



# HAITI: WATERSHED MANAGEMENT AND COMBATING SOIL EROSION

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## Introduction

Since the 1950s, there have been many attempts at afforestation and development in the Haitian mornes, but these have failed to achieve the desired results, mainly because due to a lack of understanding about the farming systems developed by the large number of local farmers. A new approach was initiated in the 1970s by Michel Brochet – supported by several French and Haitian agronomists – from the Salagnac centre in the country's southern peninsula.

This approach to supporting the development of mountain farming still inspires the methods used in Un Enfant par la Main (UEPLM)'s agricultural projects. With the combined experience of 15 years of projects, it now incorporates various strategies designed to address the constraints limiting the farmers' ability to develop an agriculture that both generates income and protects the soil. Focusing on gully bottoms with high agricultural potential, this approach favours the construction of masonry or gabion check dams and water storage basins designed to hold back some of the flood water in order to help the development of agricultural production. This strategy is reinforced by other initiatives such as: promoting market gardening in the vicinity of the

structures, fruit growing, and sugar cane cultivation, improving access to water for domestic use and opening up agricultural production areas by building rural tracks.

As part of the "Haïti filières durables dans le département du Sud" or "Support Program for watershed management through strengthening sustainable value chains in the Department of the South, Haiti" project (2019-2023), financed by the French Development Agency (AFD) via the French Global Environment Facility (FGEF), UEPLM was in charge of component 2: "Protection of fertility and water management in vetiver production areas". The aim of this component was "to strengthen the socio-ecosystemic management of Haiti's Sud Department and protected areas, by improving the management of watersheds through better water management and the fight against soil erosion, as well as generating more sustainable and diversified income from activities for farmers".

This collection of thematic booklets presents UEPLM's strategy for watershed management: our approach, achievements and new considerations to ponder. Over time, this collection will continue to be enriched by the diversity of future projects.

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## CHAPTER 1

# UEPLM's distinctive approach

## Background

### Deforestation of Haiti's mountains and severe soil erosion

For several decades, the deforestation of Haiti's mountains has been a recurring issue. It has been widely commented on by politicians, international organisations and the mainstream media because of its disastrous consequences (Maertens and Storck, 2018).

While almost half of the country's surface area is made up of slopes over 40% (MDE, 2015), the loss of forest cover is causing severe soil erosion in many mountainous regions. Downstream, this results in the accumulation of colluvium, which causes flooding in the plains during cyclonic events and results in considerable material damage and human loss. Between 2000 and 2015, the country experienced more than thirty natural disasters (torrential rains, tropical storms, hurricanes, cyclones, etc.). Each of these disasters resulted in the loss of crops, livestock, property (housing, road infrastructure, etc.) and human lives. In 2016, Hurricane Matthew devastated the departments of Grand'Anse, Sud, Nippes and a large part of Ouest, causing 1,000 deaths and affecting 1.3 million people (Unicef in La Presse, 2016).

### Massive rural exodus and "risky" farming practices

In these same mountainous regions, growing poverty has led to a massive rural exodus of ruined farmers to the capital's shanty towns (Théodat, 2009). Many of the remaining farmers are no longer able to make a living from farming alone. They are forced to diversify their activities (Bouvard, Degroote and Devienne, 2014). These include agricultural day labour, seasonal employment on the irrigated plains and charcoal-making, which remains one of the few income-generating activities in the countryside and is accelerating the loss of tree cover. Farming practices - particularly the cultivation of steep slopes, the cultivation of vetiver grass and the manufacture of charcoal - and by extension the farmers themselves, are singled out for criticism (Bellande, 2015).

When farming practices that exacerbate soil erosion are criticised, the farmer is seen as the culprit and becomes the target of awareness raising campaigns. Breaking with these negative stereotypes, UEPLM projects work with farmers to analyse their farming systems and discover the logic behind practices that sometimes have

negative effects. Farmers go from being targets to being partners.

### Partial and ill-adapted responses

The country's main response to the serious damage caused by soil erosion is to afforest the areas with the highest risk of erosion (Bellande, 2015). These afforestation initiatives are often carried out on a short-term basis, without taking into account the complexity of the agrarian crisis these regions face. As a result, they provide only a partial response and do not lead to in-depth changes in the way cultivated ecosystems are used. In some cases, they can exacerbate existing imbalances between locally available resources and the way farmers use cultivated ecosystems (Bouvard and Devienne, 2019).

### The Un Enfant Par La Main's approach

In contrast to this trend, Un Enfant Par La Main (UEPLM) has for many years been implementing an approach to the development of hillsides that focuses on supporting farmers in their efforts to diversify their agricultural and economic activities. Our activities help farmers develop more profitable and

environmentally relevant agricultural production systems (preservation of the cultivated ecosystem, combating soil erosion).

The "myth of the forest" has led to afforestation being seen as the main response to the erosion crisis. However, consolidating and extending the vegetation at the gully bottoms to create islands of fertility is a more realistic and effective response from the point of view of both agricultural production and reducing erosion. The same applies to the consolidation and extension of hedgerows on hillsides. These actions are UEPLM's priority.

## The origins of UEPLM's watershed management approach



Owing to the legacy of the Madian-Salagnac-Aquin (Nippes) approach - enriched by 10 years of experience in watershed management in the Gros Morne region, the Un Enfant Par La Main's management approach has been consolidated over time.

The first projects in the Madian region began in 1973 as part of an integrated development project run by the missionary priests of the Société des Prêtres de Saint-Jacques, the aim of which was to support the development of rural communities, particularly in the field of agriculture. The goal was to train young farmers to become "multi-skilled rural facilitators" who would spread innovations within farmers' groups, enabling them to share knowledge and more sophisticated farming equipment. After two years of activity, and despite the team's strong involvement in the field, the agronomists found that they had not achieved the expected results. Not only were the farmer groups not acting as expected, but the expected collaboration between the facilitators and the farmers was not working for most groups. While most young people who were trained ended up going to the cities or abroad to gain recognition for their skills, the technological packages on offer were not used by the farmers (Brochet, 2014).

Despite receiving encouragement to persevere with this approach, the team decided to change it and embarked on a research and training programme to improve their understanding of farmers' practices and their reasoning

to offer techniques better suited to their needs. From 1977 onwards, the Madian-Salagnac project team developed a new approach at the Salagnac centre: The initial top-down extensionist approach was replaced by an original process of creating collective knowledge of the region's agriculture that brings together research, training and development (UEPLM, GRET, 2016; Degroote and Devienne, 2019).

This knowledge of the rural environment has enabled the centre's team to identify the obstacles to and keys for agricultural development in the region. With the aim of improving the economic situation and food security of farmers, the centre has proposed initiatives tailored to the specific characteristics of the area, focusing on improving access to water, a crucial issue in the region. By building structures to store rainwater, which frees up the time initially allocated to fetch water, it has become possible to intensify work in the areas closest to the settlement, with an emphasis on high value-added crops. These interventions, tailored to the needs of farmers, have considerably improved their incomes and reduced inequalities (Degroote and Devienne, 2019).

There are many lessons that the Salagnac centre has taken from its "intervention-based" approach, but few of them have been formalised and institutionalised over time, which has made it difficult for key actors in development to adopt them. In 2005, Michel Brochet, one of the pioneers of Salagnac's approach, was asked

to manage the implementation of a watershed development project in the commune of Gros Morne. The NGO SOS Enfants Sans Frontières - which has since become Un Enfant Par La Main - is active in Haiti and is developing measures to manage runoff water in the hillsides - in the wake of the devastating cyclone Jeanne and with the help of Michel Brochet - while at the same time supporting agricultural production. Michel Brochet, in collaboration with Saintil Clossy, a civil engineer with a deep understanding of farming methods, is developing a pragmatic strategy inspired by the experience acquired since the start of the Madian-Salagnac-Aquin project and nurtured by an enriching parallel drawn between Haiti and the Cévennes. Training courses for Haitian farmers have been organised in a Cévennes-like context where water management has been at the heart of the problems of rural development.

Since then, this approach has been taken up by Un Enfant Par La Main and deployed in several mountainous regions in Haiti with different geomorphological and climatic characteristics:

- Gros Morne (400 metres above sea level), a dry mountainous region with a semi-arid climate and 800 to 1000mm of rainfall per year;

- Salagnac (800 to 1000 metres above sea level), a humid mountainous region with 2,000 to 2,200mm of rainfall per year;

- In the highest part of the Chaîne des Matheux (800 to 1000 metres above sea level), a mountainous region with an annual rainfall of 1,500 to 1,800mm, most of which occurs during a period of 8 months;

- In the central plateau, a region of medium-altitude hills (400 to 600 metres above sea level) with a marked dry season lasting 5 months;

- Port-Salut (45 to 200 metres above sea level) is a low mountainous region with an average annual rainfall of 780mm.

The Salagnac centre has made it possible to rehabilitate farmers, to take into account their "complexity" and to consider them as partners in the projects. It has promoted a detailed understanding of the logic of agricultural practices. UEPLM is now committed to disseminating this approach and the associated praxis.



## Fundamental principles of UEPLM's watershed management approach

Un Enfant Par La Main's approach is to combine the building of structures with support measures for farmers to encourage farming practices that both preserve the cultivated ecosystem (water and soil management, combating soil degradation) and remain profitable. The structures may be masonry or gabion baskets (check dams, roads) or vegetated structures. The choice of structures and actions are adapted to each region according to its specific agro-ecological (relief, rainfall, etc.) and socio-economic (land access, proximity to markets, etc.) characteristics.

*"Ready-made solutions are not always available. There are indeed principles and success stories from which to draw inspiration; however, interventions need to be tailored to the specific characteristics of each situation, and we need to continue to evaluate and capitalise on the results."* (Bellande, 2010)

The description of the principles to be respected is also to be criticised, as it only partially reflects, and only at first glance, the legacy of the projects implemented by UEPLM. These projects have enabled the development of a praxis that cannot be summed up by the mere application of principles. The transmission of this art, also and above all involves training and interaction with agronomists who already have practical knowledge. This training is facilitated by specific tools (intermediary objects, stories) that highlight what has been learnt in the field of the Transmission of Experiential Knowledge.

### Understanding the environment and adapting developments to the specific characteristics of each region and agro-ecological level

The complexity of the phenomena at play in the degradation of watersheds in Haiti calls for multiple, nuanced responses adapted to each situation. A solid understanding of the region is an essential prerequisite for any project. It can be based on research projects, exchanges with farmers and local players, or even the support of resource persons.

The benefits yielded by agronomists' use of available research is improved by intermediaries such as slide shows containing diagrams of production systems and cropping systems built up progressively and referring to explanations and basic knowledge. Instructions manuals and a collection of materials will facilitate the agronomist's own production of such tools within the framework of a given project.

A detailed understanding of the way farming systems work in different agricultural regions has enabled the Un Enfant Par La Main teams to develop activities that take into account farmers' interests, helping them adapt their farming operations to each specific cultivated ecosystem with greater environmental, social and economic sustainability.



## CHAPTER 2

# Selecting and implementing a range of complementary interventions

The robust experience in watershed management described in Chapter 1 has enabled Un Enfant Par La Main to develop a range of complementary interventions adapted to the specific characteristics of each region. Each of them focuses on improving access to water for agricultural and domestic needs, directly improving the living conditions of families and increasing the amount of working

Improving farmers' incomes and preserving the cultivated ecosystem

time available on the family farms by freeing up the time allocated to water fetching. In addition, the aim is to encourage farmers to invest this extra working time in implementing practices that combine the preservation of the cultivated ecosystem with higher income (monetary and non-monetary) by providing them with suitable means of production.

## The different types of structures

### Construction of “solid” check dams and check dam basins

Water and soil management in the medium-sized gullies can be facilitated by building structures across the valleys. These may be masonry or gabion check dams. The environmental effects of these check dams include the regulation of flood and low water flows and the reduction of solid flow in the gully by retaining sediments carried by runoff (Brochet, Lilin, 2014). The collection of alluvial deposits upstream of a check dam depends on the magnitude of the flood. Cyclonic floods carry a very large volume of coarse material. Ordinary floods carry finer materials that are richer in organic matter (plant debris, animal droppings). These types of soils are more fertile and allow farmers to create and cultivate damp micro-environments or *fond frais*. Masonry structures hold back a sheet of water upstream of the check dam, whereas gabion structures only slow down the flow of water. Masonry check dams can be supplemented by a water storage basin, which provides a water reserve that can be used by households and neighbouring farms (see fact sheets 2.1, 2.2 and 2.3).

### Construction of wells

In some alluvial valleys, wells can be built in the sediments upstream of the check dam, where a temporary water reserve is created after a rainfall. They are a complementary solution to basins that supply water to nurseries and livestock during the period when this water reserve is available.

### Construction or upgrading of rural roads

In addition to connecting previously inaccessible dwellings to the road network, rural roads make it easier to transport agricultural produce to local markets. They can also be built in order to channel runoff water to a retention basin below the road.

### Support for revegetation

The “solid” structures can be supplemented by revegetation measures in the gully bottoms and on the hillsides to step up soil management efforts. This involves helping farmers install “living” barriers at the bottom of valleys: Planting of forest trees (mahogany, taverna, oak), installation of hedgerows (gliricidia, moringa, mulberry, candelabra spurge), etc., with the aim of protecting degraded areas while using plants that can be useful on the family farm (see sheets 2.4 and 2.6).

## Complementary interventions

### Support for fruit growing

By developing the headwaters of the hillsides using masonry and living structures, it is possible to retain fertile alluvial deposits and improve the soil’s water reserves. These types of cultivated valleys are thus conducive to biomass development. In the plots of these valleys, the planting of trees along fences or in the open field also helps to create a humus-rich soil profile while providing a fruit harvest that is valuable to the families’ diet and economy (see sheet 2.5). This paves the way for the subsequent introduction in these same

areas of species that are demanding in terms of organic matter but also lucrative.

### Support for market gardening

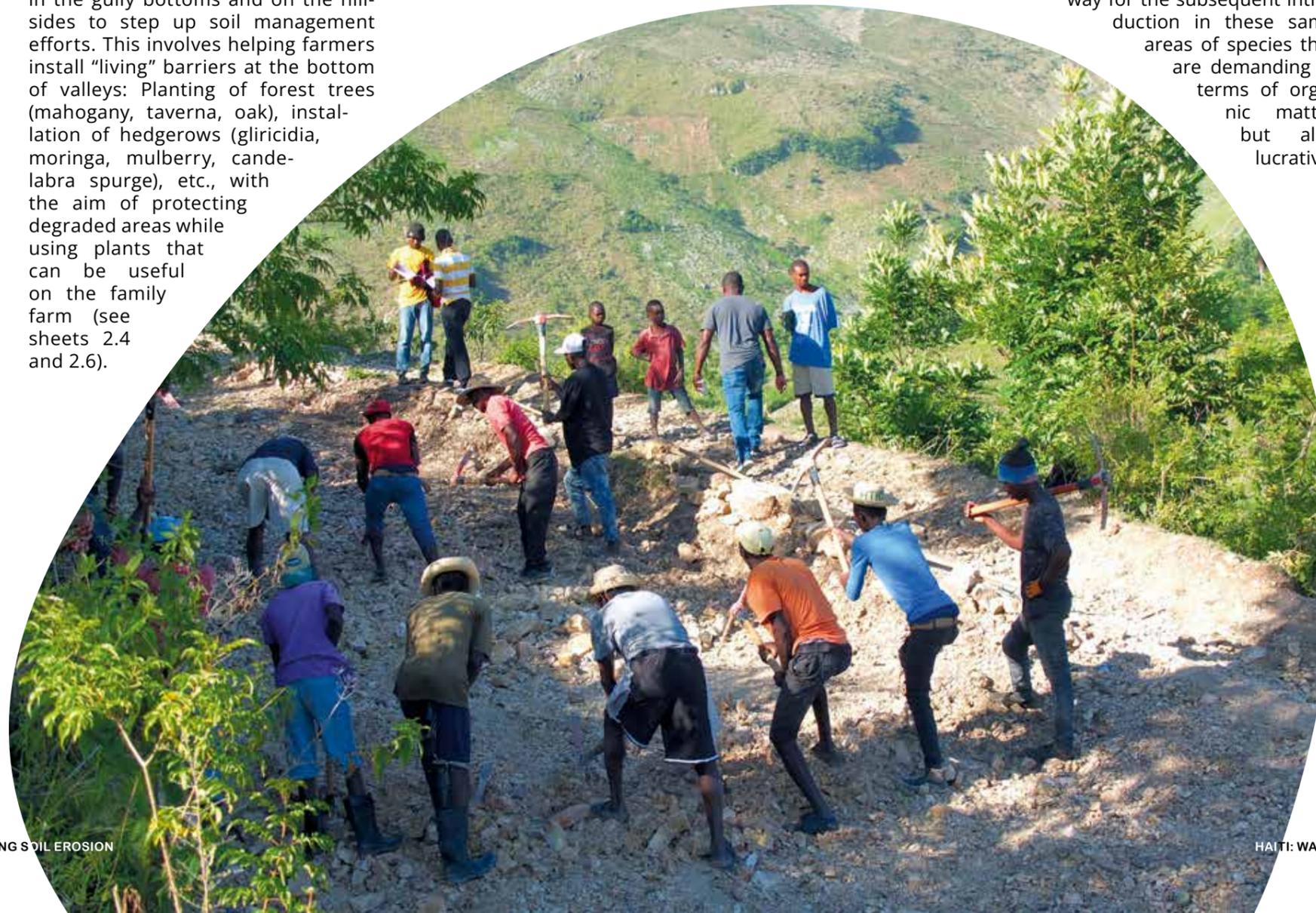
Market gardening is well-suited to Haiti’s mountainous areas, which receive more water and have more mild temperatures. Masonry structures can improve the conditions for its development by improving soil fertility through the accumulation of sediments upstream of the check dams, and by facilitating access to water for supplementary watering through basins. It is also a highly lucrative, short-cycle activity that rapidly improves family farm income and cash flow management.

### Masonry training

Masonry construction provides an opportunity to train farmers in masonry techniques through a form of buddy system. They can then develop a dual activity that will help to improve their living conditions.

### Farmer exchanges

Inherited from the Salagnac centre’s experience, farmer exchanges are field visits organised for farmers from the intervention region to another region of the country with notable similarities in terms of watershed management challenges and agricultural development. These field visits give farmers the opportunity to share their know-how and experience with each other and with farmers from another region. Experience has proven the importance of these exchanges, which are at the core of Un Enfant Par La Main’s approach.



# Vetiver production areas in the Port Salut region: an illustration

## Location and context

One of the areas covered by the “Haïti filières durables dans le département du Sud” project is in the vetiver-growing areas of Haiti’s South Department, in the Port Salut region.

The mornes to the north of Port Salut are characterised by a high proportion of woody vegetation in the gullies and a discontinuous network of hedgerows enclosing the plots. In many places, the woody vegetation in the *fond frais* and the hedgerows create a hedged landscape.

The slopes of the cultivated hillsides are steep, with those measured during an initial exploration examination (June, 2016) varying from 30% to over 60%. On such slopes, cultivation methods lead to very significant tillage erosion (or dry mechanical erosion). This results in the undercutting of the hedgerows and the appearance of a vertical bank on the downstream side, which, as it is scoured, causes the formation of a breach and the destabilisation of the hedge. The hedgerow becomes discontinuous and eventually disappears.

On sloping plots, water erosion is also significant, but it is more difficult to observe, as the incisions are periodically erased by cultivation. Hedgerows do little to reduce this erosion. They have no filter and during heavy rain runoff creates breaches. In addition,

farmers till the soil right up to the base of the hedge, thus preventing the formation of a steep downstream bank that could have encouraged the spreading and seepage of runoff.

Vetiver grass strips have been planted on small terraces, with narrow spacing between the tufts, along rows spaced at around 10 to 15m apart, in the direction of the slopes. However, these grass strips are facing the same problems as those mentioned for farmyard hedges. They do not reduce either water or tillage erosion.

For the most part, vetiver cultivation involves stripping the soil on the hillsides, and the steeper the slope, the faster the stripping. It is not sustainable.

In addition, on the night of 3 to 4 October 2016, Hurricane Matthew crossed Haiti’s southern peninsula, causing considerable damage to the intervention zone. Most of the trees were damaged or uprooted by the cyclone’s strong winds. This sudden disappearance of the tree cover considerably increased the fragility of the watersheds in the Grand Sud. It has therefore proven essential to work on the region’s plant cover to replace the trees destroyed and find strategies that can reconcile environmental conservation with profitability and rapid income for family farms in the affected areas.

## Gullies in the Port Salut hills

### Medium-sized gullies and their vegetation framework

For Haitian farmers, small gullies are first and foremost *fond frais*, fertile areas. A “medium-sized gully” is about a kilometre long (from a few hundred metres to 2km). When the gully is much longer, it becomes a “torrential gully”, making it impossible to farm the talweg.

The treatment of torrential gullies is not covered here. The very high cost of the masonry work that would be required to control this form of erosion is out of proportion when considering the relatively modest stakes downstream. Priority should be given to actions further upstream, such as those mentioned here, and downstream, to actions designed to facilitate the damage-free evacuation of floods (control of urbanisation, cleaning up the bed of the torrential gullies on the plains, treating bank undermining, etc.). The large torrent correction works built in the Alps are only justified because of the importance of what needs to be protected downstream: towns, railways, motorways, etc. In addition, these

large masonry check dams require ongoing, costly maintenance, and therefore a national agency with a substantial staff and budget.

If well managed, a medium-sized gully can offer favourable conditions for crop production, such as a good water supply and an accumulation of fertile alluvium and colluvium. This potential for agricultural production disappears in the case of large torrential gullies.

Haitian farmers often take advantage of the fertility of *fond frais* land that is not or is only slightly degraded, with tree formations that have been reworked by man and enriched with cultivated species. These “wooded courtyard gardens” are highly agriculturally productive.

The perennial vegetation of these talwegs prevents them from being incised during floods: woody plants form a “plant framework” that intercepts and partially stores alluvium and colluvium. Trees alone are not very effective at retaining these materials, but they are often combined with shrubs to create an effective filter. The deposits accumulated in

If well managed, a medium-sized gully can offer favourable conditions for crop production such as a good water supply and an accumulation of fertile alluvium and colluvium.

this way act as a buffer, regulating low water flows and mitigating floods.

The gully is a stage where the confrontation between two forces takes place: incision during major floods versus the reclamation of the talweg by vegetation that encourages alluviation. The weakening of the talweg due to the destruction of its vegetation provokes additional incision. This happens very rapidly (sometimes by several metres in a few years) when it develops on a loose substrate resulting from weathering of the bedrock. The balance between the dynamics of incision and siltation can be modified to preserve the *fond frais* and improve its fertility. This creates a second line of defence to reduce the soil runoff (and therefore loss of fertility) in the watershed, the first line of defence being the reinforced banks on the hillsides.

The masonry and live check dams used to manage medium-sized gullies are described in sheets 2.1, 2.2 and

2.3 (masonry check dams) and sheet 2.4 (vegetated structures).

An important contribution of the UEPLM projects has been to consider these developments primarily as a means of agricultural production improvements, with the reduction of erosion as a simple by-product. But such a change of perspective was only possible because UEPLM minimised the importance of one of the principles of gully correction mentioned in the Soil and Water Conservation manuals. This is the so-called "terracing" gully correction, which entails a regular spacing of the structures along the gully, an overly rigid method that undermines negotiations with farmers. We need to consolidate this progress, particularly through training, and implement these principles based on the type of gully being treated.

## The feasibility of soil conservation measures

### Priority soil conservation measures

Soil erosion is threatening the sustainability of vetiver cultivation. The techniques usually used in soil conservation in Haiti do not provide a relevant response to this problem.

In the current context, the most feasible soil conservation measures are those that have a direct impact on agricultural production: first and foremost, the construction of masonry

check dams in the medium-sized gullies combined with the planting of fruit trees. These measures have already been tested in Haiti by UEPLM giving farmers and planners examples and know-how.

Collecting runoff from the upper slopes stripped by erosion is also a feasible measure, as it is similar to the construction of impluvia.

### Soil conservation measures to be tested

In the current context, other soil conservation measures on hillsides or in gullies are not a priority, at least for the time being. Their feasibility is low, due to a lack of local examples and know-how. But these obstacles do not invalidate their long-term value in reducing erosion and conserving fertility.

On gentle to medium slopes, the technique of reinforced banks should be applied: reinforcing slopes sculpted by erosion at the bottom of the plot and creating new reinforced banks to segment long plots. To be

sustainable, such embankments must be protected against undermining at the foot of the slope because of erosion and reinforced at the top of the slope by planting grasses, shrubs and trees to form a filter capable of retaining some of the soil carried by runoff. Above all, they must be managed by the farmer. Such schemes will only become realistic once agricultural production in the medium-sized gullies has increased and a level of trust has been established with the farmers.

It takes time to disseminate new techniques. Increasing and diversifying sources of income makes farmers less dependent on vetiver, which enables:

- Harvesting vetiver during periods when heavy rainfall is less likely, thereby reducing the risk of erosion;
- Selecting very steep hillsides for perennial plantations of forest or fruit trees;
- Planting fruit trees on the newly created reinforced banks, thereby offsetting the loss of land originally used for vetiver cultivation.





## Outlook: finalising and expanding the documents produced by UEPLM

In conjunction with the Salagnac centre, documents relating to techniques and strategy will be sorted, reworked and made accessible to a wide audience via a website.

A monitoring system will be set up. For the check dams built in the medium-sized gullies, slide shows

combining photos and text will complement the documents already available. They will be enhanced with new photos with commentary taken during field visits to form a sort of “health card”, the central element of the monitoring system. Similar slide shows will be produced for the other techniques used.

### This monitoring system will be aimed at several categories of players:

- The slide shows will be made available to farmers and local officials who have been involved in the projects: website, printed documents, etc. The name of the landowner concerned by a development will appear in the “health cards”. The aim is to stimulate a sense of pride among innovative farmers, but also to elicit critical feedback or suggestions. The spread of an innovation (in particular, that of check dams with stilling basins) is facilitated when it can be emulated.

- The “health cards” for the developments will be made available to technicians and agronomists on the planned website. They will make it easier to discuss the problems that may be encountered by a structure: Is it achieving the desired effects? Are there failures? It will be very important to monitor the first live check dams to be installed, given the benefits of this technique but also its fragility.

- These “health cards” will complement the documents on the strategy implemented by UEPLM, which are available on the planned website. They are also intended for the donors and agencies involved in carrying out the projects. These “health cards” will highlight the sustainability of the investments made and their impact on rural development and provide a basis for discussion.

UEPLM has adopted a constructivist approach to the implementation of its projects, which involves developing them as they progress. In a similar way, a system will be set up to improve access to documents and organise the monitoring of developments carried out by UEPLM in Haiti in order to consolidate and develop UEPLM’s achievements.



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**HAITI:  
WATERSHED  
MANAGEMENT  
AND COMBATING  
SOIL EROSION**

**CHAPTER 1**  
**UN ENFANT PAR LA MAIN'S  
DISTINCTIVE APPROACH**

**DATA SHEET 1**  
**Landscape interpretation**

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# 3

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# Presentation of the approach



The aim of this fact sheet is to outline the key stages in the landscape interpretation process, emphasising the importance of understanding the way in which the cultivated ecosystem is used in each specific small farming area as basis for any future planning.

## Landscape: a few definitions and clarifications

### Why take an interest in the landscape as part of a development project?

- The landscape provides concrete information about the area: climate, relief, human activities, etc.
- The landscape is a means of exchange between local players. It is a relevant tool to draw up local territorial development projects, planning projects and environmental projects<sup>1</sup>.

### What is a landscape?

There are many possible definitions, as the term "landscape" has both a material dimension (a river, trees, a building, etc.) and a sensorial dimension (which evokes sensations and emotions).

As Charles Lilin points out, a landscape can be likened to a person: First contact leads to a first impression. This sensory approach means that the landscape cannot be viewed solely in terms of a set of parameters (a slope, the nature of the rock, the thickness of the soil, etc.). In this way, it is possible to say that a gully "lives, has a history and reacts in a certain way to changes in its environment".

Nevertheless, the following definition can be used: "A landscape is a portion of land which can be seen by an observer. It is marked by natural and human events, present or past, certain aspects of which are visible at a given moment<sup>2</sup>".

The landscape is obviously perceived through sight (contrasting shapes and colours), but also through sound and smell.

### Structure of a landscape

The landscape is the sum of different histories:

- The history of the Earth
- The shorter history of humankind
- The cyclical history of the seasons and vegetation<sup>3</sup>

But the landscape doesn't tell the whole story. The traces of certain events may have been erased by the flow of time, and only by pooling knowledge and exchanging ideas with skilled local players can we understand all of the area's subtleties.

### Observing and interpreting the landscape

Observation requires curiosity, a desire to learn and a particular method.

**FOR EXAMPLE:** observing hedges. At first sight they look identical, but with careful observation they all become different. One is bushy, intrusive and irregular, the other is trimmed; one is made up of a wide variety of plant material, the other is not.

Attentiveness reveals diversity.

1. Deffontaines, JP, Ritter, J, Deffontaines, B, Michaud, D (2019). A short guide to landscape observation.

2. N°. Ibid.

3. N°. Ibid.

# Interpreting agrarian landscapes for future developments

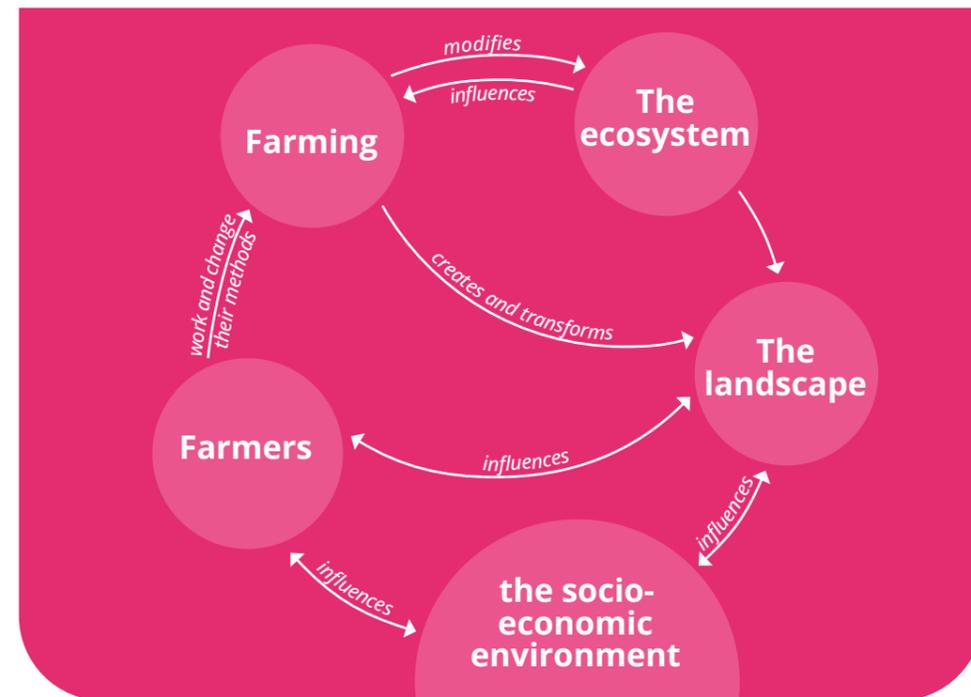
## Analysis of agrarian landscapes: Observe to understand

Landscape analysis is an essential means of providing information on agricultural systems and practices, and a method of acquiring knowledge of agricultural activity for agronomists (Deffontaines<sup>4</sup> - diagram below) and planners.

The geo-agronomic method developed by JP Deffontaines has majorly contributed to our knowledge of the links between landscape forms and farming (Henry Dominique, 2012). "Regarder pour comprendre" (Deffontaine, 1998). The landscape is a tool to challenge our ideas and the farmer's work.

"Techniques, or sets of production processes based on scientific knowledge, are described in books; practices, on the other hand, are the tangible ways people operate in a given place and time, leaving their mark on the landscape."  
(Deffontaines)

## EXISTING LINKS BETWEEN THE LANDSCAPE AND FARMING



4. Deffontaines, JP (1996). *Du paysage comme moyen de connaissance de l'activité agricole à l'activité agricole comme moyen de production du paysage.*



## INTERPRETING THE LANDSCAPE IN THE CONTEXT OF WATERSHED DEVELOPMENT IDENTIFICATION

Understanding the specificities of each region and the farming methods used by farmers is the first step in identifying potential watershed developments.

It is important to understand both the obstacles to and catalysts for the emergence of more lucrative production systems for farmers that also preserve the cultivated ecosystem.

This work can be done through:

- Agrarian diagnosis, which is an excellent way to thoroughly understand changes in the way

the environment is used over time and identify the most appropriate courses of action for farmers. In many regions where Un Enfant Par La Main is active, agrarian diagnosis has been a mainstay in terms of watershed management (Nègre, 2007; Bouvard & Degroote 2012; Bouvard, 2019; Degroote, 2019).

However, when such a complete and in-depth study is not possible:

- A careful interpretation of the landscape is essential to gather crucial information on region-specific methods of agricultural

production. The aim of landscape analysis is to identify and describe the different agro-ecological zones in the target region. The aim is to understand how the cultivated ecosystem is managed, i.e. how farmers make use of the ecosystem in the targeted farming region. This requires a meticulous and analytical observation of the landscape which combines different levels of analysis.

All of the stages detailed below are essential to draw up coherent watershed development initiatives that are adapted to the environment and the farmers' needs.

## Main stages

**1. Identify large relatively homogeneous areas in terms of landscape, geomorphology and land use.**

"There is a close relationship between the type of relief and the agricultural potential of an area, which is why it is useful to start by observing its general features. An understanding of geomorphology (the study of the shape of the landscape in relation to the underlying rocks) enables us to represent the main areas around which the slopes, water flows, benches, the shape of the valleys and the accumulation of materials that gradually form the soil are organised". (Cochet & Ferraton, 2002)

**2. Within each group, pinpoint the cultivated ecosystem's component parts that reveal its**

organisation. These observations may require an understanding of topography, geology, geomorphology, pedology, hydrology and land use.

**3. For each part of the cultivated ecosystem, identify its main components, the dynamics of water and sediment circulation according to the relief and the way in which each of them is developed (type of plot, type of plant cover, layout and nature of dwellings, etc.). This thorough identification is the premise for understanding how each part of the cultivated ecosystem works.**

"The cultivated plots are identified within the landscape (individual plot size, shape, size relative to other plots). Tree,

shrub and herbaceous plant formations are also identified, making sure that spontaneous and cultivated vegetation are differentiated and perennial and annual species are distinguished from each other.

Within the plot, the physical characteristics of the soil (structure, texture, level of stoniness, etc.), fertility (organic matter content, sediment accumulation at the bottom of the slope, rill erosion, etc.), water resources, etc. are recorded to understand how the various agricultural activities fit together in the environment. [...]

It is also important to consider the position of dwellings in the landscape, in relation to reliefs, watercourses, major roads, main markets, etc. [...]

Farming equipment found near houses provides information on the dominant types of crops and livestock, but also on the level of equipment used by farmers: identification of drying areas, granaries, farming tools, etc." (Cochet & Ferraton, 2002).

Based on an understanding of how the environment is used and the existing development options, the next step is to identify precisely which areas should be developed while accounting for physical constraints.

For solid structures, rural engineering skills are needed to ensure the sturdiness of the structure and to foresee the new dynamics of water and sediment circulation.

## Benchmarks for analysing agrarian landscapes

*These are guidelines, not a methodology to be scrupulously followed.*

### Asking questions about a landscape

Questions that depend on the landscape interpretation's goal.  
For the agronomist/planner:



### An open-ended list of questions to ask before implementing a gully development project:

- ▶ What type of soil is it? Is anchoring possible in the bedrock?
- ▶ How steep is the gully's slope?
- ▶ What are the groundwater flow dynamics during the rainy season?
- ▶ Can setting up a fond frais (small fertile zone) be profitable?
- ▶ Can setting up an access point to water be profitable?
- ▶ How accessible are water and other materials?
- ▶ What type of ownership applies to this area? Are the owners and/or neighbors ready to get invested in the project?

FIGURE 1: Extract from the summary presentation of the survey mission carried out by UEPLM in the Port Salut - Cavaillon - Les Cayes region; methodological example based on a photograph of the Hippolyte gully in Laurent, Cavaillon (source: UEPLM, 2019)

### Refer to an observation diagram

How to analyse the landscape in light of these questions?  
Notice certain objects, colours and the relationships between objects.

## GENERAL PRINCIPLES OF LANDSCAPE INTERPRETATION

### Observations for a better understanding

- ▶ An area's geomorphology and the soil erosion dynamics at play
- ▶ Farming practices in place

.....

### Asking the right questions

- ▶ What seems to be the result of non-natural forces?
- ▶ What is the cause? Answers could come from the semi-structured interviews

FIGURE 2: Extract from the summary presentation of the survey mission carried out by UEPLM in 2019 in the Port Salut - Cavaillon - Les Cayes region; methodological example based on a photograph of the Timaya gully at Favette (source: UEPLM).



Landscape interpretation combines the study of maps of the region, aerial photographs or satellite images and field observations. It is advised to move through the landscape slowly, taking the necessary time to observe and write down everything that the landscape can tell us about how the environment is organised.

It is highly recommended that the observations and information be presented in written form

(schematic map, sketch, cross-section, block diagram) to convey the understanding of the organisation and functioning of the cultivated ecosystem (see Figure 2).

The season during which the path is taken has a major influence on the observations. During the growing season, we will observe farmers' practices directly. During the dry season, other information can be obtained: farmers' use of crop residues, animal grazing areas, access to water, etc.



# To find out more

## Interpreting agricultural landscapes: a question of professional tradition

### Tools to help you analyse and interpret the landscape



When interpreting a landscape, agronomists should make extensive use of maps, Google Earth imagery and terrestrial photos. Training will help them master these tools, which require modest technical skills, and to understand their value.

The photos, which are simple reproductions of reality, help the agronomist to rework his intuitions and make sense of the landscape. They make it easier to interpret the landscape and set up an initial intervention strategy.

A photographic report is an “intermediary object” that facilitates the sharing of knowledge. The agronomist’s account can be compared with other interpretations, particularly those of farmers who know the land well and those of other practitioners. In this way, the agronomist’s interpretation

can be reshaped, confirmed and validated. The decision-maker then makes an informed decision based on consolidated working hypotheses, since reality always has an element of randomness. Once an acceptable degree of certainty has been reached, this interpretation can be the impetus for discussions that define a meaningful project with the farmers.

These tools also stimulate the agronomist’s understanding of the field. This means the agronomist becomes “capable of constructing” a mental map of the intervention area, making it easier to navigate the landscape.

This first stage of observations raises new questions and allows us to formulate the first hypotheses about why the different parts of the ecosystem are exploited in different ways.

The “constructivist” approach adopted by UEPLM is one that is in constant evolution, remaining flexible in each of our interventions to correct, experiment and, in short, innovate. This approach is made possible above all by our ability to analyse and understand farmers’ practices in the region where we operate. This ability was developed jointly with researchers – from the very beginning of the Salagnac centre’s activities – who set up tools that enabled us to ask ourselves and the farmers certain relevant questions and thus identify obstacles and ways to overcome them.

For an experienced agronomist, the ability to read and interpret an “agrarian” landscape requires learning more about farming systems. The agronomist must have access to this information from the onset, whether it is produced by a researcher or as part of a study done prior to a project. But it is not enough to produce a report; this is only the first step.

For an agronomist, the practical value of this scientific knowledge requires it to be assimilated. They must learn to manage changes of scale, both spatially and temporally.

They must learn to grasp the complexity of relationships within a farming system and between different systems. Implementing a more systemic approach means mastering a different way of reasoning and understanding situations.

Assimilation requires a change in professional norms and an interaction between the agronomist and the creator of scientific knowledge. This exchange is enhanced by actions featured in the TSE or Knowledge from Experience Transfer process. Scientific reports are supplemented by stories and by the production of Intermediate Objects (IO). The creation of these tools requires specific skills to both write compelling narratives and to use New Information Technologies (NIT) to create “objects” that make it easier to navigate through complexity. So, for example, IT techniques can be used to improve the diagram that shows the development of a cropping system, visualisation of the relationships with climatic development and exceptional climatic events, to show changes in labour constraints, and so on. This navigation through complexity, facilitated by the presence of a trainer, can also be seen as a kind of game.

## Interpreting geomorphological landscapes: a question of practical skills

However, a closer look at how an experienced agronomist takes the landscape into account shows that his approach is less linear than described above. His interpretation of the landscape is iterative. He often recalls memories of similar landscapes. His interpretation is also partly determined by his knowledge of possible actions, so he proceeds by successive adjustments of his interpretation according to possible interventions and focuses his attention on key points.

An experienced agronomist recognises the worth of the experience he has acquired: remembering situations that are comparable to the present one stimulates his intuition and leads to the creation of an interpretation that is relevant to the project. In this field, the definition of

**In Haiti, it is recommended to take advantage of research into the transmission of experiential knowledge (TSE) to complement companionship and improve transfers between old and new agronomists.**

methodology is only moderately relevant. The art of interpreting the landscape cannot be taught in the same way as mathematics.

Practical skills are usually passed on through apprenticeships with experienced agronomists. In this way, a “second university” complements the initial training.

In Haiti, however, the “second university” is inadequate. It is therefore recommended to take advantage of



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research into the transmission of experiential knowledge (TSE) to complement companionship and improve transfers between old and new agronomists. This research highlights the value of tools that facilitate the sharing of knowledge, in particular intermediary objects, also known as facilitator or transactional objects. These tools give an important place to the sensible dimension and call on New Information Technologies (NIT). UEPLM’s projects have shown these TSE skills are indeed worthwhile, and we hope to include them in training for spatial planners.

Discussions during UEPLM’s work in the field have made it possible to define new paths going forward and have led to some initial achievements along these lines. This is why UEPLM is currently investing in the production of aids, such as illustrated stories and tools that will make it easier to read a landscape and share practical skills by utilising the thousands of photos from UEPLM’s 10 years of projects in Haiti. The tools produced will be made available at the Salagnac centre.

**HAITI:  
WATERSHED  
MANAGEMENT  
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SOIL EROSION**

**CHAPTER 1**  
**UN ENFANT PAR LA MAIN'S  
DISTINCTIVE APPROACH**

**DATA SHEET 2**  
**Interviewing farmers**

# 3

## An initial bottom-up, collaborative approach

- p. 3 Maintaining a relationship of mutual trust with farmers
- p. 4 Conducting interviews to verify the hypotheses of landscape interpretation
- p. 6 Offering tailored support for overcoming obstacles
- p. 7 In practice

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## A development process carried out in consultation with farmers

- p. 8 Discussing development proposals with farmers
- p. 9 Exchange framework with farmers focus group
- p. 10 Related topics and issues
- p. 11 Suggestions

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# An initial bottom-up, collaborative approach

## Maintaining a relationship of mutual trust with farmers

Relationships with local stakeholders, especially farmers, is particularly important to implementing the development approach. Building quality relationships with farmers is key. Farmers' preconceptions about projects are very prevalent in Haiti, often with good reason. Projects can be seen both as an opportunity to capture a financial windfall and as

schemes that fail to account for the real constraints leading to relevant solutions. In this context, it is difficult to establish constructive and steady relations between project teams and farmers.

**UEPLM favours approaches that make it possible to overcome these difficulties:**

- **Consideration of the economics of family farms, which stimulates constructive dialogues** around constraints, the ways to overcome them, the benefits of developments, farmers' plans for their farms, etc. These long-term relationships enable us to perceive the evolution and transformation of farming systems, thereby promoting relevant strategic choices.
- **The special interaction with certain trusted partner farmers**, who are generally natives of the area, who have a deep understanding of it and who put these assets at the service of the projects in a voluntary, effective manner and without any risk of instrumentalisation. These contact persons play a crucial role in providing information on plot tenure, local agrarian dynamics, constraints, practices and farmers' aspirations.

Knowledge of how farming systems work in the project area provides the basis for the interviews.



As part of the "Project to support sustainable supply chains and the sustainable development of watersheds in Haiti's southern department", numerous meetings were held with farmers, both members and non-members of Vetiver cooperatives, before and during the implementation of the project.



© Kelly / Pexels

## Conducting interviews with farmers to verify the hypotheses formulated by the landscape interpretation

In order to verify and complete the initial hypotheses formulated during the landscape interpretation, it is necessary to conduct interviews with farmers.

These interviews also make it possible to continue characterising the different agro-ecological stages by gaining a deeper understanding of their mechanisms and the way farmers cultivate them. It is advised to pay particular attention to the relationships between these stages, namely water movement and the flow of organic matter and minerals (Cochet & Ferraton, 2002).

This essential phase of the agrarian diagnosis method relies on a precise understanding of how farming methods have evolved over time. It is thereby possible to explain the current situation and identify the constraints and opportunities that need to be considered when formulating a project. This enables us to understand which obstacles obstruct the implementation of a farming

“Knowledge of the crops grown, usual yields, cultivation methods, etc. will enable the agronomist to pass the test and gradually establish a relationship of mutual trust.”

method that increases agricultural production and preserves the cultivated ecosystem, and to identify the right ways to tackle them.

When there is not enough time for such in-depth work, a few interviews are necessary to gain a deeper understanding of the environment and at the

very least, to specify the methods used to farm the land.

It should be noted that at the start of an interview, farmers can sometimes test the agronomist by deliberately misleading him and observing his reactions. Knowledge of the crops grown, usual yields, cultivation methods, etc. will enable the agronomist to pass the test

and gradually establish a relationship of mutual trust. Exchanging ‘innocuous’ information before starting the survey is also a good approach, following the art of code switching. For example, a solid knowledge of the Creole names for local shrubs and trees is the agronomist’s foot in the door in distinguishing himself from the city-dweller and engaging in genuine conversations.



## Offering tailored support for overcoming obstacles

Once the obstacles have been identified, the aim is to offer appropriate structures and support to farmers to make the most of the agronomic potential of each part of the cultivated ecosystem while ensuring the renewal of soil fertility.

Identifying the right course of action can be viewed as a problem best tackled by using rural engineering techniques, plant development and support measures. Several types of management and support activities are detailed in the technical data sheets. They are a “toolbox” from which the planner may choose a set of relevant actions to deal with his problem. This “toolbox” - of which only a few examples are detailed - can be enriched by bringing up other useful experiences where similar soil, climate and socio-economic conditions were observed.

“The diversity and complementarity of the actions proposed will make it possible to offer not just one solution, but a range of responses tailored to farmers’ needs.”

The diversity and complementarity of the actions proposed will make it possible to offer not just one solution, but a range of responses tailored to farmers’ needs. The systemic approach to problems and to the possible courses of action is of great interest when proposing the most relevant and coherent methods of intervention tailored to the specific features of each situation encountered.

In terms of small-scale hydraulic structures, the initial assessment will help to choose the type of structures (masonry / gabions / vegetation) that can be built, while also considering their potential economic profitability and social utility, particularly in agricultural terms.



## In practice

### Focus group interviews

While one on one interviews are preferable, focus group interviews may be useful at a later stage.

However, one should be careful in cases where there is strong clientelism, which can put small farmers in a difficult situation. Here, a balance between open questions and suggestions is recommended (see the interview outline in the appendix).

### Organisation of farmer exchanges

In addition to the interviews organised with farmers at the project site, it is important to plan exchanges with farmers at sites where developments similar to those planned have already been carried out. Completed projects carried out by UEPLM are interesting destinations for such trips because they showcase a range of already implemented innovative techniques.

The use of videos and slideshows showing the structures in the area to be visited helps to prepare the trip more effectively and encourages the development of the planned innovations.



### AN OPEN-ENDED LIST OF QUESTIONS TO ASK ONESELF

- ▶ What type of access should be considered for the structures: individual or collective?
- ▶ What needs do these facilities meet? If the aim is to improve access to water, is it for supplementary watering, modest crop irrigation, livestock watering or domestic use?
- ▶ What are the current erosion dynamics and what solutions can be found to help reduce them?
- ▶ If the goal is the alluviation of the byproducts of erosion (colluvion, alluvium), how will the newly created space be developed? *Sheet 2.2 describes in more detail the approach taken by the Un Enfant Par La Main team in selecting suitable locations for the creation of masonry check dams.*



# A development process carried out in consultation with farmers

## Discussing development proposals with farmers

Once the development proposal has been defined, it is presented to the farmers to ensure that the project is of interest to them, in particular the owners and farmers of the concerned plots.

### Special attention must be paid to:

- **The land tenure of the plots to be developed:** selected plots should (when possible) already be surveyed and be developed where land tenure is secure.
- **The plot owner's expectations – as well as those of the farmer if they are not the same person –** is necessary to have all the information needed for the best possible adaptation of the specific development project and to anticipate any adjustments that the plot might need once the development is completed. In the case of a development project for collective access to water, it is important to know if the development will lead to an intensification of agricultural production, which could cause the plot owner to limit access to the land and therefore to the water (enclosure of the plot, high value-added crops, etc.).



The approach of the experienced agronomist is similar to that of an investigator who looks for clues, compares interpretations, and creates, deconstructs hypotheses as the investigation progresses.

The projects carried out by UEPLM have also shown that farmers invest more in the maintenance of developments on private land for individual use than on land for collective (“undivided”) use.

Finally, wherever possible, the selected sites and the planned activities should be approved by local authorities during a field visit.

## Exchange framework with farmers focus group

### Organisation

**Moderation:** 1 or 2 people lead the discussion. Observers may intervene and ask additional questions.

**Note-taking:** 1 person takes written notes of just the main ideas.

**Audio recording with a smartphone or voice recorder** enables you to listen to certain passages again once the meeting is over. In this case, inform the participants that you are recording the meeting to listen to the conversations over again, specifying that the recording will not be broadcast.

**Minutes:** Written minutes are drawn up by the project team and made available to the participants. It includes a list of participants, the main points discussed, and any commitments made by the project team regarding actions to be taken.

### Course

**1. Round of introductions:** everyone introduces themselves, including the project team.

**2. The moderation team explains the purpose of the meeting:** to reflect together on the needs of farmers in each area in terms of agricultural development and on what would be interesting to put in place. For example, the topics to be discussed could be:

- a. The family farm as a whole, its constraints and opportunities;
- b. The complementarity of agriculture and livestock farming, particularly in the lakou and pre kay (or courtyard) gardens ;
- c. Crop combinations that use fewer inputs (fertilisers, plant protection products, water);
- d. Erosion control systems.

The aim, therefore, is to create the conditions for farmers to have their say and to discuss the planned actions with the developers.

Each participant may speak as he or she wishes, therefore the moderators must ensure that all those who wish to speak are given the opportunity to do so.

## Related topics and issues

### THEME 1

#### THE FAMILY FARM AS A WHOLE

- ▶ What are the main difficulties you face on your farm? What, on the other hand, is working well?



### THEME 2

#### COMBINING FARMING AND LIVESTOCK IN AREAS CLOSE TO HOUSING (LAKOU GARDEN, PRE KAY GARDEN)

*Setting the scene (to be developed according to the zone)*

- ▶ Do you rear pigs, goats or rabbits? What role do these animals play on your farm? How are they kept? How are they fed? What types of animals do you sell? What difficulties do you encounter with these animals?
- ▶ Would you like to develop this business? Why or why not?
- ▶ Do you think that livestock farming helps to renew the fertility of areas close to the home (lakou, pre kay courtyard garden)? If so, which plant species benefit from the manure provided by livestock?
- ▶ What plant species (including tree species) would you like to grow to make it easier to keep these animals and to feed them especially?

### THEME 3

#### SETTING UP LOW-INPUT CROP ASSOCIATIONS (FERTILISERS, PLANT PROTECTION PRODUCTS)

*Setting the scene (to be developed according to the zone)*

- ▶ What are the main crop combinations you grow? Do you use fertiliser or plant protection products?
- ▶ Have you identified certain combinations that require less input? Which ones and why?
- ▶ Do you have any ideas for intercropping that you'd like to try out?
- ▶ What results have been obtained with legume combinations (soya, beans, etc.)? What are the advantages and disadvantages?

### THEME 4

#### MEASURES TO COMBAT EROSION

*Setting the scene (to be developed according to the zone)*

- ▶ Are you experiencing severe erosion on your plot? If so, why? Have there been any changes over the last few years?
- ▶ Have you implemented certain actions? If so, with what results?
- ▶ Do you have any ideas for schemes you'd like to try out?



#### SUGGESTIONS

It can be useful:

- To use intermediate objects (videos, slideshows showing layouts like those referenced earlier) to elicit reactions rather than giving a lot of time for questions. For example, get people to react to suggestions illustrated by photos, which means taking risks and not withholding your own ideas. It is often more fruitful to lay all your cards on the table.
- To shake up the people we talk to a little and turn them into real partners.
- To begin by describing one's own working hypotheses and then open the floor to questions and other proposals for a constructive debate.

The involvement of the moderation team in the debate (who should never forget that they are also developers) means that we won't fall into the trap of some large-scale projects who say "have your say, we'll take care of the rest"!

**HAITI:  
WATERSHED  
MANAGEMENT  
AND COMBATING  
SOIL EROSION**

**CHAPTER 2**  
**SELECTING AND  
IMPLEMENTING A RANGE  
OF COMPLEMENTARY  
INTERVENTIONS**

**DATA SHEET 1**  
**Functions of the gully  
bottom check dam**

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### 3

#### Presentation of gully bottom check dams

- p. 3 The role of the masonry check dam
- p. 3 The role of micro-retention (or basin)
  - p. 4 The role of the glacis
- p. 4 The role of liquid and solid flow control

### 5

#### Multifunctional structures

- p. 5 Improving groundwater recharge
- p. 5 Water for agricultural and domestic use
- p. 6 Improving agricultural productivity
- p. 6 Improving biomass and biodiversity

### 7

#### Added value of masonry structures in gully bottoms

- p. 7 The advantages of masonry over stone check dams
- p. 8 The advantages of masonry structures over hill lakes
  - p. 9 A special case: the gabion check dams
- p. 10 The roles of the check dam with a basin: maximise the potential of medium-sized gullies

### 11

#### Conclusion

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#### GENERAL OBJECTIVE: MAXIMISING THE POTENTIAL OF MEDIUM-SIZED GULLIES

Medium-sized gullies have interesting pedological and agronomic characteristics, offering high potential for agricultural development. In the experience of Un Enfant Par La Main, the construction of masonry or gabion structures across some of these gullies makes it possible to take full advantage of this potential. These structures can be used for a variety of purposes and offer several advantages over conventional structures such as rock walls or hill lakes.



## Presentation of the gully bottom check dams

The masonry structures built by UEPLM are composed of several elements. In their simplest form, they are made up of a single reinforced concrete check dam. In a more complex form, they are comprised of a check dam, a basin, and one or more glacis. The check dams can sometimes be made of gabions, in which case they have neither a basin nor a glacis.

#### Promoting alluviation: the role of the masonry check dam

The check dam built across the gully is designed to partially retain the water from rainfall and flooding. The check dam is watertight, which allows for a body of water to form upstream and gradually seep into the ground. Waterborne sediments are also deposited upstream of the check dam, forming a thick, fertile soil. Thanks to these new sediments deposited during floods, the gully bottom becomes a more productive space.

#### Water storage: the role of the micro-tank (or basin)

A basin can be built downstream of the check dam to store water. The storage capacity of the basins built by UEPLM varies between 40 and 100 cubic metres of water. The water stored in the basins can be used for agriculture (water for the livestock, watering nurseries dedicated to market gardening) and domestic uses even if the water is not drinkable (household water supply, laundry, hygiene).

## Water recovery: the role of glacis

A glacis is a concrete surface that follows the slope of the hillsides immediately upstream of the check dam or basin. It collects rainwater and discharges it into the basin. The presence of a glacis increases the quantity of water collected by the structure. It enables water to be collected even in the absence of flooding and in the event of low rainfall. A road, fully or partially paved, can also serve as a glacis if it is located upstream of the basin and is equipped with a system to channel the water into the basin.

1. Colluviation is the deposition, upstream of check dams, of sediments carried down hillsides by rainwater.

## The role of liquid and solid flow control

The impact of check dams on the risk of flooding downstream of watersheds is modest, as is their reduction of the volume of water flowing into gullies during floods (buffer effect and flood mitigation). However, feedback from our field work shows that in gullies where there is either a risk of erosion or it has already begun, check dams encourage colluviation<sup>1</sup> and tend to regulate gully by “building” soils. Achieving a greater effect on the regulation of these flows would require more numerous, taller and, above all, much more costly structures. These would be difficult to justify economically.

# Multifunctional structures

**Check dams built in gully bottoms help farmers overcome obstacles in many ways.**

## Improving groundwater recharge

The check dams and vegetation that grow in the gully reduce the flow velocity of the water, retaining it and stimulating its seepage into the aquifer. This process contributes to the recharge of the groundwater of the gully.



Agricultural potential of areas upstream of the masonry check dam (Gros-Morne). Maize and Vigna have already been harvested.

## Water for agriculture and domestic use

Water scarcity and/or difficulties in managing available water are recurrent problems in the Haitian mountains, hampering the development of market gardening of crops such as plantain, and making it difficult to get water to livestock. The lack of access to water close to their homes forces many farmers to make great efforts to supply their households with water. These water-gathering chores are predominantly done by women and children are often called upon to participate. Masonry structures provide households with water reserves in a variety of ways:

### Open water

After the rainwater has run off, a temporary reserve of open water is found upstream of the check dam. The basin

downstream of the check dam also stores water for supplementary watering, watering livestock and washing.

### Water table

Following the deposition of alluvial deposits upstream of the check dam during floods, a small, temporary water table is created in the deposited materials. This water table can be tapped by a well and occasionally used for watering nurseries and livestock.

Generally speaking, the greater biomass resulting from the development of agricultural production and the alluvial deposits act as a buffer, slowing down the flow of water in the gully without, however, significantly preventing the effects of downstream flooding.





Gully bottom masonry check dam.

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## Improving agricultural productivity

In the medium-sized gullies where masonry check dams are built, the sediment that accumulates during rainwater runoff is rich in organic matter. This sediment enables part of the water to percolate and maintains soil fertility, creating humid micro-environments that are conducive to the production of high-value-added species such as fruit trees (bread tree, mango, coconut, plantain, etc.), vegetables and water-intensive staples (malanga).

## Improving biomass and biodiversity

The creation of “fond frais” promotes diversification and multiplication of cultivated species, which consequently increases the plant biomass, with a tiering between staples and vegetable crops and fruit trees. In addition, increasing agricultural productivity in the gully bottoms can reduce the exploitation of the hillsides. This, in turn, increases the plant cover on hillsides, more effectively protecting them from erosion. Increases in both agricultural production in the gully bottoms and of species present on the hillsides contribute to an overall improvement in biodiversity of the watersheds.

# The added value of masonry structures in gully bottoms

According to UEPLM, the construction of masonry structures across gullies is more effective than that of other widely used structures such as dry-stone check dams or hillside lakes.

## The advantages of masonry structures over dry stone check dams

Dry stone check dams are structures built in gullies and ravines to slow the flow of water and control erosion. They are of less effective than masonry check dams for the following reasons:

- **They are not watertight.** As a result, they reduce the speed of water flow but do not retain water upstream. The result is less sediment deposition. In this sense, they are similar to gabions (see below).
- **Their lifespan is short,** as construction methods are often inefficient (stones too small, ill-fitting, poorly anchored which enables bypassing).

These dry-stone check dams are vulnerable to heavy flooding, trampling by livestock and scouring. As a result, they rarely lead to improved agricultural productivity.

However, dry stone check dams can be used to complement masonry check dams, whose cost limits its replication. Their lifespan can be improved by careful construction and by coating the check dam with a cement screed.



## The advantages of masonry structures over hillside lakes

Hillside lakes are much larger water reservoirs: an earthen or masonry dike blocks the water from flowing into the gully. These hillside lakes provide water reserves for irrigation, fish farming or livestock watering.

### Advantages

The ratio between the cost of building these structures and the quantity of water stored is more attractive than for smaller-scale masonry structures.

### Disadvantages

- The reservoir will drown a large area of farmland, creating land ownership problems that can lead to expropriation, despite these areas having a very high agronomic potential.
- Because of the quantity of water retained, collective management must be considered, which can be difficult to implement in areas where social webs are complex, and the promotion of collective dynamics is difficult.

In such cases, optimised use of available water resources is compromised.

- The availability of water does not necessarily mean that large areas of agricultural production can be irrigated, as it can be difficult to get water to the plots. This results in a weak increase in agricultural production which in turn impacts farmers' incomes.
- Lastly, the cost of building hillside lakes includes a significant proportion of purchases in foreign currencies (imports of earth-moving equipment, large quantities of materials, etc.).

However, despite significant advantages, one of the main difficulties in disseminating the techniques of building reinforced concrete check dams in gully bottoms is the lack of technical debates. Each agency uses its own techniques following the current trends; competition and compartmentalisation hinder feedback and calm technical debates. Technical innovations have difficulty spreading, even when their advantages have been established.



## A SPECIAL CASE: THE GABION CHECK DAM

Based on UEPLM's experience, a gabion check dam should be preferred to a masonry check dam when the width of the gully bed exceeds 20 meters, or if the bedrock is too deep to anchor a masonry check dam. The flexibility of gabions will ensure that the check dam does not break and that its effectiveness is retained even in the event of ground movement or foundation subsidence. The choice of a gabion check dam may also be preferable when there is no quality sand available close to the site for the manufacture of concrete.

UEPLM may decide to make certain gabion check dams watertight by applying a layer of concrete to the upstream wall. However, gabion check dams made in this way do not retain the same quantities of water as masonry check dams.

In addition, the cost of a gabion check dam can be higher than that of a concrete structure, due to its size and the fact that gabion baskets are generally purchased in a foreign currency. Finally, its construction requires less local manpower, which reduces opportunities for temporary paid employment.



Example of the gabion check dam in the Kady ravine, built as part of the "Haïti filières durables dans le département du Sud" project in the locality of Marcabé.

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**CHECK DAMS WITH BASINS:**  
MAXIMISING THE POTENTIAL OF MEDIUM-SIZED GULLIES

**Composition**



1

**A check dam**

Role: liquid and solid flow control.  
Encourages colluviation and tends to regulate gullyng.

● Check dam with or without a basin



● Gabion check dam

● Masonry check dam



Role: promoting alluviation, with sediments forming a thick, fertile soil upstream of the check dam.



2

**A basin**



Role: water storage for agriculture or domestic use.

3

**One or more glacis**



Role: water recovery.

**Multi-functional structures**



1

**Improving groundwater recharge, stimulating water seepage**

● Temporary reserve of open water upstream of the check dam.

2

**Water for agriculture and domestic use**

● Temporary water table in the deposited materials.

3

**Improving agricultural productivity**

● Creating humid micro-environments that are conducive to the production of high-value-added species.

4

**Improving biomass and biodiversity**

● "Fond frais" promoting diversification and multiplication of cultivated species.  
● Reducing the exploitation of the hillsides.

**Comparative advantages**



**Over dry stone check dams**



✗ They are not watertight. They reduce the speed of water flow but do not retain water.

✗ Short lifespan: they are vulnerable to heavy flooding and trampling by livestock.

✓ But can be used to complement masonry check dams.

**Over hillside lakes**



✓ The ratio between the cost of building these lakes and the quantity of water stored is more attractive than for masonry structures.

✗ The reservoir will drown a large area of farmland.

✗ It can be difficult to get water to the plots.

✗ The quantity of water retained makes collective management necessary, which can be difficult to implement.

✗ The cost of building hillside lakes includes a significant amount of purchases in foreign currencies.

# Conclusion

The masonry and gabion structures created by UEPLM are inspired by the stone check dams traditionally built by farmers in gully bottoms.

However, UEPLM's structures are more complex and better finished, granting them a greater impact than the latter. As well as controlling erosion, these developments are designed to stimulate the development of agriculture. The masonry check dams were conceived as options for creating complex courtyard gardens with a wide variety and density of species grown together in the gully bottoms.

Capitalising on its experience in the field, UEPLM has developed an expertise in the construction of masonry and gabion check dams. The following sheets (sheets 2.2 and 2.3) present design elements for these structures, providing guidelines for their construction, which can be adapted according to the specific context of each region of intervention.

**HAITI:  
WATERSHED  
MANAGEMENT  
AND COMBATING  
SOIL EROSION**

**CHAPTER 2**  
**SELECTING AND  
IMPLEMENTING A RANGE  
OF COMPLEMENTARY  
INTERVENTIONS**

**DATA SHEET 2**  
**Selection of sites for the creation  
of masonry check dams**

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Ensemble, construisons leur avenir !

# 3

## Choosing gullies for check dam construction

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- p. 3 Erosive phenomena at work in the gully
- p. 4 Other gully selection criteria

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## Narrowing the selection of sites best suited for the structures

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## Conclusion

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## INTRODUCTION

Un Enfant Par La Main recommends a two-step process for selecting sites for the construction of masonry check dams. The first step is to identify suitable gullies, based on observations and conclusions drawn from the landscape analysis (see Sheet 1.1). The second step is to narrow the selection of identified gullies where the construction of a check dam is possible and relevant.



# Choosing gullies for check dam construction

## Prioritizing medium-sized gullies

Medium-sized gullies are particularly well-suited to the creation of masonry check dams. The term medium-sized gullies is used by Un Enfant Par La Main to describe gullies of intermediate size, neither too narrow nor too deep, whose geomorphological characteristics are conducive to the creation of masonry structures. These medium-sized gullies encourage col-luviation and are subject to limited regressive erosion.

Several criteria can be used to identify this type of gully:

- The length of the gully is between 500 metres and two kilometres.
- Slopes range from 5 to 20%. Steeper slopes reduce the volume of water that can be retained upstream of the structures and the surface area effected by alluviation.
- The gully is not located on hillsides affected by intense gullying and active landslides.

## Erosive phenomena at work in a torrential gully

Ongoing erosive phenomena in large gullies (also known as torrential gul-lies) discourage the construction of masonry check dams, which are of interest to agricultural production. This is particularly the case if the gully is large, or if it shows signs of coarse

debris and mud flows. Furthermore, the construction of masonry check dams does not seem appropriate in the case of landslides. This would generate thrusts that would subject the structures to stress, leading to til-ting and cracking.

## Other gully selection criteria

### Agricultural development potential

As the construction of check dams in gullies is also intended to promote agricultural development, the conditions for increasing agricultural production must be analysed:

- Are there several farms in the vicinity that could benefit from developing the gully?
- Are there any nearby livestock farms or agricultural development areas that could benefit from the new water resources?
- How is livestock farming managed in the region, and what role will it play within the optimisation of the developed areas?

### The economic benefits of water supply

The check dams are complemented by a basin for water storage. Once the structure has been built, the gully will become a periodic water supply source. Gullies with the following characteristics are preferred:

- Nearby dwellings with a need for access to water for domestic use like washing and giving water to livestock;
- The possibility to develop high-value crops downstream of the check dam (market gardening, fruit trees, sugar cane, etc.).

### Proximity of building materials and site access

The construction of a masonry check dam requires nearby high-quality sand. Fast access to large boulders also plays a role in the choice of location.

In addition, when access to the site is difficult, the construction of rural roads can be a prerequisite for the opening of the construction site, while at the same time improving access to the area.



Material deposition (sand and boulders) in preparation for the construction of a check dam in the Kady ravine, Marcabée locality.

© UEPLM, 2020

# Narrowing the selection of sites best suited for the structures

## Gully width

Based on Un Enfant Par La Main's experience, reinforced concrete masonry check dams should be built at sites where the width of the gully does not exceed 20 metres (see technical specifications for building masonry check dams, sheet 2.3). In sites with wider gullies where the construction of a check dam is required, a gabion check dam should be considered.



© UEPLM

## The nature of the banks

Check dams must be anchored in the bedrock of the banks. The bedrock must be at a shallow depth in the gully bed to ensure solid foundations. In addition, the bank must be stable and ground movement limited, to facilitate the embedding of the structures. Clay and marl banks, which are generally unstable, must be avoided.

By embedding the check dam in the banks, we can build structures that are relatively light in comparison to gravity structures which only resist overturning and landsliding because of their weight.

However, the "embedding" effect only works if several conditions are met:

1. The width of the gully must be modest, as mentioned above;
2. The banks must be able to withstand the forces transmitted by the structure;
3. The reinforcement of the structure must be sufficient to hold all of the sections together (whereas for a gravity structure, each section must be capable of resisting the forces experienced during a flood).

If the bedrock is permeable, as is sometimes the case in limestone rich areas, the construction of check dams is of little use, as water quickly percolates and run-off is rare. In such cases, it is preferable to build impluvia to collect and store water.



Drainage channel Favette 2021

## Land tenure

Farmers who own their own land are more likely to invest in their land than those who work on plots under tenancy (tenant farming, sharecropping, or even the use of land for an indefinite period until a sum of money borrowed from the owner is repaid - a form of tenure known as “kenbe tè” in the Port-Salut region) or those who have not been able to secure land tenure (undivided). When selecting sites, UEPLM aims to ensure that land tenure is secure and non-conflicting, for example when the land user is the owner (which is the case for the structures built in Port-Salut area). If this is not the case, plots developed by the same farmer for several years should be prioritized.

Sites with a gully on the boundary of two properties are useful as long as the structures can benefit both families.

Furthermore, while the presence of fences is useful to protect structures and crops from livestock, they can limit access to water. In the Port-Salut region, all structures were built on unfenced plots, which facilitated access to water for all the inhabitants of the developed areas.

## Topography of the gully

It is advisable to choose sites immediately downstream of an area where the slope of the longitudinal profile of the gully is low (after a flat area, for example) because this increases the volume of alluvium retained by the structure.

## The production system of the plot's farmer

Masonry check dams must be built on plots of land that have been developed by a farmer. Prior to the construction of the check dam, the degraded state of the soil and the high risk of crop destruction due to water run-off during floods may explain the limited development of the land. However, the farmer's dynamic approach can also be seen in numerous other ways: crop rotation, organic matter management, small-scale improvements to the plot (stonework, planting material), and so on.

## Position upstream or downstream on the gully

In Un Enfant Par La Main's experience, there is no decisive advantage to starting structures upstream or downstream. The two possibilities offer different advantages, for which a compromise must be found:

- **In the downstream part of the gully**, the longitudinal profile is generally not very steep, enabling a larger alluvium deposit to be formed for a structure of equal height. This may lead to a preference for this part of the gully.

- **In the upstream part of the gully**, the catchment area is still of modest size and the bedload is low. The longitudinal slopes of the gully are generally steeper, which reduces the volume of alluvium behind a structure for a given height. It should be noted that some stakeholders agree that by multiplying the number of structures upstream of the gully, it is possible to influence the gully's flow rate and the bed load, limiting the impact of downstream flooding. However, this remains a hypothesis and needs to be documented.

## The constraint of access to water for construction

Where access to water is difficult, the first masonry check dam should be located such that access to water for subsequent works will be made easier (given that water is necessary to make concrete). The first check dam can also be located near a spring, where it will be complemented by a substantial glacis.

## Spacing between different check dams along the same gully

In the case of large gullies, or variable-bed torrential ravines, it is necessary to implement a “stepped” correction using a succession of check dams based on calculated spacing. These cases are not covered by the watershed management approach detailed here.

In more modest, medium-sized gullies, where incision is mainly due to deficiencies in the vegetation framework, it is not necessary to apply this type of rule. Check dams can be built at all sites that meet the above criteria.

# Tools and methods for site selection

Un Enfant Par La Main recommends that the first step to select a gully – if there is no way to be on ground – is to use Google Earth.

The length of the gully and the surface area of the hillsides upstream of the chosen location are determined via Google Earth (the Google Earth Pro version, now free, makes it easier to estimate this surface area).

The remote sensing data is then supplemented by photos to create a “report” on the site, which provides strong arguments in favour of the choices made and forms part of the “initial” state.

Subsequently, the erosive phenomena, the potential for agricultural development, the importance of water supply and the proximity of building materials need to be analysed at different times of the year and on site. During certain seasons, the abundant vegetation makes it impossible to get a precise idea of the gully's layout. It is therefore preferable to wait until the harvesting season to carry out these visits.



OUR APPROACH, ILLUSTRATED

## Illustrated example: “Haïti filières durables dans le département du Sud” project

As part of the project “Haïti filières durables dans le département du Sud”, the sites where the structures are to be installed were identified following a field survey carried out by UEPLM, its technical and financial partners and local institutions to identify the problems the region is faced with, and more specifically those linked to erosion phenomena in vetiver-growing areas. During this prospection mission,

the aim was to identify areas with high agricultural potential that could be developed (gullies, hillsides, etc.), while considering local constraints (availability of materials - water, sand - and local manpower, accessibility of the areas to be developed for the supply of materials, etc.). If all these criteria were met, the site was approved (see Figure 3); if not, it was rejected (see Figure 2).



### Example 1: an approved site

- ▶ An area surveyed by the “agro” expertise due to its high agricultural potential
- ▶ An erosion regime (both hydrological and due to tillage) that contributes to a rapid weakening of the hillsides (intense soil loss)
- ▶ The civil engineering team validated the site after verifying the feasibility of the anchoring and carefully analysing the water flow regime.



### Example 2: a rejected site

- ▶ An area surveyed by the “agro” expertise due to its high agricultural potential and shielding thanks to a road upstream: a gabion check dam was proposed.
- ▶ The civil engineering team rejected it however due to the alluvial soil, which was unfit for the anchoring of the check dam.

**Final decision: suggest a reinforcement of the green structures already present.**

Process for identifying a site for development, example 1 of 2 - Extract from the summary presentation of UEPLM's 2019 prospecting mission in the Port Salut - Cavaillon - Les Cayes region (source : UEPLM)

## Illustrated example: Maurepos gully in Salagnac (Nippes)

The Maurepos gully was developed by Un Enfant Par La Main in 2014 following 2012's Hurricane Sandy. The team's excellent understanding of the region enabled it to identify the gully's interesting agricultural potential: it was relatively sheltered from the winds and farmers had developed a few terraces with stone walls since the 1980s. In this context, the development of the gully bottom was intended to improve water availability for market garden nurseries. In addition, the construction of a rural track on the interfluvium was intended to improve the circulation of motorized vehicles for the marketing of agricultural produce, while at the same time

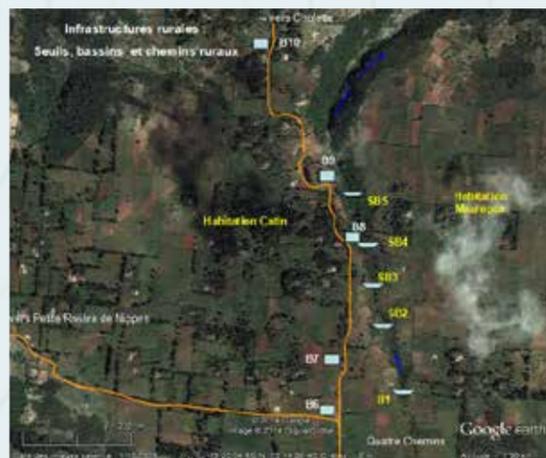
channelling runoff water, which was stored in several basins built below the track. As a result of the work carried out by UEPLM, the head of the Maurepos gully (800m to 945m above sea level) was equipped with 5 check dams at the bottom of the gully, over 1,300m of tarmac creating a large surface area for rainwater collection, and 8 basins below the tarmac.

The 8 basins were built to prevent runoff from damaging rural roads and are now used to collect water for agricultural use. Excess water is finally channelled into the Maurepos gully, a ravine equipped with flood control check dams.



Check dam with a basin (SB2) in the Maurepos gully (2013). A side glacis has been built to capture low dry-season rainfall.

SB: Check dam with a basin, B: basin, the orange line connecting basin 6 to basin 10 is that of the multifunctional road built on the interfluvium.



During the scouting phase: view of the head of the Maurepos gully and indication of planned development sites.



## Conclusion

Compliance with the criteria for identifying suitable sites for the construction of masonry check dams is a determining factor in the usefulness, quality and durability of the structure. Certain criteria must be strictly applied. These include the layout of the gully (size, slope, nature of the soil, etc.) and the erosive phenomena observed. Other criteria can be considered: For example, it is possible to build a structure even if the gully is little used, due to a significant need for water in the area.

**HAITI:  
WATERSHED  
MANAGEMENT  
AND COMBATING  
SOIL EROSION**

**CHAPTER 2**  
**SELECTING AND  
IMPLEMENTING A RANGE  
OF COMPLEMENTARY  
INTERVENTIONS**

**DATA SHEET 3**  
**Designing a gully bottom  
check dam**

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# 3

## Technical features of masonry check dams

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## Conclusion

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## INTRODUCTION

UEPLM's expertise in building masonry and gabion check dams is based on feedback and the result of testing, observing and readjusting these structures.

# Technical features of masonry check dams

## Sizing of masonry check dams

### Sizing of the check dam crest

Sizing the check dam crest must be done before sizing the check dam itself. During floods, the check dam crest acts as a spillway, enabling excess water to flow over the check dam while preventing it from going around the structure. UEPLM gauges the width of the check dam crest based on the traces left by previous floods. These traces are used to infer the flow rate in the gully and to calculate the height of the check dam crest. However, it is often difficult to identify these traces. The following dimensions are the result of our field work:

- **Width:** 4 to 6 metres
- **Height:** 0.50 to 0.80 metres

The layout of the gully defines the check dam crest's size. The more the gully is incised, the more the water flow is concentrated in a narrow bed and the narrower and higher the check dam crest must be. The wider the gully, the more the water flow is spread out and the wider and lower the check dam crest must be.

### Check dam height

Based on its experience, UEPLM has identified a trend in the height of check dams (see above), although this is not a standard that must be systematically applied. The height varies according to various factors such as:

- **The position of the anchoring points in the banks of the gully.** The higher they are, the higher the check dam will have to be.
- **The kind of soil in the gully bottom.** If excavations and foundations cannot be made due to the nature of the bedrock, the check dam will have to be low. The anchoring in the banks of the gully will have to be made at a higher elevation to ensure a minimum height for the check dam.

Picture of a gully bottom check dam in the Kady gully in Morabé. The width of the check dam is indicated by the white arrow.



The check dam can be raised once the deposited sediments have filled the space upstream of the check dam. This increases the surface area for alluviation and the volume of retained water. This cost-effective strategy allows the check dam to be built initially with smaller dimensions.

## Technical features of masonry check dam construction

The check dams are made of rock masonry and strengthened by reinforced concrete beams and posts. The dimensions of the masonry check dams built by UEPLM have evolved with experience. Each check dam must be adapted to the specific conditions of the site where it is built. Consequently, dimensions vary greatly from one structure to another.

Masonry check dams built by UEPLM are inspired by different types of structures such as retaining walls, flood control structures and torrential correction works, but they are slightly different.

Retaining walls are not impermeable and are therefore not designed to withstand hydrostatic pressure.

Flood control structures are large permeable structures fitted with

an opening to reduce flood peaks. Masonry check dams differ in that their smaller size is not designed to reduce floods significantly.

Torrential correction works are built across gullies that are subject to torrential flow (landslides, mudflows, unstable banks), which means that large dimensions and proper reinforcement are necessary. This is not the case for masonry check dams.

The masonry check dams built by UEPLM are also different from the "gravity structures" described in erosion control manuals. These structures have no reinforcement and must withstand the stress they are subjected to, like hydrostatic pressure, by their weight alone. In the absence of reinforcement, the stability of the structure is calculated for

**"Each check dam must be adapted to the specific conditions of the site where it is built."**

each 1m section. There is no mutual support between the different parts of the structure when exposed to stress, and the structure does not form a single unit. In contrast, the check dams built by UEPLM are heavily reinforced and benefit from having foundations which are sunk in the banks. The various sections of the structure are linked together, so not only does the check dam form a whole, but some of the stress is also transferred to the banks. As a result, the structure is far less thick than a gravity structure of the same height.

Formulas found in handbooks on the design of erosion control structures are not suitable for the gully projects carried out by UEPLM.

There is little value in carrying out in-depth studies on the sizing of check dams, and these studies are not worth the significant financial investment required. In fact,

according to UEPLM, the usefulness of check dams is mainly agricultural. The damage or destruction of a check dam presents no risk to human life. The challenge is therefore to find a compromise between cost and solidity that will increase agricultural yields and reduce the impact of downstream flooding at a reasonable cost.

The dimensions proposed in this sheet have been defined using observation and feedbacks on existing check dams. During the 2008 hurricanes, the heavy flooding that occurred at Gros Morne did not damage the structures built by UEPLM. This demonstrated that the design was appropriate and that the structures could withstand high hydrostatic pressure.

Listed below are the characteristics of three types of structures adapted to different gully sizes:

### AVERAGE DIMENSIONS OF CHECK DAMS CREATED BY UEPLM IN GULLY BEDS OF VARYING NARROWNESS

Type	Total check dam height	Thickness of the check dam
Type 1	2 m or less	0.50 m
Type 2	2 to 3 m	0.60 m
Type 3	3 to 4 m	0.80 m

Characteristics of the posts	Characteristics of the beams
<ul style="list-style-type: none"> <li>Spaced 2 m apart</li> <li>Reinforced with 8 3/8-inch irons and 1/4 inch frames spaced 20 cm apart</li> </ul>	<ul style="list-style-type: none"> <li>2 horizontal beams reinforced with 8 3/8-inch irons</li> <li>1 tie beam under the check dam crest reinforced with 4 3/8-inch irons</li> </ul>
<ul style="list-style-type: none"> <li>Spaced 2 m apart</li> <li>Reinforced with 12 3/8-inch irons and 1/4 inch frames spaced 15 cm apart</li> </ul>	<ul style="list-style-type: none"> <li>3 horizontal beams:                             <ul style="list-style-type: none"> <li>Ground beam reinforced with 12 3/8-inch irons</li> <li>Middle beam reinforced with 6 3/8-inch irons</li> <li>Tie beam reinforced with 4 3/8-inch irons</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>Spaced 2 m apart</li> <li>Reinforced with 16 3/8-inch irons and 1/4 inch frames spaced 10 cm apart</li> </ul>	<ul style="list-style-type: none"> <li>3 horizontal beams:                             <ul style="list-style-type: none"> <li>Ground beam reinforced with 16 3/8-inch irons</li> <li>Middle beam reinforced with 8 3/8-inch irons</li> <li>Tie beam reinforced with 6 3/8-inch irons</li> </ul> </li> </ul>



## Construction of the masonry check dam's complementary structures

### Buttresses

Buttresses can be added against each vertical post to reinforce the check dam. They are particularly useful when:

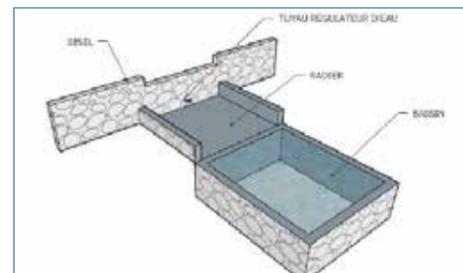
- the riverbed width is large, and post sinking is unreliable.
- superficial deposits over the bedrock are thick and the foundations shallow.

Buttresses can also support a staircase to cross the structure. A horizontal reinforced concrete beam should be placed at the base of the buttress, with the same reinforcement as the filler beam. The buttresses should be built at the same time as the structure of the check dam, before the post is cast.

### The water control pipe

A small pipe, fitted with a valve, runs through the structure. In the event of flooding, it can be used to shorten the duration of submersion upstream of the structure. It can also be used to draw small quantities of water for irrigation when the basin is empty.

The pipe makes it easier to supply water and prevents crops upstream of the check dam to be submerged too long.



### The basin

UEPLM builds two kinds of basins, one large and one small. The technical features of these basins have been determined by UEPLM using feedback from prior projects.

### UEPLM-BUILT BASIN DIMENSIONS

Type	Volume	Wall height	Wall thickness	Slab thickness
Small basin	de 40 to 60 m <sup>3</sup>	1.50 to 2 m	50 to 60 cm	15 to 20 cm
Large basin	de 60 to 110 m <sup>3</sup>	1.50 to 2 m	60 to 80 cm	20 to 25 cm

The bottom of the basin is reinforced with a 20 cm rock shaft placed beneath. The slab is made of reinforced concrete. The grid is made up of 3/8-inch irons spaced 25 cm apart for the small basins and 15 cm apart for the large basins. When the basin is laid directly on the ground, a channel is dug all around the edge of the future basin and filled with rocks and concrete masonry on which the grid irons will be laid.

6 3/8-inch irons with 1/4 inch frames spaced 10 to 20 cm apart. The irons are set 10 cm into the masonry.

When the quality of the materials is poor or the basin is too large, posts are placed in the 4 corners of the basin, supplemented by intermediate posts if the distance between the main posts exceeds 4 metres. The posts are reinforced with 8 to 12 3/8-inch bars and 1/4-inch frames spaced 10 to 20 cm apart.

The basin has an upper beam (at the crest). The beam is the same thickness as the wall. It is reinforced with 4 to

Buttresses are built to ensure the stability of the unburied walls of the large basins.



Building the basin's retaining walls during the basin's construction phase in the Kady gully (Marcabée).

### The downstream check dam apron and basin apron

The apron placed between the check dam and the micro-retention area and/or downstream of the basin reduces the risk of structure scouring. The apron should be slightly wider than the check dam and twice the height of the waterfall.

A shaft is dug, then a bed of packed rock at least 20-25 cm thick is formed. A grid of 3/8-inch reinforcing bars spaced 20-30 cm apart is laid over the shaft. A mixture of 350 kg of cement per m<sup>3</sup> of concrete is then poured into the shaft. Shims must be put in place before the concrete is poured to ensure that the reinforcement is well sunk in the concrete.

To protect the apron and the basin from soil from landslides or that has

been washed away by erosion, either small lateral walls must be built, or perennial species must be planted.

### Fitting the structure for clothes-washing

As the basins are often used for washing by neighbouring families, they need to be properly fitted to drain water. This can be done by building a glacis with a system for draining soapy water into a sump.

This photo shows a masonry check dam built in the Kady gully, Marcabée. A basin adjoins the check dam and stores run-off water. Downstream, the basin's apron is extended to avoid scouring on the basin's foundations. The stored water is used by farmers to water their livestock and for supplementary irrigation.



The gabion check dam of the Bakwas gully in Salagnac.

© UEPLM, 2014



## Technical features of gabion check dams

When the width of a gully exceeds 20 metres, UEPLM opts for the construction of a gabion check dam instead of reinforced concrete one. This guarantees the check dam's stability when the foundations cannot be reliably sunk.

The width and/or thickness of a gabion is of 1 metre. The first layer of a gabion check dam is made of gabion baskets, or "spread footing", measuring 1m x 1m x 0.5m. The next layers are made up of gabion baskets, or "boxes", measuring 1m x 1m x 1m.

Then, a 15 cm concrete screed is poured into the foundation, and 3/8-inch reinforcing bars are fixed into

the concrete every metre to stiffen the check dam and limit crushing and deformation.

When the gabions are subject to heavy run-off and/or when heavy solid transport is expected, a concrete screed about 10 cm thick is poured over the top of the gabions. The screed is anchored to the gabions using steel hooks sunk into the concrete. This slab should be laid between 6 and 12 months after the gabion structure has been built, once it has settled.

Parging is applied to the upstream-facing side of the gabion to make it impermeable.

# Additional practical information for check dam design

UEPLM has been leading a process of reflection, debate and innovation on the preparation and presentation of cost estimates for these projects. This process was carried out during the educational workshops of the Water Management Programme in the Artibonite Basin (PROGEBa), in Platteau Central, from 2014 to 2015.

UEPLM did not settle for what had already been achieved but sought to improve on it. The innovations presented here still need to be consolidated and further tested, but they concern:

- Field surveys
- Design of the structure
- Calculations leading to a cost estimate

## Field surveys

The aim is to improve the method of surveying in the field so as to facilitate the subsequent design of the structure and the preparation of the cost estimate. Once the location of the future structure and the point where one wing of the structure intersects the slope have been chosen, as well as the point where one wing of the structure intersects the slope, the width of the structure is measured with a surveyor's tape stretched horizontally. Then, the height above the gully bottom is measured with the tape stretched vertically.

An innovation was suggested after a debate had ruled out alternatives such as using an inclinometer (also known as a clinometer) to obtain a profile and cross-section of the gully at the site of the structure. The proposed method involves adding coloured marks to the horizontal tape at intervals of 3 or 4 metres. At each of these locations, the height of the structure above the bottom or banks of the gully is measured, enabling the cross-section of the gully to be drawn more accurately.



Once the tape is stretched horizontally across the gully, we can measure how high the future check dam wings (which will consolidate the existing dry stone check dam) will need to reach at the gully bottom.

## Check dam and basin design

The PROGEBA project innovated the design of all structures, not just standardized ones. The possibility of designing the structures using 3D software had not been considered at the time, as the software and training would have been too costly (software such as SketchUp can nevertheless be used with a short training course).

Defining the dimensions of the structures required both observing existing structures and speaking extensively with the UEPLM practitioners responsible for the design. We can describe this process as one of extracting knowledge from practical as well as implicit understandings.

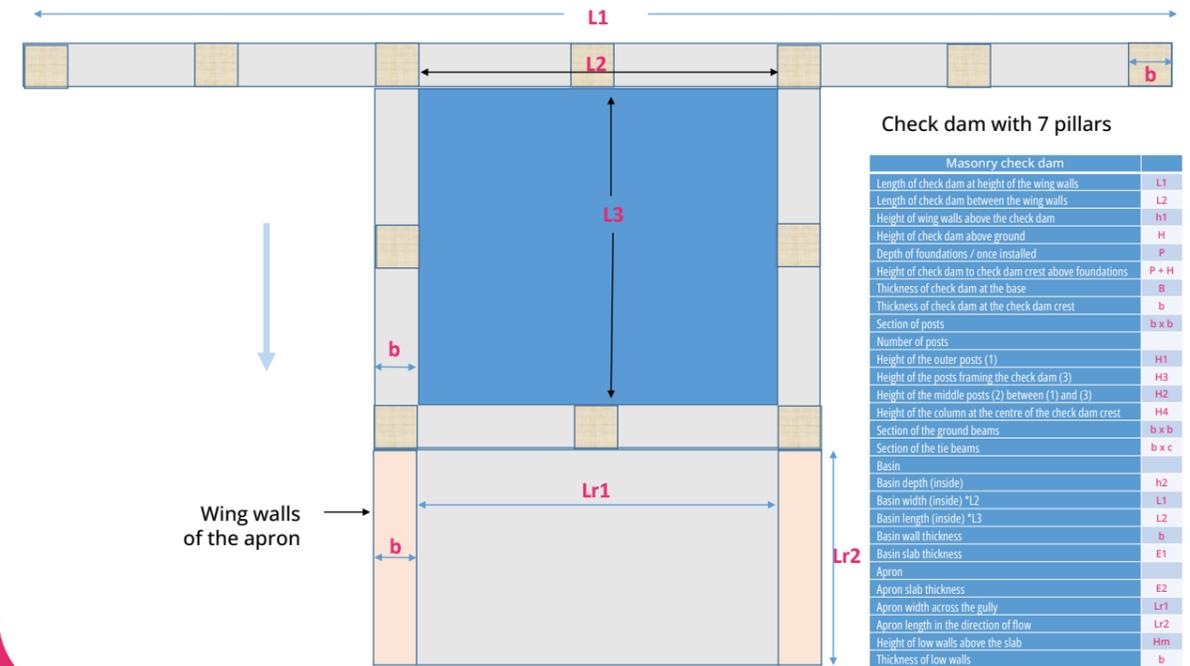
Each structure design includes:

- A plan view
- A cross-section along the axis of the gully at the level of the check dam crest, supplemented by the longitudinal profile of the gully before development
- A cross-section perpendicular to the axis of the gully, supplemented by the longitudinal profile of the gully before development.

These designs are either drawn on graph paper or made with PowerPoint using the drawing tools. They are completed with the dimensions of the structure. Having a fairly accurate profile of the gully makes it possible to draw the structure and especially its indentations in the bank.

### CHECK DAM WITH A BASIN SB2 (B)

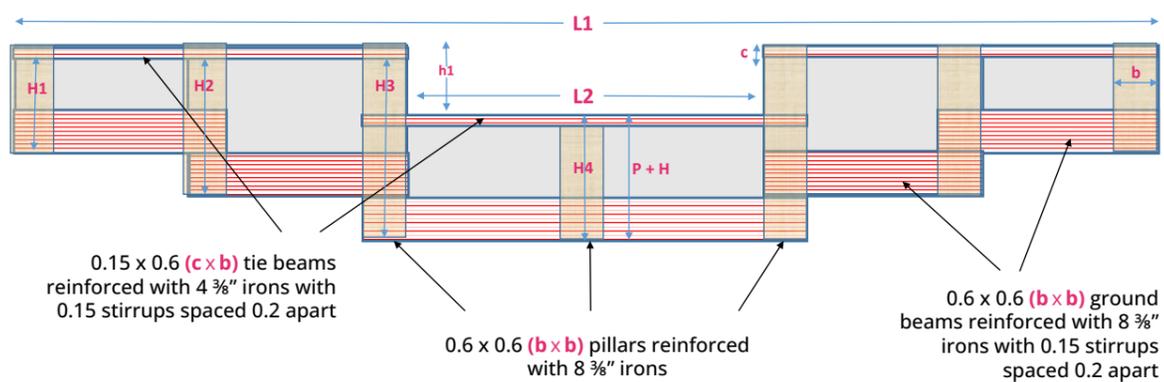
Top view (L1 = 9 m)



### CHECK DAM WITH A BASIN SB2 (A)

Front view

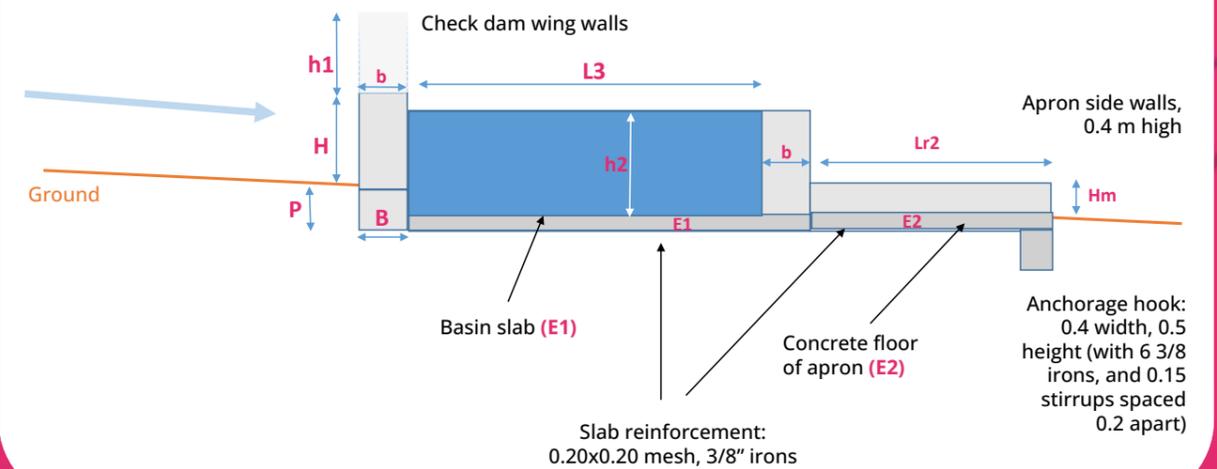
(L1 = 9 m)



*The reinforcement of the vertical columns and beams must be solid.*

### CHECK DAM WITH A BASIN SB2 (C)

Lateral view



## Cost estimation

Once the dimensioned drawings of each structure were available, an Excel spreadsheet was used to calculate the various elements of the cost estimate.

This spreadsheet was used to establish the bill-of-quantity: the total volume of earthworks required for the foundations and anchoring of the wings in the banks, the volume of large stone masonry and various types of concrete, the surface area to be rendered, the length of rebars of various diameters, etc. Once the

quantities for each type of concrete have been defined, the spreadsheet calculates the quantities of cement, sand, gravel and water required.

By assessing the cost of labour and materials, the elements of the estimate can be calculated.

More generally, the preparation of a standard calculation sheet for each major type of structure (defined according to the number of columns) has made it possible to automate the calculation of a given structure. This

calculation takes place in stages: once the dimensions have been entered, the Excel spreadsheet calculates the intermediate data used for the different elements of the cost estimate.

### Conclusions on innovations in field surveys, structure design and the calculation of cost estimates

These innovations simplify the preparation of cost estimates and are an important element in the transmission of UEPLM practitioners' know-how, as well as in communication

with the sponsor or client during a project.

Inevitably, many unforeseen circumstances will arise throughout the course of a project. For example, the nature of the banks cannot be known precisely in advance, nor can the cost per cubic metre of sand! Adaptations must be made as the project progresses. The use of sketches and spreadsheets makes it possible to assess the effects of a given modification on the budget and facilitates discussions with the financial backer and the project owner.



## Conclusion

The various elements presented in this data sheet are benchmarks for the construction of water retention structures. Based on experience, they provide a set of recommendations that can inspire professionals working on the construction of check dams. As each situation is unique, these sheets are by no means a set of guidelines to be applied systematically. Furthermore, some of these elements could still be discussed for the calculations used in hydraulic engineering to confirm and/or improve them.

In a medium-sized gully, the choice of sites to be developed requires great care. The factors to be considered are detailed in Fact Sheet 2.2.

Furthermore, once the structure has been built, a careful observation of farmers' practices on the developed plots will make it possible - with the help of suitable finishes - to optimise the use of the "fonds frais" and the use of the water retained in the basin.

**HAITI:  
WATERSHED  
MANAGEMENT  
AND COMBATING  
SOIL EROSION**

**CHAPTER 2**  
**SELECTING AND  
IMPLEMENTING A RANGE  
OF COMPLEMENTARY  
INTERVENTIONS**

**DATA SHEET 4**  
**Creating live check dams  
in gully bottoms**

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# 4

## Biological development projects that enhance masonry structures

- p. 4 In terms of gully development projects
- p. 5 From a methodology standpoint
- p. 6 The example of the “Haïti filières durables dans le département du Sud” project

# 7

## Development techniques for live check dams

- p. 7 Creating live check dams in gully bottoms with “regrowing wood” cuttings
- p. 8 Growing “protective” species in gully bottoms
- p. 9 Establishing a network of nurserymen

# 10

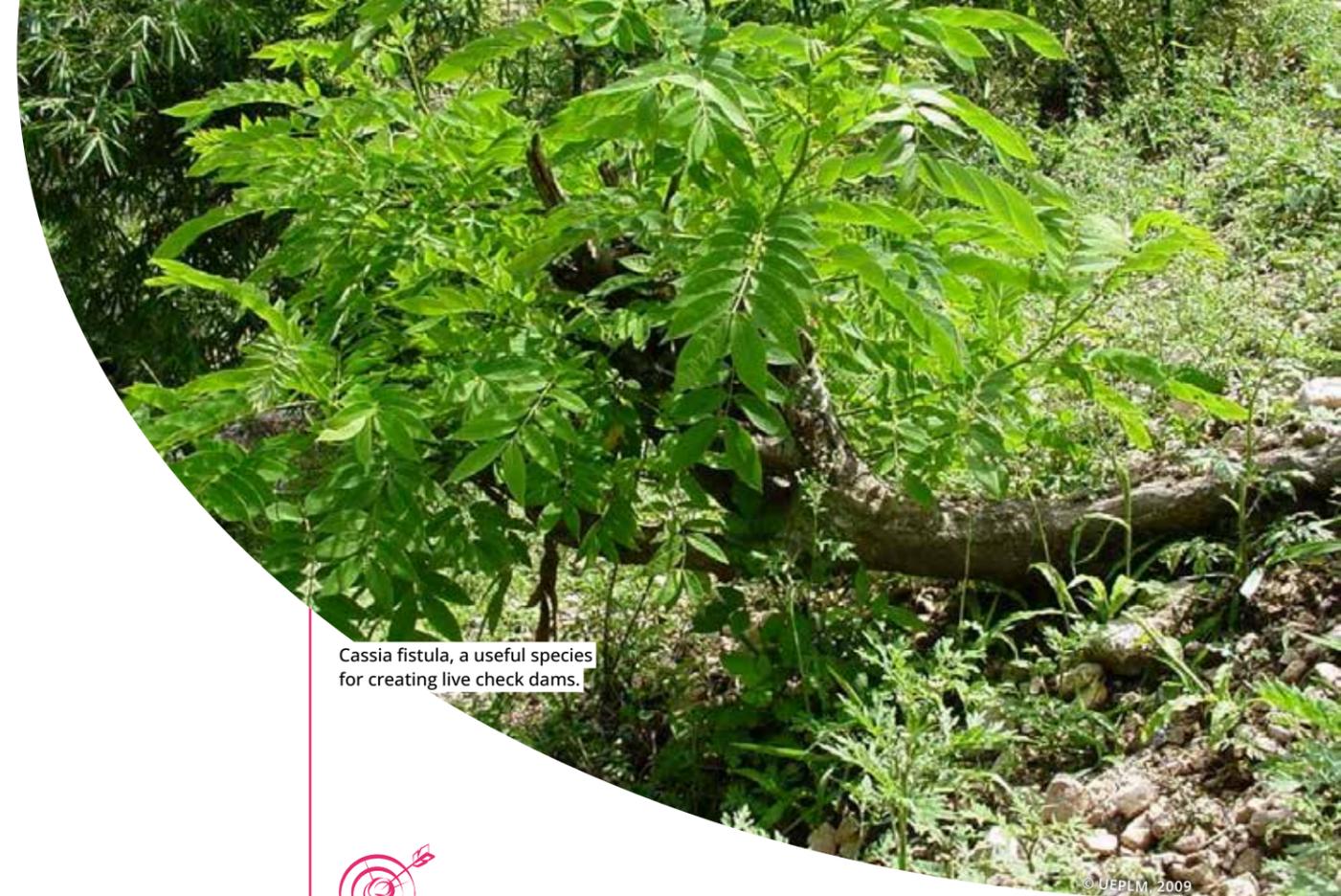
## Collaborative efforts are essential to the long-term survival of the live check dams

# 11

## Conclusion

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Cassia fistula, a useful species for creating live check dams.

© UEPLM, 2009



Despite there being a wealth of available plant material, civil engineering techniques remain the preferred method for gully development in Haiti. However, many woody plant species can be propagated via cuttings and are well adapted to colonise deteriorated environments.

Across Haiti, farmers demonstrate their mastery of plant propagation techniques such as using cuttings to build living fences around cultivated plots. Such techniques, inspired by the local farmer’s knowledge of the land, are significant tools when it comes to replicability.

When building live check dams in medium-sized gullies, these techniques are a cost-efficient way to hold back the soil that has been stripped from the slope. These techniques play a role in regulating the hydrological regime and, above all, help farmers improve the agricultural productivity of the newly created “fonds frais”. Inspired by local farmers’ know-how, these techniques are accessible to many farmers, provided they make a moderate investment (cuttings, tools).

## PREVIOUS FAILURES AND NEW PERSPECTIVES

It should be noted that some watershed development projects that introduced the technique of live check dams at the bottom of gullies resulted in failure.

One reason for this failure was the lack of consideration given to the benefits of increased agricultural production, which resulted in the regular spacing of the check dams along the gully bottom (implementing the so-called “staircase correction”). Applying this type of correction is far from being mandatory, and UEPLM has demonstrated that the choice of an adequate site for the living check dam – i.e. where successful negotiations with a farmer have taken place – is more important, particularly if it built in tandem with a masonry check dam. This negotiation improves the likelihood of the check dam being maintained, specifically through the repair of breaches and the filter after a flood. This change of perspective is an important contribution from UEPLM.

# Biological development projects that enhance masonry structures

## In terms of gully development projects

Masonry check dams and live check dams are complementary. The construction of live check dams upstream of masonry structures improves the effectiveness of the latter: live check dams increase the low-water flow in the gully and reduce solid flow (traction). In addition, live check dams created using productive plant species that are useful to farmers, help to enhance the “fonds frais” created behind each structure. In this way, biological treatment of the part of the gully located upstream of a masonry check dam improves its effectiveness from both an environmental and an agricultural standpoint.

In the same way as for the creating of masonry structures, the optimisation of the living check dam depends on the reliability of the land tenure of the developed plot and on the farmer's ability to exploit the area upstream of the check dams - which are enriched by sedimentation - with high value-added crops (market gardening, arboriculture). Possible competition for the use of these areas with livestock farming may also reduce the value of the “fonds frais”.



Complementarity of the live check dams - shown in green - and the masonry structures - shown in yellow - in the Ravine Diable at Salagnac (Nippes), improving gully development.



An example of complementarity between live check dams and masonry structures: the candelabra tree hedge limits scouring of the check dam's apron - Ravine Chatelain in Gros Morne.



## From a methodological standpoint

Given the importance of live check dams, Un Enfant Par La Main recommends a two-stage process:

- The first stage is identifying suitable locations for masonry structures designed to store water for farming and improve the fertility of the lowlands is prioritized. During this initial stage, talks between the farmers and the owners of the plots will also provide an opportunity to discuss the possible creation of live check dams.
- Once the masonry work has been completed, the second stage consists of specifying the nature of the live check dams which boost the effects of the masonry structures, as well as the potential installation of hedges (see sheet 2.6) on the gentle slopes on either side of the developed plot.

The pace at which these developments are carried out depends on:

- The availability of skilled personnel, who can select the site, create the live check dams, and identify the necessary support measures.
- The possibility of using prior projects as a basis for spreading innovation.
- The degree of trust established with the farmers, as this will determine the extent to which they take ownership of the structure and manage it in the future.

Feedback based on the innovations specific to each project will make it possible to draw up technical guidelines to encourage the spread of this technique and expand its use in practice.

The complementary nature of the two types of check dams also stems from the fact that live check dams are often created during the rainy season, whereas masonry structures are built during the dry season. However, some types of live check dams can be created during the dry season.

## The example of the “Haïti filières durables dans le département du Sud” project

We combined masonry structures with biological installations throughout this project. For example, in the Kady ravine in Marcabée (Port Salut), the construction of a masonry check dam and water storage basin was accompanied by the planting of species like bamboo, elephant grass, and cedar, upstream

and downstream of the structure. This biological structure consolidates the masonry one. Support was provided for the planting of productive species in these high-agricultural potential developed areas (banana, sugar cane, market gardening, etc.). The photo below illustrates the layout of the developed gully:



Complementary use of a masonry structure – via the installation of a check dam with a basin – and a biological structure (bamboo, elephant grass, cedar) in the Kady gully at Marcabée (Port Salut).

© UEPLM, 2020

# Development techniques for live check dams

The development will be more effective at counteracting erosion if the gully is treated in its early stages, when the loose soil at the bottom of the talweg has not yet been stripped away. In this case, the creation of live check dams is easier. Stabilising the gully using organic structures will limit the incision of its bed and the subsequent regressive erosion of the slopes. This has a preventive effect: by halting the incision process, the slopes retain a greater amount of soil than the volume deposited downstream of the check dam by alluviation.

## Creating live check dams in gully bottoms with “regrowing wood” cuttings

A live check dam can be created along the bottom of a gully using cuttings planted directly across the bed, in one or two closely spaced rows (around 0.3 m between cuttings). Using trees that are already present on the banks to build the check dams is recommended. It is also recommended to take full advantage of existing vegetation to restore a weakening woody-plant framework at a low cost.

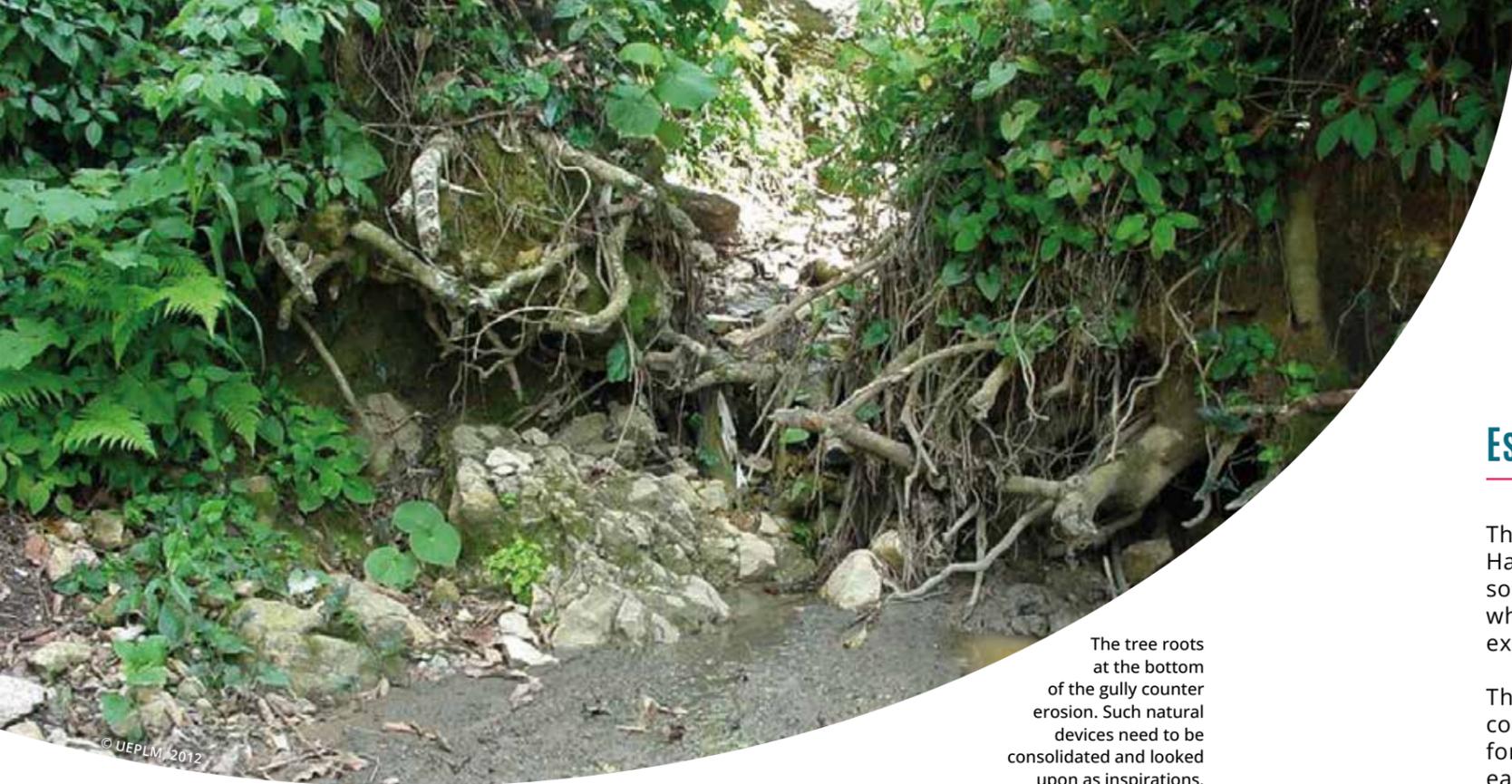
The “regrowing wood” cuttings used by farmers to build fences are generally long (around 1.5 to 2 metres), which enables them to provide the plot immediate protection from livestock. Smaller cuttings can be used for gully treatment. Cuttings should not exceed a length of 1.20 to 1.50 metres, of which around 0.50 metres will be buried using a crowbar. This will make it easier to gather the cuttings and improve the conditions for regrowth. The cuttings

that make up the check dam are strengthened by horizontal poles – made of bamboo, for example – that hold the check dam plants together.

To reinforce the check dam, various species such as Moringa and Gliricidia, among others, can be introduced by direct sowing or by planting young seedlings propagated in nurseries.

“It is also recommended to take full advantage of existing vegetation to restore a weakening woody-plant framework at a low cost.”

Once the check dam has been installed across the gully bed, a filter is created using branches placed along the check dam, supported by the established plants. The filter helps to deposit sediment carried by the water. It should be raised to match the increase in the height of the banks due to alluviation and the growth of the plants in the hedgerow.



The tree roots at the bottom of the gully counter erosion. Such natural devices need to be consolidated and looked upon as inspirations.

## Growing “protective” species in gully bottoms

In a medium-sized gully, growing long-cycle “protective” species (primarily sugar cane, but also elephant grass) helps to stabilise it.

Growing sugar cane in gully bottoms provides effectively protects against gullying. It also generates a good income from the sale of refined products extracted from sugar cane syrup. The growth of this crop can be promoted by optimising the local use of the sugar cane, especially via construction of small-scale mills.

The planting of elephant grass in gully bottoms, particularly downstream of the check dams, is highly advantageous when local livestock farming makes use of the harvested grass. However, these areas must not be affected by free-range livestock farming, which would hinder or even prevent the long-term survival of these crops.



Live check dams using sugar cane in Marmelade.

## Establishing a network of nurserymen

The scarcity of woody resources in Haiti sometimes forces farmers to source cuttings from other regions, which can make them relatively expensive.

This lack of available cuttings often concerns the most interesting species for the creation of live check dams. In each of the regions where Un Enfant Par La Main operates, it has helped to develop a network of nurseries to produce cuttings locally and to

spread the creation of live check dams over several years. Within these nurseries, the propagation of plant species that are not widespread in the area also makes it possible to broaden the range of plant material used by farmers.

A two-stage strategy can thus be developed: First, building the initial check dams using locally occurring species, and second, using cuttings from the nurseries.

Setting up a nursery in the locality of Dordy as part of the “Haïti filières durables dans le département du Sud” project.



© UEPLM, 2020

# Collaborative efforts are essential to the long-term survival of live check dams

Live check dams are useful only when they are adopted, managed and maintained by farmers. Breaches in the check dams caused by flooding must therefore be repaired quickly.

Just like solid constructions, live check dams need to be designed to suit the specific characteristics of the site. For them to be implemented throughout

the catchment area, they cannot be created hastily. Their implementation must be discussed and planned in collaboration with the farmers. For this reason, agronomists will need to be present in the field when biological techniques are used.

Past experiences have shown that live check dams did not perform as

expected when they were systematically installed as part of large-scale projects. Their lifespan has not been longer than that of contour channels, stone barriers and other civil engineering structures. The collaborative approach implemented when these hedges were planted has enabled certain characteristics of the hedges to be modified - such as the type of species planted -

but it has not always enabled the live check dams to be adopted. This is why it is necessary for the farmer who owns the developed plot to be involved from the outset of the project, to ensure that he has an interest in the development process (economic and environmental), and that he takes ownership of the check dam and the sustainability of the biological project.

Banana trees benefiting from an improved water supply in a recently formed gully. Live check dams could be created using the existing vegetation, with the landowner's approval.



© Treesftf

## Conclusion

In the vetiver-growing area, biological developments come up against livestock management practices. Livestock occasionally roam around, even on the developed plots. The structures created in these areas therefore have a typically short lifespan. These observations have led to improvements in the support offered to farmers, helping them create live check dams that integrate forage crops and/or plant species that present significant economic value to the farmer. These check dams are therefore better maintained and protected.

**HAITI:  
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SOIL EROSION**

**CHAPTER 2**  
**SELECTING AND  
IMPLEMENTING A RANGE  
OF COMPLEMENTARY  
INTERVENTIONS**

**DATA SHEET 5**  
**Improving agricultural  
production and biomass:  
Fruit growing**

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## 4

### Nursery seedling production

p. 4 Illustrated example: List of seedlings produced in the nurseries of the “Haïti filières durables dans le département du Sud” project

p. 5 Seedling production in UEPLM projects

## 6

### Promoting diverse fruit species and varieties

## 8

### The technical challenges of fruit arboriculture

p. 8 Tree planting strategies

p. 8 The benefits of grafting

p. 11 Techniques to protect grafted trees

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### Conclusion

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Given the consequences of demographic pressure in mountain regions and the urgent need to improve food security and the resilience of family farms, recreating conditions conducive to increased agricultural production and developing biomass are two of Un Enfant Par La Main's priorities. Trees are therefore at the heart of our watershed management programs. Thanks to their deep roots, trees can reach water reserves and explore deeper soil horizons than annual crops and therefore withstand drought. They also produce humus-rich litter and provide fruit, fodder and wood for rural families.

The development of medium-sized gullies using masonry and living structures (see data sheets 2.3 and 2.4) enables fertile alluvium to be retained and soil water reserves to be improved, creating “fonds frais” that, in turn, increase agricultural production and biomass development. Planting trees in fences or in open fields inside of each plot helps to create a humus-rich horizon, which has a high level of organic matter.

This, in turn, paves the way for the introduction of species with high organic matter requirements and high yields.

Finally, on the hillsides, UEPLM improves plant cover with forage grasses in wet mountain ecosystems and sugar cane in dry mountain ecosystems.

As part of the “Haïti filières durables dans le département du Sud” project, UEPLM has encouraged farmers to plant such cover crops on hillsides with low soil fertility potential and no tree cover, to recreate the right conditions for trees to grow back. It should be noted that these plantations are more suited to hillsides where vetiver grass is not cultivated. This is because vetiver grasses cover most of the hillside in areas where it is the dominant crop. This is the case in Port Salut, where around 90% of the slopes are dedicated to vetiver cultivation.

# Seedling production in nurseries

To carry out these revegetation operations, UEPLM creates a network of nurserymen in each intervention region.

UEPLM supports nurserymen in the development of their activities by providing equipment (machetes, pruning hooks with handles, forks, wheelbarrows, sieves), supplying seeds and first cuttings and improving their access to water (family cistern, well) if necessary to water the nursery.

The main objective is to allow tree seedlings of different species to develop:

- **shrub species** to create live fences;
- **fruit species** to generate income and for consumption;
- **forest species** (endemic and non-native), to plant in areas where they do not compete with staple crops.

Setting up a nursery in Marcabée as part of the "Haïti filières durables dans le département du Sud" project.



## An example of seedling production in UEPLM projects

This network of nurseries provides tree seedlings and cuttings that can be used for a variety of purposes:

- The production of seedlings for fruit arboriculture – avocado, mango and citrus trees – for transplanting in open fields. It is useful to keep some seedlings in the nursery for grafting the second year, before the final transplanting.
- The production of cuttings for live fences. This nursery-based production enables "bois repousse" or macro-cuttings to be multiplied more rapidly and new species such as mulberry and gliricidia to be disseminated. These species can do more than act as a fence: mulberry, for example, provides excellent fodder for goats.
- The production of trees or shrubs as stakes for yams. The rapid expansion of yam cultivation has increased the demand for stakes, which in turn has led to strong pressure on the areas covered with shrubs or "rack bois".
- The production of forest-tree seedlings that will supply timber, construction wood, and firewood.
- Trees and shrubs for the production of leafy vegetables or herbal teas: culinary and therapeutic uses.
- The production of endemic species that risk extinction such as *Cedrela odorata*, *Lysiloma latisiliqua* or "taverneau", *Eugenia jambos* or "pomme rose", *Calophyllum calaba* or "dame marie", *Eugenia fragrans* or "bois dine".

This list is neither exhaustive nor restrictive, its aim is primarily to select seedlings and cuttings that are adapted to the different soils and climates and meet farmers' needs.

## Illustrated example: List of seedlings produced in the nurseries of the "Haïti filières durables" project in the Sud department

Within the framework of this project, nurserymen have contributed to the production of the following species:

- **Vegetable seedlings:** chili, eggplant, kalalou, bell pepper, tomato; these seedlings are intended to enrich the *Lakou courtyard* gardens to improve the availability of vegetables for families (diversification of their diet and a small source of additional income);
- **Fruit tree seedlings:** tamarind, grenadia, mango, papaya, cherry, avocado; these seedlings are intended for transplanting to the *Lakou courtyard* garden or to other cultivated plots (in open field or at the edge of a forest).





**FOOD AND PRODUCTION CALENDARS FOR FRUIT TREES IN THE EPIN REGION (CENTRAL PLATEAU): focus on the role of fruit trees during the lean season**

# Promoting diverse fruit species and varieties

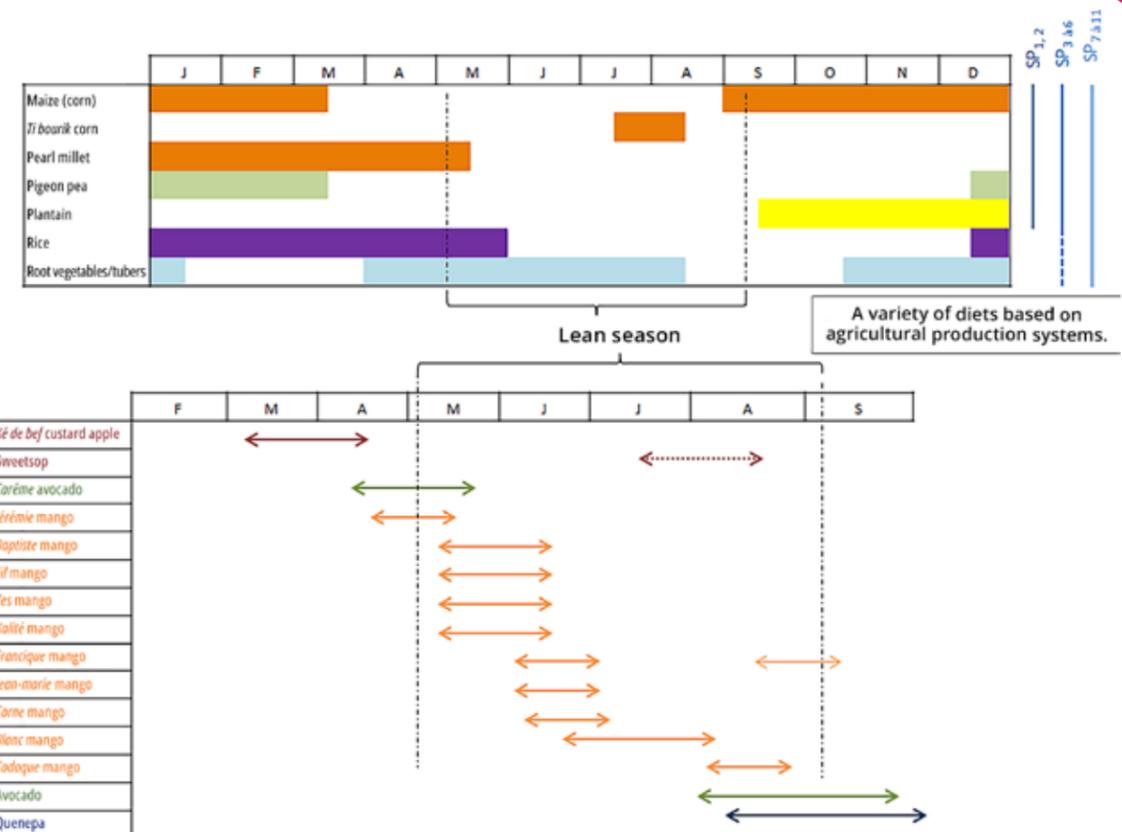
Fruit production provides farm households with significant income that complements agricultural production. The sale of fruit generates income at times when other agricultural production does not. For certain farms, the improvement and diversification of this type of income could also help limit the cultivation of steep slopes in gullies, help increase the plant cover of these areas and therefore contribute to the protection of the watershed.

The diversity of species and varieties on family farms enables:

- The successive flowering and fruiting periods of trees ensures that crops are protected against diseases and climatic hazards.
- The spreading of harvests in time generates a source of food and income when the fruit is sold throughout the year.

The growth of various species of fruit trees should be promoted. Mango is a species of particular interest, as it can be sold on the local market and exported to the Dominican Republic and North America. Other recommended species are avocado, citrus, tamarind and custard apple, given the strong demand on the local market, which enables farmers to sell their produce at advantageous prices. Breadfruit is also a highly nutritious species.

From a family food security standpoint, the plurality of fruit tree species and varieties plays a crucial role in meeting the vital needs of farming families during the lean season, particularly custard apple, mango and avocado trees (see figure 2).



The diversity of fruit varieties for sale makes it possible to multiply outlets on different scales (local, national, international) and better manage the instabilities of agricultural markets.

The different varieties of mango trees illustrate this idea particularly well: the early (*Jérémie*) and late (*Codoque*) varieties make it possible to spread the consumption of these fruit during the lean season. The *Jean-Marie* and

*Baptiste* varieties are sold on the national market, while the *Blanc* variety is sold on local markets at the end of the lean season. This is why encouraging farmers to specialize exclusively in growing mangoes for export (*Francique* variety) to the detriment of other varieties is a bad idea. Spreading the income obtained at different times of the year enables farmers to better manage their cash flow and limit the risks of decapitalization of the farm.

# The technical challenges of fruit arboriculture

## Tree planting strategies

The most water-demanding species are best planted at the bottom of hillsides, which are particularly well supplied with water. This is the case for mango and avocado trees. Citrus seedlings can be planted a little higher up on hillsides. Finally, less water-demanding species such as tamarind and custard apple can be planted on the highest parts of the hillsides.

## Grafting

Grafting helps us add value to a tree already planted on the plot and limit the exposure of young seedlings produced in nurseries to climate hazards and possible competition with other agricultural practices (burning, livestock management). This technique also enables fruit to be produced faster than when seedlings are planted: adult grafted trees start producing as early as 3 years after grafting, whereas seedlings that have successfully been planted only produce after 4 to 5 years.

Grafting high commercial value species onto stocks of local species or varieties yields better results than directly planting lucrative species. This is because the local stock is better adapted to the area's soil and climate conditions, which are often less favourable to the more demanding lucrative species (thin soils, for example).

In addition to the incentive to graft a more lucrative species, UEPLM also encourages farmers to preserve the diversity of species grown on family farms to help protect them from market and climatic hazards.



Grafts.

## Which species are preferred for grafting mango trees?

In the case of mango trees, the local species that must be preserved for stocking is the "Mango Fil". The species to be grafted are Mango Françisque (exported to the USA), Mango Baptiste (exported to the Dominican Republic), Mango Jean Marie (sold on the national market).

## What is the top-grafting technique?

1. Mature trees that are not very productive but are well adapted to the local soil and climate are pruned and cut back. Only a few main branches are retained, on which new shoots will develop. These branches will be grafted with a variety chosen for its commercial qualities.
2. Grafts are taken from trees selected for their fruit quality, early or late fruiting, or good plant health. Within each region of intervention, Un Enfant Par La Main seeks to identify a collection of trees from which to take grafts of the desired mango varieties.
3. Grafting is then carried out: the technique most used by UEPLM is approach grafting, because of its good results for mango trees.
4. Once the grafts have re-grown and developed for the first time, the future branches of the stock tree need to be pruned to encourage the development of young grafts. This work requires high-quality tools, which are unfortunately not always available in Haiti.



Approach grafting.



### Promoting grafting among farmers

Many projects have trained “master grafters” who are then expected to provide services in the countryside. However, this cascade of training does not encourage rapid dissemination of knowledge and practices. UEPLM’s experience has also shown that in difficult situations, farmers are not able to finance the services of a grafter.

To get around these limitations, UEPLM instead proposes providing grafting training to all farmers who are individually or collectively interested in maintaining their fruit trees.

A lack of maintenance of grafted trees is the main cause of graft failure. If regrowth from the stock tree is not regularly pruned, it will smother the grafts. To make it easier for farmers to maintain grafted trees, we recommend the following:

- training in grafting techniques, technical tree routing and orchard management;
- equipping farmers with pruning shears (with hardened steel blades), ladders and handsaws. These investments represent twice the average farmer’s capital in terms of tools.



### Techniques for protecting grafted trees

Young trees are vulnerable to a variety of stresses, particularly grazing by livestock. Setting up live fences to protect crops in the “fonds frais” also protects grafted trees when they are most vulnerable.

However, in most cases, individual tree protection (fencing) is still necessary.

**HAITI:  
WATERSHED  
MANAGEMENT  
AND COMBATING  
SOIL EROSION**

**CHAPTER 2**  
**SELECTING AND  
IMPLEMENTING A RANGE  
OF COMPLEMENTARY  
INTERVENTIONS**

**DATA SHEET 6**  
**Creating favourable conditions  
for the development of biomass:  
live fences**

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# 3

## The elements of a live fence

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## The functions of a live fence

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## Conclusion

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Planting quickset hedges is an agroforestry technique used by Haitian farmers to enclose plots of land. As the name suggests, these barriers are made up of hedges, as opposed to fences made of dead wood.

Live fences:

- are less expensive than block walls, wire mesh or barbed wire;
- fulfil supply functions (fodder, food);
- and can be useful to combat erosion.

These hedges are made up of a wide variety of species, each having different properties<sup>1</sup> and playing complementary agronomic and economic roles.

1. *Arbres et Arbustes de Haïti - Utilisation des espèces ligneuses en conservation des sols et en aménagement des bassins versants* by A.P. KOOHAFKAN and Ch. LILIN (December 1989) provides a wealth of information on the properties of the various shrub and tree species used by Haitian farmers.



# The elements of a live fence

## “Bois repousse” and seedlings

In a live fence, there are:

- The “bois repousse”, which are large cuttings that form the framework of the hedge from the moment it is planted.
- The plants which, thanks to their thorns or prickles, make the hedge impassable.

The spacing of the cuttings varies according to the owner's choice and

local resources of cuttings. This structure can be reinforced horizontally with split bamboo stems, agave stipes (flowering stems) or reed stems linked by lianas used as ropes. This improves the effectiveness and strength of the fence.

The plantings can be supplemented by other sown shrub species and can strengthen the hedge. They can even replace the weaker “repousse”.



# ■ The functions of a live fence

By delimiting the enclosure of plots, live fences create a bocage landscape. The techniques used to create live fences are well known and widely used by farmers, as they offer a number of advantages and ensure the presence of “linear forests” in areas where forests (as defined by the forester) are unable to grow due to demographic pressure. These hedges have several functions.

## Plot demarcation and crop protection

Plots need to be fenced off to protect crops and orchards from livestock and from community-generated stress.

## Protecting soil against erosion

When a live fence forms the boundary of a plot on a hillside and is planted perpendicular to the steepest slope, it provides protection from soil erosion by dispersing runoff and helping to deposit the soil that is carried away.

The live fence must be complemented by a filter to effectively slow down runoff. By retaining dead leaves and crop residues upstream, the filter facilitates the accumulation of sediments and gradually creates a small flat area without the need for demanding earthworks.

The live fence must be managed by the farmer to counteract erosion. Hoeing the lower plot will scour the hedgerow and sometimes cause it to collapse because of the newly created vertical slope. The farmer must agree not to work the soil near the hedge, in order to create a stable, sloping bank that catches runoff material effectively.

This bank can be planted with grass or fruit trees.

Live fences have failed to live up to expectations when installed too systematically by large-scale projects. They have not lasted longer than contour drains, dry stone walls or other civil engineering structures put in place by these projects.

With a great deal of caution, we have begun to encourage farmers to plant new hedgerows in the context of certain UEPLM projects, especially to protect areas with greater fertility, and to enrich them by planting fruit trees.

## Types of fencing: “open field” plots and “pre kay” gardens

The main types of fences are “open field” plot fences and “pre kay” garden fences.

- The main role of fences on “open field” plots is to protect crops from livestock, although this does not exclude other functions such as the production of wood, fodder or fruit. Large cuttings are preferred for immediate protection against livestock.

- “Pre kay” garden fences are often the norm near settlements and are characterised by a wide variety of plant species. Species such as moringa (*Moringa oleifera*), “paresseux” (*Polyscias paniculata*) and “choublak” Chinese hibiscus (*Hibiscus rosa-sinensis*) are planted here, but are not used for fencing in open plots.

## Windbreaks

By criss-crossing the landscape, live fences protect crops from the wind. Wind can accelerate evapotranspiration or, during cyclones, destroy many crops and wreck fruit trees. Live fences must have slightly taller, untrimmed trees in places to act as proper windbreaks, with species such as logwood (*Haematoxylum campechianum*), moringa, casuarina, tamarind trees, ash, etc.

## Wood production for domestic use or as fodder

A multi-species live fence enables different crops to be grown without competing with the annual crops in the plots.

- The production of wood for domestic use: Trees such as gliricidias, West Indian elms, mulberries and jocotes, when trimmed to a height of 1.50 meters from the ground, can produce branches every year or two that can be used for firewood or charcoal. This method of harvesting wood by pruning does not compromise the production potential of the mother plant, known as the “stump” or “stalk”.

- Production of fodder: The young stems of hibiscus, West Indian elm and moringa, trimmed to a height of 1.50 meters, can be fed to goats. This gradual distribution avoids overgrazing, which would reduce the hedgerow's production potential.

This technique makes it possible to reconcile goat rearing with the development of fruit growing. Biomass production from the hedgerow depends on how the goats are reared. Cutting and distributing fodder branches to the goats in an enclosure ensures an optimal use of the hedge.

Ideally, therefore, you should invest simultaneously in creating live fences and enclosures for goat rearing.



## Honey production

Logwood (*Haematoxylum campechianum*) and moringa (*Moringa oleifera*) are highly melliferous and their flowering periods complement each other. Candelabra tree hedges support climbing plants such as Gliricidia (*Gliricidia*

sepium), the “Belle Mexicaine” (*Antigonon leptopus*), whose flowers are very attractive to bees. As agriculture in Haiti uses little to no pesticides, the production of organic honey is a niche market that deserves to be developed.



This live fence, which is currently being developed, is intended to protect the first ring around the habitat of livestock that roam during the dry season.



View of a “pre kay” live fence made up of cacti (densifying the lower part of the fence) and fodder trees (yellow mombin, hibiscus). Bamboo stalks are laid horizontally to consolidate the structure.



© B. Lepers

## Second step: Layout of the various components of the hedge

The density of “bois repousse” or macro-cuttings within the hedge depends on the farmer’s budget or that of the project. This density also depends on the abundance or scarcity of cuttings in the vicinity of the planting site. The cuttings are held together by two horizontal crosspieces generally made up of split bamboo stalks or reed stalks joined by lianas or a few pieces of wire.

To make the hedge immediately impassable, it is completed with “cadasse” (*Euphorbia lactea*) or “garde-maison”, or Spanish bayonet (*Yucca aloifolia*), cuttings.

Planting a hedge requires teamwork to transport the cuttings and seedlings. To mobilise this work group, the farmer must at least be able to provide a collective meal in the field.

Once the above-mentioned hedge-structuring elements have been planted, the farmer can complete the composition of his hedge with the direct sowing of fast-growing trees



© UEPLM, Salagnac, 2010

Sale of gliricidia cuttings (bois repousse) to create new live fences.

and shrubs like moringa (*Moringa oleifera*), West Indian Elm (*Guazuma ulmifolia*), gliricidia and logwood (*Haematoxylum campechianum*). This can be done when the seeds are available.

It takes two growing seasons to fully establish a live fence.

# Steps to install a live fence

## First step: Acquiring a lease

The farmer must have access to the cultivated plot for a sufficient amount of time to make it worthwhile for him to invest time and production resources in planting a hedge.

A title deed (“purchase land” or “inheritance land”) guarantees that the farmer will benefit from the fruits of his labour for the desired duration. However, live fences are also set up by farmers on plots under indirect tenancy, when the lease extends over several years.

Moringa hedge trimmed for leafy vegetable production.



© UEPLM, Plateau central, 2012

## Third step: Pruning and care

The hedge needs to be trimmed regularly to prevent it from becoming invasive and competing with the crops grown on the fenced plot.

It is also important not to rope livestock to the trunks of the shrubs that make up the hedge so as not to damage them.

# Tools used to plant and maintain hedges

## Tools for taking and transporting cuttings

- The machete is the main tool: it is used to trim cuttings and regrowth.
- A billhook (or pruning knife) with a long handle (1.80 metres), also known as a “crescent”, makes trimming easier; it replaces the machete when pruning Euphorbiaceae.
- The fork makes handling less difficult.
- Wheelbarrows can be used to transport cuttings, especially “cadasse” (or candelabra tree) cuttings, whose skin-burning latex must be kept at a safe distance.

## Tools for planting

- The “piquois” is used to dig a 30 to 50 cm wide strip in the soil along the length of the hedge and install the candelabra tree cuttings.
- The crowbar (“pince” in Haitian Creole) makes it easier to dig the 20 to 30 cm deep pilot holes in which the macro cuttings will be planted, thus facilitating recovery. “Pinces” are often made from salvaged car axles.



## Tools for maintaining the fence (and/or the orchard)

In addition to the machete, tools with handles such as the billhook mentioned above are useful.

- Pruning shears and saws are used to cut back fodder trees.
- Shears or large pruning shears are essential for trimming hibiscus hedges so that the young shoots can be quickly harvested to feed goats or rabbits.
- A ladder is needed to prune the tallest trees safely.

Purchasing these tools is not always possible for Haitian farmers due to their high price.

This is an issue that must not be overlooked: the right equipment is essential for the upkeep and longevity of woodland gardens near homes and orchards.

Drawing lessons from its experience, Un Enfant Par La Main recommends helping farmers to equip themselves with these specialised tools, which, though expensive for each farmer individually, represents both a feasible financial investment for a development project and a guarantee of the sustainability of revegetation initiatives.

## Conclusion

UEPLM has undertaken an analysis of farmers’ practices in the creation of live fences in Haiti, and this fact sheet presents some of the information gathered. Further information is contained in a fifteen-page document (la création de haies vives.docx) and in slide shows designed to help agronomists recognise the species used and will be made available at the Salagnac centre.

However, only part of the farmers’ knowledge has been made explicit and accessible to agronomists. Additional surveys need to be conducted in this area to enable projects to better promote the live fence technique and advise the farmers concerned.

**HAITI:  
WATERSHED  
MANAGEMENT  
AND COMBATING  
SOIL EROSION**

**CHAPTER 3**  
**VETIVER PRODUCTION  
AREAS IN THE PORT SALUT  
REGION: AN ILLUSTRATION**

**DATA SHEET 1**  
**Tillage erosion and water erosion  
on hillsides planted with vetiver in  
Port Salut: suggested developments**

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### 3

#### Tillage erosion

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**Document author(s):** this fact sheet references several writings by Charles Lilin. It was completed with support from the field team of Un Enfant Par La Main using feedback of their experiences on recent projects.

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Various forms of soil erosion have been observed in the mornes of the Port Salut region and are presented below, along with techniques to combat them. These techniques can only be realistically implemented in conjunction with measures to develop agricultural production.



## Tillage erosion

Tillage erosion is a form of soil erosion that is still largely overlooked, even in textbooks dealing with Soil and Water Conservation (SWC). Its French name, "érosion aratoire", comes from the Latin word for plough, "aratrum". It is also referred to as "dry mechanical erosion".

In the mornes of the Port Salut region, tillage erosion is caused by the displacement of soil during vetiver harvesting. When the plant is uprooted, soil is displaced downstream, at a height of a few centimetres and a distance of approximately one metre.

### Differentiated effects

This translational movement has different effects:

- **At the top of the plot,** it results in a reduction in soil thickness. This stripping can go as far as exposing the limestone or chalk bedrock, resulting in a sterile slab.
- **At the bottom of the plot,** the farmer's pickaxe displaces some of the loose soil onto the plot below. Some soil is deposited at the boundary with this plot. A bank is thus formed at the boundary between these plots, with a vertical section created by the pickaxe when vetiver in the lower plot is uprooted, and a short horizontal section created by the accumulation of soil from uphill.
- **In the middle of the plot,** the soil displaced by the harvest is replaced by soil from a little higher up. Here, soil thickness is not significantly affected by tillage erosion.

## Exported soil

If the bank that develops at the bottom of the plot due to tillage erosion is not designed to retain the soil, it is exported from the plot:

- Some of the soil is thrown over this bank by the pickaxe or the hoe when the lowest row of vetiver is uprooted;
- The collapse of the bank at the bottom of the plot, scoured at its base during tillage, displaces some of the accumulated soil, which is then exported from the plot.

Taken together, these two mechanisms result in a modest volume of soil being exported from the plot. We estimate that this displacement represents an average soil ablation of a few millimetres of soil per year. This amount, while not negligible, is also not catastrophic.

The effects of tillage erosion are mostly indirect. In the upper part of the plot, it removes a significant amount of soil every year. Admittedly, the soil displaced in this way finds its way back into the plot, a little lower

down, but this stripping causes the soil to become locally superficial. This leads to the bedrock becoming exposed.

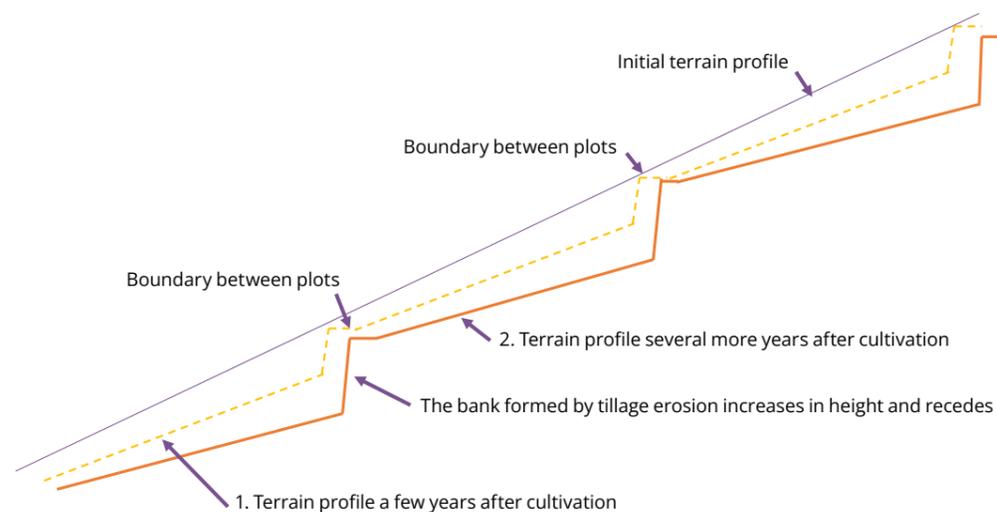
When it rains, this surface soil quickly becomes saturated, causing runoff. This process accelerates once stripping exposes an impermeable slab that functions as an impluvium.

The runoff generated in this way concentrates in rills and in gullies. These rills and gullies, in turn, both tear up the earth and transport it. The rills carry off both the stripped soil

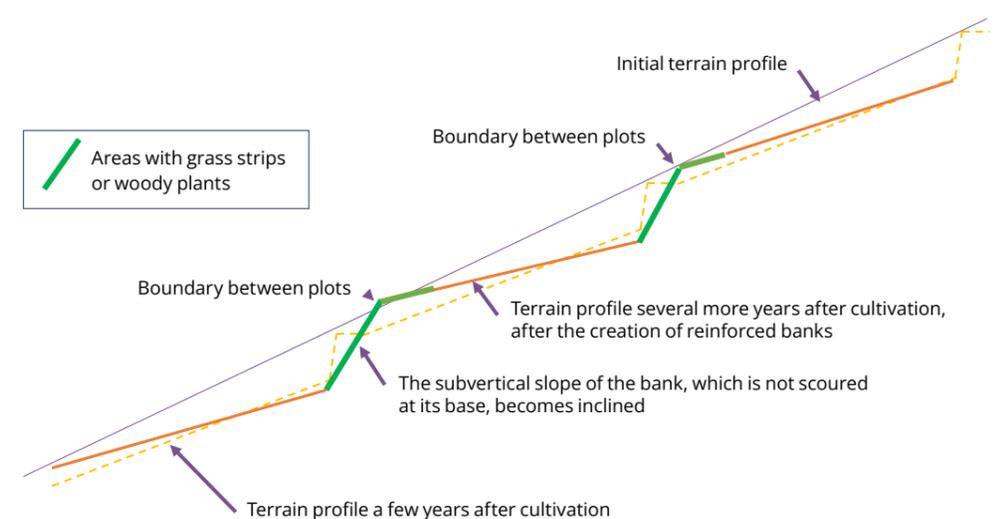
and the soil accumulated on the bank, resulting in an increase in exported soil over time. Such stripping is often visible at the top of the hillside.

The rills cut into the small banks formed at the bottom of the plot. They remove soil from the plot, and they export it out of the plot and hillside as they cut through the bank. The soil can still be retained in the gully at the bottom of the hill slope if its vegetation provides an effective filter, or if it has been reinforced with masonry and live check dams.

### PROGRESSION OF THE BANK AT THE BOUNDARY BETWEEN PLOTS WITHOUT REINFORCEMENT



### PROGRESSION OF THE BANK AT THE BOUNDARY BETWEEN PLOTS WITH REINFORCEMENT





Rill erosion.

# Organising a first line of defense on low to medium slopes

## Construction of a reinforced bank

The construction of reinforced banks prevents soil displaced by pickaxes or carried away by concentrated runoff from being exported. On gentle slopes, they can provide an effective line of defence against erosion.

Reinforcing the vertical slope of the bank, which forms “naturally” at the bottom of the plot by tillage erosion, requires a strip of soil along the foot of the slope that is not planted with vetiver grass. This enables the gradual transformation of the vertical slope of the bank into an inclined slope.

Reinforced in this way, the bank can disperse concentrated runoff and act as a filter to retain displaced soil. The downstream face of the bank is initially vertical, as it is scoured downstream by tillage. It is affected by landslides

during heavy rainfall. The vertical slope sculpted in this way must be allowed to develop into a gently sloping bank so that it stabilizes and allow the dispersion and filtering of runoff.

This inclined slope slightly reduces the area planted with vetiver, but planting hardy fruit species (citrus, cashew, moringa, etc.) at the foot of the bank can compensate for the loss of income. It also makes it easier to protect this area from the use of pickaxes.

For long plots that follow the slope lengthwise, it will be necessary to create intermediate reinforced banks to disperse runoff and prevent gully incision.

Section 6 of Chapter 2 covers the creation of live fences, particularly on reinforced banks.

# Water erosion

## Sheet or diffuse erosion

At first glance, diffuse surface erosion in the region's mornes appears to be minor. Soil is structurally stable and has a high capacity for seepage, at least

as long as it remains sufficiently thick. However, diffuse erosion can occur when very heavy rains fall on a plot that has just been harvested.

## Rill and gully erosion

As mentioned above, rill and gully erosion can result from a reduction in soil thickness in areas stripped by tillage erosion at the top of the slope. The impermeable slabs function as an impluvium, and runoff occurs at the slightest rainfall.

Thus, while tillage erosion only represents a small proportion of the total soil exported out of the plot, it locally increases the runoff coefficient and accelerates concentrated water erosion, i.e. erosion by rills and gullies, which have a significant soil-ablation capacity.



## Management of a reinforced bank

As mentioned above, the farmer must allow the bank created by tillage erosion to extend so that it can play its part in controlling soil erosion.

The effectiveness of the reinforced bank depends on how it is managed by the farmer. Heavy rainfall often leads to the formation

“The effectiveness of the reinforced bank depends on how it is managed by the farmer.”

of gaps. If these are not filled in quickly, they deepen and become increasingly difficult to fix.

The low effectiveness of the twenty-meter-spaced vetiver grass strips promoted by previous projects in the Port Salut area is mainly due to their lack of management.

## Agricultural optimisation of areas of soil accumulation

Reinforced banks accumulate soil at the bottom of the plot and on the slope itself, improving the area's water retention capacity and fertility. There is a transfer of fertility from the top of the plot to this soil accumulation zone.

This increased fertility can be used to grow more nutrient-demanding crops, offsetting the reduction in the area

planted with vetiver grass. The creation of reinforced banks will be facilitated by planting a line of hardy fruit species at the foot of the slope.

Reinforced banks are the first line of defence in retaining soil on the hillside and preventing it from being exported. As mentioned above, the gully that drains a watershed can provide the second line of defence.

## Optimising runoff from stripped areas

These areas, located at the top of the hill slope, function as an impluvium and are the cause of important gully erosion. Runoff water from these areas can be intercepted by a small channel and funnelled into a basin.

The water stored in this way can be used for supplementary watering to improve the recovery of vetiver seedlings after planting, or for plants planted to consolidate field banks.

## The limits of reinforced banks: the case of very steep hillsides

On very steep hillsides, the creation of a reinforced bank is difficult. The gradual establishment of a gentle-slope bank greatly reduces the area under vetiver cultivation, as the banks will have to be high and/or close together.

In addition, on steep slopes, the increased seepage of runoff caused by such banks encourages landslides and destabilizes the hillside.

On such slopes, replacing vetiver grass with perennial crops or afforestation are preferable alternatives to the construction of reinforced banks. However, these alternatives will only become realistic once agricultural production on the mornes of the Port Salut region has been improved and diversified.

## What is the best strategy for spreading the technique of creating reinforced banks?

In other mountainous regions, farmers have often learned to manage tillage erosion over the centuries. For example, when working the soil in the plot just downstream of the bank, the farmer avoids undercutting the bank, which is sculpted by this erosion. The bank can then slump from a vertical to an inclined and stable slope. The farmer leaves the slope to grass over, or plants woody plants to reinforce it and benefit from their production, thus creating a bocage landscape. He can also reinforce it by depositing boulders left over from the removal of stones from the field. But above all, he seals the gaps that often form in the bank after heavy rains, preventing them from becoming gullies.

“The reinforced bank, a farming technique... in other sloping regions.”

Managed in this way, these banks gradually reshapes the hillside, making it easier to work the soil, improving fertility and reducing erosion. This reshaping can also be achieved by

constructing low dry-stone walls, which requires a considerable investment in labour. The base of these walls is managed in the same way as the banks mentioned above, and any gaps are quickly filled in.

The farmers' aim is not to stop erosion, but to increase the productivity of their land and facilitate tillage. While this work reduces water and soil erosion, it is not the farmer's primary objective.

These farming techniques were not designed by engineers. Indeed, in places where cultivated hillsides are steep, these techniques represent a piece of agricultural heritage, which is handed down from generation to generation. Such groundworks first attracted the attention of a group of German geographers in the 1950s, and more recently that of ecologists with the preservation of bocage landscapes becoming a topical issue.

## Transposing this farming technique to Haiti

In Haiti, lengthy periods of fallowing have long helped farmers preserve the fertility of hillsides, providing them with an alternative to remodelling via the creation of reinforced banks. But population growth has led to shorter fallowing periods and, in many cases, to their disappearance.

### Hillside remodelling in Haiti: few and little-known models

In Haiti, there are rare cases of farmers reshaping cultivated hillsides themselves. This is the case in the mornes near Fort Jacques, above Port-au-Prince, where the development of market gardening is accompanied by fertilizer use. The durability of low walls (or live fences) is thus assured. When working the soil with the hoe, the farmer avoids digging up the small strip of soil just below the structure; in this way, a bank can grow and the wall (or hedge) is no longer scoured, but stabilized.

The farmer's primary objective here is to reduce the loss of fertilizer (used to fertilize profitable vegetable crops) caused by runoff, not to reduce soil losses. Erosion control is a by-product of the production strategy.

UEPLM projects stimulate this technical innovation in the mornes of Port Salut. The debate on the feasibility of the anti-erosion measures described above was launched when the project was formulated, and it must continue. There are still many challenges.

The "naturalization" in Haiti of a technique which, elsewhere, is a local farming technique, comes up against major obstacles. The effects of reinforced banks depend on the efficiency of the farmers' management, and

"Reinforced banks only make sense when combined with improved agricultural productivity and a diversification of production."



Tillage erosion, Port-Salut - 2017.

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Bank formed by tillage erosion.



Partially reinforced bank.



hence on their adoption of this technique. Protecting a small strip of land at the foot of the bank from the pickaxe or the hoe reduces the total size of the cultivated area. This is an obstacle to the spread of the technique.

Reinforced banks only make sense when combined with improved agricultural productivity and a diversification of production. If farmers are to adopt the technique, they need to move away from a short-term approach. Similarly, the possibility of using very steep slopes to grow perennial crops also depends on the value of their production.

Disseminating new practices takes a great deal of time and depends on innovative farmers who can act as intermediaries. This requires the creation of local models and the continuity of projects. The steps to develop and disseminate innovative practices in rural areas must be respected:

- Creating development models with farmers who are likely to become innovators, based on contracts providing for the management of the structures for a certain period of time;
- Monitoring projects and their management, particularly after major rainfall events;
- In a second phase, a wider dissemination of the land developments by relying on farmers who have already been mobilized: organisation of collective field visits, distribution of illustrated technical documents, etc.

This technique is novel not only for Haitian farmers, but also for planners. Manuals on erosion control do refer to it but often fail to mention the essential points of this farming practice. In this field, training practitioners is necessary.