



**OFFICE OF THE AUDITOR GENERAL
OF STATE FINANCES, RWANDA**

**PERFORMANCE AUDIT REPORT ON UTILIZATION AND MAINTENANCE OF
IRRIGATION AND MECHANIZATION EQUIPMENT**



May 2015

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS	1
1. EXECUTIVE SUMMARY	2
2. INTRODUCTION.....	7
3. AUDIT DESIGN	9
4. DESCRIPTION OF THE AUDIT AREA AND PROCESS	11
5. FINDINGS	17
SECTION 1: MECHANISATION	17
SECTION 2: MARSHLAND IRRIGATION INFRASTRUCTURE.....	57
SECTION 3: HILLSIDE IRRIGATION EQUIPMENT	84
6. CONCLUSION	98
7. RECOMMENDATIONS	99
APPENDICES	102
Appendix 1: Key Documents reviewed	103
Appendix 2: Details of the people interviewed.....	104
Appendix 3: Asset register of tractors and other agricultural machineries	106
Appendix 4: Roles and responsibilities of key players of the Task force	107
Appendix 5a: List of TYM tractors.....	109
Appendix 5b: List of Mahindra tractors.....	111
Appendix 6: Maintenance schedule as stipulated by TYM and MAHINDRA Manufacturers.....	113
Appendix 7: Marshlands and Hillside irrigation infrastructure constructed by the Task force	119
Appendix 8: Cost benefit analysis for maize production in Matimba and Nasho irrigation schemes	121
Appendix 9: Organization chart of the Task force.....	123

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

ACRONYMS AND ABBREVIATIONS

EDPRS 2	Economic Development and Poverty Reduction Strategy (Phase 2)
IAI - GFI	Immediate Action Irrigation - Government Funded Irrigation Project
KWAMP	Kirehe Community - Based Watershed Management Project
LWH	Land Husbandry, Water Harvesting and Hillside Irrigation Project
PSTA III	Strategic Plan for the Transformation of Agriculture (Phase III)
QWMDP	Quick Win Marshland Development Project
VMSC	Village Mechanisation Service Centre
WUA	Water User Association

1. EXECUTIVE SUMMARY

Significant progress has been made in Rwanda in the past decade with regard to overall agricultural production. However, operational efficiency and farm productivity, and therefore, the prosperity of a very large proportion of the rural population, continued to be a concern. The Government through EDPRS I therefore made the increase in agricultural productivity a key priority area. It is in this regard that Government proposed measures to modernize the agricultural sector by using two interrelated powerful tools - that is **irrigation** on one side and **mechanization** on the other side. The responsibility to manage these tools was assigned to the Irrigation and Mechanization Task Force (“Task force”) that was put in place on 9th July 2010.

Over the last four years, the Task force has worked with farmers to implement modern farming methods including mechanization and irrigation. This has led to increase in food production. However, there have been recent concerns raised in the media regarding the insufficient number of mechanization equipment coupled with withdrawal of some equipment from the village mechanization service centres (VMSCs) located in various parts of the country back to a central location at Kabuye workshop in Kigali. It is against this background that I conducted a performance audit of the Task force in order to assess how irrigation and mechanization equipment are utilized and maintained in furtherance of EDPRS objectives of increasing agricultural productivity. Below I highlight the key findings noted and recommendations:

MECHANISATION

- **Utilization of caterpillars (heavy machinery):** In 2010, MINAGRI purchased five caterpillars at a cost of USD 2,880,000. The five caterpillars were meant to support MINAGRI in implementing irrigation activities through building of dams and other related irrigation infrastructure. However my analysis of utilization rates of these machines shows that they have largely been underutilized with some lying idle at Kabuye workshop yet the Task force continues to pay significant annual insurance premiums for these assets (see details in **section 5.2**).
- **Utilization of tractors:** The task force has three types of tractors namely; 62 TYM tractors, 30 Mahindra tractors and 1 Randin tractor. Most of the tractors (84 out of 92 tractors representing 92%) operated below the manufacturer’s recommended utilization rate of 62.5 days per year (see details in **section 5.3**).
- **Management of tractors:** 60% of tractors did not have logbooks and for the remaining few that had logbooks, I noted that tractor operators did not record the movements and fuel consumed by the tractors on a daily basis. In such cases, it was not easy to monitor tractor movements, their utilization (in terms of hectares tilled by each tractor) and fuel consumption. Furthermore, I noted that none of the tractors was serviced in line with requirements of their

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

respective user manuals. The Task force also continues to register increasing numbers of tractors that are broken down. The number of broken down tractors at Kabuye workshop has increased from 32 in March 2014 to 46 in January 2015. This is caused by delays in performing repair works on broken down tractors (see details in **section 5.4**).

- **Management of power tillers:** The Task force has 21 power tillers of model 15HP and 109 of model 12HP. However, none of the power tillers has a logbook to track their movements and monitor fuel consumption. Furthermore, I noted that none of the power tillers was serviced in line with the manufacturer's guidelines. In addition, 16 power tillers model 15 HP and 17 power tillers model 12 HP were broken down and were still in the workshop awaiting repair (see details in **section 5.5**).
- **Tractors operating without Roll Over Protective Structures (ROPS):** Most tractors did not have their respective ROPS, mounting hardware and seat belts yet this safety equipment had been procured by the Task force and was sitting idle in the central workshop in Kabuye. This negligence puts the lives of the tractor operators at unnecessary risk in the event of a tractor rollover (see details in **section 5.6**).
- **Tractors and tractor attachments continuously exposed to rain and humidity:** All tractors and tractor attachments in the VMSCs were left continuously exposed to both sun and rain. Exposing machinery having metal components to excessive sunlight and water causes corrosion which accelerates the rate of degradation of the machine components. This reduces the life expectancy of the machinery as well as its performance (see details in **section 5.7**).
- **Idle stock of power tiller trailers, potato harvesters and other attachments:** In 2011, the Task force purchased 250 power tillers, 50 potato harvesters, and significant quantity of various tractor and power tiller attachments. However by the time of the audit in November 2014, most of this equipment lay idle and unused at the Kabuye workshop (see details in **sections 5.8 to 5.10**).
- **Building constructed to accommodate a Power Tillers Assembly Plant completed but not in use:** In June 2013 the task force completed construction a building worth Frw 529,215,536 in preparation for the implementation of a project to set up a Power Tillers Assembly Plant in Rwanda. This plant was expected to increase the output of power tillers as well as lower the unit cost hence making them more affordable to farmers. However by November 2014, the assembly plant had not yet been set up (see details in **section 5.11**).

MARSHLAND IRRIGATION

- **Irrigation infrastructure constructed but not operational:** I noted cases where the irrigation infrastructure were built above the water level of the river feeding the structure. Consequently the irrigation infrastructure did not receive the intended water supply and hence lies idle and unused since commissioning (see details in **section 5.12**).

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

- **Unregulated flow of water at the intake dam:** There were cases where water users did not promptly regulate the flow of water at the intake dam resulting into over flooding which led to bursting of the river banks and hence flooding of farmland and destruction of crops (see details in **section 5.14**).
- **Infrastructure cracked and not rehabilitated:** I noted various cases where the installed irrigation infrastructure were cracked and not maintained. These infrastructure were cracked and damaged yet they had been in operation for less than three years. Furthermore, the Task force did not have a rehabilitation plan for the repair of these infrastructure (see details in **section 5.16**).
- **Marshland fields converted into mining sites:** There were a number of cases where farmers had converted farmland into mining sites for extraction of sand. This practice reduces the size of farmland available for cultivation of crops and in some cases has resulted into blockage of the canal meant for distribution of irrigation water to the surrounding fields (see details in **section 5.17**).
- **Failure to sign the Irrigation Management Transfer Agreement (IMTA):** Ministerial Order No 001/11.30 of 23/11/2011 proposed to put in place an IMTA whose purpose is to transfer the responsibility for the operation and maintenance of irrigation scheme from the Task force to the IWUA. This Ministerial Order was effective from 23rd November 2011. However, by the time of the audit in March 2015, I noted that no single IWUA had signed an IMTA transferring responsibilities for the operation and maintenance of the respective irrigation scheme to the IWUA. Consequently, these IWUAs have not taken personal responsibility (ownership) and therefore they do not maintain these infrastructure. This has resulted into overgrowth and blockage of various irrigation canals rendering the infrastructure unusable (see details in **section 5.18**).

HILLSIDE IRRIGATION

- **Production cost versus sales value of crops cultivated under the irrigation schemes:** The hillside irrigation schemes of Nasho and Matimba use expensive modern methods of irrigation such as sprinklers, centre pivot, drip and hydrant systems. Ministerial Order No 001/11 of 30/11/2011 has proposed for the transfer of management of these irrigation schemes to the IWUAs. I therefore assessed the **sustainability** of these schemes in a scenario where transfer to IWUAs has taken place by comparing the current total running expenses of each scheme to the sales value of crops currently cultivated. My analysis shows that at the current production level of 4 tonnes and 3.5 tonnes of maize per hectare in Matimba and Nasho respectively, the schemes are loss making and therefore unsustainable. The production levels would need to increase to 5.3 tonnes and 4.3 tonnes per hectare for Matimba and Nasho for the schemes to break even and much higher for them to realise a profit (see details in **section 5.19**).

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

- **Lack of maintenance records and procedures manual for hillside irrigation schemes:** I noted that each equipment used in the irrigation scheme has a manufacturer's manual that provides guidance on the operation of the equipment. However, both irrigation schemes have not developed an internal maintenance policy and procedures manual to guide all maintenance activities. In addition, no maintenance schedules highlighting scheduled maintenance dates were drawn up to guide the technicians involved in maintaining the machinery to ensure that all required maintenance work was actually carried out (see details in **section 5.20**).
- **Lack of spare parts for irrigation and mechanization equipment:** I noted that there is a challenge of getting spare parts for irrigation equipment on the local market in case they are needed. In case spare parts are needed, they are ordered and imported by MINAGRI from France. Since management of the scheme operations will eventually be handed over to the WUAs, it will be difficult for them to import such spare parts from Europe. There is a high risk that absence of such spare parts could lead to failure of this irrigation scheme once ownership is transferred to the WUAs. Furthermore, I noted that once tractors breakdown, they take long to get repaired. This is due to lack of spare parts within the country (see details in **section 5.22**).
- **Inefficient drip irrigation system:** I noted that the installed drip irrigation network in Matimba irrigation scheme was not uniformly irrigating crops with some areas over irrigated while others are not supplied with sufficient water. This consequently results in poor crop yields in some parts of the farmland (see details in **section 5.24**).

OVERALL CONCLUSION

I acknowledge the progress made by the Task force in contributing to overall increase in agricultural production in the country. However, a number of weaknesses were noted including: low utilization of mechanization equipment, idle machinery, delays in repairing broken down machinery and irrigation infrastructure that were either not operational or were not properly operated and maintained. OAG is of the view that the Task force needs to urgently address all weaknesses highlighted in this report in order to achieve set targets regarding agricultural productivity.

Auditee's comment: Most of the weaknesses were due to budget constraints.

OVERALL RECOMMENDATION

Going forward, before a decision to buy **capital equipment** is made, the task force should carry out detailed feasibility studies to assess the suitability of each equipment in addressing local needs. The task force should also promptly service tractors and power tillers at the due dates and repair all broken down machinery to minimize time spent in the garage. To ensure better utilization of

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

marshland irrigation infrastructure, the task force should rehabilitate damaged structures and offer training to water users to enable them correctly operate the installed irrigation infrastructure. For sustainability and continuity of **hillside irrigation schemes**, the Task force should ensure that a sufficient number of high turnover spare parts are readily available for both irrigation and mechanisation equipment. This will ensure that key irrigation and mechanisation activities are not derailed due to lack of spare parts.

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Auditor General

Kigali

..... **2015**

2. INTRODUCTION

2.1. Terms of reference for the audit

In accordance with Article 183 of the Constitution of the Republic of Rwanda as amended to date and Law N°. 79/2013 of 11/9/2013 determining the mission, organization and functioning of the Office of the Auditor General of State finances (OAG), I carried out a Performance audit of the utilization and maintenance of irrigation and mechanization equipment for the period 1st July 2010 to 31st January 2015.

2.2. Background

Farming in Rwanda remains largely subsistence in nature¹. With a rapid increase in the population, the pressure on ensuring food security is a constant challenge for stakeholders. Significant progress has been made in Rwanda in the past decade with regard to overall agricultural production. However, operational efficiency and farm productivity, and, therefore, the prosperity of a very large proportion of the rural population, continue to be a concern.

The Government of Rwanda (GoR) through the Economic Development and Poverty Reduction Strategy² (EDPRS I) has therefore made the increase in agricultural productivity a key priority area. It is in that regard that GoR proposed all necessary measures to modernize agricultural sector by using two interrelated powerful tools - that is *irrigation* on one side and *mechanization* on other side. The responsibility to manage the tools was assigned to the Irrigation and Mechanization Task Force (“Task Force”) that was put in place on 9th July 2010³.

In order to operationalise the above goals, MINAGRI (the parent ministry of the Task Force) launched a Mid-Term (2011-2017) plan targeting the development of a total of 100,000ha area under irrigation of which 65,000ha will be marshland and 35,000ha hillside Irrigation projects. To achieve this objective, MINAGRI is using public funds as well as sourcing for funding from bi-lateral and multi-lateral funding agencies. Alongside with donors’ projects like; Kirehe Water Management Program (KWAMP), Land Husbandry & Water Harvesting Program (LWH) and the Rural Sector Support Program (RSSP), the Immediate Action Irrigation Government Funded Program (GFI-IAI) was put in place to contribute to achieving the above irrigation targets. These projects are meant to complement the agricultural mechanization program. Both programs have been operating by utilizing various modern irrigation and mechanization equipment.

Tractors, caterpillars, power tillers and their implements have been provided to speed up achieving

¹ Agricultural Mechanization Strategy for Rwanda, 2013, page 4

² Economic Development and Poverty Reduction Strategy 2008 - 2012, page 35

³ Cabinet Resolutions of 9th July 2010

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

crop yields beyond the capacity of human labor. Modern irrigation equipment like sprinklers, center pivots, and various types of water pumps were acquired by the Task Force through MINAGRI to implement the ongoing Strategic Plan for the Transformation of Agriculture in Rwanda, Phase III (PSTA III).

2.3. Funding

The Task force is funded by the Government of Rwanda through MINAGRI ordinary budget. As at 30th June 2014, Frw 26,209,009,002 has been spent by the task force on irrigation and mechanisation activities. See table below for details.

Activity	2010/2011 (Frw)	2011/2012 (Frw)	2012/2013 (Frw)	2013/2014 (Frw)	Total (Frw)
GFI (irrigation)	2,642,753,242	5,020,086,379	8,546,169,381	5,000,000,000	21,209,009,002
Mechanization	1,500,000,000	1,400,000,000	1,500,000,000	600,000,000	5,000,000,000
Total	4,142,753,242	6,420,086,379	10,046,169,381	5,600,000,000	26,209,009,002

The funds were used to acquire and install hillside and marshland irrigation infrastructure and equipment like tractors, power tillers and their respective accessories, other agricultural machineries, construction of the building to house a power tillers assembly plant, fuel and repairs, and other expenditure related to mechanization.

2.4. Necessity (reasons) for the audit

Agriculture mechanisation equipment has been utilized by farmers to increase food production during the last four years in which the task force has been in existence. However, there have been recent concerns raised in the media regarding the insufficient number of equipment. An example is the New Times newspaper article date 12th February 2013 highlighting the need to increase tractors. The headline reads: “Farmers ask for more tractors”. In addition, I noted that most mechanization machinery are currently being withdrawn from the village mechanization service centres located in various parts of the country back to a central location at Kabuye workshop in Kigali. It is against this background that I planned to conduct a performance audit of the task force in order to assess how irrigation and mechanisation equipment is utilized and maintained in furtherance of EDPRS objectives of increasing agricultural productivity.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

3. AUDIT DESIGN

The audit was conducted in accordance with the International Organization of Supreme Audit Institutions Auditing Standards and guidelines in the Office of the Auditor General's Performance Audit manual. The standards require that the audit is planned in a manner which ensures that an audit of high quality is carried out in an economic, efficient and effective way and in a timely manner.

3.1. Audit scope

Audit object: This audit focused on all activities involved in the utilization and maintenance of equipment acquired by the Task Force for irrigation and agricultural mechanization. The audit also covered irrigation infrastructure built by the Task Force in selected marshlands.

Geographic coverage: The task force operates in selected districts in Rwanda as shown in **Appendix 3**. The task force activities are divided under two main lines - irrigation and mechanisation.

Irrigation - Under irrigation, the task force engages in building irrigation infrastructure in selected marshlands as well as hillside irrigation schemes. Marshlands visited are located in Gasabo district and Southern province (Kamonyi, Nyanza, Gisagara and Huye districts) while the hillside irrigation projects visited are located in Eastern province (Kirehe and Nyagatare districts).

Mechanisation - The audit team inspected tractors and other agricultural machinery located in their respective Village Mechanisation Services Centres (VMSCs) in Bugesera, Ngoma and Nyanza districts. The team visited also visited the Kabuye VMSC and workshop located in Gasabo district.

Sample selection:

Marshland irrigation - By the time of audit, the task force had set up 33 marshland projects in 14 districts. Out of the 33 projects, we visited 19 projects (58%) located in the five districts mentioned above. The sample selection was based on the fact that these five districts had the highest number of marshland irrigation projects per district as well as the largest acreage under irrigation.

Hillside irrigation - There are currently two hillside irrigation schemes under management by the task force. One scheme is located in Kirehe district and the other is in Nyagatare district. We visited both schemes providing a coverage of 100%.

Mechanisation equipment - All 93 tractors, 2 combine harvesters, 5 caterpillars and 2 workshop mobile vans have been visited. An average of 92% of other agriculture equipment (including tractor attachments, rice transplanters, power tillers, water pumps, potato harvesters and iron wheels) have been physically verified.

Refer to **Appendix 3** for details of marshland irrigation infrastructure, hillside irrigation schemes and agricultural equipment verified.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Period covered: The audit covered the period from 1st July 2010 to 31st January 2015.

3.2. Objective of the audit

The overall objective of the audit is to assess whether irrigation and mechanization equipment under the responsibility of the Task Force have been adequately utilized and maintained so as to contribute to increased productivity of farmland.

3.3. Key audit questions

The Performance audit answered the following questions:

- Has the Task Force developed appropriate strategies and laid down procedures for managing the utilization and maintenance of equipment used in mechanization activities at strategic and operational levels?
- To what extent are the mechanization equipment utilized, monitored and maintained?
- Has the Task Force put in place an operational and maintenance plan for the sustainability of irrigation infrastructure?
- To what extent are the irrigation infrastructure utilized, monitored and maintained?

3.4. Sources of information and methods of data collection

The following methods were used to collect data:

- Interviews: Primary data was collected through interviews carried out with staff of the Task Force and representatives of the Water Users Associations (WUAs) that were regularly involved in management of the irrigation and mechanization equipment. The details of key players interviewed are provided in **Appendix 2**.
- Documentary review: Secondary data was mainly collected through review of various documents. Key documents reviewed are listed in **Appendix 1**.
- Physical verification: Physical verification was carried out with the aim of verifying the information provided to the audit team regarding mechanisation equipment such as tractors, power tillers, caterpillars and other agricultural machineries. The team also performed field visits to verify irrigation infrastructures installed in selected marshlands and irrigation equipment used in hillside irrigation schemes of Nasho and Matimba located in Kirehe and Nyagatare Districts respectively. During the inspections, photographs of the irrigation equipment, infrastructure and mechanisation equipment were taken to provide evidence of their current physical status. Details of agricultural infrastructure and equipment visited are provided in **Appendix 3**.

4. DESCRIPTION OF THE AUDIT AREA AND PROCESS

4.1. Introduction

The irrigation and mechanisation task force is designed to achieve the GoR targets set out in EDPRS 1. These targets call for an increase in agricultural productivity through use of modern farming methods such as irrigation and mechanization. The task force was put in place in 2010 to support GoR attain these broad objectives. By the time of the audit the task force was operating under MINAGRI, the parent ministry.

4.1.1. Roles and responsibilities of the Task Force

The main roles and responsibilities of the task force are^{4,5}:

- Formulation, monitoring and evaluation of policies, strategies and programs aimed at promoting agriculture mechanisation and irrigation development;
- Developing appropriate systems to improve agricultural mechanisation, marshland and hillside irrigation;
- Coordinate all activities related to the modernization of agriculture initiated by the Government of Rwanda;
- Supervise mechanisms for setting up support structures to private initiatives and local communities in order for them to invest in agriculture especially in mechanisation; and
- Supervise the activities of resource mobilization and promotion of partnership in the field of agriculture mechanisation and irrigation.

4.1.2. Roles and responsibilities of key players

The key players in the task force include: MINAGRI, KWAMP project, districts and WUAs. Roles played by each key player are outlined in **Appendix 4**.

4.1.3. Task force organisation structure

The Task force is headed by a Chairman. The daily activities related to the utilisation and maintenance of irrigation and mechanisation equipment are coordinated by the Mechanisation and Irrigation departments. Details of the Task force organisation chart are included in **Appendix 9**.

⁴ Cabinet resolutions of 9th July 2010

⁵ Duties and Responsibilities of Irrigation and Mechanisation Task Force, page 1

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

4.2. Tractors and other agricultural machinery

The Task force performs many roles in respect of its mandate of increasing agricultural production via mechanisation. These include; increasing awareness of agricultural mechanisation among farmers through extension services, hire of equipment and/or outright sale of equipment to interested farmers.

Promotion of agriculture mechanisation through Village mechanization service centres (VMSCs): The task force has deployed tractors in districts with the objective of availing tractors and related services near farmers. The Task force expects private operators to eventually play a key role in farm mechanisation after awareness has been built and strengthened.

Extension services: This includes awareness of farm mechanisation, training and demonstration of machinery to machine operators and farmers, providing any advice related to the purchase, hire and use of agricultural machinery. Tractors and their attachments are used for promotion of agricultural activities across the country and hiring services at VMSC level. Power tillers and their attachments can be used for promotion of agricultural mechanisation activities across the country, directly sold to individual farmers or donated to agricultural cooperatives.

Earth Moving Machinery are used in construction of irrigation infrastructure and activities include dam construction, land reclamation, clearing and leveling. They are also hired for private work to different public and private institutions.

Maintenance and repair services: Maintenance includes both routine maintenance (servicing) and repair of tractors and other agricultural machinery. Major repairs and servicing are carried out at Kabuye workshop. Catalogues and operator manuals from manufacturers (TYM and MAHINDRA) contain detailed guidelines/schedules that serve as reference for servicing and repairs. Caterpillars, tractors and power tillers require servicing after every fixed number of hours of operation as recommended by maintenance guidelines. Each month, the Chief maintenance officer prepares and presents a written monthly report to the workshop manager on repairs and servicing carried out during the month. That report also contains the monthly status and location of the tractors located in different VMSCs.

4.3. Marshland irrigation

Objective of the project: Marshlands are state owned lands where farmers are allocated plots on lease. The Task force developed irrigation infrastructure in marshlands under the Quick Win Marshland Development Project (QWMDP) and the project objective was to enable even distribution of water in all cultivable marshlands throughout the country with the overall goal of increasing agricultural output in the country, sustaining food security and generating incomes for farmers. Construction of the marshland irrigation infrastructure was carried out in two phases. During the first phase, construction of irrigation infrastructure was carried out by the Task force

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

itself from February to September 2011. In the second phase (February 2013 to June 2014), construction of irrigation infrastructure was subcontracted to private contractors who were selected after a bidding process.

Systems in use: The improved surface irrigation systems used in marshlands are gravity stream diversions or from valley dams used to supply canal networks to plots of land where crops are grown/ planted. Such crops include: rice, beans, vegetables, maize, soya beans, onions, passion fruits, tomatoes and depend on the type of soil where irrigation infrastructure are developed.

Maintenance of marshlands: Farmers in the marshland share common irrigation infrastructure and it is the responsibility of farmers (who are actually members of the WUAs) to carry out maintenance of irrigation infrastructure put in place by the Task force.

4.4. Hillside irrigation

Overview of government funded hillside irrigation systems in Rwanda: The Immediate Action Irrigation - Government Funded Irrigation Project (IAI-GFI) is a project initiative adopted by the Government of Rwanda in 2010 to combat drought through the development of hillside irrigation schemes⁶. Currently IAI-GFI has developed two projects in Kirehe (580 ha) and Nyagatare districts (400 ha). A total land surface area of 980 ha (divided in five lots) is now under irrigation with three (3) lots located in Nasho irrigation scheme (Kirehe district) and two (2) lots in Matimba - Musheru irrigation scheme (Nyagatare district). These two irrigation schemes are now operational.

⁶ Annual report of the Government-Funded Irrigation Project (GFI) - June 2013, page 8 and 19

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Increasing maize production in Nasho due to introduction of modern irrigation equipment. Photo taken on 26th January 2015.

Types of irrigation systems: The Nasho irrigation scheme uses pressurized sprinkler irrigation systems while the Matimba irrigation scheme uses a combination of sprinklers, center pivots, drip and hydrant systems. Examples of some of the equipment used in the irrigation schemes is shown below.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Irrigation of vegetables in Matimba with Center Pivot Equipment. Photo taken on 28th January 2015.



Pumping machines that enable hectares of crops to be irrigated in Nasho. Photo taken on 26th January 2015

Handover from contractors to MINAGRI: For Nasho irrigation scheme, the final handover from the contractor (China Geo-Engineering Corporation Ltd.) to the Task force was done on 9th January 2015. The Matimba irrigation scheme has been operational since 25th March 2014 and is still under guarantee. The contractors for this scheme are Uni-Tech Valley (for lot 5) and Jain Irrigation Systems (for lot 4).

FINDINGS

5. FINDINGS

The findings chapter of the report is divided into three sections. The first section highlights findings relating to movable agricultural machinery such as tractors, bulldozers, potato harvesters, power tillers and other equipment located in Bugesera, Nyanza, Kayanza, Ngoma districts and Kabuye workshop. The second section focuses on findings from Marshland projects located in Gisagara, Huye, Nyanza, Gasabo and Kamonyi districts. The third section contains findings from the two hillside irrigation schemes of Nasho and Matimba located in Kirehe and Nyagatare districts respectively.

SECTION 1: MECHANISATION

Following the Government decision⁷ to support the transformation of agriculture, specifically in irrigation, MINAGRI took the initiative to purchase heavy caterpillars. The caterpillars were planned to be used within the GFI program to build dams and other related irrigation infrastructure in the hillside areas. The purchase of caterpillars followed a decision to purchase tractors, power tillers, other agricultural machineries and an agreed plan to establish a power tiller assembly plant.

During the audit, I reviewed the utilization and maintenance of these caterpillars, tractors and other agricultural machineries. I noted the following:

5.1. Strategies and procedures for managing the utilization and maintenance of equipment

The Task force developed appropriate strategies, procedures and guiding documents for managing the utilization and maintenance of equipment used in mechanisation activities at strategic and operational levels. The documents developed include: Strategic plan for the transformation of agriculture in Rwanda (PSTA III), Agriculture mechanisation strategy and Agricultural mechanisation procedures manual. However, as shown below, a number of weaknesses were noted during implementation of mechanisation activities.

5.2. Utilization of caterpillars (heavy machinery)

On 12th February 2010, a letter reference number 0203/11-30 was written by the Permanent Secretary of MINAGRI to the Director General of RPPA, seeking for non-objection regarding the procurement of five caterpillars. The five caterpillars were meant to support MINAGRI in implementing irrigation activities through building of dams and other related irrigation infrastructure. RPPA granted MINAGRI authorisation and the five caterpillars below were purchased. These caterpillars were acquired through single source procurement method due to the emergency need expressed by MINAGRI.

⁷ Cabinet decisions of 16th December 2009

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Table 1: Caterpillars acquired by the Task force

N°	Type of caterpillar	Model	Plate number	Purchase date	Purchase price
1	Soil compactor	CAT 825H	GR 030D	2010	\$ 858,000
2	Track loader	CAT 963D	GR 028D	2010	\$ 384,000
3	Excavator	CAT 365CL	GR 031D	2010	\$ 762,000
4	Wheel loader	CAT 928Hz	GR 029D	2010	\$ 228,000
5	Bulldozer	CAT D8R	GR 027D	2010	\$ 648,000
Total (\$)					\$ 2,880,000
Exchange rate					573.5 ⁸
Total (Frw)					Frw 1,651,680,000

Below I describe the status of each type of caterpillar as observed during the audit.

5.2.1. Soil compactor model CAT 825H with plate number GR 030D

The soil compactor was acquired in 2010 at a cost of \$ 858,000 (equivalent to Frw 492,063,000⁹) and was meant to support MINAGRI in implementing irrigation activities through building of dams and other related irrigation infrastructure. However, it was found to be too big compared to the dimensions of dams that needed to be constructed. Consequently, it has not been used for irrigation related work. This soil compactor has for the most part been lying idle at Kabuye workshop since acquisition with the exception of small requests for hire by private firms. For the four years since its purchase, it has only operated for 101.7 hours. Taking an average working day of 8 hours implies that the soil compactor has only operated for 12.7 days over the four years. This gives an average of 3 days of operation for each year since its purchase.

I also noted that even with this level of underutilization, the task force still had to pay annual insurance amounting to Frw 15,071,000. See photos below for details:

⁸ NBR exchange rate of 29th March 2010 or click at <http://www.bnr.rw/index.php?id=384>

⁹ NBR exchange rate of 29th March 2010 or click at <http://www.bnr.rw/index.php?id=384>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Soil compactor model CAT 825H with plate number GR 030D (side view) lying idle at Kabuye workshop. Photo taken on 6th November 2014.



Soil compactor model CAT 825H with plate number GR 030D (front view) lying idle at Kabuye workshop. Photo taken on 6th November 2014.

5.2.2. Track loader model CAT 963D with plate number GR 028D

Just like the soil compactor above, the track loader was acquired in 2010 at a cost of \$384,000

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

(equivalent to Frw 220,224,000¹⁰) and was meant to support MINAGRI in implementing irrigation activities through building of dams and other related irrigation infrastructure. However, it was found to be too big compared to the dimensions of dams that needed to be constructed. Consequently, it has not been used and has been lying idle at Kabuye workshop since 18th March 2013.

For the four years since the purchase of the track loader, it has only operated for 324.3 hours. Taking an average working day of 8 hours implies that the track loader has only operated for 40.5 days over the four years. This gives an average of 10 days of operation for each year since its purchase.

I also noted that even with this level of underutilization, the task force still had to pay annual insurance amounting to Frw 6,825,505. See photos below for details:



Track loader model CAT 963D with plate number GR 028D (side view) lying idle at Kabuye workshop. Photo taken on 6th November 2014.

¹⁰ NBR exchange rate of 29th March 2010 or click at <http://www.bnr.rw/index.php?id=384>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Track loader model CAT 963D with plate number GR 028D (front view) lying idle at Kabuye workshop. Photo taken on 6th November 2014.

5.2.3. Excavator model CAT 365CL with plate number GR 031D

The excavator was acquired in 2010 at a cost of \$ 762,000 (equivalent to Frw 437,007,000¹¹) and was meant to support MINAGRI in implementing irrigation activities through building of dams and other related irrigation infrastructure.

Underutilization of the excavator: For the four years since the purchase of the excavator, it has only operated for 847.8 hours. Taking an average working day of 8 hours implies that the excavator has only operated for 106 days over the four years. This gives an average of 26 days of operation for each year since its purchase.

Hire to private firms: Out of the 847.8 hours worked, the excavator spent only 367.6 hours on task force activities. For the remaining 480.2 hours, the excavator was on hire to a private engineering firm at a rate of Frw 80,000 per hour. The private work the excavator was contracted to perform was different from task force irrigation activities and included road construction works by the private engineering firm GM Ltd in Migina sector in Bugesera district. The task force earned Frw 38,430,666 from the hire of this excavator.

Hiring versus outright purchase: Given that the task force only needed the excavator for 367.6 hours during this four year period, we analysed the value of hours worked by the excavator in performing task force's own activities and this equals Frw 29,416,000 (367.6 hours at Frw 80,000 per hour). This is equivalent to 6.7% (29,416,000/437,007,000) of the cost of the excavator implying that the task force was better off by hiring an excavator whenever needed instead of

¹¹ NBR exchange rate of 29th March 2010 or click at <http://www.bnr.rw/index.php?id=384>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

buying it outright. Furthermore, I noted that even with this level of underutilization, the task force still had to pay annual insurance amounting to Frw 13,401,027. See photo of the excavator below.



Excavator model number CAT 365CL with plate number GR 031D parked in Migina where it was on hire to a private engineering firm. By the time of the audit, the excavator had spent two weeks without work and was lying idle at the site. Photo taken on 13th February 2015.

5.2.4. Wheel loader model CAT 928Hz with plate number GR 029D

The wheel loader was acquired in 2010 at a cost of \$ 228,000 (equivalent to Frw 130,758,000¹²) and was meant to support MINAGRI in implementing irrigation activities through building of dams and other related irrigation infrastructure.

Underutilization of the wheel loader: For the four years since the purchase of the wheel loader, it has only operated for 1,282.7 hours. Taking an average working day of 8 hours implies that the wheel loader has only operated for 160 days over the four years. This gives an average of 40 days of operation for each year since its purchase.

¹² NBR exchange rate of 29th March 2010 or click at <http://www.bnr.rw/index.php?id=384>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Hire to private firms: Out of the 1,282.7 hours worked, the wheel loader spent 830.4 hours on task force activities. For the remaining 452.3 hours, the wheel loader was on hire to a private engineering firm at a rate of Frw 65,000¹³ per hour. The private work the wheel loader was contracted to perform was different from task force irrigation activities and included land reclamation works by the private engineering firm Topo Duo Construction in Nyandungu plain in Gasabo district. The task force earned Frw 24,655,400 from the hire of this excavator.

Hiring versus outright purchase: Given that the task force only needed the wheel loader for 830.4 hours during this four year period, we analysed the value of hours worked by the wheel loader in performing task force's own activities and this equals Frw 53,976,000 (830.4 hours at Frw 65,000 per hour). This is equivalent to 41% (53,976,000/130,758,000) of the cost of the excavator implying that the task force was better off by hiring a wheel loader whenever needed instead of buying it outright. Furthermore, I noted that even with this level of underutilization, the task force still had to pay annual insurance amounting to Frw 4,111,798.

See photos of the wheel loader below.



¹³ Contract for hiring a chain loader (CAT 928Hz between TFIM and TOPO DAO Construction Ltd.), 28th March 2013

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Wheel loader model number CAT 928Hz with plate number GR 029D (rear view) parked at Kabuye VMSC. Photo taken on 11th February 2015.



Wheel loader model number CAT 928Hz with plate number GR 029D (side view) parked at Kabuye VMSC. Photo taken on 11th February 2015.

5.2.5. Bulldozer model CAT D8R with plate number GR 027D

The bulldozer was acquired in 2010 at a cost of \$ 648,000 (equivalent to Frw 371,628,000¹⁴) and was meant to support MINAGRI in implementing irrigation activities through building of dams and other related irrigation infrastructure.

Utilization of the excavator: For the four years since the purchase of the bulldozer, it has operated for 3,284 hours. Taking an average working day of 8 hours implies that the excavator has only operated for 410 days over the four years. This gives an average of 102 days of operation for each year since its purchase. This is a decent utilization rate compared with the four caterpillars above.

Hire to private firms: Out of the 3,284 hours worked, the bulldozer spent only 290 hours on task

¹⁴ NBR exchange rate of 29th March 2010 or click at <http://www.bnr.rw/index.php?id=384>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

force activities. For the remaining 2,994 hours, the bulldozer was on hire to various entities such as RSSP, LWH, Reserve Force and others at a rate of Frw 80,000 per hour. The private work the bulldozer was contracted to perform was different from task force irrigation activities. This was confirmed during the audit field visit where the team observed the bulldozer preparing land for an RSSP beneficiary in Rukara sector sector in Kayonza district. The task force earned Frw 218,943,200 from the hire of this bulldozer.

Hiring versus outright purchase: Given that the task force only needed the bulldozer for 290 hours during this four year period, we analysed the value of hours worked by the bulldozer in performing task force's own activities and this equals Frw 23,200,000 (290 hours at Frw 80,000 per hour). This is equivalent to 6.2% (23,200,000/371,628,000) of the cost of the bulldozer implying that the task force was better off by hiring a bulldozer whenever needed instead of buying it outright. Furthermore, I noted that the task force had to pay annual insurance amounting to Frw 11,417,933. See photos below for details:



Bulldozer model CAT D8R with plate number GR 027D (front view) is in use and was found to be hired by RSSP in preparing a section of Gacaca marshland in Kayonza District. Photo taken on 28th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Bulldozer model CAT D8R with plate number GR 027D (side view) is in use and was found to be hired by RSSP in preparing a section of Gacaca marshland in Kayanza District. Photo taken on 28th January 2015.

With the exception of the bulldozer utilisation, the usage rates of the other four caterpillars show that they were not efficiently utilized. The reasons for the poor utilization rates include:

- No feasibility study was carried out to assess the actual need for these machines. We were unable to obtain a detailed plan showing how these machines would be used in building different irrigation infrastructure. Consequently, after purchase, these machines were deemed inappropriate for construction of the types of irrigation infrastructure needed in Rwanda.
- Upon realisation of the above fact, MINAGRI together with the task force, subcontracted the construction of the irrigation infrastructure to private firms. These firms used their own equipment and this also meant that the task force machines were left with no work to do.

There was no value for money spent in procuring these machines and it is deemed wasteful expenditure.

Recommendations

- Going forward the task force should carry out detailed feasibility studies highlighting cost benefit analyses before committing to procure such expensive capital items. The analyses should include the comparison of hiring such equipment from private players to perform specific tasks whenever needed vis a vis outright purchase. This will save taxpayers from unnecessary expense.
- The task force should either dispose these machines by selling them to private players in order to realise some value rather than leaving them to lay idle or transfer them to another government agency where they could be put to active use.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Management comments

Most of these heavy machines were purchased by MINAGRI to support the implementation of irrigation works such building of dams and other related irrigation infrastructure. By the time of purchase, few caterpillars' machines were in the country, and mostly busy with construction works. By that time, most of the companies contracted for irrigation work execution were having problems of mobilization of such heavy machines.

Besides, due to budget constraints for operation and maintenance of the heavy machines, MINECOFIN has recommended the Task Force to sell all of them in order to implement our strategy of engaging private sector in the implementation of the Mechanization program. This recommendation has started to be implemented through request of transfer of the equipment to MININFRA for auction.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.3. Utilization of tractors

The task force has three types of tractors namely; 62 TYM tractors, 30 Mahindra tractors and 1 Randin tractor. The TYM tractors were acquired between 2009 and 2012 while the Randin and Mahindra tractors were acquired in June 2013. The TYM tractor operating manual states that the average utilization rate of a tractor is 1,000 hours over a 24 month period¹⁵. This gives an average of 500 hours per year. Taking an 8 hour working day, this gives an average of 62.5 days per year.

During the audit I analysed the hours operated by each tractor during the period it has been in the task force and computed the average number of days operated per year. I then compared this data to the average specified by the manufacturer above. Based on this analysis, I noted the following:

- Overall performance: Most of the tractors (85 out of 92¹⁶ tractors representing 92%) operated below the manufacturer's recommended utilization rate of 62.5 days per year.
- TYM tractor performance: Majority of TYM tractors (50 out of 61 tractors representing 82%) operated in the range of 10 to 40 hours per year.
- Mahindra tractor performance: Most Mahindra tractors (25 out of 30 tractors representing 83%)) operated in the range of 30 to 70 hours per year.

This performance is illustrated in the charts below and shows that the Mahindra tractors had a better utilization rate compared to the TYM tractors. For details of hours operated by each tractor, see **Appendix 5a and 5b**.

¹⁵ TYM Tractor operator's manual (T353), page 107

¹⁶ One TYM tractor model T353NCRW with plate number GR 112D was broken down since 2013 and could not restart to enable the team to take dashboard readings of hours worked.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Table 2 showing utilization of TYM tractors

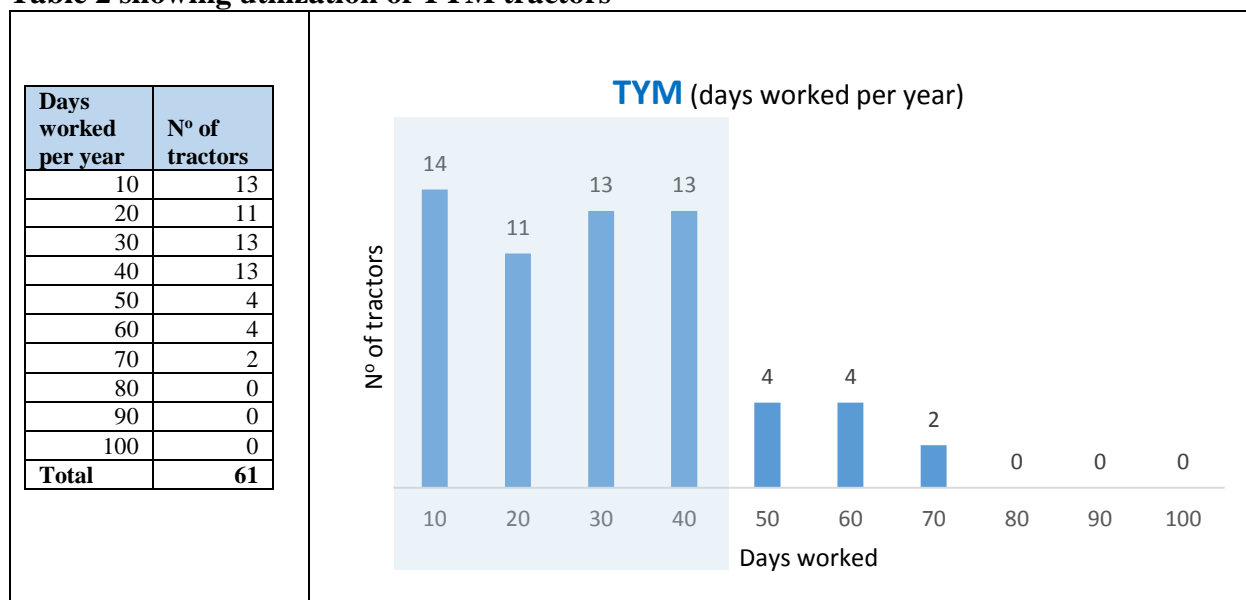
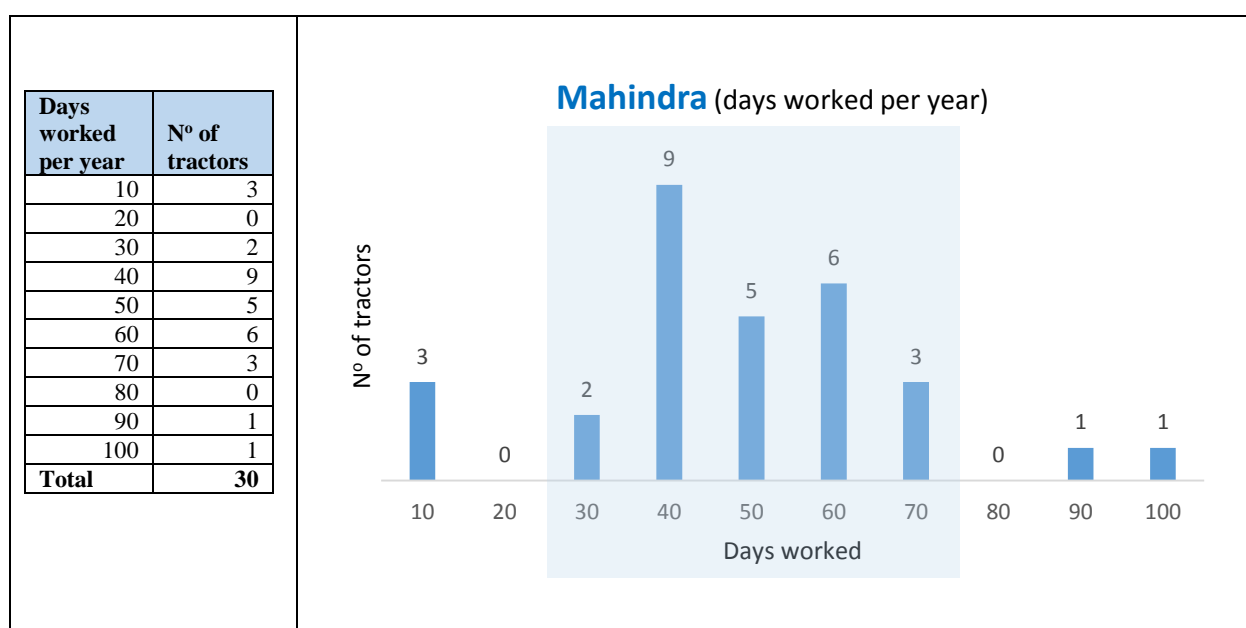


Table 3 showing utilization of Mahindra tractors



This low rate of utilization implies that the Task force did not extract significant value from most of the tractors.

Recommendations

The Task force should:

- Increase awareness by increasing the level of extension services in order to increase demand for tractor services.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

- Regularly service the tractors at the due date as stipulated in the manufacturers' operating manual in order to minimise the rate of breakdowns.
- Conduct repairs in a timely manner to minimise time spent by the tractors in the garage.

Management comment

The Task Force has put in place strategies to engage private sector in mechanization services. These strategies aim to strengthen and intensify mechanization services through private companies. The implementation of these strategies has started mainly in the Eastern province, where private companies like VAC and STBC Ltd are offering hiring services to farmers. Today, the utilization of tractors in farm operations has increase from 1,000 ha to more than 2,000Ha only in the Eastern Province.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.4. Management of tractors

The task force acquired tractors from two manufacturers, TYM and MAHINDRA. 111 tractors of various models were acquired and 18 tractors have so far been sold to private farmers. The remaining 93 tractors are still being used by the task force. I carried out physical verification to assess the existence of these assets, their current physical status, how they are utilized & maintained and documentation (logbooks and maintenance cards) kept to track their utilization and maintenance. During the audit I noted the following:

5.4.1. Weaknesses in tracking tractor movements and fuel consumption

In 2011, the task force established an agricultural mechanization procedures manual¹⁷ that provides guidance on use of logbooks to record movement of tractors. The guidance is also in line with the requirements of the Government policies and procedures manual¹⁸ that stipulates the need for daily updating of the logbook with information regarding the movements and fuel consumed by each government vehicle. This is expected to result in better management of government vehicles including tractors.

However, during the audit, I noted the following:

- **Logbooks not used for all tractors:** Out of the 93 tractors available, only 37 tractors (40%) had logbooks. The remaining 56 tractors (60%) did not have logbooks.
- **Logbooks not regularly updated:** Of the above 37 logbooks, I noted that tractor operators did not record the movements and fuel consumed by the tractors on a daily basis. In such cases, it was not easy to monitor tractor movements, their utilization (in terms of hectares tilled by each tractor) and fuel consumption. This creates a risk that tractors could be used for activities not related to the Task force and this may be difficult to identify.

Recommendation

The task force supervisory staff should ensure that all tractor log books are updated on a daily basis with a record showing the movements of the tractors and the fuel consumed. This will facilitate monitoring tractor movements on a regular basis and ensure they are well utilized.

Management comment

We started to fill logbooks and the TFIM will ensure that the regular recording of them.

¹⁷ MINAGRI/TF I&M, Agricultural Mechanization Procedures Manual, Paragraph 2.2.15, page 7

¹⁸ Government policies and procedures, Volume I, section 7.2.4, page 33

5.4.2. Weaknesses in tractor maintenance (servicing)

The task force acquired various tractors from two manufacturers TYM and MAHINDRA. The tractors acquired have a manufacturer's manual¹⁹ that clearly stipulates the maintenance schedule for each model of tractor. According to the manufacturer's manual, regular servicing is required to be performed on tractors to ensure they continue to function and meet the required quality standards throughout their anticipated lifetime. The maintenance schedule stipulates that different forms of maintenance have to be carried out every 50 hours, 100 hours, 200 hours, 300 hours, 500 hours and 1,000 hours. A summary of the maintenance schedule for each manufacturer is provided in **Appendix 6**.

During the audit, I compared these maintenance schedules to the available maintenance cards provided to assess how the task force had carried out regular servicing of the tractors. Following my review of these records, I noted that none of the tractors was serviced in line with requirements of their respective user manuals.

If routine servicing is not done, there is a risk that the assets will deteriorate and the long run costs to restore or replace them will become much higher.

Recommendation

Routine servicing should be done on a timely basis and in compliance with the manufacturer's user manual.

Management comment

Minor maintenance were being done but not recorded, we started to record them as recommended. The major maintenance is the one which was not being done due to the budget constraints.

We proposed a new option of auctioning some of tractors, the proposal was submitted to the Minister. Also, in this coming fiscal year, a budget for spare parts had been provided, so we hope that all machines which will be kept in the hiring and extension system will be all repaired.

5.4.3. Delays in performing tractor repairs

Tractor repairs are crucial for sustainability of the mechanization program under the task force²⁰. Timely repairs are necessary to ensure that tractors promptly return to active use for the benefit of

¹⁹ TYM operator's Manuals T305, T503, T603, T903/1003 and MAHINDRA 7050 Operator manual

²⁰ TYM Operator's Manual for Tractors T353, page 51

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

farmers²¹. Repairs are carried out at Kabuye workshop in Kigali.

However during the audit I noted that out of the 93 available tractors, 46 tractors were broken down, 44 were in a good condition, while 3 were parked awaiting pending repair works. My review of task force monthly reports prepared since January 2014 indicates that tractor repairs were delaying. The number of tractors that have been categorised as broken down at Kabuye workshop has increased from 32 in March 2014 to 46 in January 2015. Included within these numbers are same tractors that have been reported as broken down every month without being repaired. This indicates that repair works were delaying and ineffective and has contributed to the reduction in the number of active tractors available for deployment.

The increased number of damaged tractors that are not repaired timely will hinder the task force from achieving its objective of increasing agricultural productivity. Refer to photos below showing a selection of tractors that are broken down and still await repairs.



TYM tractors broken down and awaiting repair in Kabuye workshop. Photo taken on 04th November 2014.

Recommendation

The task force management should promptly repair all broken down tractors. This will increase the number of tractors available for deployment.

²¹ <http://www.tarahaat.com/tractormaintenance.aspx>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Management comment

We made the inspection and clarified the problems of machines and we identified all needed spare parts in order to repair them. This list has been submitted for funding to the PS office. So far, we are also thinking on plan B due to the high cost of repairs; auctioning some of the equipment so that the revenues generated could be used in maintenance of the remaining machines.

5.5. Management of power tillers

In line with management of tractors highlighted above, it was expected the task force would put in place a record system to track and monitor the utilization and maintenance of power tillers on a regular basis. However during the audit I noted the following:

- **Lack of logbooks:** Of all the available power tillers (21 of model 15HP and 109 of model 12HP), none of them had a logbook to track their movements and monitor fuel consumption. It was therefore not possible to ascertain how power tillers had been utilized.
- **Lack of regular servicing:** The power tiller maintenance schedule stipulates that different forms of maintenance have to be carried out every 20 hours, 100 hours, 500 hours, 1,500 hours and 2,000 hours. The power tillers are not equipped with an hour counter system and given that no logbooks have been kept to track utilization of these machines, it meant that management did not know when to service them. I did not obtain any evidence to prove that the power tillers have ever been serviced in line with the manufacturer's guidelines.
- **Delays in performing power tiller repairs:** Repairs are crucial for sustainability of the mechanization program under the task force. Timely repairs are necessary to ensure that power tillers promptly return to active use for the benefit of farmers. However during the audit I noted that out of the 21 available power tillers 15 HP, 16 were broken down while only five were in good condition. Out of 109-power tillers 12HP, 17 were broken down while the remaining 92 were in good condition. The increased number of damaged power tillers that are not repaired timely will hinder the task force from achieving its objective of increasing agricultural productivity. Refer to photos below showing a selection of power tillers that are broken down and still await repairs.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Power tillers broken down and awaiting repair in Kabuye workshop. Photo taken on 6th November 2014.

Recommendations

- The task force supervisory staff should ensure that all power tillers are assigned logbooks. These logbooks should then be updated on a daily basis with a record showing the movements of the power tillers and the fuel consumed. This will facilitate monitoring power tiller movements on a regular basis and ensure they are well utilized.
- Routine servicing should be done on a timely basis and in compliance with the manufacturer's user manual.
- The task force management should promptly repair all broken down power tillers. This will increase the number of power tillers available for deployment.

Management comment

Minor maintenance were being done but not recorded, we started to record them as recommended. The major maintenance is the one which was not being done due to the budget constraints.

We proposed a new option of auctioning some of tractors, the proposal has submitted to the Minister. Also, in this coming fiscal year, a budget for spare parts had provided, so we hope that all machines which will be kept in the hiring and extension system will be all repaired.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.6. Tractors operating without Roll Over Protective Structures (ROPS)

The Roll over Protective Structures (ROPS) are operator compartment structures mounted on top of tractors and are intended to protect equipment operators from injuries caused by tractor overturns or rollovers²². However, during the field visit of Bugesera and Ngoma VMSCs, I found most tractors did not have their respective ROPS, mounting hardware and seat belts yet this safety equipment had been procured by the task force and was sitting idle in the central workshop in Kabuye. This negligence puts the lives of the tractor operators at unnecessary risk in the event of a tractor rollover. See details in the photos below:



Tractors operating without ROPS. Photo taken at Bugesera VMSC on 26th January 2015.

²² TYM operator's manual for tractors, page. 12

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Tractors operating without ROPS. Photo taken at Bugesera VMSC on 26th January 2015.



A Mahindra tractor on the left is not equipped with ROPS while a TYM tractor in the middle is equipped with it. Photo taken at Ngoma VMSC on 26th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Brand new ROPS still packed in their wooden boxes remain unused at Kabuye workshop yet tractor operators are operating tractors in the field without adequate protection. Photo taken at Kabuye workshop on 6th November 2014.

Recommendation

The task force should comply with the manufacturers' manuals to provide adequate safeguards to tractor operators by immediately mounting the ROPS to their corresponding tractors. This will help minimise the risk of injury or death in case of rollover during operation of the tractors.

Management comment

This recommendation has been implemented already; the rops were fixed later on after the auditors' field visit.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.7. Tractors and tractor attachments continuously exposed to rain and humidity

To the extent possible, it is advisable to house metal objects indoors to reduce exposure to rain²³ and temperature extremes. However during the audit field visit at Bugesera, Ngoma and Nyanza VMSCs in January 2015, I noted that all tractors and tractor attachments were continuously exposed to both sun and rain. Exposing machinery having metal components to excessive sunlight and water can cause corrosion which accelerates the rate of degradation of the machine components. This reduces the life expectancy of the machinery as well as its performance. Examples of deteriorating machine components are highlighted in the photos below.

Tractors:



Tractor seats are worn out due to continued exposure to rain and humidity. Metal components below the seat have also started getting corroded yet the tractor has been operation for only one and a half years²⁴. Normally, a tractor can last 8 years when well maintained. Photo taken at Bugesera VMSC on 26th January 2015.

²³ NPS Museum Handbook, Part I (2002) <http://www.nps.gov/museum/publications/MHi/Appendix%20O.pdf>

²⁴ All these tractors were acquired in July 2013.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Tractors are parked in an exposed area without a protective shade. Photo taken at Bugesera VMSC on 26th January 2015.



Tractors are parked in an exposed area without a protective shade. Photo taken at Ngoma VMSC on 26th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

A tractor seat holding a puddle of water following rainfall the day before the audit visit. Continuous exposure of water



on tractor components leads to accelerated depreciation of these parts. Photo taken at Sake sector in Ngoma district on 26th January 2015.

Tractor attachments:

Tractor ploughs are not cleaned after use and are left exposed to the direct sunlight and rain hence making them rust. In the long run this compromises their structural integrity making them more susceptible to damage when returned to service. See details in the photos below.



Ploughs are stored in the open where they are exposed to continuous sunlight and rain. This one was damaged but not repaired. Photo taken at Sake sector in Ngoma VMSC on 26th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



On removing the plough cover plate, it shows the extent to which they are poorly maintained. The ploughs are not cleaned on completion of each task from the garden and yet they are continuously exposed to humidity. This poor handling exposes the ploughs to rusting within a very short period. Photo taken at Bugesera VMSC on 26th January 2015.



PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Rotary ploughs are found scattered outside Bugesera district headquarter grounds. They are corroded and worn out and are susceptible to breakdown on return to service. Photo taken on 26th January 2015.



Ploughs are left outside on the ground. They are continuously exposed to the sun and rain in Nyanza VMSC. Photo taken on 12th January 2015



Additional disc ploughs that were damaged and left unrepaired outside Nyanza VMSC. Photo taken on 12th January 2015

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Ploughs are scattered in the grounds of Sake sector in Ngoma district. Both ploughs have started to rust and their future use is in doubt. Photo taken on 26th January 2015.



Tractor attachments kept in the open at Kabuye VMSC. They are continuously exposed to rain and humidity making them susceptible to rust. Photo taken on 10th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Additional tractor attachments kept in the open at Kabuye VMSC. They are continuously exposed to rain and humidity making them susceptible to rust. Photo taken on 10th January 2015.



Tractor ploughs kept in the open at Kabuye VMSC. They are continuously exposed to rain and humidity making them

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

susceptible to rust. Photo taken on 10th January 2015.

According to best practice, it is expected that machines with metal components should be safely stored under a protective shed. An example is depicted in the photo below where tractors are appropriately parked in a simple shed at the central workshop in Kabuye. This protects the machinery against rain and humidity and ensures a longer and productive life of the asset.



Tractors in Kabuye workshop appropriately parked in a protected area. Photo taken on 6th November 2014.

Recommendation

- Tractors and their attachments should be parked/stored in a protective area to safeguard them against humidity, sunlight and rain in order to ensure a longer and productive life of the asset.
- The task force and all entrusted users should handle all equipment with due care and carry out regular maintenance of tractors and their respective attachments on timely basis in accordance with the maintenance schedules as highlighted in the manufacturers' manuals.

Management comment

Currently, we have cleaned them after auditors' visit. Shades for tractors and implements were planned for construction at each VMSC; but due to budget constraints and the unexpected period of closure of the Task Force, this plan was postponed.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.8. Idle stock of power tiller trailers

On 4th March 2011, MINAGRI / Task force signed a contract with a Ugandan supplier named TONNET Agro-Engineering Co. Ltd worth Frw 130,855,263 for the supply of 250 power tiller trailers used for transporting farm produce. On 7th October 2011 all the 250 trailers were delivered to the Task force. In addition 2 trailers were given to the Task force by TYM Co. bringing the total number of trailers to 252.

However, during our field visit in Kabuye workshop on 6th November 2014, I noted the following:

- **Underutilization of the trailers:** 22 trailers have been used in the extension activities, 88 have been sold to farmers and 5 were donated to the best model farmers. The remaining 137 trailers have never been used since they were delivered to the Task force. By the time of audit, they had been in stock for more than 3 years.
- **Storage of trailers:** While the corresponding 274 trailer tyres (2 tyres per trailer for the 137 trailers currently at the Task force) were safely stored in the workshop, the main metallic trailer bodies were left in the open where they are continuously exposed to direct sunlight and rainwater. Consequently, most trailer bodies have started to degrade through rusting. There was no value for money derived from purchase of these power tiller trailers. See details in the photos below.



The trailer bodies are continuously exposed to direct sunlight and rain water leading to rapid degradation through rusting. Photo taken at Kabuye workshop on 6th November 2014.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



A combination of rainwater and sunlight has resulted in rusting of the trailer bodies. Photo taken at Kabuye workshop on 6th November 2014.



Trailer tyres have been kept unused inside the workshop since October 2011. Photo taken at Kabuye workshop on 6th November 2014.

There is no value for money derived from assets purchased but could not be put to use for three

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

years after acquisition. Such unutilized assets result in unnecessary losses for the government and may require continuous maintenance for assets that are not needed.

Recommendations

- Going forward, equipment should only be purchased after conducting a thorough feasibility study to assess how the equipment directly contributes to solving the actual needs of Rwandans.
- MINAGRI and the task force should immediately put these power tiller trailers to their intended purpose or seek to hire them out at a fee or out rightly sell them to recoup the money invested.

Management comment

These machines have been purchased by MINAGRI based on the supply agreement signed between MINAGRI and TYM in 2009. It is in this year when the first shipment different machines have been received by MINAGRI from Korea (TYM). The TF I&M started its activities in 2010, and before that, other shipments were already ordered by MINAGRI.

The TF I&M would like to introduce a leasing to own contract with farmer's cooperatives, mainly young farmers or young graduates to involve them in the Mechanization business.

The big part of the agri-machineries currently under the TF I&M will put on Auction. Others will be transferred to Rwanda Work-Force Development (WDA) for technical skills development in Mechanization (as agreed between MINAGRI and MINEDUC-TVET).

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.9. Idle stock of potato harvesters

On 20th October 2010, MINAGRI signed a contract with TYM Co. Ltd worth for \$ 74,750 (equivalent to Frw 44,166,038²⁵) for the supply of 50 potato harvesters. On 12th April 2011 all the potato harvesters were delivered to the Task force.

During our field visit in Kabuye workshop on 6th November 2014, I noted that following:

Suitability to the local terrain: Only 5 potato harvesters among the 50 available were actively used for demonstration purposes in extension services. The other 45 potato harvesters have never been used to harvest throughout all the four years since their delivery in April 2011 and are currently lying idle at Kabuye workshop. This situation resulted from the fact that most Irish potatoes are grown in mountainous districts in Northern Province and this makes mechanization (using potato harvesters) a problem for such a terrain. However I noted that no feasibility study about the suitability of this type of equipment was carried out prior to acquisition.

Affordability to farmers: I also noted that these harvesters were meant to be sold to individual farmers. However, each harvester costs \$1,495 (equivalent to Frw 1,046,500). This was found to be expensive for the average farmer and contributed to the slow uptake. See details of idle potato harvesters in the photos below.



New potato harvesters still wrapped in their delivery packaging. Photo taken at Kabuye workshop on 6th November 2014.

²⁵ NBR exchange rate of 20th October 2010 or click at <http://www.bnr.rw/index.php?id=384>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Potato harvesters lying idle at Kabuye workshop. Photo taken on 6th November 2014.



Potato harvester parts are not protected against moisture in the workshop leading to degradation through rusting. Photo taken at Kabuye workshop on 6th November 2014.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

There is no value for money derived from assets purchased but could not be put to use for four years after acquisition. Such unutilized assets result in unnecessary losses for the government and may require continuous maintenance for assets that are not needed.

Recommendations

- Going forward, equipment should only be purchased after conducting a thorough feasibility study to assess how the equipment directly contributes to solving the actual needs of Rwandans.
- MINAGRI and the task force should immediately put these potato harvesters to their intended purpose or seek to hire them out at a fee or outrightly sell them to recoup the money invested.

Management comment

These machines have been purchased by MINAGRI based on the supply agreement signed between MINAGRI and TYM in 2009. It is in this year when the first shipment different machines have been received by MINAGRI from Korea (TYM). The TF I&M started its activities in 2010, and before that, other shipments were already ordered by MINAGRI.

The TF I&M would like to introduce a leasing to own contract with farmer's cooperatives, mainly young farmers or young graduates to involve them in the Mechanization business.

The big part of the agri-machineries currently under the TF I&M will put on Auction. Others will be transferred to Rwanda Work-Force Development (WDA) for technical skills development in Mechanization (as agreed between MINAGRI and MINEDUC-TVET).

5.10. Idle stock of other tractor and power tiller attachments

Apart from potato harvesters and power tiller trailers, the task force acquired other tractor and power tiller attachments such as; mould board, rotary plough, disc harrow, iron wheel and disc plough. Based on the fact that the tractors and power tillers were used inefficiently, these corresponding attachments were consequently not utilized as well. Therefore a large number of these attachments is lying idle in Kabuye workshop as shown in the photos below.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Iron wheels for both Power tiller 12HP and 15 HP lying idle in Kabuye VMSC premises. Photo taken on 6th November 2014.



Power tiller iron wheel attachments have started to wear out while still packed. Photo taken 6th November 2014.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Mold board parts scattered in the storage area. They are lying idle and already worn out. Photo taken 6th November 2014 in Kabuye VMSC.



Combination of iron wheels and mold boards lying idle in Kabuye VMSC. Photo taken 6th November 2014.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Combination of power tillers and other related attachments. They are stored like scrap in Kabuye VMSC. Photo taken 6th November 2014.

There is no value for money derived from assets purchased but could not be put to use for three years after acquisition. Such unutilized assets result in unnecessary losses for the government and may require continuous maintenance for assets that are not needed.

Recommendation

Going forward, equipment should only be purchased after conducting a thorough feasibility study to assess how the equipment directly contributes to solving the actual needs of Rwandans.

Management comment

These machines have been purchased by MINAGRI based on the supply agreement signed between MINAGRI and TYM in 2009. It is in this year when the first shipment different machines have been received by MINAGRI from Korea (TYM). The TF I&M started its activities in 2010, and before that, other shipments were already ordered by MINAGRI.

The TF I&M would like to introduce a leasing to own contract with farmer's cooperatives, mainly young farmers or young graduates to involve them in the Mechanization business.

The big part of the agri-machineries currently under the TF I&M will put on Auction. Others will be transferred to Rwanda Work-Force Development (WDA) for technical skills development in Mechanization (as agreed between MINAGRI and MINEDUC-TVET).

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.11. Building constructed to accommodate a Power Tillers Assembly Plant completed but not in use

On 31st August 2011, the task force signed a contract with Groupement BEAH Ltd & SEICO COMPANY SA for construction of a building at Agriculture Park in Kigali Special Economic Zone for Frw 529,215,536. This building was constructed in preparation for the implementation of a project to set up a Power Tillers Assembly Plant in Rwanda. This plant was expected to increase the output of power tillers as well as lower the unit cost hence making them more affordable to farmers. The task force provisionally received the building in June 2013.

During the audit, I noted the following:

- The project to set up a Power Tillers Assembly Plant was to be implemented through a Joint Venture Agreement between the Government of Rwanda (represented by MINAGRI) and Tong Yang Moolsan Co. Ltd (TYM), a Korean Company specialized in the manufacturing of Power Tillers. However, since 2012 up to the time of my audit in December 2014, MINAGRI and TYM are still in negotiations on the terms of the Joint Venture Agreement and the quality and specifications of the power tillers that will be supplied. These negotiations are taking a long time and are delaying. There is no clear indication of when these negotiations are likely to be finalized for the plant to commence operations and utilize the completed structures.
- I also visited this building site and noted that due to the delay in completing the negotiations as stated above, it is instead being used as a warehouse for Inyange Industries Ltd. Inyange industries Ltd has been using this building as a warehouse since July 2013 (one month after it was provisionally handed over to the Taskforce).

This implies that the building is not used to serve the intended purpose of assembling power tillers. Consequently the government is at risk of not achieving its set targets of mechanizing 25% of farm operations by the year 2017.

Recommendation

Continued efforts should be made by MINAGRI and the task force to finalise negotiations with Tong Yang Moolsan Co. Ltd and ensure that the joint venture agreement is signed to commence operations of a Power Tillers Assembly Plant.

Management comment

MINAGRI has tried in vain to convince TYM to come into this Joint Venture business. A plan B solution is now on-going – whereby a MoU is planned to be signed with V.S.T. Tillers and Tractors, a private company from India, to supply and sell Power Tillers and Tractors in Rwanda. The company is planning also to start assembling tillers in the country in future. It is in that context that V.S.T. Tillers and Tractors is planning to use the building.

SECTION 2: MARSHLAND IRRIGATION INFRASTRUCTURE

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

The Task force was also tasked to develop irrigation infrastructure in marshlands under the Quick Win Marshland Development Project (QWMDP). The project objective was to enable even distribution of water in all cultivable marshlands throughout the country with the overall goal of increasing agricultural output in the country. The audit team conducted an audit of selected marshlands in Gasabo, Kamonyi, Huye and Gisagara districts to assess whether the installed irrigation infrastructure were properly utilized and maintained by the intended users - WUAs. Construction of the marshland irrigation infrastructure was carried out in two phases. During the first phase, the construction of the irrigation infrastructure was carried out by the task force itself from February to September 2011. However, during the second phase (February 2013 to June 2014), construction of the irrigation infrastructure was subcontracted to private contractors who were selected after a bidding process. The marshlands visited and the construction cost of irrigation infrastructure built within are highlighted in the table below. Details for expenditure incurred in building marshland infrastructure in the entire country are shown in **Appendix 7**.

Table 4 showing cost of irrigation infrastructure visited

District	Sector	Marshland	Amount (Frw)
Huye	Tumba, Kigembe, Mukura, Kibiriza, Nyaruteja, Kansi	Migina	270,000,000
Huye	Mukura	Mukura	125,000,000
Gisagara	Gikonko	Mwura - Gatara	215,000,000
Gasabo	Kinyinya, Kimironko, Nduba	Nyagisenyi - Rufigiza	204,000,000
Kamonyi	Rugarika and Gacurabwenge	Bishenyi	147,500,000
Kamonyi	Nyamiyaga, Mugina, Rugalika	Ruboroga	130,000,000
Total			1,091,500,000

1. The various marshland irrigation infrastructure built followed the same design and are made up of the following key components/ structures:
2. Intake well/valley dam;
3. Main and secondary irrigation supply canals;
4. Headwork's diversion structure/mainstream;
5. Simple and combined drop and pipe turnouts;
6. Steep sloping transaction;
7. Through aqueduct;
8. Box culvert; and
9. Lined ravine.

During the audit, I noted the following weaknesses:

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.12. Irrigation infrastructure constructed but not operational

Irrigation in the marshlands follows the principle of natural gravity flow whereby the water source is situated on a higher ground while the areas to be irrigated are situated in low lying land relative to the water source. This enables water to flow naturally from the water source to the low lying farmland.

However, during the audit I noted cases where the irrigation infrastructure were built above the water level of the river supplying/ feeding the structure. Consequently the irrigation infrastructure does not receive the intended water supply and hence lies idle and unused since commissioning. The surrounding fields are therefore not irrigated using this infrastructure and hence the infrastructure is not fulfilling its intended purpose. This situation has resulted into poor crops yields. There is no value for money of irrigation infrastructure built but is not in use. Examples of irrigation infrastructure that are lying idle are shown in the following photos:

HUYE DISTRICT: Mukura Marshland



Headwork Diversion Structure that cannot serve water to surrounding areas in Mukura Marshland because it is situated above the water level of the river intended to feed it. Photo taken at Mukura marshland on 13th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



There is no value for money of irrigation infrastructure built but is not in use. Photo taken at Mukura marshland on 13th January 2015.

GISAGARA DISTRICT: Mwura - Gatara Marshland



The water canal and the infrastructure built on- are not in use since it was built at a level above the water intake stream. Photo taken at Mwura - Gatara marshland on 15th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

GISAGARA DISTRICT: Mwura - Gatare Marshland



The infrastructure became useless due to the water that can't reach the level the structure was built. Photo taken on 15th January 2015

KAMONYI DISTRICT: Ruboroga marshland



More irrigation infrastructure that is unfunctional and is blocked by overgrowth of grasses. Irrigation water does not reach this part of the marshland. Photo taken at Ruboroga marshland on 7th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

KAMONYI DISTRICT: GIKORO Marshland



More irrigation infrastructure that is unfunctional and is blocked by overgrowth of grasses. Irrigation water does not reach this part of the marshland. Photo taken at Gikoro marshland on 9th January 2015.

KAMONYI DISTRICT: Bishenyi marshland



Some canal parts are built in such a way that they cannot supply water to the next part of the canal. Farmland along subsequent parts of the canal do not get access to irrigation water because they are on a raised surface relative to the canal supplying the area. Photo taken at Bishenyi marshland on 14 January 2015.

Recommendation

The task force should rehabilitate all marshland irrigation structures to restore them to a usable state to benefit farmers in the respective marshlands.

Management comment

The first phase of Quick Win Marshland Development program (QWMDP-I) was implemented in such a way that MINAGRI used young graduates without enough experience to supervise the construction of irrigation infrastructures, while the digging of irrigation and drainage canals were done by the man powers through HIMO approach. On some sites, this resulted in non-functional of some infrastructures indeed. Thus, in the QWMDP-II, we had to change and we involved private companies for the construction works. The strategy proposed a rehabilitation plan of affected marshlands, with immediate effects – this is now being implemented progressively.

5.13. Irrigation infrastructure that was left incomplete and cannot be utilized as intended

Irrigation infrastructure is built to facilitate even distribution of water to all parcels in the marshland. However, I noted that some marshland irrigation infrastructure was left incomplete.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

This meant that irrigation water was not able to evenly irrigate all parcels in the marshland. An example is in Mwura-Gatare marshland in Gikonko sector of Gisagara district. The construction of irrigation infrastructure in this marshland was carried out by the task force itself during the first phase (February to September 2011). However, not all infrastructure was completed. See details in the photo below.

GISAGARA DISTRICT: Mwura-Gatare marshland



The infrastructure was left incomplete. Photo taken at Mwura-Gatare marshland on 15th January 2015.

Recommendation

The task force should rehabilitate all irrigation structures to restore them to a usable state to benefit farmers in the respective marshlands.

Management comment

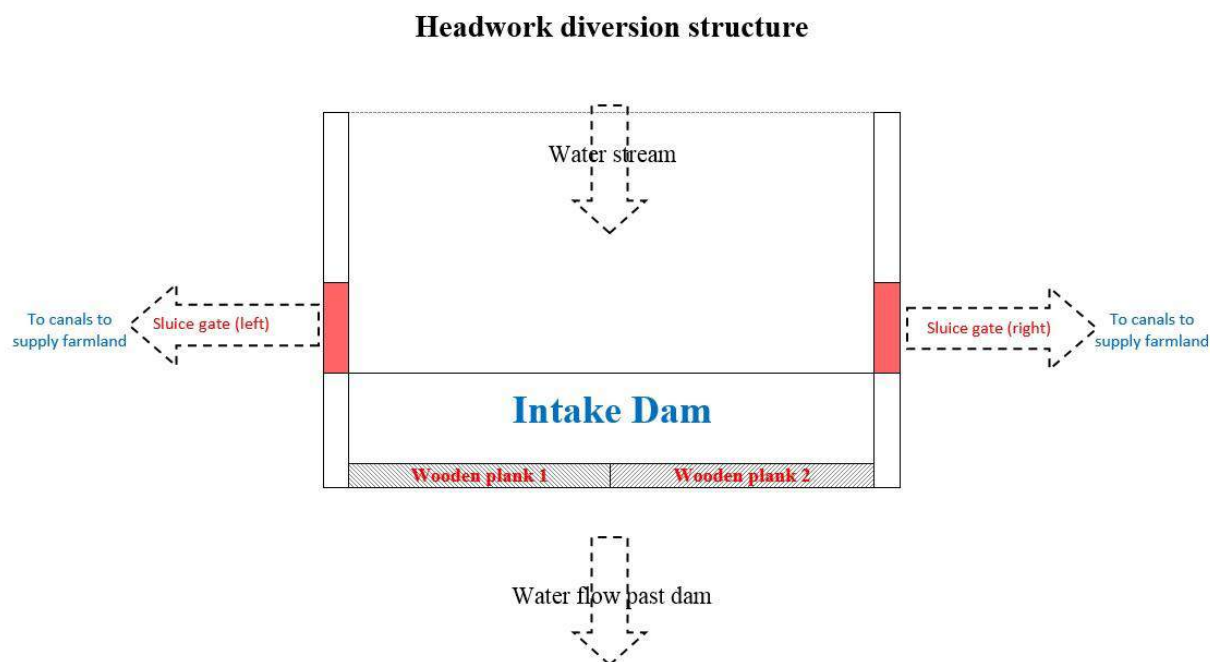
The first phase of Quick Win Marshland Development program (QWMDP-I) was implemented in

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

such a way that MINAGRI used young graduates without enough experience to supervise the construction of irrigation infrastructures, while the digging of irrigation and drainage canals were done by the man powers through HIMO approach. On some sites, this resulted in non-functional of some infrastructures indeed. Thus, in the QWMDP-II, we had to change and we involved private companies for the construction works. The strategy proposed a rehabilitation plan of affected marshlands, with immediate effects – this is now being implemented progressively.

5.14. Unregulated flow of water at the intake dam

Before construction of the marshland irrigation infrastructure, the task force is required to carry out topographic surveys in order to provide the final layout of irrigation/drainage canals and layout of irrigation water management structures. One of the key irrigation infrastructure in marshlands is the headwork diversion structure (HDS)²⁶. The HDS is made up of an intake dam and two sluice gates (one gate either side of the dam). This is illustrated in the picture below.



The purpose of the wooden planks on the intake dam is to regulate the flow of water. They are inserted or removed manually by the water users (farmers). When the water users need to irrigate their farmland, they insert these wooden planks in the intake dam to reduce the rate of flow of water and hence increase the water level. The sluice gates are then opened to allow flow of water into the irrigation canals and finally into the farmland. In case sufficient irrigation has taken place, the wooden planks need to be removed from the intake dam to allow the water level to drop and hence stop flow of water into the farmland.

²⁶ Report on marshland developed under QWMDP

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

However during the audit, I noted cases where the water users did not promptly regulate the flow of water by inserting and removing the wooden planks timely. This resulted into:

Over flooding (in cases where the wooden planks were left in the dam for extended periods of time); or

Very low water levels and consequently no irrigation of the fields (in cases where the wooden planks were not inserted in the dam at all).

In cases where over flooding occurred, this led to bursting of the river banks and hence flooding of farmland and destruction of crops. In cases of very low water levels, this meant that farmers' crops were not irrigated resulting into poor crop yields. There is no value for money derived from expensive infrastructure that is not operated as intended and hence not of benefit to users. For illustration of the above, refer to the photos below.

HUYE DISTRICT: Mukura marshland



Water flowing uncontrollably through the intake dam. The wooden planks were not removed (see blue arrow) to allow a drop in the water level. This led to over flooding and bursting of the river bank (see the following photo) and consequently led to flooding of surrounding farmland. Photo taken on 13th January 2015

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Water flowing uncontrollably through the intake dam. The wooden planks were not removed (as explained above) to allow a drop in the water level. This led to over flooding and bursting of the river bank (see blue arrow) and consequently led to flooding of surrounding farmland. Photo taken on 13th January 2015

HUYE DISTRICT: Migina marshland



Water flowing uncontrollably through the intake dam. The wooden planks were not removed (see blue arrow) to allow a drop in the water level. This led to over flooding and bursting of the river bank and consequently led to flooding of surrounding farmland (see photo below). Photo taken on 12th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Over flooding and bursting of the river bank led to flooding of surrounding farmland. Photo taken on 12th January 2015.



Flooding of farmland led to destruction of crops. Photo taken on 12th January 2015

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

GASABO DISTRICT: Nyagisenyi - Rufigiza marshland



Wooden planks were not inserted in the dam at all. The water level dropped significantly to a level below the red sluice gates. Consequently water could not go through the irrigation canals to the farmland. Photo taken 18th November 2014.



Wooden planks were not inserted in the dam at all. The water level dropped significantly to a level below the red sluice gates. Consequently water could not go through the irrigation canals to the farmland. Photo taken 18th November 2014.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

GISAGARA DISTRICT: Nyirabuyogera marshland



Wooden planks were not inserted in the dam at all. The water level dropped significantly to a level below the red sluice gates. Consequently water could not go through the irrigation canals to the farmland. Photo taken 14th January 2015.

Recommendation

The task force should liaise with the WUAs and educate them on the benefits of correctly operating the installed irrigation infrastructure. The task force should also enforce proper operation of these infrastructure.

Management comment

The Task Force has an annual training plan of the WUOs to increase the capacity of farmers in Operation, Management and Maintenance (OMM) of the irrigation infrastructures. The trainings are conducted in all irrigation schemes, before, during and after the installation of the infrastructures. The capacity building plan also involves the members of the District and Scheme Irrigation Steering Committees (DISC and SISC). The Operation, Management and Maintenance are also carried out through organization of community works “umuganda” at the sites. To enforce these strategies, the Task Force is recruiting WUO Manager at each scheme, as a Community Development Officer to continue farmer’s mobilization, support capacity building of the WUOs and to help the WUO in water fees collection; these water fees are used by the scheme WUO as revolving funds for OMM.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.15. Blocked irrigation canals

Irrigation infrastructure was built to convey water throughout farmers' parcels. This only happens when water can freely flow through the infrastructure without impediment of mud.

However during the audit I noted a case of Jabana marshland in Gasabo district where the irrigation canals are blocked by lots of mud. The blockade of the canal is caused by lots of mud discharged by cassiterite operators into the “Umurindi” river which is the source of water that irrigates Jabana Marshland. This makes it difficult for water to flow to the rice fields in the marshland resulting into poor crop yields.



The entire 1 km length of the canal is blocked by mud and is no longer usable. Photo taken on 10th December 2014.

Recommendation

The Task force should seek assistance from Gasabo district in preventing businesses from discharging mud into “Umurindi” river. This will enable Jabana marshland to get water free of mud and allow for unimpeded irrigation of the rice fields.

Management comment

This issue is also part of the agenda of the District and Scheme Irrigation Steering Committees (DISC and SISC). The DISC and SISC have committed to mobilize farmers through “umuganda”

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

to solve the problem. However, the Task Force will continue advocacy to the District and Sector authorities for appropriate measures.

Besides, through its appointed Scheme WUO the Task Force Manager has continued to mobilize farmers on proper Operation, Management and Maintenance (OMM) of the irrigation infrastructures.

5.16. Infrastructure cracked and not rehabilitated

According to the MINAGRI/ Task force staff handbook, the marshland irrigation specialist and irrigation engineers are required to develop a rehabilitation plan²⁷ for damaged irrigation structure. They are also required to implement this plan through rehabilitation of all damaged irrigation structures in order to keep them in good working condition.

However, during the audit field visits of various marshlands including Nyiramageni & Mwuragatare (completed in 2011) and Budubi & Bishenyi (completed in 2013-2014), I noted that most of these infrastructures were cracked and not maintained. These infrastructures were cracked and damaged yet they had been in operation for only three years and one year respectively. I also noted that the Task force had not prepared a rehabilitation plan for the repair of these infrastructure.

Without a rehabilitation plan and lack of rehabilitation of damaged irrigation infrastructure implies that there is a very high risk these infrastructure, though still new, would soon be destroyed and become nonfunctional. Refer to the photos below for details:

GISAGARA DISTRICT - Nyiramageni marshland

²⁷ MINAGRI/Task force, Duties and Responsibilities of Irrigation and Mechanization Task Force Staff, page 22-23

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Cracks like this one above are found on many irrigation infrastructure throughout the marshland. Photo taken at Nyiramageni marshland on 19th January 2015.



When you get closer, you realize that the infrastructure has big cracks and if not rehabilitated, will eventually fail. Photo taken at Nyiramageni marshland on 19th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

NYANZA DISTRICT - Budubi marshland



Upper view of the intake dam structure was cracked and if not repaired, can fall down in case of a heavy rain. Photo taken at Budubi marshland on 20th January 2015

GISAGARA DISTRICT: Mwura - Gatare marshland



Cracked infrastructure at Mwura - gatare marshland. Photo taken on 15th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Cracked infrastructure at Mwura - gatare marshland. Photo taken on 15th January 2015.

KAMONYI DISTRICT: Bishenyi marshland



Dilapidated irrigation infrastructure that has been in use for less than a year. Photo taken at Bishenyi marshland on 7th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Recommendation

The task force should prepare and implement a rehabilitation plan for all infrastructures to ensure that all they are in good working condition to achieve the intended objectives.

Management comment

The Task Force has already planned the implementation of this recommendation starting from this fiscal year 2014-2015, mainly where damages of irrigation infrastructures are beyond the rehabilitation capacity of WUAs. The WUAs will be supported to prepare the rehabilitation calendar of these marshlands. The Irrigation and Mechanization Task Force planned the rehabilitation of the irrigation infrastructures of Bishenyi, Ruboroga and Busogwe marshlands.

5.17. Marshland fields converted into mining sites

Irrigation infrastructure have been installed in marshlands with the specific objective of increasing crop yields. However, during the audit, we noted a number of cases where farmers had converted farmland into mining sites for extraction of sand.

This practice reduces the size of farmland available for cultivation of crops and in some cases has resulted into blockage of the canal meant for distribution of irrigation water to the surrounding fields. This renders the money spent on irrigation project wasteful and creates a risk that the overall project objective of increasing crop yields will not be achieved. See photos below for details.

HUYE DISTRICT: Migina marshland



Farmland converted into a sand mining site in Migina marshland in Huye district. Photo taken on 12th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

HUYE DISTRICT: Mukura marshland



Farmland converted into a sand mining site in Mukura marshland in Huye district. Photo taken on 13th January 2015.

GASABO DISTRICT: Nyagisenyi - Rufigiza



Farmland converted into a sand mining site in Nyagisenyi - Rufigiza marshland in Gasabo district. The mining activity has contributed to the blockage of the irrigation canal. Photo taken on 18th November 2014.

KAMONYI DISTRICT: Ruboroga marshland



Farmland converted into a sand mining site in Ruboroga marshland in Kamonyi district. Photo taken 7th January 2015.

Recommendations

The task force in liaison with local leaders should:

- Reclaim the land to ensure that this practice is stopped with immediate effect.
- Apply stiff penalties to private prospectors who destroy public infrastructure as a deterrent against further destruction of farmland.

Management comment

These issues are part of the agenda of the District and Scheme Irrigation Steering Committees (DISC and SISC). The DISC and SISC, whose among members, the District Vice-Mayor in Charge of Economic Affairs, Security Officers and District Environmental Officer, have committed to solve the problems of sand mining, and to take appropriate measures. However, the Task Force will continue advocacy at REMA.

5.18. Failure to sign the Irrigation Management Transfer Agreement (IMTA)

Ministerial Order No 001/11.30 of 23/11/2011 (establishing Irrigation Water Users Associations (IWUAs) in irrigation schemes) proposed to put in place an Irrigation Management Transfer

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Agreement (IMTA). The IMTA is a document by signed between three parties that is: MINAGRI, the IWUAs and the respective district within which the IWUA is located. The purpose of the document is to transfer the responsibility for the operation and maintenance of irrigation scheme to the IWUA. The document also lists the obligations of all parties above. This Ministerial Order was effective from 23rd November 2011.

However, by the time of the audit in March 2015, I noted that no single IWUA had signed an IMTA transferring responsibilities for the operation and maintenance of the respective irrigation scheme to the IWUA.

The failure to sign this agreement, means that the transfer of such responsibilities has not taken place. Currently, the legal responsibilities for the marshland infrastructure still lie with the task force and MINAGRI. Furthermore, some IWUA members still believe that since this infrastructure belongs to MINAGRI, it is MINAGRI's responsibility to maintain them. Consequently, these IWUAs have not taken personal responsibility (ownership) and therefore they do not maintain these infrastructure. This has resulted into overgrowth and blockage of the irrigation canals rendering the infrastructure unusable. See details in photos below.

GASABO DISTRICT: Kajevuba marshland



A canal that is not maintained and does not allow flow of water. Photo taken at Kajevuba marshland on 7th August 2014.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

GASABO DISTRICT: Nyagisenyi - Rufigiza marshland

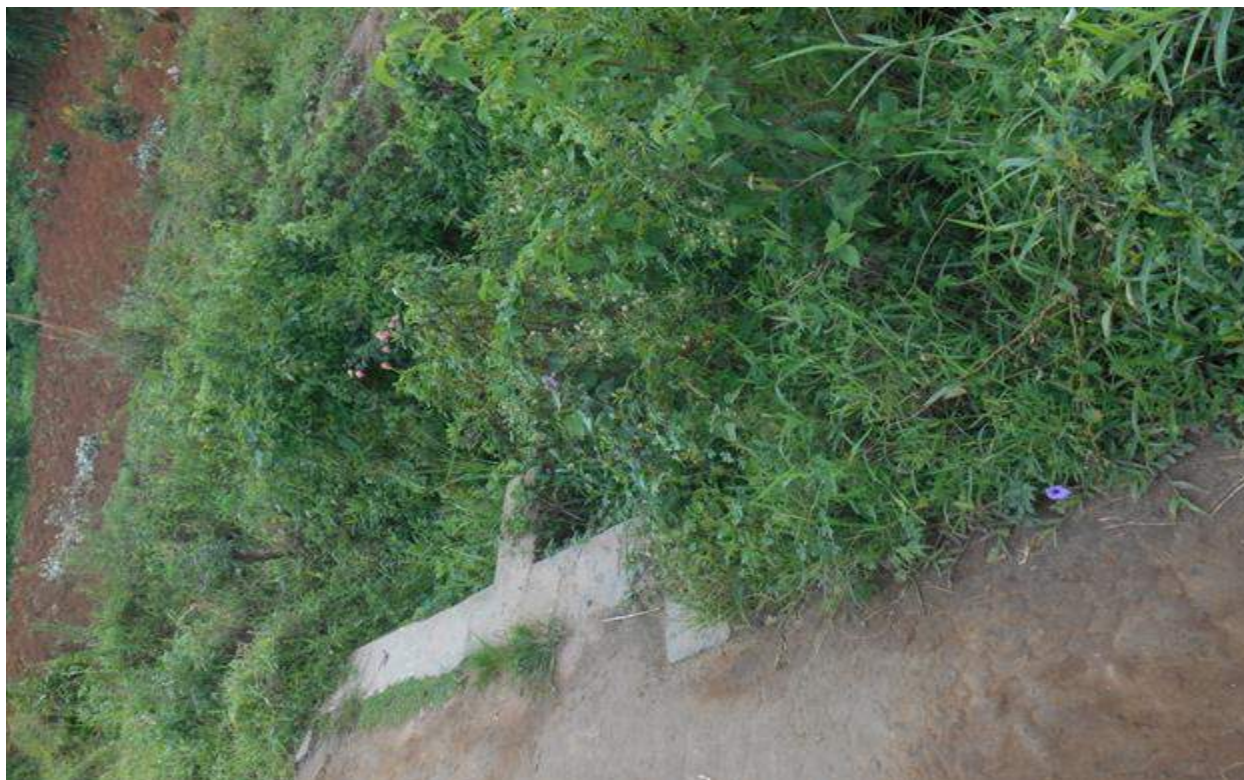


Irrigation canal covered by plant overgrowth rendering it unusable. Photo taken at Nyagisenyi - Rufigiza marshland on 18th November 2014.



Another irrigation canal covered by plant overgrowth rendering it unusable. Photo taken at Nyagisenyi - Rufigiza marshland on 18th November 2014.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Another irrigation canal covered by plant overgrowth rendering it unusable. Photo taken at Nyagisenyi - Rufigiza marshland on 18th November 2014.

NYANZA DISTRICT: Budubi marshland



Irrigation canal covered by plant overgrowth rendering it unusable. Photo taken at Budubi marshland on 20th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Another irrigation canal covered by plant overgrowth rendering it unusable. Photo taken at Budubi marshland on 20th January 2015.

KAMONYI DISTRICT: Bishenyi marshland



Irrigation canal covered by plant overgrowth rendering it unusable. Photo taken at Bishenyi marshland on 7th January 2015.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

KAMONYI DISTRICT: Gikoro marshland



Irrigation canal covered by plant overgrowth rendering it unusable. Photo taken at Gikoro marshland on 9th January 2015.

Recommendation

MINAGRI and the task force should comply with the Ministerial Order in place and design appropriate IMTAs for each IWUA and transfer the ownership of these infrastructure to ultimate users. The transfer should happen after the IWUAs have been given appropriate training on how to operate and maintain these infrastructures. Hence, through DISC and SISC, local government will be responsible for the management of the schemes and their role will be significant.

Management comment

The registration of WUOs at the RGB were found to take time, and thus to delay the implementation of the IMTA. However, the concept proposal with basic ideas to transfer the irrigation scheme to the IWUOs immediately after development is under development, and will be approved by the Agriculture Sector Working Group. Thereafter, it will be then suggested to the Scheme Irrigation Steering Committee (SISC) for immediate implementation; this will thus enhance the tripartite collaboration between MINAGRI, Local Government and the Farmers through the IWUO committees.

SECTION 3: HILLSIDE IRRIGATION EQUIPMENT

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Overview of government funded hillside irrigation systems in Rwanda: The Immediate Action Irrigation - Government Funded Irrigation Project (IAI-GFI) is a project initiative adopted by the Government of Rwanda in 2010 to combat drought through the development of hillside irrigation schemes²⁸. Currently IAI-GFI has developed two projects in Kirehe (580 ha) and Nyagatare districts (400 ha). A total land surface area of 980 ha (divided in five lots) is now under irrigation with three (3) lots located in Nasho irrigation scheme (Kirehe district) and two (2) lots in Matimba - Musheru irrigation scheme (Nyagatare district). These two irrigation schemes are now operational.

Types of irrigation systems: The Nasho irrigation scheme uses pressurized sprinkler irrigation systems while the Matimba irrigation scheme uses a combination of sprinklers, center pivots, drip and hydrant systems.

Handover from contractors to MINAGRI: For the Nasho irrigation scheme, the final handover from the contractor (China Geo-Engineering Corporation Ltd.) to the Task force was done on 9th January 2015. The Matimba irrigation scheme has been operational since 25th March 2014 and is still under guarantee. The contractors for this scheme are Uni-Tech Valley (for lot 5) and Jain Irrigation Systems (for lot 4).

Transfer from MINAGRI to WUAs: In accordance with Ministerial Order No 001/11 of 30/11/2011, the Ministry of Agriculture and Animal Resources (MINAGRI) and its partners have set up Water Users Associations (WUAs) that are expected to take charge of operating and maintaining the above irrigation schemes. By the time of the audit in January 2015, management of the irrigation infrastructure in the schemes was still under MINAGRI and the transfer to WUAs had not taken place.

During our audit field visit, we assessed how the irrigation infrastructure in the above schemes were utilised in furtherance of government's object of combating drought. The following issues were noted:

5.19. Production cost versus sales value of crops cultivated under the irrigation schemes

The main costs incurred in running Nasho and Matimba irrigation schemes are:

- **Staff costs:** Both irrigation schemes use permanent staff including an Irrigation Engineer, Agronomist, Electro-mechanical Technician and a site Watchman. These staff are paid by the Task force.
- **Electricity cost:** The cost of electricity that keeps water pumps and irrigation equipment

²⁸ Annual report of the Government-Funded Irrigation Project (GFI) - June 2013, page 8 and 19

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

functioning in each irrigation scheme is also paid for by the Task force.

- **Regular maintenance:** Considering that the two irrigation schemes were under one year of guarantee, the costs for carrying out regular repairs and maintenance were covered by the contractors. However, once final handover has been done, these costs will revert to the Task force.
- **Production costs:** Direct production costs are covered by cooperatives and are estimated for a planting season of five (5) months.

Following the implementation of the Ministerial Order No 001/11.30 of 23/11/2011, both irrigation schemes will be handed over to WUAs operating in each scheme. At that time, the WUAs will have to take charge of running costs of the irrigation schemes including regular maintenance, staff overheads, electricity costs and replacement of spare parts of irrigation equipment. The Task force will only retain responsibility over general supervision and continuous training of WUAs.

Basing on a case study of a maize crop, I made an analysis of the current production levels of the irrigation scheme, revenue generated from sale of produce and costs incurred in running the scheme. The analysis aims to assess whether the WUAs will be in position to meet the overhead costs without the support of the Task force.

Direct production costs - The direct production costs per hectare (Ha) of maize cultivated for each irrigation scheme are included in **Appendix 8**. These are Frw 791,750 and Frw 638,250 for Matimba and Nasho respectively.

Overhead costs - The main overhead costs are electricity and staff costs. These have been estimated for a five month planting season and are included in the table below.

Table 5: Overhead cost per Ha planted

	Matimba (Frw)	Nasho (Frw)
Electricity	7,017,724	16,004,810
Technical staff (5) / (7)	13,011,501	12,036,814
Total overhead cost	20,029,225	28,041,624
Farmland cultivated (Ha) - based on scheme acreage	400	580
Overhead cost per Ha	50,073	48,348

Source: Task force records

Regular repairs and maintenance - I have not taken these costs into consideration due to lack of information given that the two irrigation schemes were under guarantee by the contractors. However, once final handover has been done, these costs will revert to the Task force and are only expected to increase as the machines become old.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Profitability of the irrigation scheme - Using the above direct production costs and overhead costs, I have computed the expected profitability per kilogram of maize once the scheme is handed over to the WUAs. Based on the current average sales price of Frw 160 per kg of maize, and production level of 4 tonnes per Ha (Matimba) and 3.5 tonnes per Ha (Nasho), it shows that the operations of both schemes are loss making. At the current production levels and market prices, Matimba will be making a loss of Frw 50 per kg while for Nasho it will be Frw 36 per kg.

Table 6: Profitability per kilogram of maize - with overheads included

	Matimba	Nasho
	(Frw)	(Frw)
Production cost per Ha (A) (See Appendix 8)	791,750	638,250
Overhead cost per Ha (B)	50,073	48,348
Total cost per Ha (C = A + B)	841,823	686,598
Kg harvested per Ha (D)	4,000	3,500
Production cost per Kg of maize (E = C/D)	210	196
Average sales price per Kg of maize (F)	160	160
Loss per Kg of maize (G = F - E)	(50)	(36)

Breakeven analysis - Given that the schemes are loss making, I computed the required level of production for the schemes to break even and noted that Matimba would need to increase production to a level of 5.3 tonnes per Ha while Nasho would need 4.3 tonnes per Ha. Refer to details in the table below.

Table 7: Breakeven analysis (with overheads included)

	Matimba	Nasho
Sales price per kg (Frw) – A	160	160
Kg per Ha that need to be harvested – B	5,261	4,291
Sales revenue per Ha (Frw) - C = A x B	841,823	686,598
Production cost per Ha (Frw)	841,823	686,598

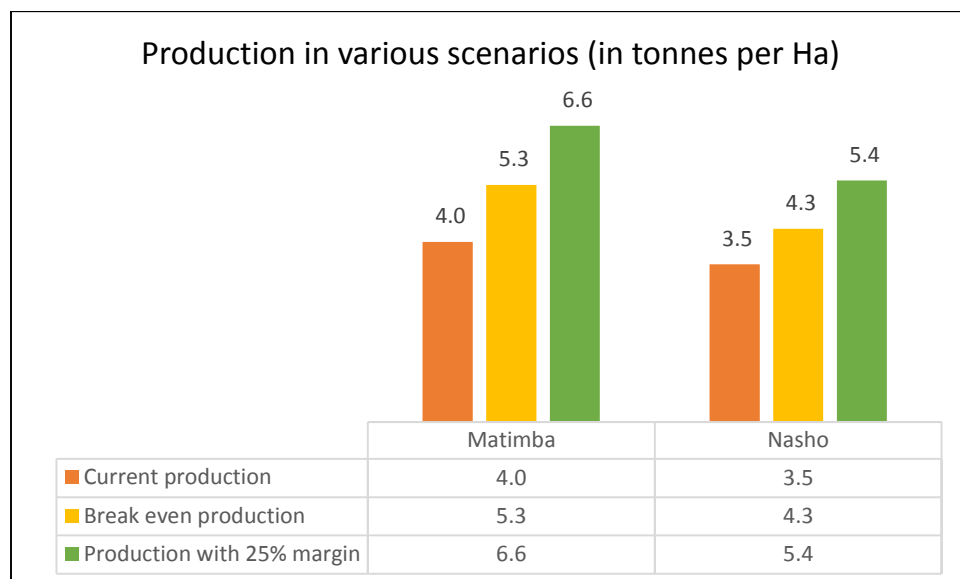
Farmers' margin - During the audit I noted that the farmers have a target of making at least 25% margin on their production cost. Therefore, in order to make a 25% profit, they would need to increase production by the same percentage over and above the breakeven production level. This results into a target production level of 6.6 tonnes per Ha for Matimba and 5.4 tonnes per Ha for Nasho. Refer to details in the table below.

Table 8: Target production for farmers to get the desired 25% margin

	Matimba	Nasho
Breakeven production per Ha (Kg)	5,261	4,291
Add margin (25%)	1,315	1,073
Target production per Ha (Kg)	6,577	5,364

The chart below summarises the production levels required in the various scenarios.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



This implies that, taking all costs into consideration, growing maize under these irrigation schemes is very expensive and will expose the farmers (WUAs) to losses. The situation can only be improved by increasing the yield per Ha given that farmers have no control over market sales prices. If yields are not enhanced, growing maize under this arrangement is not sustainable especially once the management of the schemes has been transferred to the WUAs.

Recommendations

- The task force should work closely with the equipment manufacturer to help farmers employ international best practices for farming under irrigation to improve yields above 7 tonnes per Ha in order for the project to be profitable and sustainable.
- The task force should advise farmers to be organised in cooperatives and add value to the produce before sale and also directly accessing markets using their own transport network instead of selling at farm gate to middlemen.
- The task force should advise farmers to go into growing higher value crops instead of low value staples like maize.

Management comment

Since the completion of the irrigation schemes of Nasho, Matimba and Kagitumba, The GoR has continued to mobilize funds for their Operation, Management and Maintenance (OMM), while building capacity of the end-users, the farmers. A full technical team composed of Irrigation Engineer, Agronomist, Electro-Mechanical, and an Officer in charge of Water User Organization is based at each scheme to build capacity of farmers in OMM.

Besides, GFI was adopted by the GoR to support the CIP program and thus, to improve farmers' food security. To the development budget of GFI, in addition, MINAGRI supports the OMM of these irrigation schemes with about 700 Million per year.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

In order to sustain the development, MINAGRI has started to engage the private sector in the OMM of the irrigation scheme – for instance, starting from the next season 2016A, Matimba and Kagitumba schemes will be private OMM through a sub-leasing contract agreement between the KABOKU Cooperative and WildFig and CDI companies. While waiting for a private company to operate and manage the Nasho irrigation scheme, MINECOFIN has to create a separate budget line on OMM to support the investment done.

5.20. Lack of maintenance records and procedures manual for hillside irrigation schemes

Maintenance is the act of keeping assets in an acceptable condition or at a prescribed level of performance. It includes preventive maintenance, emergency repairs and replacement of parts or components and other activities needed to preserve the asset so that it continues to provide acceptable services and achieves its expected useful life.

The guiding instrument for all maintenance activities is a maintenance policy that provides for different types of maintenance to be carried out, the scheduled maintenance routine, and the different procedures to follow. It also defines the terms used, describes the decision making process governing the assignment of maintenance priorities, the selection of cost benefit analysis processes and quality assurance.

During the audit I noted that each equipment used in the irrigation scheme has a manufacturer's manual that provides guidance on the operation of the equipment. However, both irrigation schemes have not developed an internal maintenance policy and procedures manual to guide all maintenance activities. In addition, no maintenance schedules highlighting scheduled maintenance dates were drawn up to guide the technicians involved in maintaining the machinery to ensure that all required maintenance work was actually carried out.

The lack of formal maintenance policy and procedures manual coupled with lack of maintenance schedules leads to lack of guidance and coordination of maintenance activities. This creates a risk that important maintenance procedures may be skipped resulting into failure of major equipment with a consequence that expensive major overhauls are needed to return the machine to serve.

Recommendations

The task force should:

- Put in place a maintenance recording register to hold all maintenance records as required by manufacturers' manuals.
- Draw up a maintenance schedule showing all scheduled maintenance works.
- Ensure that all maintenance personnel comply with the provisions of the maintenance manual and maintenance schedule. This will guide them in undertaking maintenance in an efficient

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

and effective manner.

Management comment

Agreed. The idea of maintenance procedure manual is the most welcome.

5.21. Poor access to markets for finished produce of the farms

Easy access to markets is crucial for farmers to sell their produce (especially perishable produce) timely whenever they are ready for harvest. Easy access allows transporting farm produce to areas where demand is high to enable the farmers fetch higher prices for their produce and minimise the risk of the produce going bad.

However, during the audit field visit, we noted that the Matimba irrigation scheme is located far from the main road and the access road is in poor condition. This negatively impacts on the ability of traders to access the irrigation scheme and consequently the farm produce. We noted cases where cabbages and eggplants produced in Matimba irrigation scheme were ready for market but there were no ready buyers due to poor road network from the main road leading to the irrigation scheme.



Cabbages ready for harvest but there are few buyers due to poor road network from the main road to the irrigation scheme. Photo taken on 28th January 2015

Poor road access to the irrigation scheme does not allow farmers to realise better prices for their farm produce.

Recommendation

The Task force in collaboration with Nyagatare district and WUAs should improve access to

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

markets of farm produce from the irrigation scheme. This could be done either by farmers themselves improving the condition of the road using community work (“*umuganda*”) or by requesting the district to commence road rehabilitation works to improve the entire road network in the irrigation scheme.

Management comment

The recommendation has started to be implemented through involvement of NEAB, RGCC, Eastern Africa Exchange, DSM-CHAI, etc, where the cooperatives under the irrigation schemes signed supply agreement with these companies.

Besides, it is planned in the next fiscal year to build storage facilities of cereals and grains, but also for perishable vegetables like cold rooms and warehouses.

5.22. Lack of spare parts for irrigation and mechanisation equipment

The value of any spare part is not what is spent on the cost of the actual component²⁹. What matters is the dramatic savings in time and money from having the part available. It is worthwhile to spend a few thousand Francs on a part that will save you millions of Francs in lost time. Normally, in order to sustain the project, spare parts for all irrigation and mechanisation equipment need to be available on local markets. Availability of these spare parts prevents extended break downs that can negatively impact the crop production process.

However, during the audit I noted the following:

Irrigation equipment: In the Nasho irrigation scheme, I noted that there is a challenge of getting spare parts on the local market in case they are needed. In case spare parts are needed, they are ordered and imported by MINAGRI from France. Since management of the scheme operations will eventually be handed over to the WUAs, it will be difficult for them to import such spare parts from Europe. There is a high risk that absence of such spare parts could lead to failure of this irrigation scheme once ownership is transferred to the WUAs.

Mechanisation equipment: Regarding mechanization equipment, I noted that once tractors breakdown, they take long to get repaired. This is due to lack of spare parts within the country. This has resulted into a situation whereby tractor mechanics repair tractors using parts from other grounded tractors³⁰. Lack of spare parts on the market will make it difficult for potential buyers to purchase the equipment well knowing that in case of repairs, spare parts are not readily available on the local market.

²⁹ <http://www.ahs1.com/news/whitepapers/139-the-importance-of-spare-parts>

³⁰ This case happened on 11th March 2014, when tractor Mahindra, plate no. GR 363D had a problem of leakage on the fuel tank, and the technician resolved the problem by replacing that piece by another one from another tractor. Another example is the replacement of a drake chain from tractor plate number GR 365D to GR 377D which took place on 27th January 2014.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Recommendation

The Task force should ensure that a sufficient number of high turnover spare parts are readily available for both irrigation and mechanisation equipment. This will ensure that key irrigation and mechanisation activities are not derailed due to lack of spare parts.

Management comment

The recommendation has been started to be implemented; whereby, private service providers through MoUs signed with MINAGRI to supply Small Scale Irrigation kits in various Districts, they could also sell and distribute other irrigation equipment and spares needed by farmers at the large scale schemes.

On the other side, MINAGRI has signed MoUs with various Mechanization dealer companies like VAC, SBTC Ltd., NISSI, V.S.T. Tillers & Tractors, ETC Agro-Mahindra, etc, to offer mechanization services in the country, but also to sell spare parts on sold farm machineries.

5.23. Weaknesses in maintenance of the center pivot sprinkler irrigation system

For the centre pivot irrigation system to work efficiently and effectively, water needs to flow unimpeded throughout the machinery, especially the filtration nozzles. This can be achieved through two ways. The first is by filtration of water supplied to the nozzles from the reservoir dam. This is meant to trap particulate matter (that can cause blockage) before it reaches the nozzles hence maintaining smooth flow of water. The second is by cleaning (flushing) the nozzles during pre-season to remove any embedded particulate matter that have found their way to the nozzles³¹. This procedure ensures that the centre pivot uniformly distributes water throughout the area under irrigation.

However, during the audit I noted the following:

Filtration: The pumping station does not have a filtration system. This implies that particulate matter finds its way into the nozzles of the centre pivot hence blocking some of the nozzles. This leads to non-uniform distribution of water during irrigation. This problem is exacerbated by the design of the reservoir dam that is made of compacted soil instead of concrete. The soil material carries a risk of slowly seeping into the center pivot nozzles hence contributing to the blockage noted above.

Cleaning of nozzles: I observed that during the irrigation process, water was flowing from sprinkler nozzles in a non-uniform manner. This was an indication that the nozzles are not cleaned regularly. Consequently, some crops were irrigated with less water compared to others. This carries risk of some crops not receiving adequate water supply. Refer to the photo below showing irregular distribution of irrigation water resulting from poor maintenance of the system.

³¹ Valley, Single Span Engine Drive Pivot Owner's Manual, Maintenance Schedule, pge 99



The irrigation water is not uniformly distributed with risk that some crops do not receive adequate water supply. Photo taken at Matimba irrigation scheme on 28th January 2015.

Recommendations

Filtration: The task force should ensure that the reservoir is cleaned every 60 days in line with the contractor's recommended schedule of maintenance.

Cleaning of nozzles: The Task force should ensure that all nozzles are cleaned (flushed) before start of the planting season. This will ensure that all particulate matter are removed to facilitate uniform distribution of water to all crops.

Management comment

The recommendation is noted and it will be implemented, especially on doing close supervision and follow up.

5.24. Inefficient drip irrigation system

Drip irrigation, also known as trickle/ micro/ localized irrigation, is an irrigation method that saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters. It

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

is done through narrow tubes that deliver water directly to the base of the plant.

In order to be efficient³², a drip system must apply water uniformly throughout the crops. This is accomplished by having little variation (high emission uniformity) in flow rate among drippers (i.e. holes in the irrigation tubing where water flows from the pipe to plant roots).

However, we noted that the installed drip irrigation network in Matimba irrigation scheme was not efficiently irrigating crops as some drippers were damaged causing water to be sprayed as if it were a sprinkler. This results into some areas of the farmland being clogged with water while others are not supplied with sufficient water. This consequently results in poor crop yields in some parts of the farmland. See details in the photos below.



Parts of the farmland are flooded due to excessive flow of water. Photo taken at Matimba irrigation scheme on 28th January 2015.

³² Drip Irrigation Must Apply Water Uniformly to be Efficient, *Bill Peacock and Dale Handley* or click on <http://cetulare.ucanr.edu/files/82036.pdf>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Some drippers have very high flow rates and behave like sprinklers. This leads to non-uniform flow of water in the farmland. Photo taken at Matimba irrigation scheme on 28th January 2015.

The scheme agronomist explained to the audit team that the reason for such failures is due to the mismatch between the manufacturer's spacing of drippers in the irrigation tubing and the needs of the farmers. The irrigation tubing comes with a spacing of 180 cm between each dripper. However this spacing is large compared to the recommended spacing for crops grown in the irrigation scheme. The crops grown are tomatoes and maize that require a spacing of 100 cm and 70 cm respectively. This resulted in a scenario where a number of tomatoes and maize in the planting line did not have access to water for irrigation. As a temporary solution, the farmers manually inserted holes in the tubing to create additional dripper points. During this exercise, drippers of larger diameter than required were created resulting in the effects highlighted above.

Recommendation

The task force should support farmers by installing tubing that contains drippers with adequate spacing to support the type of crops grown locally in Matimba irrigation scheme.

Management comment

Drip laterals are very sensitive to the risk of damages including rat, clogging of emitter and weather treat which makes them to be handling with much care. Farmers do not have enough skills in drip system for vegetable production, hence, demonstration on various crops is being undertaken on various crops.

Yet the system was designed for banana, a plan for banana plantation is being negotiated with cooperatives under drip irrigation system.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

5.25. Hydrants not properly regulated

Irrigation of crops by hydrant is one of the methods of water delivery used in a pressurized irrigation system³³. The water is delivered to the field plots direct from the main or sub-main pipelines through the hydrants. This device is equipped with a shut-off valve that can be opened to allow delivery of water (irrigation) to adjacent farmland and can be turned off to stop delivery of water when irrigation is no longer needed³⁴.

Matimba irrigation scheme has installed irrigation hydrants in addition to sprinklers and centre pivot systems. However, during the field visit of Lot 5 of Matimba irrigation scheme, we noted a case of an irrigation hydrant that was left unlocked and unattended to leading to flooding of adjacent farmland containing tomatoes that were ready for harvesting. As shown in the photo below, this particular case resulted from a farmer who forget to close the water hydrant on his parcel of land in the irrigation scheme. This behaviour carries a risk of accidental flooding of farmland in case the irrigation section for hydrants is opened in the farmers' absence.



Uncontrolled irrigation is bad for crops. As shown above, mature tomatoes are easily spoilt by excess water. Photo taken at Matimba irrigation scheme on 28th January 2015.

When excess amounts of water are applied to farmland, this leads to waterlogging, increased cases of soil erosion, reduced plant vigor, greater incidence of diseases and consequently leads to poor crop yields.

³³ Pressurized irrigation methods

³⁴ BERMAD Irrigation, Principle of Operation, 900-D Series <http://www.bermad.com/Data/Uploads/IR-Engineering%20900-D.pdf>

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT



Shown above is the Site irrigation coordinator trying to close off the irrigation hydrant after we found it flooding the tomato farmland. Photo taken at Matimba irrigation scheme on 28th January 2015.

Recommendation

To facilitate adequate supply of water to plants (neither too little nor excess supply), the irrigation hydrants need to be properly regulated with adequate safeguards (for example using a padlock system) to ensure that the water nozzles are not accidentally left open hence reducing the risk of flooding farmland.

Management comment

The recommendation is noted and it will be implemented.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

6. CONCLUSION

The Task force was established to spearhead and drive implementation of government's set targets for agricultural productivity. I acknowledge the progress made by the Task force in contributing to overall increase in agricultural production in the country. However, I noted the following:

Strategies and procedures for managing the utilization and maintenance of equipment used in mechanization activities - The Task force developed appropriate strategies, procedures and guiding documents for managing the utilization and maintenance of equipment used in mechanisation activities at strategic and operational levels. However, as shown below, a number of weaknesses were noted during implementation of mechanisation activities.

Utilization, monitoring and maintenance of mechanisation equipment - Generally the equipment under use by the Task force (including caterpillars, tractors, power tillers, and various tractor and power tiller attachments) have been underutilized. In addition, the Task force purchased a significant number of power tiller trailers, potato harvesters and various attachments but these have never been put to use and are lying idle at Kabuye workshop. For equipment in operation, their movements, utilization (in terms of hectares tilled) and fuel consumed are not adequately tracked. Furthermore, the Task force continues to register increasing numbers of broken down equipment due to significant delays in carrying out repairs. There is no value for money spent in procuring machines that are not put to use and hence the Task force is at risk of not achieving the target of mechanizing 25% of farm operations by the year 2017.

Operational and maintenance plan for the sustainability of irrigation infrastructure - To ensure the sustainability of irrigation infrastructure, the irrigation management transfer agreement should have been signed to transfer responsibility for operation and maintenance of irrigation infrastructure to the water users. However, this has not happened to date. Furthermore regarding hillside irrigation no maintenance policy and procedures manual has been developed to guide all maintenance activities. This implies that the sustainability of the irrigation schemes is in doubt.

Utilization, monitoring and maintenance of irrigation infrastructures - The equipment used in hillside irrigation is new and generally is functioning well. However some weakness noted include lack of readily available spare parts and an inefficient drip irrigation system. Regarding marshland irrigation infrastructures I noted cases where infrastructure were constructed but were not operational while others were left incomplete. Some water users did not operate the infrastructure as intended resulting into bursting of river banks and hence over flooding of the farmland. Numerous cases were noted where the irrigation infrastructure were not properly maintained resulting into overgrowth and blockade of the canals while cases were also noted where the irrigation farmland was converted into mining sites. There is no value for money for irrigation infrastructure built but is not used or is used incorrectly. The Task force is at risk of not achieving set irrigation targets.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

7. RECOMMENDATIONS

In view of the above highlighted shortcomings, it is recommended that:

7.1. Mechanization

- Going forward the task force should carry out detailed feasibility studies highlighting cost benefit analyses before committing to procure such expensive capital items. The analyses should include the comparison of hiring such equipment from private players to perform specific tasks whenever needed vis a vie outright purchase. This will save taxpayers from unnecessary expense.
- The task force should either dispose these machines by selling them to private players in order to realise some value rather than leaving them to lay idle or transfer them to another government agency where they could be put to active use.
- The Task force should regularly service the tractors and power tillers at the due date as stipulated in the manufacturers' operating manual in order to minimise the rate of breakdowns.
- The task force management should promptly repair all broken down tractors and power tillers to minimise time spent in the garage. This will increase the number of tractors and power tillers available for deployment.
- The Task force should increase awareness by increasing the level of extension services in order to increase demand for tractor services.
- The task force supervisory staff should ensure that all tractor and power tiller logbooks are updated on a daily basis with a record showing the movements and fuel consumed. This will facilitate monitoring tractor and power tiller movements on a regular basis and ensure they are well utilized.
- The task force should comply with the manufacturers' manuals to provide adequate safeguards to tractor operators by immediately mounting the ROPS to their corresponding tractors. This will help minimise the risk of injury or death in case of rollover during operation of the tractors.
- Tractors and their attachments should be parked/stored in a protective area to safeguard them against humidity, sunlight and rain in order to ensure a longer and productive life of the asset.
- The task force and all entrusted users should handle all equipment with due care and carry out regular maintenance of tractors and their respective attachments on timely basis in accordance with the maintenance schedules as highlighted in the manufacturers' manuals.
- Going forward, equipment should only be purchased after conducting a thorough feasibility study to assess how the equipment directly contributes to solving the actual needs of Rwandans.
- MINAGRI and the task force should immediately put power tiller trailers and potato harvesters to their intended purpose or seek to hire them out at a fee or out rightly sell them to recoup the money invested.
- Continued efforts should be made by MINAGRI and the task force to finalise negotiations with Tong Yang Moolsan Co. Ltd and ensure that the joint venture agreement is signed to

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

commence operations of a Power Tillers Assembly Plant.

7.2. Marshland irrigation

- The task force should rehabilitate all marshland irrigation structures to restore them to a usable state to benefit farmers in the respective marshlands.
- The task force should liaise with the WUAs and educate them on the benefits of correctly operating the installed irrigation infrastructure. The task force should also enforce proper operation of these infrastructure.
- The Task force should seek assistance from Gasabo district in preventing businesses from discharging mud into “umurindi” river. This will enable Jabana marshland to get water free of mud and allow for unimpeded irrigation of the rice fields.
- The task force should prepare and implement a rehabilitation plan for all infrastructures to ensure that all they are in good working condition to achieve the intended objectives.
- The task force in liaison with local leaders should reclaim farmland converted to mining sites to ensure that this practice is stopped with immediate effect. Furthermore, the Task force should apply stiff penalties to private prospectors who destroy public infrastructure as a deterrent against further destruction of farmland.
- MINAGRI and the task force should comply with the Ministerial Order in place and design appropriate IMTAs for each IWUA and transfer the ownership of these infrastructure to ultimate users. The transfer should happen after the IWUAs have been given appropriate training on how to operate and maintain these infrastructures. Hence, through DISC and SISC, local government will be responsible for the management of the schemes and their role will be significant.

7.3. Hillside irrigation

- The task force should work closely with the equipment manufacturer to help farmers employ international best practices for farming under irrigation to improve yields above 7 tonnes per Ha in order for the project to be profitable and sustainable.
- The task force should advise farmers to be organised in cooperatives and add value to the produce before sale and also directly accessing markets using their own transport network instead of selling at farm gate to middlemen.
- The task force should advise farmers to go into growing higher value crops instead of low value staples like maize.
- The task force should develop a well-articulated maintenance policy and procedures manual for hillside irrigation equipment.
- The task force should draw up a maintenance schedule showing all scheduled maintenance works.
- The task force should ensure that all maintenance personnel comply with the provisions of the maintenance manual and maintenance schedule. This will guide them in undertaking maintenance in an efficient and effective manner.

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

- The task force should purchase appropriate insurance policies for hillside irrigation equipment as well as other insurable assets under its control.
- The Task force in collaboration with Nyagatare district and WUAs should improve access to markets of farm produce from the irrigation scheme. This could be done either by farmers themselves improving the condition of the road using community work (“*umuganda*”) or by requesting the district to commence road rehabilitation works to improve the entire road network in the irrigation scheme.
- The Task force should ensure that a sufficient number of high turnover spare parts are readily available for both irrigation and mechanisation equipment. This will ensure that key irrigation and mechanisation activities are not derailed due to lack of spare parts.
- Filtration: The task force should ensure that the reservoir is cleaned every 60 days in line with the contractor’s recommended schedule of maintenance.
- Cleaning of nozzles: The Task force should ensure that all nozzles are cleaned (flushed) before start of the planting season. This will ensure that all particulate matter are removed to facilitate uniform distribution of water to all crops.
- The task force should support farmers by installing tubing that contains drippers with adequate spacing to support the type of crops grown locally in Matimba irrigation scheme.
- To facilitate adequate supply of water to plants (neither too little nor excess supply), the irrigation hydrants need to be properly regulated with adequate safeguards (for example using a padlock system) to ensure that the water nozzles are not accidentally left open hence reducing the risk of flooding farmland.

APPENDICES

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Appendix 1: Key Documents reviewed

Nº	Documents reviewed
1	Agricultural Mechanization strategy, 2013
2	EDPRS 1 and 2
3	RAB strategic Plan 2013-2018
4	New Times dated February 13, 2013, in its article entitled “Farmers ask for more tractors”
5	Minagri annual activity report 2010-2011
6	Minagri annual activity report 2011-2012
7	The National Budget - A Citizen’s Guide 2013-2014
8	Agriculture Mechanization Extension in Rwanda, Final report, 2013.
9	Strategic Plan for the Transformation of Agriculture in Rwanda – Phase II (PSTA II)
10	Strategic Plan for the Transformation of Agriculture in Rwanda Phase III, July 2013
11	Power tiller business plan and feasibility Study
12	Rwanda Irrigation Policy, 2014
13	Mission Agriculture Mechanization Extension in Rwanda (1st Quarter Report)
14	Mission Agriculture Mechanization Extension in Rwanda (2nd Quarter Report)
15	Mission Agriculture Mechanization Extension in Rwanda (3rd Quarter Report)
16	Mission Agriculture Mechanization Extension in Rwanda (Final Report)

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Appendix 2: Details of the people interviewed

N°	Names	Responsibility
I.	Task force	
	Nizeyimana Innocent	Chairman of the Task force
II.	Nasho hillside irrigation schemes	
	Calvalho Sylvestre	Hillside project electro-mechanical engineer
	Hitayezu Jerome	Hillside project irrigation engineer
	Ntawukuriryayo Pierre	Hillside projects agronomist
	Nyirinkindi Jean Damascene	President of COVAMIS cooperative in Nasho schemes
III.	Nyagatare hillside irrigation schemes	
	Cyiza Vedaste	GFI site coordinator
	Musabeyezu Francine	Hillside project Electro-mechanical engineer
	Ibanga Aimable	GFI site Agronomist
	Mukarusagara Grace	Hillside project irrigation engineer
	Ntezeyombi Ngabo	WUA manager lot 4
	Ngabonziza Emmanuel	WUA manager lot 5
IV.	WUAs	
	Niyongana Vincent	President of WUA Tujye heza-Nyiramageni
	Ndagijimana Fidele	Vice-president of WUA Tujye heza-Nyiramageni
	Nikuze Epiphane	Chief Accountant of WUA Tujye heza-Nyiramageni
	Habyarimana Philbert	President of WUA Tuyasaranganye-Budubi
	Nteziryayo Simeon	Internal auditor of WUA Tuyasaranganye-Budubi
	Dushimirimana Emmanuel	Scheme manager of Budubi marshland
	Ntakirutimana Theodor	President of WUA Tuyakwirakwize-Migina
	Ntihabose Cleophas	Scheme manager of Migina marshland
	Hitimana Vincent	President of WUA Twuzuzanye-Gatare

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

N°	Names	Responsibility
	Mbanjeneza Isaac	COPRORIZ manager
	Uwizeyimana Jean Damascene	In charge of infrastructures in WUA
	Iryivuze Marie claire	President of WUA Tuyabungabunge-Nyabuyogera
	Nsanzumuhire Gabriel	Ex-president of WUA Tuyabungabunge-Nyabuyogera
	Manirareba Antoine	Village leader of Gahora village in Nyabuyogera
	Kampayire Maurice	President of WUA Abuzuzanya-Mukura
	Habanzintwali Dennis	Scheme manager
	Munyantore Callixte	President of WUA Tuyabyazumusaruro-Ruboroga
	Karangwa Francois	Ruboroga marshland scheme technician
	Nshimiyimana Emmanuel	WUA accountant
	Nzabanita Jean Bosco	President of zone I in CODEPRAG Ishema ry'abahinzi
	Ntaribi Samuel	President of Cooperative IMPABARUTA in Rwabashyashya marshland
	Mukaruzindana Dorothee	President of WUA Twongerumusaruro-Bishenyi
	Rwaka Dusingize Devotha	Scheme manager and agronomist of Bishenyi marshland
	Bikorimana Janvier	President of WUA Tuyasaranganye-Gikoro
	Kanyemera Jacques	President of zone I in COALEKA
	Gahutu Ignace	President of CORIKA
	Mujawayezu Alexia	President of WUA Tuyuhize-Nyagisenyi-Rufigiza
V.	VMSC	
	Mukeshimana Venuste	Ngoma-Bugesera VMSC manager
	Nsengayire fabrice	Tractor operator in Ngoma VMSC
VI.	Districts	
	Mutesi Jean Pierre	Nyanza district agronomist

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Appendix 3: Asset register of tractors and other agricultural machineries

Nº	District	No. of Marshland projects	No. of Hillside projects	No. of tractors	Combine harvesters	Tractors attachments	Agricultural Mobile Workshop	Earth Moving Machinery	Power Tillers	Power Tillers 12HP	New Iron Wheels for PT 12HP	New Iron Wheels for PT 15HP	Potato harvesters	Trailers for Power Tillers	Rice	Irrigation Water Pumps	Power Tiller Water Pumps	Power Tiller Sprayer Pumps
1	Gisagara	7																
2	Huye	5																
3	Gasabo	3		77	2	205	2	3	20	104	206	74	51	152	13	16	44	47
4	Kamonyi	4																
5	Nyagatare		3													2		
6	Kirehe		1														2	
7	Rulindo	1																
8	Nyanza	2		2		10			1	2	4	2	1	3			1	1
9	Rusizi	1																
10	Nyamagabe	2																
11	Nyamasheke	3																
12	Ruhango	1								1						3	1	
13	Musanze-Gakenke	1		1						1	2		1	1			2	1
14	Muhanga	1																
15	Nyaruguru	1																
16	Bugesera	1		11		19		1			8					1		
17	Ngoma			2		3				1				1		1	1	1
18	Rwamagana																	
19	Gatsibo																	
20	Kayonza							1										
21	Gicumbi																	
22	Karongi													2			8	8
	Total	33	4	93	2	237	2	5	21	109	220	76	53	159	13	23	59	58

Source: Task Force Asset Register, January 2015

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Appendix 4: Roles and responsibilities of key players of the Task force

Key player	Roles and responsibilities
Ministry of Agriculture (MINAGRI)	<ul style="list-style-type: none"> ● Parent ministry of the task force ● Sets policy direction ● Provides budget for the activities of the Task force
District local governments	<ul style="list-style-type: none"> ● Co-sign the Irrigation Management Transfer Agreement (IMTA) with IWUAs and MINAGRI. ● Assuring the overall management of WUAs belonging to the District ● Monitoring and evaluation of the WUAs ● Heads the District Irrigation Steering Committee (DISC). The DISC has to fulfil following responsibilities: <ul style="list-style-type: none"> ● Provide technical and managerial support to WUAs ● Financial audit of WUAs ● Monitor and evaluate the operation and maintenance of all irrigation infrastructures within the District ● Share and coordinate responsibilities between different stakeholders operating in irrigation schemes within the District ● Coordinate the implementation of the land lease and management agreements, the water permit, the irrigation management transfer agreement ● Draft and evaluate, every growing season, the performance contract between the district and the WUA ● Draft and evaluate, every growing season, the performance contract between the WUA and the cooperative ● Resolve any differences of opinion between the WUA and the cooperative ● Approval of the WUA annual plans and budgets ● Approval of the WUA annual activities and financial reports ● Any other responsibility specified in internal regulation of the committee
Irrigation Water Users Associations (IWUAs)	<p>Assuring operation and maintenance of irrigation schemes. Specifically WUAs should:</p> <ul style="list-style-type: none"> ● ensure full participation of all members in all its activities ● ensure full transparency of all its accounts to all water users by giving full access to all documents

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Key player	Roles and responsibilities
	<ul style="list-style-type: none"> ● ensure decision making is fair and democratic ● ensure that all water users receive their fair share of water in time ● minimize waste of water ● promote the use of new techniques and technologies for raising yield per unit of water ● avoid erosion, salinization, overwatering and control flooding ● ensure members maintain the fertility of the soil and protect the environment ● Respect the rights and legal interests of all owners and all users of the scheme
KWAMP Project	<p>Following the MOU signed between KWAMP Project and the Task force for the period of 2011 to 2014, the project committed to:</p> <ul style="list-style-type: none"> ● support the establishment of WUA unit within the Task force ● provide financial and technical support to the implementation of the policy of transferring management of irrigation schemes to WUAs under the Agreed Annual Work Plan and Budget (AWPB)

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Appendix 5a: List of TYM tractors

Nº	Tractor	Plate number	Purchase date (A)	Hours worked ^a (B)	Audit verification date (C)	Days worked (based on 8 hour day) D = B/8	Days in service (E = C-A)	Years in service (F =E/365)	Average days worked per year (G = D/F)
1	T1003	GR 265 D	01-Aug-11	1,716	19-Dec-14	214.5	1,236	3.4	63
2	T1003	GR 175 D	01-Aug-11	1,481	19-Dec-14	185.14	1,236	3.4	55
3	T353	GR 393 D	01-Aug-11	665	19-Dec-14	83.15	1,236	3.4	25
4	T503NCRW	GR 129 D	01-Aug-11	839	19-Dec-14	104.89	1,236	3.4	31
5	T353NCNZT	GR 399 D	01-Aug-11	260	06-Feb-15	32.44	1,285	3.5	9
6	T1003	GR 262 D	01-Aug-11	1,615	06-Feb-15	201.89	1,285	3.5	57
7	T503NCRW	GR 125 D	01-Aug-11	1,066	06-Feb-15	133.29	1,285	3.5	38
8	T353	GR 396 D	01-Aug-11	247	19-Dec-14	30.91	1,236	3.4	9
9	T503NCRW	GR 124 D	01-Aug-11	1,536	12-Feb-15	191.96	1,291	3.5	54
10	T353NCRW	GR 121 D	01-Aug-11	355	09-Feb-15	44.43	1,288	3.5	13
11	T353NCRW ⁺⁺⁺	GR 112 D	01-Aug-11		19-Dec-14	-	1,236	3.4	
12	T503NCRW	GR 130 D	01-Aug-11	1,764	09-Feb-15	220.5	1,288	3.5	62
13	T1003	GR 179 D	01-Aug-11	956	19-Dec-14	119.46	1,236	3.4	35
14	T503NCRW	GR 057 D	01-Aug-11	1,193	19-Dec-14	149.13	1,236	3.4	44
15	T353NCRW	GR 122 D	01-Aug-11	168	19-Dec-14	21	1,236	3.4	6
16	T353NCRW	GR 123 D	01-Aug-11	129	19-Dec-14	16.13	1,236	3.4	5
17	T353NCRW	GR 053 D	01-Aug-11	326	19-Dec-14	40.76	1,236	3.4	12
18	T353NCRW	GR 259 D	01-Aug-11	171	19-Dec-14	21.4	1,236	3.4	6
19	T353NCRW	GR 119 D	01-Aug-11	173	19-Dec-14	21.63	1,236	3.4	6
20	T353NCRW	GR 117 D	01-Aug-11	208	19-Dec-14	26	1,236	3.4	8
21	T353NCNZT	GR 909 C	07-Nov-09	517	19-Dec-14	64.63	1,868	5.1	13
22	T353NCNZT	GR 059 D	07-Nov-09	332	19-Dec-14	41.45	1,868	5.1	8
23	T503NCRW	GR 133 D	01-Aug-11	784	19-Dec-14	98	1,236	3.4	29

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Nº	Tractor	Plate number	Purchase date (A)	Hours worked ^a (B)	Audit verification date (C)	Days worked (based on 8 hour day) D = B/8	Days in service (E = C-A)	Years in service (F =E/365)	Average days worked per year (G = D/F)
24	T503NCNZT	GR 969 C	07-Nov-09	896	19-Dec-14	112	1,868	5.1	22
25	T503NCNZT	GR 260 D	07-Nov-09	1,217	19-Dec-14	152.13	1,868	5.1	30
26	T503NCRW	GR 134 D	01-Aug-11	1,103	19-Dec-14	137.88	1,236	3.4	41
27	T503NCRW	GR 131 D	01-Aug-11	810	19-Dec-14	101.25	1,236	3.4	30
28	T603STNZT	GR 908 C	07-Nov-09	853	19-Dec-14	106.58	1,868	5.1	21
29	T 603	GR 184 D	12-Jan-12	590	19-Dec-14	73.76	1,072	2.9	25
30	T 603	GR 182 D	12-Jan-12	631	19-Dec-14	78.86	1,072	2.9	27
31	T 603	GR 183 D	12-Jan-12	848	19-Dec-14	105.94	1,072	2.9	36
32	T 603	GR 185 D	12-Jan-12	706	19-Dec-14	88.28	1,072	2.9	30
33	T 603	GR 188 D	12-Jan-12	687	19-Dec-14	85.9	1,072	2.9	29
34	T 603	GR 186 D	12-Jan-12	327	19-Dec-14	40.86	1,072	2.9	14
35	T 603	GR 187 D	12-Jan-12	695	19-Dec-14	86.85	1,072	2.9	30
36	T903STNZT	GR 970 C	07-Nov-09	512	19-Dec-14	64	1,868	5.1	13
37	T1003	GR 177 D	01-Aug-11	853	19-Dec-14	106.58	1,236	3.4	31
38	T503NCNZT	GR 910 C	07-Nov-09	1,385	19-Dec-14	173.13	1,868	5.1	34
39	T353NCRW	GR 113 D	01-Aug-11	455	19-Dec-14	56.89	1,236	3.4	17
40	T503NCRW	GR 055 D	01-Aug-11	973	19-Dec-14	121.63	1,236	3.4	36
41	T1003	GR 180 D	01-Aug-11	1,058	19-Dec-14	132.25	1,236	3.4	39
42	T1003	GR 261 D	01-Aug-11	1,253	19-Dec-14	156.6	1,236	3.4	46
43	T1003	GR 178 D	01-Aug-11	1,293	19-Dec-14	161.64	1,236	3.4	48
44	T1003	GR 176 D	01-Aug-11	1,049	19-Dec-14	131.08	1,236	3.4	39
45	T353NCRW	GR 118 D	01-Aug-11	311	19-Dec-14	38.83	1,236	3.4	11
46	T353NCRW	GR 050 D	01-Aug-11	219	19-Dec-14	27.33	1,236	3.4	8
47	T353NCRW	GR 120 D	01-Aug-11	223	19-Dec-14	27.89	1,236	3.4	8
48	T503NCRW	GR 056 D	01-Aug-11	909	19-Dec-14	113.58	1,236	3.4	34

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Nº	Tractor	Plate number	Purchase date (A)	Hours worked ^a (B)	Audit verification date (C)	Days worked (based on 8 hour day) D = B/8	Days in service (E = C-A)	Years in service (F =E/365)	Average days worked per year (G = D/F)
49	T353NCNZT	GR 051 D	07-Nov-09	548	19-Dec-14	68.53	1,868	5.1	13
50	T353NCRW	GR 116 D	01-Aug-11	761	19-Dec-14	95.06	1,236	3.4	28
51	T353NCRW	GR 054 D	01-Aug-11	644	19-Dec-14	80.44	1,236	3.4	24
52	T603STNZT	GR 052 D	07-Nov-09	567	19-Dec-14	70.88	1,868	5.1	14
53	T353	GR 395 D	01-Aug-11	117	19-Dec-14	14.59	1,236	3.4	4
54	T353	GR 394 D	01-Aug-11	264	19-Dec-14	32.94	1,236	3.4	10
55	T503NCRW	GR 132 D	01-Aug-11	903	19-Dec-14	112.85	1,236	3.4	33
56	T503NCRW	GR 128 D	01-Aug-11	1,042	19-Dec-14	130.25	1,236	3.4	38
57	T353	GR 263 D	01-Aug-11	186	19-Dec-14	23.29	1,236	3.4	7
58	T503NCRW	GR 126 D	01-Aug-11	164	19-Dec-14	20.44	1,236	3.4	6
59	T353	GR 264 D	01-Aug-11	490	19-Dec-14	61.29	1,236	3.4	18
60	T503NCRW	GR 127 D	01-Aug-11	1,516	09-Feb-15	189.5	1,288	3.5	54
61	T353NCNZT	GR 058 D	07-Nov-09	700	09-Feb-15	87.48	1,920	5.3	17
62	T 603	GR 181 D	12-Jan-12	828	09-Feb-15	103.5	1,124	3.1	34

+++ Tractor T353NCRW broke down in 2013 and could not be restarted to allow reading the hours worked

^a Hours worked by each tractor were obtained from the respective tractor dashboards

Appendix 5b: List of Mahindra tractors

Nº	Tractor	Plate number	Purchase date (A)	Hours worked (B)	Audit verification date (C)	Days worked (based on 8 hour day) D = B/8	Days in service (E = C-A)	Years in service (F =E/365)	Average days worked per year (G = D/F)
1	Mahindra 7030(PSMX)	GR 383 D	01-Jun-13	770	19-Dec-14	96.25	566	1.6	62
2	Mahindra 7030(PSMX)	GR 378 D	01-Jun-13	1,125	09-Feb-15	140.63	618	1.7	83
3	Mahindra 7030(PSMX)	GR 388 D	01-Jun-13	1,199	19-Dec-14	149.91	566	1.6	97
4	Mahindra 7030(PSMX)	GR 386 D	01-Jun-13	598	19-Dec-14	74.69	566	1.6	48
5	Mahindra 7030(PSMX)	GR 390 D	01-Jun-13	416	19-Dec-14	51.94	566	1.6	33
6	Mahindra 7030(PSMX)	GR 397 D	01-Jun-13	450	19-Dec-14	56.24	566	1.6	36

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

N ^o	Tractor	Plate number	Purchase date (A)	Hours worked (B)	Audit verification date (C)	Days worked (based on 8 hour day) D = B/8	Days in service (E = C-A)	Years in service (F =E/365)	Average days worked per year (G = D/F)
7	Mahindra 7030(PSMX)	GR 364 D	01-Jun-13	322	19-Dec-14	40.23	566	1.6	26
8	Mahindra 7030(PSMX)	GR 381 D	01-Jun-13	54	10-Feb-15	6.74	619	1.7	4
9	Mahindra 7030(PSMX)	GR 385 D	01-Jun-13	652	19-Dec-14	81.49	566	1.6	53
10	Mahindra 7030(PSMX)	GR 368 D	01-Jun-13	326	19-Dec-14	40.79	566	1.6	26
11	Mahindra 7030(PSMX)	GR 372 D	01-Jun-13	648	19-Dec-14	80.95	566	1.6	52
12	Mahindra 7030(PSMX)	GR 387 D	01-Jun-13	446	19-Dec-14	55.76	566	1.6	36
13	Mahindra 7030(PSMX)	GR 374 D	01-Jun-13	655	10-Feb-15	81.89	619	1.7	48
14	Mahindra 7030(PSMX)	GR 373 D	01-Jun-13	450	19-Dec-14	56.25	566	1.6	36
15	Mahindra 7030(PSMX)	GR 376 D	01-Jun-13	412	31-Oct-14	51.5	517	1.4	36
16	Mahindra 7030(PSMX)	GR 384 D	01-Jun-13	727	10-Feb-15	90.85	619	1.7	54
17	Mahindra 7030(PSMX)	GR 370 D	01-Jun-13	722	09-Feb-15	90.25	618	1.7	53
18	Mahindra 7030(PSMX)	GR 363 D	01-Jun-13	811	19-Dec-14	101.43	566	1.6	65
19	Mahindra 7030(PSMX)	GR 377 D	01-Jun-13	456	09-Feb-15	57	618	1.7	34
20	Mahindra 7030(PSMX)	GR 366 D	01-Jun-13	596	09-Feb-15	74.5	618	1.7	44
21	Mahindra 7030(PSMX)	GR 369 D	01-Jun-13	637	19-Dec-14	79.61	566	1.6	51
22	Mahindra 7030(PSMX)	GR 371 D	01-Jun-13	575	19-Dec-14	71.84	566	1.6	46
23	Mahindra 7030(PSMX)	GR 379 D	01-Jun-13	41	19-Dec-14	5.09	566	1.6	3
24	Mahindra 7030(PSMX)	GR 367 D	01-Jun-13	619	09-Feb-15	77.41	618	1.7	46
25	Mahindra 7030(PSMX)	GR 365 D	01-Jun-13	412	19-Dec-14	51.54	566	1.6	33
26	Mahindra 7030(PSMX)	GR 389 D	01-Jun-13	77	19-Dec-14	9.6	566	1.6	6
27	Mahindra 7030(PSMX)	GR 398 D	01-Jun-13	717	09-Feb-15	89.63	618	1.7	53
28	Mahindra 7030(PSMX)	GR 375 D	01-Jun-13	494	12-Feb-15	61.73	621	1.7	36
29	Mahindra 7030(PSMX)	GR 382 D	01-Jun-13	478	10-Feb-15	59.74	619	1.7	35
30	Mahindra 7030(PSMX)	GR 380 D	01-Jun-13	925	09-Feb-15	115.61	618	1.7	68

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Appendix 6: Maintenance schedule as stipulated by TYM and MAHINDRA Manufacturers

Component of the Tractor	1	2	3	4	5	6	7	8
MAHINDRA								
Engine	Oil and filter changed after first 100 h (and topped up if necessary) and every next 250 h	Torque cylinder head bolts and valve clearance are adjusted within a specified time frame of a 1,000 h	Injector pressure is checked and adjusted within a specified time frame of a 1,000 h	Radiator descaling is checked and adjusted within a specified time frame of a 1,000 h	Rubber clutch Gear Hydraulic Pump is checked and adjusted within a specified time frame of a 1,000 h			
Air cleaner	Air-cleaner connections are checked and tighten on every 250 h	primary element is cleaned in every 300 h	Safety cartridge is changed in every 900 h					
Fuel system	Water from fuel filters is drained within a period of every 15 days.	Primary filter element is changed in every 250 h or even before when necessary.	Secondary filter element is changed in every 500 h or even before when necessary.					

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Component of the Tractor	1	2	3	4	5	6	7	8
Cooling system	Water from fuel filters is drained within a period of every 15 days.	Primary filter element is changed in every 250 h or even before when necessary.	Secondary filter element is changed in every 500 h or even before when necessary					
Electrical system	Battery terminals is cleaned after a specified time frame of a 250 h	cooling system is checked(and replaced if necessary) after a specified time frame of 1000 h						
Transmission	Oil level is initially changed after 50 h (and Toped-up if necessary) and every 250 h for following times.	Fan belt tension was initially changed after 50 h (and adjusted if necessary) and every 250 h for following times	Transmission oil is changed after 1,000 h	Side shift and nipple are greased after every 250 h				
Hydraulic system	Suction filter is initially changed after 50 h (and	Steering wheel play is checked every 500 h	Toe-in is set every 500 h					

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Component of the Tractor	1	2	3	4	5	6	7	8
	Toped-up if necessary) and every 500 h for following times							
Front axle	Front axle oil level is changed every 250 h	front axle oil is changed after every 1,000 h						
TYM TRACTORS								
Tractors T353								
Engine	Oil and cartridge are changed every 100	Air cleaner is cleaned every 100 h and replaced every 200 h	Oil filter to be changed every 400 h	Radiator hose clamp is replaced every 2 years				
Chassis	Transmission oil is changed every 300 h after first 50 h	TF I&M consult the service dealer to make toe-in check up in every 300 h's intervals.	Front wheel hub is greased and adjusted every 300 h	Steering wheel joint is greased every 900 h	Throttle pedal is regularly adjusted and checked every 300 h	Hydraulic oil filter is changed every 300 h' time intervals	Oil of the 4WD front axle is checked every 100 h, changed every 600 h and/or replace it in case it leaks.	Electric wiring is checked every year.
Tractors T503								
Engine	Oil and cartridge is be changed every	Engine air cleaner is cleaned every	Oil filter is changed every 400 h and	Radiator hose clamp is replaced every				

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Component of the Tractor	1	2	3	4	5	6	7	8
	100h and recorded	100 h and replaced every 200 and recorded.	recorded	2 years and recorded.				
Chassis	Transmission oil is checked on daily basis and if transmission oil is changed every 500 h or 12 months after first 50 h	Toe-in check up in every 300h intervals	Front wheel hub is greased every 900 h	Radiator hose clamp is replaced every 2 years and recorded				
Tractors T603								
Engine	Oil and cartridge are be changed every 100h and recorded	Engine air cleaner is cleaned every 100 h and replaced every 200h and recorded	Oil filter is be changed every 400 h and recorded	Radiator hose clamp is be replaced every 2 years and recorded				
Chassis	Transmission oil is checked on daily basis and if transmission oil is changed every 500 h or 12 months after first 50 h	Toe-in check up in every 300h intervals	Front wheel hub is greased every 900 h	Steering wheel joint is adjusted every 300 h	Throttle pedal is regularly adjusted and checked every 300 h	Hydraulic oil filter is changed every 300 h time intervals	Oil of the 4WD front axle is checked every 100h, changed every 600 h and/or replace it in case it leaks	Electric wiring is checked every year

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Component of the Tractor	1	2	3	4	5	6	7	8
Tractors T903								
Engine	Oil and cartridge is changed every 100h and recorded	Engine air cleaner is cleaned every 100 h and replaced every 200h and recorded	Oil filter is be changed every 400 h and recorded	Radiator hose clamp is replaced every 2 years and recorded				
Chassis	Transmission oil is checked on daily basis and if transmission oil is changed every 500 h or 12 months after first 50 h	Toe-in check up in every 300 h intervals	Front wheel hub is greased every 900 h	Steering wheel joint is adjusted every 300 h	Throttle pedal is regularly adjusted and checked every 300 h	Hydraulic oil filter is changed every 300 h time intervals	Oil of the 4WD front axle is checked every 100h, changed every 600 h and/or replace it in case it leaks	Electric wiring is checked every year
Tractors T1003								
Engine	Oil and cartridge is changed every 100h and recorded	Engine air cleaner is cleaned every 100 h and replaced every 200h and recorded	Oil filter is changed every 400 h and recorded	Radiator hose clamp is replaced every 2 years and recorded				
Chassis	Transmission oil is checked on daily basis and if	Engine air cleaner is cleaned every 100 h and	Front wheel hub is greased every 900 h	Steering wheel joint is adjusted every 300 h	Throttle pedal is regularly adjusted and checked every	Hydraulic oil filter is changed every 300 h time	Oil of the 4WD front axle is checked every 100h, changed	Electric wiring is checked

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Component of the Tractor	1	2	3	4	5	6	7	8
	transmission oil is changed every 500 h or 12 months after first 50 h	replaced every 200 h and recorded			300 h	intervals	every 600 h and/or replace it in case it leaks	every year

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Appendix 7: Marshlands and Hillside irrigation infrastructure constructed by the Task force

7a: Marshlands irrigation infrastructure

Name of the marshland	District	Command Area (ha)	Construction period	Value (Frw)
Nyiramageni	Gisagara	180	2,011	180,000,000
Kibugazi	Gisagara	108	2,011	108,000,000
Mwura-Gatare	Gisagara	110	2,011	215,000,000
Nyabuyogera	Gisagara	109	2,011	109,000,000
Ruvugangoma	Gisagara	43	2,011	43,000,000
Migina	Gisagara-Huye-Nyaruguru	270	2,011	270,000,000
Umwaro	Huye	40	2,011	49,000,000
Mukura	Huye	125	2,011	125,000,000
Ruboroga	Kamonyi	130	2,011	130,000,000
Makera	Muhanga	100	2,011	100,000,000
Muzirantwago	Nyamagabe	72	2,011	72,000,000
Busogwe	Nyanza	102	2,011	102,000,000
Urwonjya	Nyaruguru	40	2,011	40,000,000
Nyirakiyange	Ruhango	117	2,011	117,000,000
NyagisenyiRufigiza	Kigalicity	204	2,011	204,000,000
Mugonero	Nyamasheke	50	2,011	56,000,000
Kibati	Nyamasheke	28	2,011	38,000,000
Nyagahembe	Nyamasheke	40	2,011	69,081,106
Bahimba	Rulindo	325	2,011	290,000,000
Rwondo	Nyamagabe	64	2,011	84,000,000
Bishenyi	Kamonyi	59	2013-2014	147,500,000
Gikoro	Kamonyi	86	2013-2014	198,763,340
Kajevuba	Gasabo	83	2013-2014	207,500,000
Budubi	Nyanza	151	2013-2014	147,205,000
Kanyegenyeye	Ruhango	137	2013-2014	192,035,088
Jabana	Gasabo	146	2,014	92,833,888
Nyaburiba	Bugesera	51	2,014	124,261,000
Agatare	Gisagara	59	2,014	88,500,000
Umusizi	Huye	51	2,014	137,769,897
Akaboti	Gisagara	76	2,014	130,821,061
Rwabashyashya	Kamonyi	59		59,000,000

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Name of the marshland	District	Command Area (ha)	Construction period	Value (Frw)
Mukinga	Musanze-Gakenke	108	2,014	184,253,040
Total		3,323		4,111,523,420

7 b: Hillside irrigation infrastructure

Item	District	Area(ha)	Amount (Frw)
Development of sprinkler systems in the valley of Nasho Lot1,2,3 (Pressurized sprinkler irrigation and gravity systems)	Kirehe	580	7,305,138,826
Development of sprinkler/ Micro Irrigation systems in the valley of Muvumba Lot4	Nyagatare	200	2,379,075,479
Development of sprinkler/Micro Irrigation systems in the valley of Muvumba Lot5	Nyagatare	200	2,477,402,729
Development of center pivot system in the valley of Akagera river	Nyagatare	500	4,289,356,857
Supervision of work relating to development of sprinklers irrigation systems at the coast of Cyambwe and Mpanga lakes (lots 1,2,3)	Kirehe		206,507,505
Supervision of work relating to the development of sprinkler irrigation systems in the valley of Muvumba Lot 5 and 4	Nyagatare		199,010,186
Supervision of work relating to the development of center pivot systems at the cost of Muvumba in Nyagatare District	Nyagatare		240,994,000
Total			17,097,485,582
Total 7.a + 7.b			21,209,009,002

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

Appendix 8: Cost benefit analysis for maize production in Matimba and Nasho irrigation schemes

A. Maize Production Cost with subsidies in Maize seed and Fertilizers (DAP and Urea)

N ^o	Activity	Area (ha)	Materials or equipment	Casual labour	Unit Price (Frw)	Total Price - Matimba irrigation scheme (Frw)	Total Price- Nasho irrigation scheme (Frw)
1	Bush Clearing	1					
2	First and second tillages	1	Tractors			95,000	74,500
3	Application of Organic Manure	1		15	1,000	15,000	-
4	Maize seed sowing	1		30	1,000	30,000	30,000
5	First weeding	1		30	1,000	30,000	30,000
6	Second weeding	1		30	1,000	30,000	20,000
7	Water fee	1				17,000	28,000
8	Pesticide application	1		10	1,000	10,000	-
9	Harvesting	1		50	1,000	50,000	100,000
10	Threshing and winnowing	1				20,000	-
11	Drying	1		10	1,000	10,000	-
12	Packaging	1		5	1,000	5,000	-
13	Manpower for irrigation (kuvomera)					-	20,000
14	Manpower					-	8,000
15	Contingency					-	20,000
Subtotal						312,000	330,500

B. Money paid for input and field value

N ^o	Item	Units	Quantity	Unit Price (Frw)	Total Price - Matimba scheme (Frw)	Total Price - Nasho scheme (Frw)
1	Maize Seeds(Hybrid PAN 4M21)	Kg	25	570	14,250	11,750
2	Organic Manure	Kg	10,000	10	100,000	135,000
3	Fertilizer-DAP	Kg	100	470	47,000	47,000
4	Fertilizer-Urea	Kg	50	410	20,500	20,500
5	Pesticide	Liter	10	5,000	50,000	24,000
6	Sheetings (Tool for drying)	pcs	2	12,500	25,000	62,500
7	Thresher machine (for threshing)	nbr	1	15,000	15,000	-
8	Bags (for packaging)	pce	40	200	8,000	7,000
9	Field value	ha	1		200,000	-
Subtotal					479,750	307,750

**PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION
AND MECHANIZATION EQUIPMENT**

N°	Item	Units	Quantity	Unit Price (Frw)	Total Price - Matimba scheme (Frw)	Total Price - Nasho scheme (Frw)
	Total				791,750	638,250

PERFORMANCE AUDIT OF UTILIZATION AND MAINTENANCE OF IRRIGATION AND MECHANIZATION EQUIPMENT

Appendix 9: Organization chart of the Task force

