 cm deep; the excavated soil is piled up down slope along the staking line;

c) Installation of mulch, straw and green leaves heaped and backed against the stakes and the excavated soil;

d) Installation fees amount to 7.50 HTG per meter and maintenance costs are negligible

Reported felt benefits are that hydric erosion is reduced and overall greater fertility and crops' yield is anticipated.

Since mulch and straw may shelter rodents, slugs and other pests though, detrimental to crops they should be processed by preventively drying them out through exposure to sunlight, natural biologic insecticide application, etc..

Planting candelabra (Euphorbia lactea Haw) along the ravine/river banks

Rather uncommon, this technique dates back to a remote past and no specific changes were presently observed. It may be practiced in an environment prone to gullying and to river banks erosion/landslide to address negative impacts of flood, windstorm and hurricane.

Its installation costs amount to no more than 7.00 HTG per meter making it affordable to farmers of all socio-economic classes. For 100.00HTG a day a single person can plant 15 meters of candelabra fence, and maintenance costs and fees of 3.50 HTG per meter are reported to filling in the gaps, and prune.

Materials to implement the structure include traditional farming tools such as machete, pickaxe and cuttings of candelabra planted at 40 cm distance from each other on the riverbanks bordering on the parcels in a 15-20 cm deep hole

Felt benefits include the protection of the parcel against bank erosion, and the long-term overall increase of land surface area if planted on both riverbanks. Failing this the river would tend to wander on the opposite side to attack nearby parcels whose soil would be likely to be more intensively eroded

The main drawback lies in the fact that candelabra is very hard and dangerous to manipulate; when cut the contact with its sap is very toxic to the human body and its thorns may prick the hands that are manipulating it.

Planting vetiver (Vetiveria zizanoides) on the edges of the cultivated parcel

A traditional identified local agricultural soil conservation practice very infrequently implemented consists in planting vetiver along the edges of the plot to prevent or slow down the erosion of riverbanks. Vetiver is a perennial plant requiring minimal maintenance, and once established it is able to withstand drought, flood and long periods of water logging, making this technique easy to sustain and highly replicable. It is applicable to an environment prone to riverbank landslide to control riverbanks/mass erosion, and flood. Vetiver seedlings are collected and brought to the needed spot to be planted in bulk at 10-15 cm interval on the borders of a plot adjoining a ravine or a river with a changing and disorderly flow or trajectory.

Once landslide has been controlled on one riverbank, the river would normally tend to "wander" on the opposite side, affecting nearby parcels whose soil is likely to be more intensively eroded and eventually reaching the farmers' recently processed plots. A further benefit is therefore gained by planting Vetiver on both sides of the riverbank, and ensuring long-term overall increase of land surface area.

Suitable to all socio-economic categories and utilization scales, traditional farming tools such as pick, machete, pruning knife and seedlings of vetiver are necessary to implement it as follows:

Vetiver seedlings are collected, brought to the needed spot, and planted in bulk at 10-15 cm interval on the edges of a plot adjoining a ravine or a river with a changing and disorderly flow and trajectory. No installation and maintenance fees are required.

The main problem with this practice arises from the fact that vetiver is a rampant plant whose roots are likely to make the soil plot profile become stiff and hence unfertile.

In general soil conservation techniques are more commonly practiced or identified in the *Lavanneau* site as compared to *Bassin Magnan* because the former site is in prevalence located on a hillside, while *Bassin Magnan* is situated on a smoothly sloped plateau. This practice, and soil conservation techniques in general, are crucial to the Haitian farming system, currently characterized by generally poor unfertile soils, deforested, and extremely eroded lands. However, the particularly fragile national socio-economic context coupled with the small size of land holding and indirect tenure, and associated with cost intensity of soil conservation practices make them hard to be applied by local farmers.

Some recommendations likely to favour harmonious and successful implementation of soil conservation good practices are among the following:

There is an urgent need for the farmers to master the manipulation of slope meters/instruments

(clinometers and A-Frame) of crucial importance in soil conservation. Special care should be taken to train the farming personnel involved in soil conservation in the sound manipulation of an A-frame which is the simplest and the most easily affordable slope meter in Haiti.

A coping strategy of Haitian farmers retraceable to the small sizes of their land holding is the tendency to indefinitely extend the inter-soil conservation structure beyond the technically recommended distance with the consequence that the installed structures are less and less technically effective and efficient.

Farmers should be given specific training to help correct this attitude.

Additionally, if realized under an NGO's umbrella, farm development projects involving soil conservation should be supported by a formal environmental impact assessment survey to prevent extreme negative and irreversible damages on local environment.

Other recommendations are related to the need for:

- Scientific research to determine the most appropriate practices for given specific environments, e.g. based on soil type, slope percentage, rain regimen, etc.;
- Provision of adequate technical training to benefit the concerned farmers;
- Institutional strengthening to improve solidarity links between the concerned local farmers to encourage mutual labour aid relationship, which may allow to successfully address the labour intensive characteristics of soil conservation practices.

Traditional farm granary/"Colombier" to store the harvest

Traditional agricultural adaptation practices address the consequences of hazards, preventing and mitigating them. One such practice, intended to reduce the impact of droughts, floods and tropical cyclones and storms, is the construction of a granary called "colombier". It consists of a structure built on high posts where grains and beans may be harvested for extended periods of time, securing them from being washed away or otherwise damaged by catastrophic events.

This kind of granary constitutes a traditional technique common to the Artibonite and Central part of Haiti, dating back to a remote past. It is employed to store grains like sorghum and/or common beans (sometimes initially placed in pre-processed calabashes) for extended periods of time, that is, 6 months or longer, and to function as farm household kitchen, constituted by the granary ground-floor, and as general purpose warehouse.

The natural disasters this technique addresses are drought, flood, rain, and windstorm. In the rest of the country, alternative dominant ways to store the harvested grains include silo storing, installation on a tree branch in the case of unpicked-off corn, storing on the ìgallatasî, which refers to the room between the ceiling and the roof of the farm house.

This kind of structure can be afforded by medium to high socio-economic scale farmers. The changes it has undergone that have been identified are that in the study site and at *Bassin Magnan* the structure supporting posts are now also made of iron, while in the past they were exclusively made of wood. Architecturally, the farm granaries in Marmelade are built on four supporting poles instead of the six used in *Bassin Magna*n (See pictures). Materials used include posts, timber, poles, straw and corrugated iron, iron, ropes, nails. The structure is built on a pile made of four or six wooden or metallic posts, about two meters high, which in turn support a 1.5 meter high floor, the actual roof of the system. The space between the upper part of the pile and the roof constitutes the storing section. The roof is A-framed, with a window placed at either of the two smallest sides of the roof. The upper three quarters of each of the posts are covered with a metallic upside-down funnel to prevent rodents to access the stored harvests and damage them.

Unit installation fees are about 2,000.00HTG for a 3x2 m structure at the ground level with a thatched roof. Associated maintenance fees are 300.00 HTG every 2 to 3 years (that is, roughly 100.00 to 150.00HTG/year) to repair/fill in breaches in the roof.

Reported weaknesses are related the high-intensity winds potentially blowing away the structure's roof. Besides, sheltered rodents could proliferate, damaging stored grains, particularly in granaries with a thatched roof.

General improvements to this practice require to:

a) Modernize harvest storing facilities infrastructures through the promotion of galvanized iron individual or community silo;

b) Provide post-harvest technology and organic/natural insecticide based training;

c) Promote new seed conservation techniques and;

d) Piggy-back locally existing FAO projects (for example the FAO silo project at *Bassin Magnan)*

Traditional granary, "Colombier" in French (up) to store and conserve the won crops, particularly harvested grains placed in bulk (down left and right) when not yet picked off, or initially placed in a pre-processed calabash (down center) for better and longer protection. Credits: the Author.

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<u>*Banana (Musa spp.) Management Package*</u>

That is a special package made of three to five traditional and widespread practices used by local farmers to mitigate losses brought about by floods, hurricanes/storms, and/or strong winds. dating to the early 1950s when Daryon Alexandre, a professional blacksmith native of the Lavanneau forged a knife known today as *kouto bannann*, to prune banana trees, which is the main practice within the package. The scale of application of these practices that have not changed through time and space, are not hindered by any institutional requirements, and require no maintainance fees, may depend on the economic means of the household and on the relative timeliness of early warning information available.

General improvement associated to this package relates to the crucial importance of sound and timely early warning information to support successful execution of the documented practices. It is also important to acknowledge that phytopathology and chemical and/or organic fertilization aspects of the proposed practices are not paid due heed.

Staking banana trees

Staking of banana trees is an all-socio-economic, all-scale and traditional technique which has not changed through time or space. It is applicable in banana farming zones prone to winds and windstorms. It is implemented before the disaster occurrence, and involves using traditional farming tools such as hand hoe, machete, and knife, besides stakes, poles, etc. The objective of this technology is to support banana crops and protect them from the impact of hurricane and hurricane-related damages.

2-to-3 meter high stakes/poles forked at their upper end are first prepared and then used to support individual stem-bearing banana trees. Each post is placed with its forked upper-end touching the inferior side of the banana tree stem's peduncle. The stake is placed in front of the banana tree parallel to the highest falling probability position. Generally, to make the design more secure, at the exact lodging spot for the stake the ground is first excavated superficially to a 10 cm depth.

Installation costs and fees are approximately 16.50HTG/banana tree, of which 15.00HTG are paid per individual stake/pole, and the remaining 1.50HTG for manpower labour, that is approximately 33,000.00HTG/hectare.

Though the stakes need to be cut from local trees, no requirements are enforced related to tree cutting. The concerned subsectors here are represented by crops, livestock, and forestry.

Felt benefits are that the banana plantation is relatively protected against high winds and the stakes are recyclable for at least one additional year or disaster event.

Drawbacks associated to this technique lie in its cost intensive characteristics.

General improvements associated to this package relate to the crucial importance of sound and timely early warning information to support successful execution of the documented practices. It is also important to acknowledge that phytopathology and chemical and/or organic fertilization aspects of the proposed practices are not paid due heed.

Leaf removal

Banana trees are generally pruned in wind, windstorm, and/or hurricane prone environment before the related disaster occurs. If possible, local farmers try to apply this technique in compliance with a specific lunar phase, seven days before the new moon.

The practice is suitable to banana growers who locally represent medium to high class farmers and the spatial range throughout which it is applied may vary with the farmers' availability financial means.

A specially designed knife, the *Kouto bannann* (banana knife) and a machete are used to implement the technique as follows: the leaves of the banana tree are removed starting with the dry, ripe, and damaged ones. These are removed flush, generally with their petiole, as far as the banana trees in vegetative growth stage are concerned. For banana trees that are already in the production phase, i.e. those in bloom or close to their physiological maturity, leaf removal is practiced on at most 50% of the total healthy canopy of the plant. That is, at most six of the ten to twelve prescribed green leaves needed by an adult banana tree to normally grow and bear fruit are removed. The oldest healthy leaves are then pruned at most at their 2/3 distal end.

Installation fees amount to about 9,500.00/hectare. And crops and livestock are the concerned subsectors.





An excessive leaf removal is likely to negatively interfere with the growth and maturation process of the fruit (stem) of the banana tree.

General improvement associated to this package relates to the crucial importance of sound and timely early warning information to support successful execution of the documented practices. It is also important to acknowledge that phytopathology and chemical and organic fertilization aspects of the proposed practices are not paid due heed.

<u>Anticipated Harvesting off all mature and/or marketable stems</u>

This measure is based on common sense, and has been adopted in disaster-threatened parcels by local farmers since a remote past, mainly for high market value crops. A pre-disaster measure, it is a technique - or rather, a decision – farmers of all socio-economic categories apply to mitigate the extreme negative impacts of flood, wind, windstorm, and hurricane on cultivated parcels of every scale and on farming household economy.

The main perceived benefit is that farmers make sure that at least part of the harvest is saved rather than spoilt or washed away by winds, flood, and/or hurricanes.

The aim is to harvest in emergency and in bulk all mature and/or marketable crops of the parcel starting with those bananas that have the highest market value, using traditional farming tools, knife, machete, etc.. The harvested crops are then either stored or brought to nearby markets for commercialization. No installation and/or maintenance fees are involved, the whole process being supported by household-based manpower.

The concerned agriculture sub sector here is cropping. Heavy economic losses are however likely to incur as far as the global investment is concerned as the selling prices of the goods will automatically fall and considering that household storing capacity is generally very limited.

The Banana Management Package showing two individually stacked stem-bearing banana trees (upper left and right); a banana knife pruning the plant leaves (down left), a wind-broken and lain down fruit bearing tree whose exhumed roots are covered with straws (middle right), and the stem stuffed with the tree yet green leaves to prevent desiccation. (Credits: the Author and FAO-Haiti Emergency Unit

Other additional banana management practices

Two additional practices were identified in the study site at Lavanneau and found worthy to be part of the banana management package:

-Topping broken and/or bent trees: trees at a vegetative stage broken or irreversibly bent by weather-related disasters are topped at a level that does not to interfere with their hypothetic blossoming. Such practice favours the topped trees' sucker shooting forth.

-Intensive caring of fallen-down fruit bearing banana trees: rooted-up trees need to have their exhumed root system carefully covered with dust and/or straw, and their sprawling fruit mulched with the remaining intact leaves of the tree to prevent general desiccation and/or sunburns. A 45 to 60 day lag is generally observed between the maturation time of a normal tree stem and that from a banana tree that has been rooted up by strong winds or flooding.

Annex 3

Additional Good Practices identified on the field (within and outside the study site)

Good Practice A	
Item	*Description*
Name	Post-harvest conservation of seeds in a pre-processed calabash (Crescentia cujete)
Introduction date/time	Traditionally used technique
Changes through time	Nowadays, seeds are being conserved in containers made of polyethylene material (cans, gallons, pitchers, etc.).
Changes through space	Possibly, however we are not sure.
Environment where applicable	Farming structures concerned with storing grains or cereals (e.g. corn, beans, etc.) for more or less long extended period of time.
Suitable to disaster types	Flood, hurricane, post-harvest pests and diseases.
DRM phase of insertion	Before disaster ☒ During disaster ☐ After disaster ☐ Every stage ☐
Suitability to socio-economic categories	Any
Scale/range of utilization	Any
Implementation material	Pre-processed calabash, insecticides and/or fungicides, grains ready fro storing
Implementation technique	The grains/cereals are initially dried up on the sun and processed with insecticide or fungicide products and then placed in a pre-processed empty calabash.
Installation costs and fees	50 HTG per calabash of 2.50 marmites capacity. In general, the calabash is available for free.
Institutional requirement for operation	None
Maintenance costs and fees	None or negligible ; a calabash with holes is generally replaced with no charges
Felt benefits	The seeds and other farm products are protected and the household food security is secure.
Concerned subsector (s)	Crops ☒ Livestock ☐ Forestry ☐ Other ☐

Good Practice B	
Item	*Description*
Name	Construction of shelter in the garden to temporarily store the harvest
Introduction date/time	Traditionally practiced technique
Changes through time	None
Changes through space	In high-altitude and houseless areas, an A-frame roof is used in which the A's edge is very to the ground surface contrasting with the most commonly practiced flat squared roof.
Environment where applicable	In the plots located in remote spots away from the farmer's house
Suitable to disaster types	Heavy and sudden rain events
DRM phase of insertion	Before disaster ☒ During disaster ☐ After disaster ☐ Every stage ☐
Suitability to socio-economic categories	Any
Scale/range of utilization	Varies with the number of plots exploited by the concerned farmer
Implementation material	Thatches, straw, posts, ropes, creeper thread, poles, etc.
Implementation technique	That is a temporary structure built with 4 posts placed following a square figure of about 2 X 2 m^2 and with a horizontal (or an A-framed) roof of thatches and straw to shelter the recently harvested grains against sudden rains and to temporarily store the harvested crops being dried up in the garden where they were grown.
Installation costs and fees	Manpower: 2 persons/day @ 75 HTG; needed material is available locally and free of charge.
Institutional requirement for operation	None
Maintenance costs and fees	None
Felt benefits	• The harvested beans or cereals are avoided from being spoiled by rain water susceptible to cause them to rot and/or to massively germinate. • More efficient farm work after the sudden rains stop.
Concerned subsector (s)	Crops ☒ Livestock ☐ Forestry ☐ Other ☐
Weaknesses	The straw may constitute a home for rodents and other pests and/or vermin.

Good Practice C	
Item	*Description*
Name	Closing down water irrigation system from stream /primary channels
Introduction date/time	Traditionally used technique
Changes through time	None
Changes through space	None
Environment where applicable	Irrigated areas
Suitable to disaster types	Flood, heavy rain-dominated hurricanes
DRM phase of insertion	Before disaster ☒ During disaster ☐ After disaster ☐ Every stage ☐
Suitability to socio-economic categories	Any
Scale/range of utilization	All scales
Implementation material	Farming tools such as: hoe, pickaxe, shovel ; raw material to block water (banana trunks)
Implementation technique	Once an eventual weather-related perturbation is known of, the first or closest available of the irrigation water users rushes to close down the primary channel bringing water from the river bank water point or deviate it to the river. The water access to the fields is temporarily blocked avoiding the crops to be directly damaged as a result of the flood.
Installation costs and fees	None
Institutional requirement for operation	None
Maintenance costs and fees	None
Felt benefits	Direct physical damages to the crops are relatively avoided or prevented.
Concerned subsector (s)	Crops ☒ Livestock ☐ Forestry ☐ Other ☐
Weaknesses	It is difficult and even impossible to be early warned about the weather related disasters as far as their nature and their exact occurrence time/period are concerned.

Good Practice D	
Item	*Description*
Name	Clearing the parcel off stones
Introduction date/time	Traditionally used technique
Changes through time	None
Changes through space	None
Environment where applicable	Plots located below a ravine with a torrential flow
Suitable to disaster types	Floods
DRM phase of insertion	Before disaster ☐ During disaster ☐ After disaster ☒ Every stage ☐
Suitability to socio-economic categories	Any
Scale/range of utilization	Varies with the farmer's economic and financial means
Implementation material	None
Implementation technique	The stones spread over the plot are removed and piled up at its center and on its borders to free up room and pure soil needed to grow the crops.
Installation costs and fees	15 persons/day/ Cx @ 75-100 HTG/person/day
Institutional requirement for operation	None
Maintenance costs and fees	None
Felt benefits	The soil of the plot is cleared of stones and ready to receive to harbor the crops.
Concerned subsector (s)	Crops ☒ Livestock ☐ Forestry ☐ Other ☐
Weaknesses	Costly and boring activity which needs to be undertaken ever and ever after each rain event.

Good Practice E	
Item	*Description*
Name	Harvesting crops which are already mature and/or marketable
Introduction date/time	Traditionally used technique
Changes through time	None
Changes through space	None
Environment where applicable	Plots containing high-market value crops and located in risky areas
Suitable to disaster types	Flood, winds, hurricane
DRM phase of insertion	Before disaster ☒ During disaster ☐ After disaster ☐ Every stage ☐
Suitability to socio-economic categories	Any
Scale/range of utilization	Varies with the farmer’s economic means and the early warning delay.
Implementation material	Farming harvest tools (pruning knife, machete)
Implementation technique	The issue is to harvest in emergency and in bulk every mature and/or marketable crops of the plot starting those with the highest market value (e. g. banana). The harvested crops are then either stored or directly brought for commercialization to the nearby markets.
Installation costs and fees	Generally negligible/household provided manpower
Institutional requirement for operation	None
Maintenance costs and fees	None
Felt benefits	At least, a part of the harvest can be saved, recuperated.
Concerned subsector (s)	Crops ☒ Livestock ☐ Forestry ☐ Other ☐
Weaknesses	Heavy economic losses are likely to incur as far as the global investment to the plot are concerned as the selling prices of the goods will automatically fall while the household storing capacity is generally very limited.

Good Practice F	
Item	*Description*
Name	Replanting after inundation
Introduction date/time	Traditionally used practice
Changes through time	None
Changes through space	None
Environment where applicable	Banana farming (in particular)
Suitable to disaster types	Flood, wind, hurricane
DRM phase of insertion	Before disaster ☐ During disaster ☐ After disaster ☒ Every stage ☐
Suitability to socio-economic categories	Any
Scale/range of utilization	Varies with the farmer's available financial means
Implementation material	Concerned/needed seeds, banana tree stumps
Implementation technique	It consists in reinstalling the crops in the plot in the same way they were before the disaster occurred. The whole technical itinerary for the concerned crops is then applied again.
Installation costs and fees	15 HTG/banana tree stump, 10 HTG/plantation hole, and 2000 stumps/hectare: 50000 HTG/hec- tare or 64500 HTG/hectare
Institutional requirement for operation	None
Maintenance costs and fees	125 HTG/person/day and 20 persons/day/Cx: 2500 HTG/Cx.
Felt benefits	Good hope that harvest will take place, anticipation that revenues will be available.
Concerned subsector (s)	Crops ☒ Livestock ☐ Forestry ☐ Other ☐
Weaknesses	That practice is hard to implement in the absence of any insurance coverage and/or credit program to support the farmers since after undertaking the regular crop season, the farm household is always deprived of the least financial means.

Good Practice G	
Item	*Description*
Name	Sowing technique in alternate rows (e.g. common bean / pigeon peas association)
Introduction date/time	Traditional but not wide-spread technique
Changes through time	None
Changes through space	That is an adapted version of the row sowing technique for common beans
Environment where applicable	Farming areas prone to strong winds where the common beans are intensively grown
Suitable to disaster types	Winds
DRM phase of insertion	Before disaster ☒ During disaster ☐ After disaster ☐ Every stage ☐
Suitability to socio-economic categories	Common beans growers within the plain irrigated perimeters
Scale/range of utilization	Any
Implementation material	Farming tools traditionally used in Haiti (hand hoe, machete, etc.), appropriated seeds
Implementation technique	First, pigeon peas seeds are sown in alternate rows within an average 1 m–wide distance between consecutive seed holes. Then, 7 to 10 days later, common beans are sown in 20-cm –all-part distant seed holes located between the pigeon peas seed holes. The already-established pigeon peas seedlings play a windbreak role for the common beans. Sometimes, the mentioned design is reinforced with Guinean grass planted on the plot edge and which will be pruned at 3-month interval to feed the cattle.
Installation costs and fees	Negligible
Institutional requirement for operation	None
Maintenance costs and fees	None
Felt benefits	The common beans (among the Haitian highest market value crops) are guaranteed against a massive flowers' falling due to high winds
Concerned subsector (s)	Crops ☒ Livestock ☒ Forestry ☐ Other ☐
Weaknesses	None

Good Practice H	
Item	*Description*
Name	Construction of shelter for the livestock (for gravid beasts in late gestation phase)
Introduction date/time	Traditionally used technique
Changes through time	None
Changes through space	Possible, no specific information is however available
Environment where applicable	Safe and secure spots within the family house backyard
Suitable to disaster types	Rain, hurricane, wind, very intense sunshine
DRM phase of insertion	Before disaster ☒ During disaster ☐ After disaster ☐ Every stage ☐
Suitability to socio-economic categories	Any farmer involved in goat and pig raising activity
Scale/range of utilization	5 middle livestock heads is the optimal scale manageable by a single farmer
Implementation material	Tools (spade, machete), poles, stakes/posts, bough, coconut tree and/or palm tree leaves
Implementation technique	A 2 m X 2 m large basic shed is built using 4 posts (of which one at each corner to make the structure squared). A stake is placed at the middle to tie the animal secured in the structure. That shelter can reach 1.50 m to 2 m high, and it is fenced with bough and faggot or with stakes with negligible diameter placed very closely (3 – 5 cm apart) to each other. The roof is horizontal or slightly slanted and made of coconut tree and/or palm tree leaves. The gestating middle cattle (she-goat, sow) is placed in the shelter before dropping.
Installation costs and fees	About 300 HTG for manpower; the construction material is generally free; though being scarce
Institutional requirement for operation	None
Maintenance costs and fees	Negligible
Felt benefits	If the secured cattle survive to the disaster, the economic benefits gained from its exploitation will increase the household revenue.
Concerned subsector (s)	Crops ☒ Livestock ☒ Forestry ☒ Other ☐
Weaknesses	The utilization scale is limited since the construction needed material may be very scarce and limiting ; additionally it is generally hard and difficult to feed the enclosed and tied animal which food needs to be brought everytime

Good Practice I	
Item	*Description*
Name	Transhumance
Introduction date/time	Traditionally used technique
Changes through time	None
Changes through space	None
Environment where applicable	Wherever free pasture is available
Suitable to disaster types	Drought
DRM phase of insertion	Before disaster ☐ During disaster ☒ After disaster ☒ Every stage ☐
Suitability to socio-economic categories	Small cattle farmers which also act as seasonal and traveling farm workers
Scale/range of utilization	2 to 3 cattle heads are the optimum manageable size of the herd to apply that practice
Implementation material	Standing fodder, pasture
Implementation technique	As the small cattle farmer moves from place to place to sell farm labor, he brings his small sized herd of cattle along with him to make them feed on small scarce pastures located either on the rural main road sides or on parcels owned by friends or his current employer/hirer
Installation costs and fees	Negligible
Institutional requirement for operation	None
Maintenance costs and fees	None
Felt benefits	The raised herd can relatively cope with the drought-induced fodder shortcoming period and fulfill its assigned economic function (savings) as thought in the Haitian farming system.
Concerned subsector (s)	Crops ☐ Livestock ☒ Forestry ☐ Other ☐
Weaknesses	The manageable size of the concerned herd is too small.

Good Practice J	
Item	*Description*
Name	Low intensity marketing to support the agricultural production
Introduction date/time	Traditionally used technique
Changes through time	None
Changes through space	None
Environment where applicable	N/A
Suitable to disaster types	N/A
DRM phase of insertion	Before disaster ☐ During disaster ☐ After disaster ☐ Every stage ☒
Suitability to socio-economic categories	Any
Scale/range of utilization	N/A
Implementation material	Money to buy the needed products
Implementation technique	Savings accumulated from the farm production system (particularly: livestock) is used to carry on small retail trade/business in which diverse products (generally food-related) are commercialized. The trading profits are in turn used to either replace the very livestock initially sold to start up the business or to enlarge the existing herd. And so on.
Installation costs and fees	About 1500 HTG (as a start-up amount)
Institutional requirement for operation	None
Maintenance costs and fees	N/A
Felt benefits	Such practice or decision ensures the perennity/sustainability of the overall farm production system which otherwise is likely to collapse in the long run
Concerned subsector (s)	Crops ☒ Livestock ☒ Forestry ☐ Other ☐
Weaknesses	None, except that credit (money) is very hard to find in the rural/farming areas of Haiti.

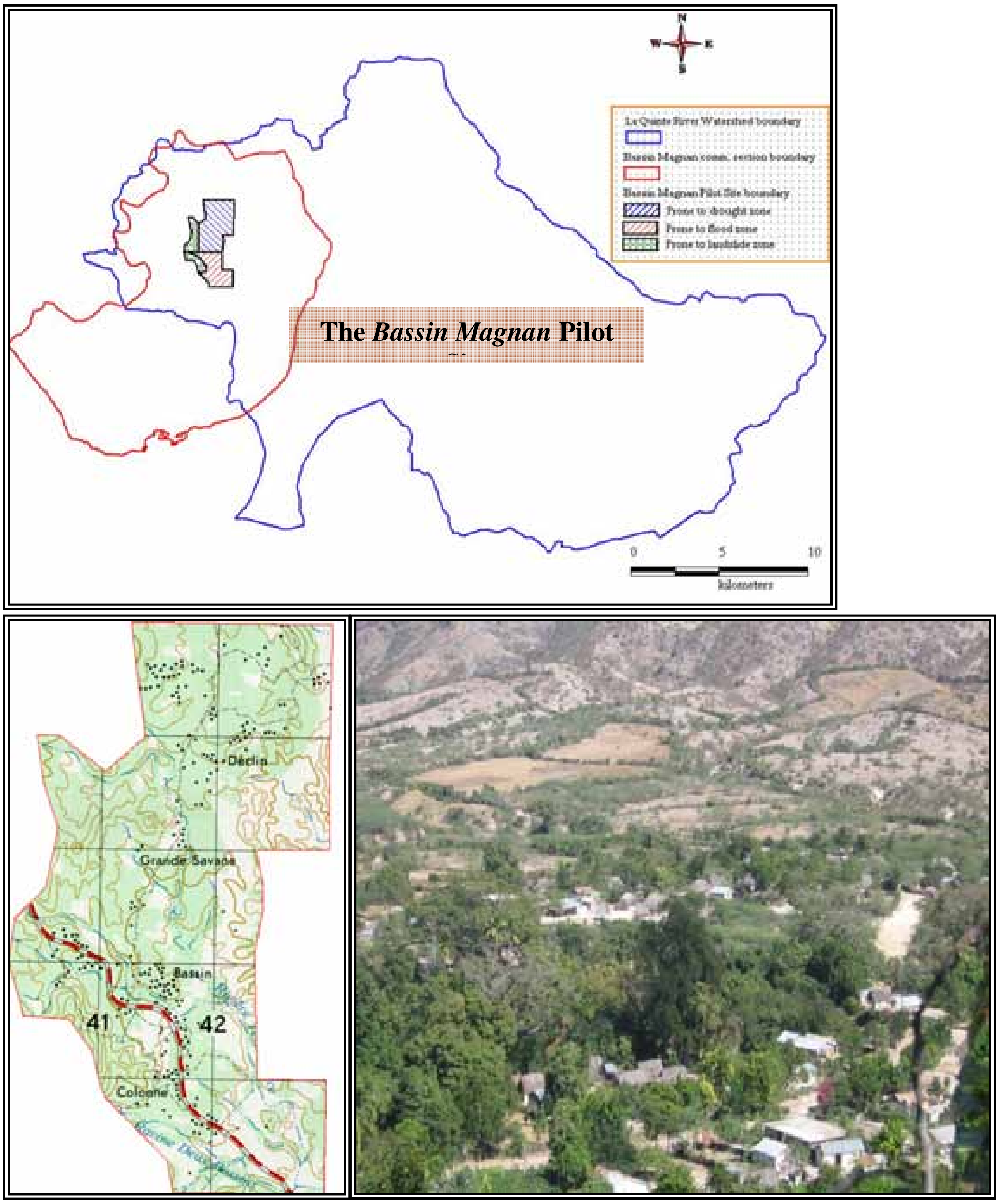
Good Practice K	
Item	*Description*
Name	Repairing the family house and outbuildings
Introduction date/time	Traditionally practiced technique
Changes through time	N/A
Changes through space	N/A
Environment where applicable	N/A
Suitable to disaster types	Any type
DRM phase of insertion	Before disaster ☒ During disaster ☐ After disaster ☐ Every stage ☐
Suitability to socio-economic categories	Categories including the house owners
Scale/range of utilization	Any scale
Implementation material	House building and repairing material (thatches, straw, nails, corrugated iron (in sheets), putty)
Implementation technique	An appropriate skilled worker is hired to perform the needed tasks consisting chiefly of filling up gaps in the house roof, repairing the family house walls to make them more resistant and/or resilient to the negative and strong impacts of the weather-related disasters.
Installation costs and fees	A 4-room thatched-roof, residential house located in the Haiti's rural area is repaired every 2 to 3 year period for about 750.00 HTG
Institutional requirement for operation	None
Maintenance costs and fees	N/A
Felt benefits	Human lives within the farm household are protected or spared; so, health and means needed for monitoring and producing the labor force required for the best management of the overall farm production system are perpetuated
Concerned subsector (s)	Crops ☒ Livestock ☒ Forestry ☒ Other ☐
Weaknesses	The needed money to perform that activity can be very hard to be collected from the farm regular production activity

Annex 4

Pilot Sites

A) Bassin Magnan

View of the *Bassin Magnan* Pilot Site showing its main watershed system (above), a topography based site boundary map (below left), and a panoramic picture of the area (below right. Credits: the Author.



B) Lavanneau

View of the *Lavanneau* Pilot Site showing its main watershed system (above), a topography based site boundary map (below left), and a panoramic picture of the area (below right). Credits: the Author.