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MINISTRY OF AGRICULTURE AND ANIMAL RESOURCES

MINISTERE DE L'AGRICULTURE ET DES RESSOURCES ANIMALES

Final Report

PILOT EXERCISE OF PROFILING OF DEVELOPED TERRACES

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1. GENERAL INTRODUCTION

MINAGRI understands that increasing land under land husbandry infrastructures such as terraces is not an end in itself; what is of greater concern are the harvests/yields realized by farmers from the latter treated sites.

It is in that context that the Ministry of Agriculture and Animal Resources (MINAGRI), after identification of the two concerns surrounding developed terraces; which are to ensure that the sites are being optimally utilized to make sure invested funds are maximized for food production and economic benefits for the country, decided to undertake this profiling exercise to have accurate data on how developed terraces are being exploited.

The initial overall objective of developing terraces was to improve crop productivity through sustainable management of available land, and soil conservation and the specific objectives were:

- To protect hillsides and wetlands against soil erosion and floods;
- To restore soil fertility; and
- To improve land productivity.

2. OBJECTIVES OF THE PROFILING OF TERRACES ACTIVITY

After realizing that some developed terraces all over the country are not efficiently exploited, MINAGRI decided to proceed on profiling developed terraces in order to identify problems met by farmers that lead them to resist the exploitation of terraces, make specific recommendations that would lead to the increased productivity and propose turnaround strategies for their operationalization.

The overall objective of the profiling project is to address the issues of non/under exploited terraces to identify sites that potentially could be offered to private investors in order to achieve the dual objective of cost reduction for the Government and increased land productivity.
For the sites with no potential for private sector involvement, the objective is to make specific recommendations that would lead towards their effective utilization.

3. ACTIVITIES CARRIED OUT

- ✓ *Gathering information related to the historical background of the developed terraces sites;*
- ✓ *Assessment of the current status of developed terraces: Soil husbandry, agronomic aspect and financial returns;*

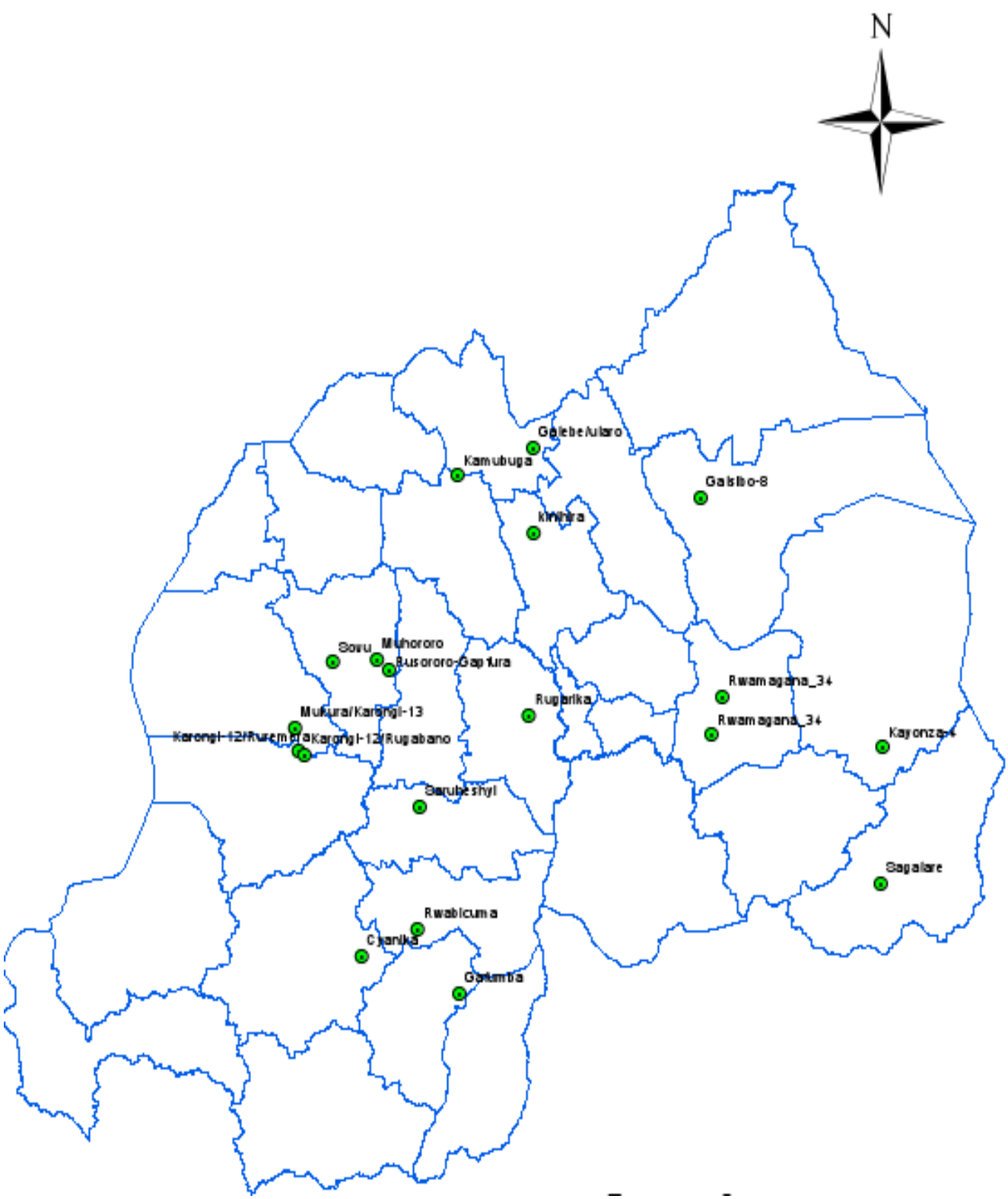
- ✓ *Recommendation of key interventions and strategies to optimize returns.*

4. METHODOLOGY

The exercise of profiling of terraces proceeded on selected 18 developed terraces sites which served as a starting point; these were selected according to the following criteria:

- ✓ Country representative (sites from every province);
- ✓ Size of the site, practically, this means that the chosen sites were mainly above 100ha;
- ✓ Size of the non/under-exploited terraced land;
- ✓ Availability of post-harvest infrastructures;

The team that carried out the exercise started with desk review of existing secondary data; interviews for key informants (local leaders, cooperative managers and agronomists) and focus groups discussions (mainly composed of beneficiaries/farmers owners of land on the visited terraces).
The locations of the profiled terraces are presented on the following map



Legend

- Profiled sites
- District boundaries

5. SOUTHERN PROVINCE

5.1 Rwabicuma, Nyanza District

5.1.1 Site description

a. Historical background

Rwabicuma site is located in Rwabicuma sector, Nyanza district of the southern part of Rwanda. It includes 6 cells with non-exploited terraces in the command area above the constructed dam. Radical terraces were constructed at 1300 ha under funding of LWH/RSSP project. Geographic coordinates of the site are 02.37780°, 029.70060° and 1630 m. According to farmers' discussions, the site is mainly characterized by different soil types with the following vernacular names: Umusenga, Mugugu, Urubuye and Kokobe. The part of Umusenga soil type is mostly cultivated while the other three soil types are abandoned by farmers due to low productivity.

b. Terrace maintenance and exploitation

Rwabicuma is mainly exploited by individual farmers who are growing priority crops like maize, beans and horticultural crops. Rwanda Correctional Service (RCS) has some land area on the site and there is a Private investor who started to grow macadamia on 240 ha. The non-exploited terraced area is about 268 ha due to several reasons as they are mentioned in the following part. In fact, most of this site is not or is under exploited.

c. Site profitability

Through farmer's group discussion, Data were collected for production cost and generated revenue at harvest on selected and grown crops.

Table 1: Rwabicuma Site Crop Profitability

District	Site name	Crop in current production	Production cost(Frw)/ Ha	Gross revenue (Frw)/ Ha	Profit(Frw)/ Ha
Nyanza	**Rwabicuma**	Maize	1,151,154	176,000	**-975,154**
		Beans	1,051,654	320,000	**-731,654**

Table 1 shows that farmers are not making profit from their agriculture activities because of their traditional cropping systems that do not use inputs at optimal level.

5.1.2 Challenges

During discussions with farmers and local leaders, several challenges, that caused the land area at 260 ha to be unexploited and underexploited, were mentioned and they are as follows:

Social and institutional challenges

- Resistance of farmers to cultivate any other crops except cassava, sorghum and Banana;
- Land owners, mainly survivors of Genocide against Tutsi, do not live near the site and are not willing to release their lands for exploitation by other investors or farmers. However, local authorities are unceasingly sensitize them to avail their lands for exploitation
- Farmers in vulnerable groups (elders, orphans, widows) are not able to exploit their lands due to lack of workforce.
- There is weak mobilization of farmers to understand the ongoing investment of Macadamia on their lands

Technical challenges

- Only a few farmers can afford agricultural inputs mostly organic fertilizers; especially vulnerable groups cannot afford these inputs
- Farmers have low technical skills in agriculture practices such as Integrated Soil Fertility Management (ISFM) technologies
- Inappropriate techniques in developing terraces; some land was not agricultural land as it was on rock stone with shallow depth whereas other fertile top soils of arable lands were not kept aside before establishment of radical terraces, hence low productivity.

Financial challenges

- Farmers (Beneficiaries) lack means to purchase the inputs (fertilizers, cuttings/seeds…) to boost their production;
- As many people belong to vulnerable groups, there is a lack of workforce to cover the whole area of arable land.

5.1.3 Proposed Key interventions/strategies towards optimal exploitation of radical terraces and estimated budget

- ✓ There is need to do an assessment of land owners who live far from their land and the ones in vulnerable groups to mobilize and sensitize them on the necessity of availing their land for exploitation. This assessment would also capture lands whose owners were killed during the genocide and are now unexploited.
- ✓ There is need to sensitize farmers to understand the macadamia project on their lands and to group them into cooperatives.

- ✓ From farmers' request, the consolidated lands with terraces should be divided into blocks according land suitability to various crops in one season; this way, in one season they would be allowed to cultivate not only maize and beans but also cassava, sorghum and banana.
- ✓ Farmers need enough supply of inputs mainly organic fertilizers to revitalize the unfertile soils that have been affected by bad terraces construction.
- ✓ Farmers also need disease free cassava cuttings for the abandoned lands.

These interventions can be put in place with strong collaboration with farmers through cooperatives, local authority and government support. Particularly, main terraced land should be availed to private investors. The estimated budget for these interventions is summarized in the table 3 once it is done through farmer's cooperatives.

Table 2: Budget Estimation for Proposed Key interventions towards the optimization of Rwabicuma Site

No	Key interventions	Area (ha)	Unit (t/ha)	Total quantity (t)	Unit price (Frw)	Total cost (Frw)
1	Manure/compost	1060	10	10600	27000	286,200,000
2	Lime	1060	2.5	2650	70000	185,500,000
3	Cassava cuttings	50	1000	50000	30	1,500,000
4	Agroforestry	433	2500	1082500	40	43,300,000
	Total budget					516,500,000

5.2 Saruheshyi, Ruhango District

5.2.1 Site description

a. Historical background

Saruheshyi site is located in Mwendo sector, Ruhango district of the southern province of Rwanda. Radical terraces were established by COCASTER and VUP at 12.8 ha. The geographic location of the terraces is at 02.15514°, 029.70380° and 1811m. Farmers are still doing traditional farming where crops are scattered and grown on some few terraces. According to our discussions with farmers, the site is mainly characterized by different soil types with the following vernacular names: Urusenyi, Inombe and Kokobe. This site represents the reality of radical terrace status of Ruhango district because approximately 90% of developed terraces are not exploited.

b. Terraces maintenance and exploitation

Saruheshyi is mainly exploited by individual farmers who are growing various crops such as cassava, sweet potato, maize and banana. These terraced lands are not well maintained because they are not exploited and are used for grazing animals.

c. Site profitability

Through farmer's group discussion, data were collected for production cost and generated revenue at harvest on selected and grown crops. The following table is a summary of these data.

Table 3: Saruheshyi Site Crop Profitability

District	Site name	Crop in current production	Production cost (Frw)/ Ha	Gross revenue (Frw)/Ha	Profitability (Frw)
Ruhango	Saruheshyi	Cassava	1,586,300	2,536,400	**950,100**
		Beans	1,190,900	2,499,900	**1,309,000**
		Banana	2,098,680	833,333.00	**-1,265,347**

Table 3 shows that farmers are not making profits from their agricultural activities because of their traditional cropping systems that do not use inputs at optimal level.

5.2.2 Challenges

From discussions with farmers and local leaders, the following are challenges faced by farmers and are causing the 12.8 ha of terraced land of to be under or unexploited:

Social and institutional challenges

- Resistance of farmers to cultivate terraced lands with perception that terraced land is not productive;
- Weak support from local authorities in valorising terraces; normally, this is easy when farmers are grouped into cooperatives, which is not the case on this site.
- The terraced land reported by the local authorities are mainly under or overestimated. Thus Deep assessment and survey of terraced land is necessary to get accurate data on terraced lands country wide.

Technical challenges

- Farmers lack inputs mostly organic fertilizers to revitalize unproductive soils (kokobe, inombe and urusenyi) from underlying horizons.

- Lack of cassava planting materials for farmers on Mwendo sector, which is one of their staple crops;
- Lack of knowledge of better agriculture practices such as ISFM technologies. Farmers are still mixing crops on one plot without taking into consideration improved agriculture practices of intercropping, mono cropping and rotation systems.
- Inappropriate techniques in developing terraces; some land was not agricultural land as it was on rock stone with shallow depth whereas other fertile top soils of arable lands were not kept aside before establishment of radical terraces, hence low productivity. This has been observed for terraces constructed by COCASTER.

Financial challenges

- Low purchasing power of farmers, which makes it hard for farmers to afford fertilizers and cassava cuttings.

5.2.3 Proposed Key interventions/ Strategies towards optimal exploitation of radical terraces and estimated Budget

- ✓ There is need to organize and train farmers on integrated soil fertility management as adapted good agriculture practices
- ✓ Furthermore, there is need to supply inputs such as organic fertilizers, improved seeds, cassava cuttings and lime for a period of 2 years in order to revitalize the soil fertility and increase the productivity.
- ✓ From farmers' request, the consolidated lands with terraces should be divided into blocks according to land suitability to various crops in a season.
- ✓ Farmers require enough supply of inputs mainly organic fertilizers to revitalize the unfertile soils that have been affected by bad establishment. Farmers also require the cuttings for cassava to grow abandoned lands.
- ✓ These unexploited terraces represent the status of Ruhango district since approximately 90% of developed terraces are under exploited.

These interventions can be put in place with strong collaboration between farmers through cooperatives, local authority and government support. The estimated budget for these interventions channeled through cooperatives is summarized in the table below:

Table 4: Budget Estimation for Proposed Key Interventions Towards the Optimization of Saruheshyi Site

No	Key interventions	Area (ha)	Unit (t/ha)	Total quantity (t)	Unit price (Frw)	Total cost (Frw)
1	Manure/compost	12.8	10	128	27000	3,456,000
2	Lime	12.8	2.5	32	70000	2,240,000
3	Cassava cuttings	5	1000	5000	30	150,000
4	Agroforestry	5	2500	12500	40	500,000
	Total budget					**6,346,000**

5.3 Cyanika, Nyamagabe district

5.3.1 Site description

a. Historical background

Cyanika site is located in the Southern province in Nyanza cell, Cyanika sector of Nyamagabe district. The site is located at a latitude of 02025.253°, a longitude 029035.706° and an altitude 1847 m. This site has been developed by two organizations LWH/RSSP and Good Neighbours with respectively 54.5 ha and 138 ha but the biggest area, that is not exploited, has been developed by LWH/RSSP. From the discussions with farmers, the site is mainly characterized by different types of soils with the following vernacular names: Mugugu, Urusenyi and Inombe. The Mugugu soil type is the dominant type.

Farmers mainly grow sweet/Irish potato, cassava, and beans. Farmers have access to storage facilities on the support of the Catholic Church. Farmers store their produce and pay a fixed rent for a given time period.

b. Terrace maintenance and exploitation

Terraced land on this site is about 268 ha where about 71.8 % of it (192.5 ha) is under/unexploited. It is mainly exploited by individual farmers in a traditional non-consolidated agriculture; currently, farmers are organized in cooperative but it is still at young stage.

c. Site profitability

Through farmer's group discussion, data were collected for production costs and generated revenues on selected and grown crops.

Table 5: Cyanika Site Crop Profitability

District	Site name	Crops in current production	Production cost (Frw)/Ha	Gross revenue(Frw)/ Ha	Profit (Frw)
Nyamagabe	Cyanika	Irish Potato	2,002,600	3,750,000	**1,747,400**
		Beans	1,413,000	1,125,000	**-288,000**

This table 5 shows that farmers are not making profit in their agricultural activities because of their traditional cropping systems that do not use inputs at optimal level.

5.3.2 Challenges

From discussions with farmers and local leaders, several challenges, source of under/non exploitation of 192.5 ha of the Cyanika were identified and are described below:

Social and institutional challenges

- Land owners, mainly survivors of the Genocide against Tutsi, do not live near the site location and are not willing to release their lands for exploitation by other investors or farmers. However, local authorities are unceasingly sensitizing them to avail their lands.
- Other farmers, owners of terraced land belong in vulnerable groups (old, orphans, widows) and are unable to exploit their lands.
- Farmers are not well organized into cooperatives and have weak support to exploit terraces.

Technical challenges

- Farmers lack support of mostly inputs (organic fertilizers and manure) and can barely afford to buy those inputs
- Farmers have low knowledge on the use of agriculture inputs and adapted agriculture practices such as ISFM technologies
- Bad techniques in terraces construction
- Lack of cassava planting materials

Financial challenges

- Low purchasing power of agricultural inputs (fertilizers, cuttings/seeds, …) to boost their production;
- Farmers in vulnerable groups do not have enough workforce to cover all their land

5.3.3 Proposed Key interventions/ strategies towards optimal exploitation of radical terraces

- ✓ There is need to do an assessment of land owners who live far from their land and the ones in vulnerable groups to mobilize and sensitize them on the necessity of availing their land for exploitation. This assessment would also capture lands whose owners were killed during the genocide and are now unexploited.
- ✓ There is a need of farmers' mobilization and organization to strengthen young cooperatives and maximize the exploitation of terraces
- ✓ Farmers need enough agricultural inputs mainly organic fertilizers to revitalize the unfertile soils on terraces that were bad constructed.
- ✓ Farmers also need cassava planting materials to grow on abandoned lands.
- ✓ For a successful implementation of these interventions, there is need of collaboration between farmers through cooperatives, local authorities and government support. Particularly, the big underexploited sites should be availed to private investors. The estimated budget for these interventions is summarized in the table below.

Table 6: Budget Estimation for Proposed Key Interventions Towards the Optimization of Cyanika Site

No	Key interventions	Area (ha)	Unit (t/ha)	Total quantity (t)	Unit price (Frw)	Total cost (Frw)
1	Manure/compost	192.5	10	1925	27000	51,975,000
2	Lime	192.5	2.5	481.25	70000	33,687,500
3	Cassava cuttings	80	1000	80000	30	2,400,000
4	Agroforestry	49	2500	122500	40	4,900,000
	Total budget					**92,962,500**

5.4 Rugarika, Kamonyi District

5.4.1 Site description

a. Historical background

Rugarika site is located in Sheri cell, Rugarika sector of Kamonyi district in the Southern province. Terraces were developed in the upper part by FHI-KISARO while the lower part of the hillside was developed by the District through TIG. These terraces were developed in 2008.

In addition, Soils vary along the landscape where Urubuye (Entisols) is located in the upper part; Umusenga is located in the middle part and Kokobe (laterite) on the lower parts. Beans and maize are grown in the

upper part, rarely, cassava is grown in the middle and there are no crop grown in the lower part of the terraces.

b. Terraces maintenance and exploitation

This site covers 52.792 ha which are not and under-exploited. The upper part of the hillside terraced lands developed by FHI_KISARO are exploited whereas the lower part developed by TIG is not exploited at all. This is due to bad construction of terraces by TIG where the horizon layers of the soil profile were completely disturbed by putting the underlying horizons on the upper surface.

c. Site profitability

The table below provides a summary of the site profitability from data collected through farmers' discussions. Farmers are under exploiting the terraced lands, thus they do not get a profits from their produce.

Table 7: Rugarika Site Crop Profitability

District	Site name	Crops in current production	Production cost (Frw)/ Ha	Gross revenue (Frw)/ Ha	Profit (Frw)/ Ha
Kamonyi	Rugarika	Cassava	1,868,154	800,010	**-1,068,144**
		Beans	557,808	466,500	**-91,308**

5.4.2 Challenges

During discussion with farmers and local leaders, several challenges that caused the 52.8 ha of terraced land to be unexploited and underexploited:

Social and institutional challenges

- Resistance of farmers to cultivate terraced lands with perception that terraces are not productive, especially in the lower parts of terraced lands. According to farmers, they would rather build houses on that land than cultivating it.
- Farmers are not grouped into cooperatives to facilitate the optimal exploitation of terraces
- The terraced area reported by the local authorities are under or overestimated.

Technical challenges

- These lands should be surveyed deeply to identify the land capability and adapted crops for each land unit, since the soils are varying along the transect from the top to the valley.

- Farmers are lacking the inputs mostly organic fertilizers to revitalize unproductive soils (Kokobe, Inombe and Urusenyi) from underlying horizons.
- Farmers lack adapted seeds/cuttings to grow on these unproductive terraced lands.
- They have also low knowledge of the use of better agriculture practices such as ISFM technologies.
- Terraces were not well developed with no respect to some technical aspects where fertile top soils of arable lands were not kept aside before establishment of radical terraces, hence low productivity. This has been observed for terraces constructed mainly by TIG.

Financial challenges

- In addition, farmers have low purchasing power, thus they cannot afford to buy enough inputs to cover the land they have.

5.4.3 Proposed Key interventions/ strategies towards optimal exploitation of radical terraces and estimated budget

- ✓ It is required to organize, mobilize and train farmers and conduct research trials on integrated soil fertility management
- ✓ From farmers' request, the consolidated lands with terraces should be divided into small blocks according to soil type and crop adaptability for various crops in a season.
- ✓ Farmers need enough inputs mainly organic fertilizers and lime to revitalize the soil fertility status that has been disturbed during terrace establishment to increase the productivity.

The estimated budget for these interventions is summarized in the following table 8.

Table 8: Budget Estimation for Proposed Key Interventions Towards the Optimization of Rugarika Site

No	Key interventions	Area (ha)	Unit (t/ha)	Total quantity (t)	Unit price (Frw)	Total cost (Frw)
1	Manure/compost	52.8	10	528	27000	14,256,000
2	Lime	52.8	2.5	132	70000	9,240,000
3	Cassava cuttings	20	1000	20000	30	600,000
4	Agroforestry	13	2500	32500	40	1,300,000
	Total budget					**25,396,000**

5.5 Gafumba/ Cyiri Site, Huye district

5.5.1 Site description

a. Historical background

Cyiri site is located into four cells Gafumba, Kimuna, Kimurehe of Rusatira sector and Byinza cell located in Kinazi sector, Huye district in the southern province of Rwanda. Radical terraces were constructed on 600 ha under support of LWH/RSSP. The site is located at latitude of 02027.044°, longitude of 029049.495° and 1433 m. Before terrace establishment, there was a problem of erosion; hence the Government, through LWH/RSSP, took the initiative of constructing radical terraces. According to discussion held with farmers, terraces were well developed and are productive.

b. Terrace maintenance and exploitation

The site is mainly exploited but one important part is non-exploited, which was the case also before terrace development. To date, they are exploited by farmer cooperatives, which was not the case before terracing. Individual farmers are grouped in one cooperative that grows maize and beans. The non-exploited land is about 174.5 ha.

The non-exploitation of terraced land on this site is due to different reasons such as low financial capacity, lack of workforce for some land owners and others who live far from their land. Though farmers have been trained through the project, terraced lands under exploitation and non-exploited have average to low maintenance status respectively.

c. Site profitability

Through discussions with farmers, data were collected for production costs and generated revenues from grown crops on the site and the table below summarizes the findings:

Table 9: Cyiri Site Crop Profitability

District	Site name	Crop in current production	Production cost (Frw)/ Ha	Gross revenue(Frw) /Ha	Profit (Frw)/Ha
Huye	Cyiri	Maize	531,000	536360	**5,360**
		Beans	390,000	455000	**65,000**

5.5.2 Challenges

During the discussion with farmers and local leaders, several challenges that caused the land to be under or unexploited, were highlighted and grouped into three categories:

Social and institutional challenges

- Farmers' mind set and resistance to cultivate terraced lands with perception that the land is more productive for cassava crops rather than maize and beans;
- Adult/Vulnerable persons who are unable to exploit their terraced lands due to lack of workforce;
- Farmers who live far from their land.

Technical challenges

- Farmers lack inputs mostly organic fertilizers and lime to revitalize unproductive soils;
- Low skills on integrated soil fertility management as adapted agriculture practices;
- Bad managed feeder roads to facilitate the transport of the produce from field to the market place.

Financial challenges

- Farmers have low purchasing power, thus they cannot afford to buy organic fertilizers;
- Farmers have low capacity/workforce to cultivate the total terraced land size, therefore, they decide to exploit a small portion.

5.5.3 Proposed Key interventions/ Strategies towards optimal exploitation of radical terraces and estimated budget

- ✓ There is need to train farmers on integrated soil fertility management as adapted agriculture practices by use of demonstration plot strategies;
- ✓ Maintenance of feeder roads to facilitate easy transport of agriculture products and inputs;
- ✓ Farmers are requesting to grow various crops according to the types of soils and adapted crops in one season. They particularly would like to grow cassava and banana crops on soils unsuitable to maize and beans.
- ✓ Farmers need enough supply of inputs mainly organic fertilizers and lime to revitalize the unfertile soils;
- ✓ Farmers also require the cassava cuttings to grow abandoned lands;
- ✓ Farmers require support for cattle rearing or other small livestock to increase access to organic manure.
- ✓ This site has potential for private sector involvement since, farmers are not exploiting it and according to them, it is not easy to afford the required inputs to increase its productivity.

Table 10: Budget Estimation for Proposed Key Interventions Towards the Optimization of Cyiri Site

No	Key interventions	Area (ha)	Unit (t/ha)	Total quantity (t)	Unit price (Frw)	Total cost (Frw)
1	Manure/compost	174.5	10	1745	27000	47,115,000
2	Lime	174.5	2.5	436.25	70000	30,537,500
3	Cassava cuttings	50	1000	50000	30	1,500,000
4	Agroforestry	44	2500	110000	40	4,400,000
	Total budget					**83,552,500**

The following table shows a summary of the optimal production plan per hectare for the sites visited in the southern province:

Table 11: Optimal production plan for visited sites in Southern Province

District	Site name	Total area (Ha)	Optimal crops	Optimal yield (t/ Ha)	Price at harvest (Frw)	Gross revenue (Frw)/ Ha	Production cost (Frw)/ Ha	Optimal profit (Frw)/ Ha
Kamonyi	Rugarika	52,79	Cassava	12 000	150	1 800 000	1 500 000	**300 000**
			Beans	2 500	200	500 000	450 000	**50 000**
Nyanza	Rwabicuma	1300	Maize	4 500	160	720 000	463 800	**256 200**
			Beans	2 500	200	500 000	450 000	**50 000**
Ruhango	Saruheshyi	12,8	Cassava	12 000	150	1 800 000	1 500 000	**300 000**
			Beans	2 500	200	500 000	450 000	**50 000**
			Banana	7 000	100	700 000	620 500	**79 500**
Nyamagabe	Cyanika	51,6	Irish Potato	25 000	100	2 500 000	2 314 000	**186 000**
			Climbing beans	3 000	200	600 000	500 000	**100 000**
Huye	Cyiri	600	Maize	4 500	160	720 000	463 800	**256 200**
			Beans	2 500	200	500 000	450 000	**50 000**

6. WESTERN ZONE

6.1 Mahembe, Nyamasheke District

6.1.1 Site description

a. Historical background

Mahembe site is located in Mahembe sector, Kagarama cell, Kagobero village. The site is also known as Kagobero site. The area as reported by the local authority is 75ha; the GPS measurements taken by the team during this exercise shows that the site has only 8ha. The terraces of this site were established in 2013 by VUP. There is also another adjacent site, established by VUP, located in Kanombe cell. It was also reported by the local authorities to be 50 ha but the GPS measurements showed 10ha only. This brings it to a total of 18 ha instead of 125ha as reported by the local authorities.

b. Terraces maintenance and exploitation

Before terracing, the land belonged to individual smallholder farmers; it was terraced as government initiative targeting the poorest sector to reduce the issues of low productivity, soil erosion and land siltation that were observed in the area. Workers were paid using cash and were mainly the poorest of the village that belong to category 1 of Ubudehe. To-date, terraces are exploited by owners, smallholders farmers, estimated at 110 households, among which 98% inherited this land.

Mahembe site is exploited at 95%. The main reasons to why the site is not exploited at 100% are that farmers live far from their land and the old ones get sick most of the times thus, are unable to cultivate all the land or hire manpower for it. From the team's observation, the terraces on the site are very well maintained. Farmers reported to have some knowledge in terrace maintenance, mostly regarding cultivating on contour lines; and they have been trained for contour cultivation, maintenance of embankments, use of organic manure and crop rotation as they do not receive regular technical support for maintenance of terraces.

c. Site profitability

The main source of income in the area is farming and trade of agricultural products and livestock reared is cattle (90%), goats (1%), pigs (1%) and chicken (2%). A typical farmer of the area can earn between Frw 50,000 to Frw 100,000 per season. The main crops cultivated on the site are maize and beans. However, farmers are still mixing all crops including banana, soybean, potato and cassava on one part of the site. Beans are cultivated on the upper side of the site considered as less fertile whereas maize is cultivated downside of the site considered as more fertile.

From the discussions with groups of farmers, data were collected on their total investment in their land and the revenues they are making from it. The table below shows the current productivity of the site.

Table 12: Mahembe Site Crop Profitability

District	Site name	Crops in current production	Production cost (Frw)/ Ha	Gross revenue (Frw)/Ha	Profit (Frw)/Ha
Nyamasheke	Mahembe	Maize	1,299,750	564,485	**-735,265**
		Beans	1,087,500	498,174	**-589,326**

Farmers on the site are making losses mainly because they are not putting enough inputs and because they do their farming only or feeding their families not as a business that could generate revenues for them.

6.1.2 Challenges

The following are the challenges being faced by farmers exploiting this Mahembe site:

- The area presented by the local authorities is very much different from the area measured by the team using GPS
- The soil of the terraces is still acidic which leads to infertility
- Lack and insufficient soil amendments (lime and organic manure); approximately 100 households among 128 households of the village have cows; 32 households are the ones that received cows in the Girinka Project for ease of obtaining manure to be applied in terraces
- Lack of linkage to market and market information for maize produce
- Lack of post-harvest infrastructures
- Terraces' soils have not yet recovered their natural fertility
- Lack of capacity building for farmers in maintenance of terraces
- Lack of proximity extension services and research on crops that could easily adapt to the type of soils in the area
- Limited knowledge of sector agronomists in maintenance of terraces
- Farmers are not organized into cooperatives which has been observed to be one of the means to help the poorest get access to soil amendments and other inputs as well as access to markets

6.1.3 Key interventions/Strategies to maximize terraces exploitation and estimated budget

✓ There is need to conduct a survey of existing terraces established in the whole country to have accurate data on terraced area since it appears that reported terraced area is very far from reality. After this survey, there is need of digital mapping of terraces

- ✓ There was a suggestion of creating a credit scheme for the subsidized fertilizers to allow poor farmers access the enough fertilizers to apply the required amount on their land
- ✓ Lime to be applied on this site have been offloaded far from the site itself; bringing it near the site eases its transport and encourages farmers to apply it in their terraces instead of being charged for transport (they are currently being charged Frw 23/kg).
- ✓ There is need to sensitize farmers on the importance of only growing crops that adapt to their soils as well as the importance of the CIP programme

Table 13: Budget Estimation for Proposed Key Interventions Towards the Optimization of Mahembe Site

Activity	Total area (ha)	Total quantity (t)	Unit cost/Ha (Frw)	Total cost (Frw)
Lime	18	90	40,000	3,600,000
Compost	18	180	40,000	7,200,000
Capacity building		30	50,000	1,500,000
Total budget				**12,300,000**

6.2 Karongi 12, Karongi district

6.2.1 Site description

a. Historical Background

The Karongi 12 site is located in Rubengera, Rugabano and Mukura sectors. It was established from the support of LWH and in Karongi District, it covers 390.75 (net area) and 651.25Ha (gross area). Farmers are organized in self-help groups up to Cooperatives. The land covered by terraces was used by individual farmers before terraces.

b. Terrace maintenance and exploitation

Karongi 12 site was established in 2010 on government initiative to resolve the issues of erosion and low productivity observed in the area and farmers who participated were paid cash. The site currently mainly belongs to individual farmers from parents' inheritance; part of it (18 ha) has been leased to a private investor producing vegetables for export and very few of them purchased terraced land on this site.

The total number of beneficiaries is estimated at 2,058 among which 1158 are men. Farmers are grouped into 146 self-help groups and divided in seven zones; and two cooperatives KOABIBIKA and KOABIKARU. By the

time of the visit, the non-exploited area was estimated at slightly above 138 ha, part of which is the command area that is cultivated in season C. One of the reasons that farmers have not exploited the terraces which are not in the command area is their mind set; that they have not agreed to cultivate what they are requested to cultivate and therefore, leave their part unexploited while others have relocated to Burundi. From the team's observation, the terraces on this site are very well maintained.

The site having been established by LWH, farmers have a lot of knowledge in terrace maintenance regarding the maintenance of irrigation canals/ water ways, use of compost, embankment protection, planting agroforestry and contour cultivation for which they have received trainings in their respective zones in addition to kitchen gardens construction and compost making. They receive regular technical support in maintaining terraces from LWH.

c. Site profitability

In the water catchment area, the main crops are maize and beans while in the command area catchment (CAC), farmers cultivate fruits and vegetables. From data collected from the LWH project on the current investments by farmers, the following table shows the current profitability per crop from the three crops cultivated in season 2014B on the site.

Table 14: Karongi 12 Site Crop Profitability

District	Site name	Crops in current production	Production Cost (Frw)/Ha	Gross Revenue (Frw)/Ha	Profit (Frw)/ Ha
Karongi	Karongi 12	Climbing Beans	549,133	747,240	**198,107**
		Maize	510,495	447,606	**-62,889**
		Irish Potato	671,229	504,886	**2,833,657**

6.2.2 Challenges

- Lack of good quality of Irish potato and wheat planting materials
- Pests and diseases of crops on the site
- Decline of soil fertility after terracing
- Low quantity of lime provided and the frequency of liming is not respected (recommended after every 3 years)
- The cropping calendar is not respected; consequently, the harvesting time is different from farmer to farmer and the market is not ensured.
- Part of the land has been leased to a private investor, this has worsened the financial position of the farmers who only depend on their portion of land because prices are varied downward which discourages farmers.

- Land lease price per hectare is very low (Frw 1,500/0.01ha/year); it cannot sustain families that were initially depending on that portion of land
- Lack of post-harvest infrastructures for fruits and vegetables which brings big losses during harvest time to farmers
- Terraces have not yet recovered their natural fertility
- The organic manure is used at low rate

6.2.3 Proposed Key interventions/strategies to maximize terraces exploitation and estimated budget

- ✓ Consultation between farmers, the project and the government on crops adapted to the site which constitutes a win-win situation to the farmers and brings returns on the investment made by the Government through that project on the site. This is for the Water catchment area since the command area is reserved to high value crops. However, there is need for more sensitization of the farmers to understand this.
- ✓ Beans being a staple food in the area, as well as part of the crops allowed in the area, the recommendation would be to allow farmers to cultivate beans on the site one season
- ✓ Link farmers to markets for fruits and vegetables and avail post-harvest infrastructure for fruits and vegetables
- ✓ Advocacy on the increase of land lease cost per hectare in the area or rather do contract farming instead of leasing their land. This is because from contract farming, they can still exploit their land and get some produce after selling the contracted quantity and at the end of the contract; they can replicate what they learnt from the contractor.
- ✓ Increase soil amendments and respect frequency of liming
- ✓ Construction of a market specific to vegetables (like Bazirete market)
- ✓ Organize farmers in order to cultivate at the same time (capacity building for the cooperatives)
- ✓ Avail lime to the site

Table 15: Budget Estimation for Proposed Key Interventions Towards Optimisation of Karongi 12 Site

Activity	Total area (ha)	Total quantity/ha	Unit cost/ha (Frw)	Total cost (Frw)
Lime	651.25	3,256	40,000	130,250,000
Compost	651.25	6,513	40,000	260,500,000
Capacity Building		60	50,000	3,000,000
Market construction		1	400,000,000	400,000,000
Total Budget				**793,740,000**

6.3 Karongi 13, Rutsiro district

6.3.1 Site description

a. Historical background

Karongi 13 site was established in Rutsiro District on the support of LWH project and its area is about 141.5 ha (net area) and 226.24Ha (gross area). The total number of members is 820 heads of household among which 371 are women. The farmers are grouped into 53 self-help groups and three zones in KOABIMURU cooperative. The total number of beneficiaries is 4563 among which 2413 are women. This site is exploited at 70-80%.

b. Terrace maintenance and exploitation

Approximately only 60% of farmers cultivating terraces use fertilizers but still at non recommended rates because most of them cannot afford the required amount of fertilizers for the size of land they have. Some farmers have opted to lease their unexploited land terraces to farmer cooperatives which are willing to exploit them; this is one of the strategies by the local authorities to increase the rate of exploitation of terraces. some terraces are in critical condition, they have been destroyed by rains and one of the strategies adopted by the local authorities is punishments to those destroying terraces; for the ones, who bring in cows, they are charged Frw 10,000/cow and for goats and sheep, they are charged Frw 5,000/goat/sheep.

c. Site profitability

According to the local agronomist, the most reared livestock in the area are cattle, goat and sheep; chicken, rabbits and pigs are rarely seen in that area. In regards to the crops that are recommended for this site is the Irish Potato but it is not currently cultivated on this site, it was last cultivated there in 2011A and a disease destroyed all of it, which brought fear to farmers and are now reluctant to cultivate it again.

From discussion with farmer groups and staff of the LWH project, data on their current investment in the site were gathered and the table below captures the current profitability from crops cultivated on the site.

Table 16: Karongi 13 Site Crop Profitability

District	Site name	Crops in current production	Production Cost (Frw)/Ha	Gross Revenue (Frw)/Ha	Profit (Frw)/Ha
Rutsiro	Karongi 13	Maize	611,164	190,049	**-421,115**
		Irish Potato	1,040,437	884,677	**-155,760**
		Peas	131,628	4,320,592	**4,188,964**
		Climbing beans	746,283	300,452	**-445,831**
		Wheat	631,037	994,002	**362,965**

6.3.2 Challenges

- The lack/ insufficient manpower lead some farmers to abandon terraces unexploited
- Lack of good quality seeds for Irish potato
- Pests and diseases. Rats are destroying crops at very early stage
- Lack of linkage to markets for their produce
- Some owners of land live far from their terraced land and leave it unexploited
- A number of terraces are already in critical condition, destroyed by rains
- The storage and drying facilities on the sites are not utilized because the production is very low.

6.3.3 Proposed Key interventions/strategies to maximize terraces exploitation and estimated budget

- ✓ Empowering cooperatives operating on the site
- ✓ Linking farmers to seed multipliers
- ✓ Mobilize farmers owners of unexploited terraces to exploit them or lease them to willing farmers/cooperatives
- ✓ Technical support to farmers to repair destroyed terraces
- ✓ Linking farmers to market for wheat

Table 17: Budget Estimation for Proposed Key Interventions Towards Optimization of Karongi 13

Activity	Total quantity	Unit cost (Frw)	Total cost (Frw)
Capacity Building	60	50,000	3,000,000
Terraces reparation	Lump sum		400,000,000
Total budget			**403,000,000**

6.4 Muhororo site, Ngororero District

6.4.1 Site description

a. Historical background

Muhororo site was established by VUP, TIG and PAM from 2007 to 2009. It is located in Ngororero District, Muhororo sector and is dispatched in two cells, Rusororo (Gapfura village) and Mubuga (Mitsimbi and Buringo). The reported area covered by terraces is 78ha not consolidated. Before terracing, the land belonged to individual smallholder farmers, and most of it was inherited from their parents. Terraces were established to solve the erosion problem that was severe in the area and conflicts between farmers related to land.

b. Terraces maintenance and exploitation

These terraces were constructed as the Government initiative as part of the VUP program to help the poorest get jobs and increase their income but also to solve the problem of erosion and land siltation, fertile soils washed by rains to the marshland. PAM initiative was to also offer jobs to local population and paid in food. Approximately the site is exploited at 75%. From the observations of the team, the terraces on this site are well maintained, however not productive. The terraces developed by VUP require a lot of soil amendments because of techniques used during terraces established which left the unfertile soils on top. There is only one cooperative exploiting terraces, COIMU, others are individual smallholder farmers who inherited that land from their parents.

c. Site profitability

From discussions with groups of farmers exploiting the site and some members of this COIMU cooperative, data on the productivity from the site were collected. The table below summarizes the finding on the profitability of the site.

Table 18: Muhororo Site Crop Profitability

DISTRICT	Site name	Crops in current production	Production cost (Frw)/ Ha	Gross Revenue (Frw)/ Ha	Profit (Frw)/Ha
Ngororero	Muhororo	Cassava	1,658,230	1,580,000	**-78,230**

The area is suitable for cassava plantation and according to farmers, it used to be very productive before terraces were established, which lead to the construction of a cassava processing plant near the terraced site (5 years

ago) by the district authorities; but after terraces were established the production reduced and the processing plant was never operational till now.

6.4.2 Challenges

- Unexploited terraces: Some land owners have relocated to Kigali others have gone to look for jobs in other Districts.
- Soil infertility due to acidity and lack of lime and organic manure resulting in low productivity of cultivated crops.
- Lack of planting material for adapted crops which is mainly cassava. This low productivity of terraces has led to non-use of the cassava processing plant that was constructed in the area in anticipation of increase of production; but this was the opposite after the terraces were constructed.
- Need of research on soil type and recommendation on adapted crops
- Low purchasing power for agro-inputs (manure, lime and mineral fertilizers) leading to very low use of agro inputs.
- Pests (mainly rats) which go into the embankment part and make it impossible to grow plants on the affected terraces
- Due to lack of knowledge in construction of terraces during the time this site was established, the terraces are in bad condition and for others, it is impossible to exploit them due to small benches.

6.4.3 Proposed Key interventions/strategies to maximize terraces exploitation and estimated budget

- ✓ There is need to rehabilitate terraces in Muhororo site
- ✓ There is also need to avail inputs to farmers mainly lime and compost at least every three years
- ✓ Carry out research for adapted crops based on pedologic and edaphic conditions
- ✓ Avail clean cassava planting materials to support the constructed cassava processing factory
- ✓ Avail enough lime to the site to correct the soil acidity
- ✓ Prioritize poor farmers, owners of land in those sites in the Girinka program to allow them get access to manure for their terraces
- ✓ Support in planting agroforestry trees

Table 19: Budget Estimation for Proposed Key Interventions Towards Optimization of Muhororo Site

Activity	Total area (ha)	Unit (t/ha)	Total quantity (t)/Ha	Unit cost (Frw)/Ha	Total cost (Frw)
Lime	78	2.5	195	70,000	13,650,000
Compost	78	10	780	28,000	21,840,000
Capacity Building	Lump sum		60	50,000	3,000,000
Cassava planting material	78	1000	78,000	30	2,340,000
Agroforestry	78	2,500	195,000	40	7,800,000
Total Budget					**48,630,000**

6.5 Sovu site, Ngororero District

6.5.1 Site description

a. Historical Background

The Ngororero site is located in Sovu sector, in 4 cells Birembo, Rutovu, Kagano and Kanyana cells. It was established starting from 2014 on the support of LWH and covers the total area of 534 Ha, still being expanded. It was established in the purpose of protecting the soil against erosion but also with the purpose of consolidating land. Before terracing, the land was exploited by individual smallholder farmers and they used to cultivate wheat, maize, beans and Irish potato. Terraces were constructed to resolve issues about erosion, low productivity and conflicts between owners of land.

They were constructed as government initiative and a few farmers also, after seeing the benefits from terraces, paid for laborers to establish terraces on their land. During terrace construction, land owners contributed in terms of labor and were paid in cash.

b. Terraces maintenance and exploitation

To date, the terraced land belongs to individual farmers and is exploited by 4,780 households, grouped into 164 self-help groups, in five zones. Approximately 70% of farmers exploiting this site have bought it while the remaining 30% inherited it from their parents. Beneficiaries are organized in a very young cooperative called KOZAMUSO which is yet to acquire legal personality. This is a site that is still under construction and according to the local agronomist, there is still potential for terracing in the area.

It is exploited at 99%, the remaining 1% is nonagricultural land that is close to the forest. The terraces on this site are very well maintained since farmers have knowledge in maintaining terraces on the support of LWH project.

c. Site profitability

Farmers started exploiting the site for the season of 2014B and they are making profits because the site is still new and despite the low use of agro inputs, the site still has all the inputs required. From discussions with farmer groups and staff of the LWH project, data were collected and the following table summarizes the profitability of the site.

Table 20: Sovu Site Crop Profitability

DISTRICT	Site name	Crops in current production	Production cost (Frw)/ Ha	Gross revenue (Frw)/ Ha	Profit (Frw) / Ha
Ngororero	Sovu	Maize	717,475	792,350	**74,875**
		Beans	947,340	1,300,500	**353,160**
		Irish Potato	453,200	2,800,000	**1,346,800**
		Wheat	670,265	1,025,970	**355,705**

6.5.2 Challenges

- The Irish potato seeds used for the previous planting seasons is no longer appropriate, it is no longer giving expected optimal yields
- Low use of agricultural inputs (the site is still productive because it is still new)
- No access to pesticides for Irish Potato
- Improved Irish Potato seeds
- Agro dealers delay to avail seeds which leads to delay in planting
- No structured market
- The Twigire Muhinzi program is yet to be well understood and implemented by farmers which makes it hard for farmers to get useful information

6.5.3 Proposed Key interventions/strategies to maximize terraces exploitation and budget estimates

- ✓ Ensure availability of new potato seeds (linking farmer cooperatives to seed multipliers)
- ✓ Availability of agriculture inputs at affordable prices- the suggestion is to avail these inputs and farmers would pay after harvesting
- ✓ Prioritize poor farmers for the Girinka Program for ease of access to manure
- ✓ Organize/ link farmers to markets for potato, maize and wheat
- ✓ Sensitize agro dealers on the importance of availing seeds and other inputs on time well before planting

Table 21: Budget Estimation for Proposed Key Interventions Towards Optimization of Sovu Site

Activity	Total area (ha)	Unit (t/ha)	Total quantity(t)	Unit cost (Frw)	Total cost (Frw)
Lime	534	2.5	1,335	70,000	93,450,000
Compost/Manure	534	10	5,340	28,000	149,520,000
Capacity Building			60	50,000	3,000,000
Soil analysis	Lump sum				50,000,000
Survey & Digitization of terraces	Lump sum				70,000,000
Total Budget					**365,970,000**

Table 22 summarizes the optimal production plan per hectare of the sites visited in the Western province.

Table 22: Optimal Production plan for Western Province visited sites

District	Site name	Total area (Ha)	Optimal crops	Optimal yield (kg/ Ha)	Price at harvest (Frw/kg)	Gross revenue (Frw)/Ha	Production cost Frw)/Ha	Optimal profit (Frw)/Ha
Nyamasheke	Mahembe	18	Maize	3,000	180	540000	463,800	**76,200**
			Beans	4,500	450	2025000	450,000	**1,575,000**
Karongi	Karongi 12	651.25	Maize	3,000	180	540,000	463,800	**76,200**
			Wheat	3,000	400	1,200,000	616,800	**583,200**
			Climbing Beans	8,000	350	2,800,000	610,000	**2,190,000**
			Green beans	15,000	400	6,000,000	906,500	**5,093,500**
			Irish Potato	25,000	100	2,500,000	2,314,00	**186,000**
			Snow Peas	3,500	1000	3,500,000	1,212,55	**2,287,449**
			Cow Peas	7,000	500	3,500,000	615,000	**2,885,000**
			Onion	40,000	350	14,000,000	753,500	**13,246,50**
			Garlic	10,000	1500	15,000,000	1,147,50	**13,852,50**
			Cabbage	30,000	75	2,250,000	524,000	**1,726,000**
			Sweet Pepper	15,000	375	5,625,000	2,353,00	**3,272,000**
			Eggplant	12,000	175	2,100,000	1,213,19	**886,805**
			Carrots	30,000	175	5,250,000	540,000	**4,710,000**
			Tomatoes	80,000	450	36,000,000	561,084	**35,438,91**
Rutsiro	Karongi 13		Maize	3,000	180	540,000	463,800	**76,200**
			Irish Potato	15,000	165	2,475,000	2,314,00	**161,000**
			Climbing beans	3,000	300	900,000	500,000	**400,000**
			Snow Peas	3,000	1000	3,000,000	1,212,55	**1,787,449**
			Wheat	3,000	400	1,200,000	616,800	**583,200**
Ngororero	Muhororo	78	Cassava	20,000	150	3,000,000	1,500,00	**1,500,000**
	Sovu	534	Maize	5,000	170	850,000	463,800	**386,200**
			Irish Potato	25,000	170	4,250,000	2,314,00	**1,936,000**
			Beans	3,000	550	1,650,000	450,000	**1,200,000**
			Wheat	3,000	300	900,000	616,800	**283,200**

7. NORTHERN ZONE

7.1 Karama Site, Rulindo District

7.1.1 Site description

a. Historical background

Located in Rulindo district, Kinihira sector, Marembo Cell, Kiyehe village. This site covers 42 ha, and was terraced by TIG 8 years ago; and the land was used before terracing. A total of 260 households are estimated to be exploiting the land at 100%. From the team's observations, terraces are well maintained.

The issues faced by farmers during exploitation of this land before terraces were erosion, which lead to low productivity. According to the farmers, the land was terraced from the government initiative. The contribution of farmers in establishing the terraces were in terms of labor and the crops cultivated were common beans, Irish potato, peas, sorghum, and sweet potatoes. The major crops currently cultivated are maize and common beans.

b. Terraces maintenance and exploitation

Before the establishment of terraces, the land belonged to individual farmers, and up to now it is the case. Those individual farmers are the ones who are exploiting the land to date. A total of 260 households are estimated to be exploiting the land. The site is exploited at 100% and terraces are well maintained.

c. Site profitability

Data on input as used by farmers and their yield were collected through discussions with farmers, and it was used to do a cost benefit analysis. As observed in the table for this site, there is a loss for the farmers, both on common beans and maize.

Table 23: Karama Site Crop Profitability

District	Site Name	Crops in current production	Total Production cost (Frw)/Ha	Gross Revenue (Frw)/ Ha	Profit /Loss (Frw)/Ha
Rulindo	Karama	Beans	617,200	143,000	**-474,200**
		Maize	465,976	143,000	**-322,976**

7.1.2 Challenges

- The low use of fertilizers by farmers, as they are not able to buy them, due to low purchasing power to afford the required fertilizers;

- There is no clear service provider to avail agriculture inputs in the area;
- Due to failure experienced during the 2 previous seasons with maize, the farmers are not willing to continue with growing maize.

7.1.3 Proposed Key interventions/Strategies to maximize terrace exploitation and estimated budget

- ✓ To facilitate the farmer producers' groups and cooperatives to easily access fertilizers and other agricultural inputs and assist in searching for a market of their produce as cooperatives;
- ✓ Trainings of farmers may be organized to improve their agricultural practices.
- ✓ Identification of farmers who can be considered in the Girinka program in order to allow them to have manure. Also, poor farmers that can't afford the minimum of feeding cows can be identified and given goats and sheep.

Table 24: Budget Estimation for Proposed Key Intervention Towards Optimization of Karama Site

Activity	Total area(ha)	Unit (t/ha)	Total quantity	Unit cost (Frw)	Total cost (Frw)
Distribution of Cows (Girinka)	N/A		50 cows	350,000	17,500,000
Distribution of Goats and sheep			100 goats	80,000	8,000,000
Supply of lime	42	2.5	105 tons	7,350,000	7,350,000
Long Season Training of Trainers (FFS	N/A		11 Farmers	1,500,000	16,500,000
Mobilization of Farmer promotors	N/A		4 Farmers	100,000	400,000
Training of farmers			240 Farmers	40,000	9,600,000
Total Budget					**59,500,000**

7.2 Gitwe site, Gakenke District

7.2.1 Site status

a. Historical background

Located in Gakenke district, Kamubuga sector, Kamubuga cell in Gitwe village, this site covers an area of 16 Ha and was terraced in 2008. A consulting company was hired to develop the terraces. Before terracing, the land was exploited by individual farmers, and it is still the case.

According to farmers, the initiative of developing the terraces came from the Government. And they say that there was no problem before the terrace

development. Their role in the development of terraces is that they were hired as labor and were paid Frw 500 per person per day.

b. Terraces maintenance and exploitation

Before the establishment of terraces, the land belonged to individual farmers, and this is the case to date. Those individual farmers are the one who are exploiting the land to date; they are estimated at 246 Households.

The site is well maintained but poorly exploited in terms of agricultural practices. The farmers do not use fertilizers as required, and they are still mixing crops.

Farmers on this site have knowledge in terrace maintenance, such as tree planting, fodder planting and canalization of water and they are the ones who maintain terraces without any technical support.

c. Site profitability

Data on input as used by farmers and their yield were collected through discussions with farmers, and it was used to do a cost benefit analysis. As observed in the table below, there is a loss for the farmers exploiting this site. This is explained mainly by the insufficient/non-use of inputs such as organic and inorganic fertilizers. It was also observed that the agricultural practices are still poor. Those are the two major reasons of this loss.

Table 25: Gitwe Site Crop Profitability

District	Site Name	Crops in current production	Total Production cost (Frw)/ Ha	Gross Revenue (Frw)/ Ha	Profit /Loss (Frw)/ Ha
Gakenke	Gitwe	Maize	886,250	80,000	**-806,250**

7.2.2 Challenges

The main challenges encountered by farmers on Gitwe site are:

- Maize crop disease;
- Disorganized ways of input supply (Mineral fertilizers and seeds);
- Traditional agricultural techniques applied;
- Difficulties to find organic fertilizers.

All of these challenges lead to that it is very difficult for these farmers to even produce enough for their family consumption.

7.2.3 Proposed Key interventions/Strategies to maximize terrace exploitation and estimated budget

✓ There should be reinforcement of the Twigire Muhinzi, specifically in establishing demo plots and farmer field school, where farmers will be enabled to learn better agriculture practices (the use of improved seeds,

the use of fertilizers and compost making, pest control and management) in order to maximize the returns from their farming activities;

- ✓ Facilitation of farmers to be grouped into cooperatives;
- ✓ Trainings on crop production, mainly including disease management and control is required.
- ✓ Identification and selection of farmers that can't get manure due to poverty. Those farmers can be grouped into two groups:
  - Those who can afford the price of keeping a cow in order to consider them in the Girinka program.
  - Those who cannot afford the price of keeping cows in order to give them goats and sheep for the farmers that are not able to get manure

Table 26: Budget estimation for Proposed Key Interventions Towards Optimization of Gitwe Site

Activity	Total quantity(t)	Unit cost (Frw)	Total cost (Frw)
Distribution of Cows (Girinka)	50 cows	300,000	15,000,000
Distribution of goats and sheep	100 goats	80,000	8,000,000
Long Season Training of Trainers (FFS Facilitators)	10 Farmers	1,500,000	15,000,000
Mobilization of Farmer promotors	2 Farmers	100,000	200,000
Training of farmers	236 Farmers	40,000	9,440,000
Total Budget			**47,640,000**

7.3 Bifurwe site/Burera District

7.3.1 Site status

a. Site location and historical background

This site is located in Burera district, Gatebe sector, Gabiro cell in Kagano village. It covers 34.5 ha, which are fully cultivated. It was established in 2011 by VUP, where farmers were paid in cash. This site was exploited due to the request of farmers, as there was a problem of erosion. Therefore, the role of the farmers was to request for terrace development and labor in the development of terraces.

b. Terraces maintenance and exploitation

Before terraces, the land was owned and exploited by individual smallholder farmers. All the area of this site is exploited and very well maintained. Farmers in this area normally cultivate Irish Potato, Climbing beans and Garden peas. Better more, farmers in this site use the control of all diseases using pesticides even in beans which is normally not done by many farmers in others sites.

Farmers have knowledge in terrace maintenance such as establishment of canal, fodder planting and agro forestry trees in terraces. They receive technical support in terraces maintenance through Umuganda and by the sector agronomist.

c. Site profitability

Farmers exploiting this site benefit from the cultivation of peas and Irish potato. The cultivation of common beans results in losses, due to the low use of fertilizers and the very low price of beans at harvest. Even if they gain from the cultivation of peas and the cultivation of Irish potato as summarized in the table below, it is not the optimal profit. It can go beyond it, if farmers use sufficient organic and inorganic fertilizers and if they can receive better prices at harvest.

Table 27: Bifurwe Site Crop Profitability

District	Site Name	Crops in current production	Total Production cost (Frw)/Ha	Gross Revenue (Frw)/Ha	Profit /Loss (Frw)/Ha
Burera	Bifurwe	Common Beans	1,509,000	1,500,000	**-9,000**
		Peas	1,205,000	1,250,000	**45,000**
		Irish Potato	958,000	80,000	**313,750**

7.3.2 Challenges

- The major problem is that at harvest of Irish potato, the price is very low compared to the expenses (the amount and cost of inputs).
- Some farmers are not able to get organic fertilizers which are very important to maintain soil fertility and contribute to higher productivity.

7.3.3 Proposed Key interventions/Strategies to maximize terrace exploitation and estimated budget

- ✓ Farmers training are to be reinforced so that there may be sustained and improved production;
- ✓ Livestock number is to be increased so as to satisfy farmers not able to easily produce organic fertilizer for their betterments.
- ✓ Organizing farmers into cooperatives, allowing them to share costs such as the cost of storage,
- ✓ Creation of a collection center of the Irish potato crop that could help in price regulations.

Table 28: Budget Estimation for Proposed Key Interventions Towards Optimization of Bifurwe Site

Activity	Total quantity	Unit cost (Frw)	Total cost (Frw)
Distribution of Cows (Girinka)	50 cows	350,000	17,500,000
Supply of lime	34.5 ha	70,000	2,415,000
Mobilize farmers to form cooperatives	10 Farmers	1,500,000	15,000,000
Construction of an Irish potato collection center	1 collection center	15,000,000	15,000,000
Total budget			**49,915,000**

The table 29 below provides a summary of the optimal production plans of the visited sites in the Northern Province.

Table 29: Optimal Production Plans for the Visited Sites in the Northern Province

District	Site name	Total area (Ha)	Optimal crops	Optimal yield (kg/ Ha)	Price at harvest (Frw/kg)	Gross revenue (Frw)/Ha	Production cost (Frw) /Ha	Optimal profit (Frw) /Ha
Rulindo	Karama	42	Beans	4,500	450	2,025,000	450,000	1,575,000
			Maize	3,500	180	630,000	463,800	166,200
Gakenke	Gitwe	16	Maize	3,500	180	630,000	463,800	166,200
Burera	Bifurwe	34.5	Irish Potato	15,000	165	2,475,000	2,314,000	161,000
			Climbing beans	3,000	300	900,000	500,000	400,000
			Peas	3,000	1000	3,000,000	1,212,551	1,787,449

8. EASTERN PROVINCE

8.1 Rwamagana 34 & 35 Sites, Rwamagana District

8.1.1 Sites description

a. Historical background

The site of Rwamagana 35 is located in the Eastern Province in the district of Rwamagana, where it is scattered in four sectors which are Muyumbu, Nyakariro, Karenge and Nzige. The site was developed by the MINAGRI SPIU/LWH-RSSP and has smooth hills.

Rwamagana 34 is located in the Eastern Province in the district of Rwamagana, where it is shared by three sectors which are Mwulire, Gahengeri and Nzige. The site was developed by the **MINAGRI SPIU/LWH-RSSP.**

b. Terraces exploitation and maintenance

Rwamagana 34 is exploited at approximately 80%, but the mode of exploitation is not commendable as some are occupied by mixed-crops (Maize and beans); this is mainly due to long drought where farmers started by planting Maize and added beans so as to minimize risks of bigger harvest loss.

A special notice was made on some farmers who have destroyed some parts of terraces by cultivating on risers (estimated at **7-8ha).** The under/non exploited area is estimated **47ha** dispatched within the site and according to farmers, this is due to the type of soil (rocky soil not adapted to Maize crop proposed by CIP)

Rwamagana 35 is exploited at 85%, with some parts of the site having mixed crops (Maize and beans) this was caused mainly by the long drought where farmers started by planting Maize and added beans so as to minimize risks of bigger harvest loss.

Some parts of the site have been destroyed by farmers who cultivated on the risers. The under/unexploited area was estimated at **38ha** non-consolidated, and the main raison given was the type of soils which are not favourable to maize recommended by CIP in the area (rocky soils).

The **Command Area** is the most exploited where all the **131ha** are totally occupied by Maize crop, this part is suitable for high value crops and eventually may be given to potential investors as it be irrigated, once irrigation works are completed.

c. Site profitability

Table 30 is summary of the profits/losses made by farmers exploiting the Rwamagana 34 and 35 sites. It shows that farmers are not making profits.

Table 30: Rwamagana 34 & 35 Sites Crop Profitability

District	Site name	Crops in current production	Production Cost (Frw)/Ha	Price at harvest (Frw/kg	Gross Revenue (Frw)/Ha	Profit (Frw)/ Ha
Rwamagana	RW-34	Maize	469,127.8	145	195 750	**-273 378**
		Soybean	469,127.8	425	233 750	**-235 378**
		Beans	429,566.7	375	81 250	**-148 317**
	RWH 35	Maize	650,125	150	321 450	**-328 675**
		Beans	450,000	275	139 975	**-310 025**

8.1.2 Challenges

During sites visits, the team had discussions with not only local leaders, but also with groups of farmers (beneficiaries) so as to collect the right information from the primary source.

Some terraces are under or not exploited by farmers because of several reasons such as low productivity, wrong construction, farmer's perceptions, and the poor quality of seeds.

The following are key issues and challenges mentioned by farmers/beneficiaries and local leaders at different levels:

- Long dry periods where farmers started by planting Maize and added beans so as to minimize risks of bigger harvest loss;
- According to farmers, some parts of terraced area, are under or not exploited because of the unsuitability of land compared the recommended crop to be cultivated, one single crop cannot fit everywhere in those sites visited;
- Due to losses encountered by farmers the previous season on soybeans, they are now reluctant to cultivate it again;
- Post-harvest infrastructures are still few and far from cultivated farms, which complicate the transport of the harvest to the drying and storage facilities
- The low price of maize is a big challenge to farmers, they would like to be involved in price negotiation and fixing.
- When terracing works were being carried out, crops in fields were valued and a promise of compensation was given, but not realized, this has discouraged many of the beneficiaries;
- Lack of roads or the roads poor conditions still hampers the circulation of goods and persons within the site;

8.1.3 Proposed Key interventions/Strategies to maximize terrace exploitation and estimated budget

Taking into account challenges observed and those raised by farmers during our visit, the following would be considered as key interventions needed in

order to increase the sustainable use of terraced sites visited especially at Rw-34 site:

Table 31: Budget Estimation for Proposed Key Interventions Towards Optimization of Rwamagana 34 & 35 Sites

No	Key interventions	Area (ha)	Unit (t/ha)	Total quantity (t)	Unit price (Frw)	Total cost (Frw)
1	Manure/compost	2,370	10	23,700	27,000	639,991,800
2	Lime	2,370	2.5	5,925	70,000	414,809,500
3	Cassava cuttings	75	1,000	75,000	30	2,250,000
4	Agroforestry	75	2,500	187500	40	7,500,000
	Total budget					**1,064,551,300**

8.2 Gatsibo site (8), Gatsibo district

8.2.1 Site description

The site of Gatsibo/8 is located in the Eastern Province in the district of Gatsibo, where it is shared between two sectors which are Kageyo and Gatsibo. The site was developed by the **MINAGRI SPIU/LWH-RSSP** it is composed by smooth hills and is estimably exploited at 80%, with parts having mixed crops (Maize and beans);

The under/ unexploited area is mainly the upper part (**8ha)** near the steep hills due to non-suitability of the soils vis a vis Maize crop.

Site profitability

Table 32 shows the current profitability of the Gatsibo/8 site as reported by farmer exploiting the terraces

Table 32: Gatsibo/8 Site Crop Profitability

DISTRICT	Site name	Crops in current production	Production Cost (Frw)/Ha	Price at harvest (Frw/kg)	Gross Revenue (Frw)/Ha	Profit (Frw)/Ha
Gatsibo	Gatsibo	Maize	673,783	136		-328,675
		Beans	450,000	263		-262,008
		Soybeans	455,800	350		-245,800

8.2.2 Challenges

During sites visits, the team had discussions with not only local leaders, but also with groups of beneficiaries to collect the right information from the primary source.

The following are the key issues and challenges found on the site:

- Long drought periods, reason of mixing crops to avoid hunger periods
- Unsuitability of the soil types to recommended crops;
- Previous failures of soybean brought reluctance to cultivate it again;
- Limited number of post-harvest infrastructure and their location far from farms which increases the losses during transport;
- Low price of maize at harvest;
- Not enough pathways within terraces to facilitate movements of people and goods within terraces or use of various means of transport such as bikes, wheel burry or even power tillers in transporting harvest;
- Terracing this site did not take into consideration other needs like the villages location sites, the graveyards; therefore, it is hard to get space for these;
- Some drainage channels crossing roads were not connected to their below-road parts in order to evacuate run-off water to a safe disposal place; this can cause destruction of roads or even houses near those channels;

8.2.3 Proposed Key interventions/Strategies to maximize terrace exploitation and estimated budget

Taking into account challenges observed and those raised by farmers, the following would be suggested as key interventions needed in order to increase the sustainable use of terraced sites visited:

Table 33: Budget estimation for Proposed Key Interventions Towards Optimization of Gatsibo Site

No	Key interventions	Area	Unit	Total	Unit	Total cost (Frw)
1	Manure/compost	656	10	6,560	27000	177,120,000
2	Lime	656	2.5	1,640	70000	114,800,000
3	Cassava cuttings	8	1000	8,000	30	240,000
4	Agroforestry	300	2500	750,000	40	30,000,000
	Total budget					**322,160,000**

8.3 Kayonza site/4, Kayonza District

8.3.1 Site description

The site of KAYONZA-4 is located in the Eastern Province in the district of Kayonza, where it is located in one sector which is Kabale, in Cyarubale and Gitara cells. The site was developed by the **MINAGRI SPIU/LWH-RSSP**; it is composed by depressions and rocky hills and it is approximately exploited at 85%; farmers mix crops (Maize and beans).

The **Command Area** is the one exploited at 100% (274.36ha all exploited) and totally occupied by Maize crops. This area is suitable for high value crops and eventually could be given to potential investors once irrigation works are completed as it will be irrigated.

There is an under exploited area within the site which is estimated at 200 ha. It was mostly occupied by not very well maintained cassava.

Site profitability

Table 34 shows the current profitability of the Kayonza-4 site as reported by farmer exploiting the terraces

Table 34: Kayonza/4 Site Crop Profitability

District	Site name	Crops in current production	Production Cost (Frw)/Ha	Price at harvest (Frw/kg)	Gross Revenue (Frw)/Ha	Profit (Frw)/Ha
Kayonza	**Kayonza/4**	Maize	739,775	155	308,264	**-431,511**
		Beans	450,000	350	33,250	**-416,750**
		Soybeans	455,800	375	150,000	**-305,800**

8.3.2 Challenges

From discussions with local leaders and beneficiaries, the following challenges emerged:

- Long dry seasons that leads farmers to cultivate both maize and beans to minimize losses during harvest
- Unsuitability of the soil types to recommended crops;
- Previous failures of soybean brought reluctance to cultivate it again;
- Limited number of post-harvest infrastructure and their location far from farms which increases the losses during transport;
- Low price of maize at harvest; farmers would like to be involved in the process of fixing prices for maize
- No enough pathways within terraces to facilitate movements of people and goods within terraces or use of various means of transport such as bikes, wheel burry or even power tillers in transporting harvest;
- When terracing works were being carried out, crops found in the fields were valued and a promise of compensation was given, but not realized, this has discouraged many of beneficiaries to exploit their terraces;
- There are arrears not yet paid by RAB to Imbereheza Cooperative which is affecting their activities;
- Weak/mal-functioning inputs supply chain, which have caused terrible loss in terms of harvest due to the late supply of inputs (seeds and fertilizers).

8.3.3 Proposed Key interventions/Strategies to maximize terrace exploitation and estimated budget

Taking into account challenges observed and those raised by farmers during our visit, the following would be considered as key interventions needed in order to increase the sustainable use of terraced sites visited:

Table 35: Budget Estimation for Proposed Key Interventions for Optimization of Kayonza/4 Site

No	Key interventions	Area (ha)	Unit (t/ha)	Total quantity(t)	Unit price (Frw)	Total cost (Frw)
1	Manure/compost	794	10	7,940	27,000	214,380,000
2	Lime	794	2.5	1,985	70,000	138,950,000
3	Cassava cuttings	200	1,000	200,000	30	6,000,000
4	Agroforestry	100	2,500	250,000	40	10,000,000
	Total budget					**369,330,000**

8.4 SAGATARE site, Kirehe district

8.4.1 Site description

Sagatare site is located in the Eastern Province in the district of Kirehe, where it is located in one sector Kirehe, in Nyabikokora cell. The site was developed by the **MINAGRI SPIU/KWAMP**. It is composed by depressions and rocky hills and is more or less well-exploited estimably at 75%.

The terraces technical quality was not at its optimum too, this will demand efforts in maintenance in order to keep them sustainably productive.

The unexploited area on the site is estimated at **23ha**. This part is mainly owned by vulnerable people who cannot afford to cultivate themselves the land or hire casual workers for agricultural activities.

Site profitability

As shown in the table below, farmers exploiting this site are basically making losses due to challenges listed below:

Table 36: Sagatare Site Crop Profitability

District	Site name	Crops in current production	Production Cost (Frw)/Ha	Price at harvest (Frw/kg)	Gross Revenue (Frw)/Ha	Profit (Frw)/Ha
Kirehe	**Sagatare**	Maize	541,556	150	330,000	**-211,556**
		Beans	533,744	350	210,000	**-323,744**
		Soybeans	561,084	375	522,500	**-38,584**

8.4.2 Challenges

As said above, during sites visits, the team had discussions with not only local leaders, but also with groups of farmers (beneficiaries) to collect the right information from the primary source.

The following are key issues and challenges mentioned by farmers/beneficiaries and their leaders:

- This site of Kirehe is particular as it is located in an area where finding manpower has been a challenge, the same as labour for cultivating farms. There is a big number of vulnerable groups owners of land on the site.
- Some technical errors were made during the terracing where there lacks drainage system (cut-off drains & waterways);
- Vertical interval was not respected during construction of terraces, where risers do not stand for a long time, and pathways construction along the terraces were neglected. There was abnormal presence of banana plantation in terraces
- Long sunshine periods where farmers started by planting Maize and added beans so as to minimize risks of bigger harvest losses;
- According to farmers, some parts of terraced area, are not exploited because of the unsuitability of land compared the recommended crop to be cultivated, one single crop cannot fit everywhere in those sites visited;
- Post-harvest infrastructures are not located near the site, which causes losses during transport after harvest
- The low price of maize

8.4.3 Proposed Key interventions/Strategies to maximize terrace exploitation and estimated budget

The following are quick interventions that would lead to optimal exploitation of the site:

Table 37: Budget Estimation for Proposed Key Interventions for Optimization of Sagatare Site

No	Key interventions	Area (ha)	Unit (t/ha)	Total quantity (t)	Unit price (Frw)	Total cost (Frw)
1	Manure/compost	123	10	1,230	27,000	33,210,000
2	Lime	123	2.5	307.5	70,000	21,525,000
3	Cassava cuttings	23	1000	23,000	30	690,000
4	Agroforestry	123	2500	307,500	40	12,300,000
	Total budget					**67,725,000**

The table below provides a summary of the optimal production plans of the visited sites in the Eastern Province:

Table 38: Optimal Production Plans for visited sites in the Eastern Province

District	Site name	Total area (Ha)	Optimal crops	Optimal yield (kg/Ha)	Price at harvest (Frw/kg)	Gross revenue (Frw)/Ha	Production cost (Frw)/Ha	Optimal profit (Frw)/Ha
Rwamagana	RW-34	913,36	Maize	3 800	160	608 000	463800	**144 200**
			Beans	3 500	375	1 312 500	450000	**862 500**
	RW- 35	1456,93	Maize	4 000	160	640 000	463 800	**176 200**
			Beans	3 500	275	962 500	450 000	**512 500**
Gatsibo	Gatsibo/8	656	Maize	3 300	150	495 000	463 800	**31 200**
			Beans	3 500	263	920 500	450 000	**470 500**
			Soybean	1 800	350	630 000	455 800	**174 200**
Kayonza	Kayonza/4	794,9	Maize	3 000	155	465 000	463 800	**1 200**
			Beans	3 500	165	577 500	450 000	**127 500**
			Soybean	1 800	350	630 000	455 800	**174 200**
Kirehe	Sagatare	123	Maize	3 800	150	570 000	463 800	**106 200**
			Beans	3 500	300	1 050 000	450000	**600 000**
			Tomatoes	3 500	275	962 500	561084	**401 416**

9. GENERAL RECOMMENDATIONS COUNTRYWIDE

From this pilot profiling of terraces activity that was conducted on 19 sites from the 4 provinces of the country, we can get a general picture of radical terraces developed in the whole country and it is in this spirit that the followed recommendations were made:

- To mobilize and organize farmers on consolidated terraced lands into cooperatives and strengthen non-operational, young and weak cooperatives/ farmers' associations. This will ease the management of post-harvest infrastructures and ease linking them to markets;
- There is need for consistent technical and financial supports for compost making to improve unfertile soils for at least a period of two years;
- Consistent support of lime application for acidic and highly weathered soils through cooperatives at least for a two-year term;
- Recommend specific priority crops on consolidated radical terraced lands based on pedologic and edaphic conditions
- Improve TWIGIRE MUHINZI approach in order to involve farmers in decision making about specific, adapted, and priority crops and cropping systems. Within watershed area, terraced lands can be split into several blocks based on crop adaptability (maize, bean, cassava, soybean, …);
- Enhance the ownership of the districts towards the sustainability of developed land husbandry and post-harvest infrastructures;
- The above recommendations were made according to agronomic and financial data collected during this activity; however, since on most sites, the issue of land suitability to recommended crops was raised, there is need to complete this report by conducting soil tests analysis for 54 samples that were taken from visited sites, to verify the above mentioned issue. The following table shows a tentative budget for sample soil analysis:

Table 39: Estimated budget for sample soil analysis

Parameters	Number of soil samples	Unit price (Frw)	Total price for soil samples (Frw)
OC	54	5000	270 000
pH	54	800	43 200
N	54	5000	270 000
P	54	4000	216 000
K	54	4000	216 000
Ca	54	4500	243 000
Mg	54	4500	243 000
Texture	54	10000	540 000
Total budget			**2 041 200**

10. CONCLUSION

The information provided in this report only provides a general picture of the level of exploitation of radical terraces in Rwanda since it was a pilot exercise to perfect the methodology that will be used for all the terraces.

Quick win interventions to be undertaken to solve the specific issues on visited sites and provide required support to valorize these terraces have been suggested. Among these proposed interventions include: consistent support of input supply like organic fertilizer (manure), lime and agroforestry trees to revitalize abandoned lands, not only in the visited pilot sites but also at the country level, specifically for the liming which has to be periodic (every 3 years) for acidic soils. Furthermore, the selected crops at each site should be adapted to the types of soils of the site and after consolidation, sites can be divided into blocks according to specific crops and farmers organized into cooperatives to maximize the site potential.

In addition to that, more means (technical and financial) should be availed in order to conduct a comprehensive study which should tackle on issues related to soil conservation practices and productivity of sites developed. The above mentioned study would have tasks to develop new approaches of soil conservation, which not only have to be effective in controlling soil degradation but would also have to be “economically beneficial” as this would promote farmer-to-farmer dissemination and adoption of appropriate practices which, in turn, would be paramount in ensuring an even higher land husbandry technologies adoption and sustainable use of the latter.