Technical Assistance in Environment and Natural Resources Management

Final Report

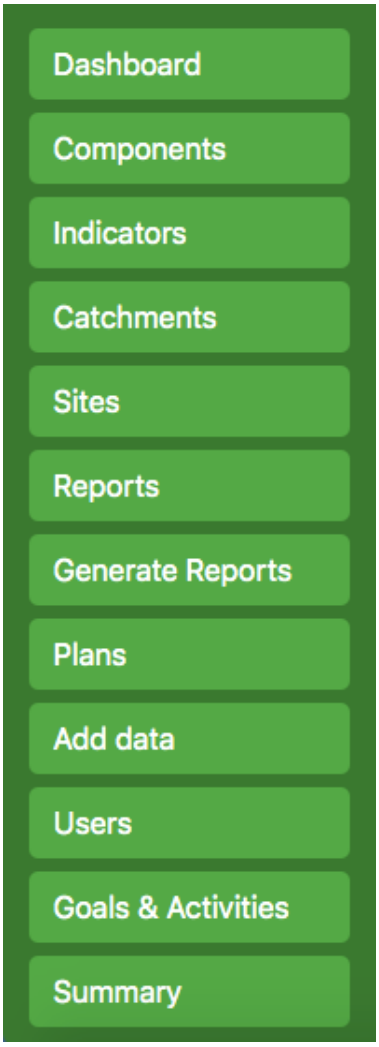
Catchment Monitoring & Evaluation System

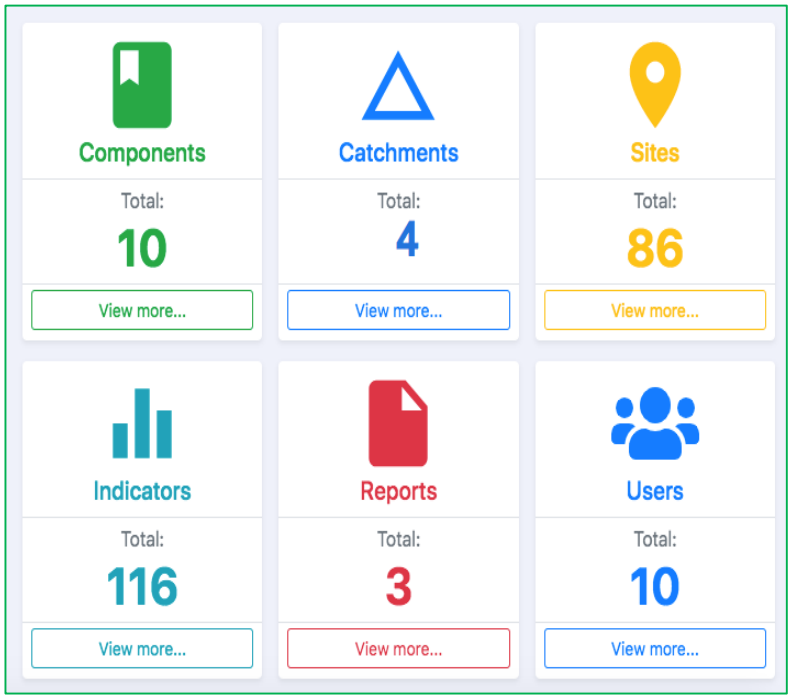
M&E TOOL

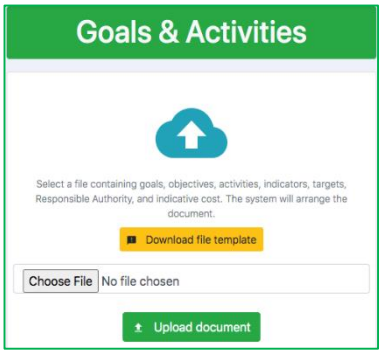
October, 2020

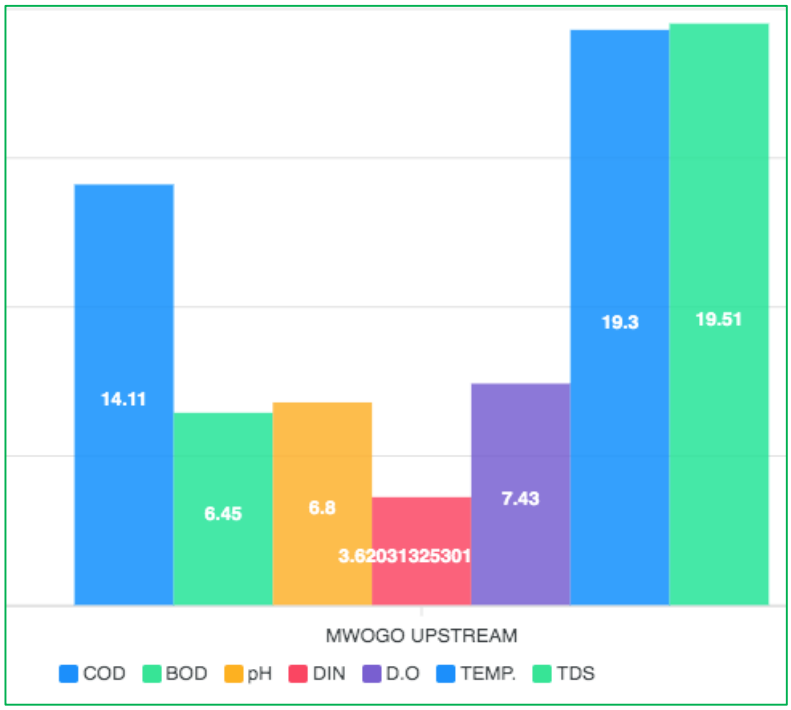
By Centre of Excellence in Biodiversity and Natural Resource Management

Catchment Monitoring & Evaluation System









Final Report

October, 2020

TECHNICAL ASSISTANCE IN ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT

CATCHMENT MONITORING AND EVALUATION SYSTEM

The Reporting Team

This report was prepared for Rwanda Environment Management Authority by a team of University of Rwanda, College of Science and Technology academic staff led by the Center of Excellence in Biodiversity and Natural Resource Management with collaboration from the School of ICT, School of Engineering, School of Sciences and Centre for GIS. The team included Prof Beth Kaplin (project lead), Dr. Christian Sekomo (water quality team leader), Mardoche Birori Mudakikwa and Emmanuel Nkurunziza (water quality field assistants), Prof Umaru Garba Wali (Catchment Management Plans team leader), Venerand Gwiza (Catchment Management Plans field assistant), Elisée Gashugi (wetland team leader), Chrisostome Ufitinema (wetland field assistant), Elias Nyandwi (GIS team leader), Maurice Mugabowindekwe (GIS co-team leader), Celestin Mbonabucya (IT team leader), Pelin Mutanguha (IT co-team leader), Dr. Richard Musabe and Dr. Alfred Uwitonze (IT strategic advisors). Suggested report citation: REMA, 2020. Environment and Natural Resources Management (ENRM): Monitoring and Evaluation System. Rwanda Environment Management Authority, Kigali, Rwanda.

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1. Executive Summary

Reference is made to the Memorandum of understanding between Rwanda Environment Management Authority and the University of Rwanda, on the Completion of Technical Assistance in Environment and Natural Resources Management Project signed on 17th September 2020

This report focuses on the Development of **Monitoring and Evaluation Tool** which is the crosscutting component over Wetland, Pollution and Catchment management and the development of Monitoring and evaluation tool depends on the data and results from other components in the same consultancy. This tool will help in the monitoring and evaluation of key indicators from various components where the decision makers will be able to analyze the trends and changes with the help of data, images and maps uploaded in the system over a given period of time. This will also help in the catchment management plans and reporting.

The data has been collected, analyzed and designed with target to make the M&E tool more flexible and user friendly to any type of user and the system can accommodate various types of indicators based on the need on the institutions that owns it. The training manuals have been prepared for end users at national, at catchment and at district levels.

For the sustainability and for the maintenance of this tool, we recommend the strong partnership between University of Rwanda through the Center of Excellence in Biodiversity and Natural Resource Management and the School of ICT, with the Rwanda Environment Management Authority, Rwanda Water Board and with the Ministry of Environment, where the University of Rwanda will keep overseeing the growth of the system hence propose the possible solutions for the improvements and the upgrades of the system.

Reported by:

MBONABUCYA Celestin,

M&E IT Specialist

2. Selection of Technologies

The selection of the technology to be used has been done based on the new emerging technologies which allow the flexibility in the management of online system, and which allow the integration with other systems in easy way. The following table, shows the list of technologies and their descriptions.

Technology	Description
React JS	**React JS** is an open-source JavaScript library that is **used for** building user interfaces specifically for single-page applications. It's **used for** handling the view layer for web and mobile apps. **React** also allows us to create reusable UI components. React allows developers to create large web applications that can change data, without reloading the page. The main purpose of React is to be fast, scalable, and simple. It works only on user interfaces in the application
Node JS	**Node JS** is a runtime environment, which let users choose how to use, whether **frontend or backend**, and one common language can be used as **backend** and **front end**. This environment is entirely based on V8 JavaScript engine. ... so, you can even use it as front –end environment, which will enhance development of software.
PostgreSQL	**PostgreSQL** is considered the most advanced and powerful SQL compliant and open-source objective-RDBMS. It has become the first choice for corporations that perform complex and high-volume data operations due to its powerful underlying technology.
System Integration	What Is System Integration? System integration is the **process** of linking software products to act as one coordinated system. By joining databases and data sources together to provide new, valuable information and create new products, businesses avoiding having to re-key the same data into their systems twice or more.

Technology	Description
API	API is the acronym for Application Programming Interface, which is a software intermediary that allows two applications to talk to each other.
JSON	Is an open standard file format, and data interchange format, that uses human-readable text to store and transmit data objects consisting of attribute–value pairs and array data types (or any other serializable value).

3. The Scope of the Work

- To develop a comprehensive system for monitoring and evaluation of sustainable land and water management activities as part of catchment management planning.
- The system operates on 4 levels :
    - (i) national-level tracking of ongoing catchment management needs and progress made against them, based on the national catchment analytics and systems for ongoing mapping of investments,
    - (ii) catchment-level tracking the ongoing catchment management needs at catchment level
    - (iii) district-level to facilitate the data entry at district levels in a standardized format to ease the impact monitoring for catchment management investments within specific catchments and within specific period of time.
    - System management to facilitate the system settings for other users.
- The monitoring system is designed with reference to National water quality monitoring program being developed by RNRA.
- The M&E framework supports the provision of the right information to the right stakeholders at the right time in the right format – starting from supporting the planning process to tracking of implementation progress and performance at every critical stage of the project to provide reliable and timely information needed for ongoing project planning and management.

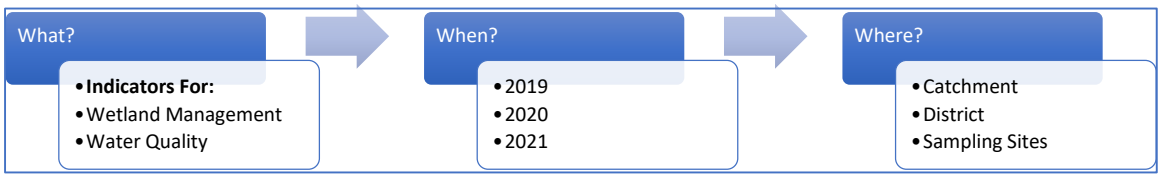
- The Consultant/firm have selected appropriate indicators (including bio-physical and social aspects) for catchment management activities and their impact.
- These indicators capture both qualitative and quantitative aspects, and also include multi-media inputs (e.g. photographs, videos, documents) where appropriate.
- The indicators include those indicated in the LVEMP Project results framework, but should be broad-based to cover all key inputs, outputs, and outcomes of such catchment management activities.
- The Consultant/firm developed a computerized web-based MIS system that allows for secure organization, storage, processing, analysis, visualization, access, reporting, and dissemination of the M&E information.
- The user interface is user-friendly, interactive, web-based and provide easy access with intuitive navigation to all relevant project-related monitoring information and documentation.
- The indicators, input and reporting formats, and screens have been developed with feedback from the Client.
- The training of core staff on the use of the M&E MIS System is being organized in partnership with REMA, and the date for the training will communicated soon to the client and to the trainees.
- The list of species to be planted is generated by the system
- In the implementation plan table, activities are categorized per each District and respective area (ha)
- The consultant elaborated a mapping and screening of issues exactly where they are located; the area already protected; the area that needs protection; which protection does it need; which activities should be carried out in a specific area: radical terraces, progressive terraces, trenches, afforestation, agroforestry, rivers and lakes buffer zone protection…
- Is there a possibility to make the monitoring system nationally shared & link data from other institutions and not from REMA only? Can it be linked to other M&E Systems? What about security of data?: Yes, since the system is web based tool, the link can be shared with many institutions. The system will be hosted in national data centres and be managed by AOS on a contract basis.

- The volume of the software is so huge (500 GB) that handling it is difficult. Think of a user friendly and easy-to-manipulate system: The system has been optimized with the development of strong algorithms and the system is now faster and user friendly to any type of user.
- Indicate the limitations of the system and if there are costs involved to acquire the system it should be clearly stated in the report. The rationale behind the choice of this specific system should also be indicated: There no additional cost related to the technology we have used while developing the system a part from the hosting cost paid to the national data centres. Later, the system will require the maintenance cost which can be negotiated in a separate contract.

4 The Requirements Analysis of the M&E Tool

4.1 The Basis for Developing the M&E Tool

The development of this Monitoring and Evaluation tool, has focused on the variables to be monitored, when they are monitored, where they monitored and specifically to which indicators are being monitored and why this monitoring is required. This figure shows the overview of any monitoring and evaluation tool.



The Monitoring and Evaluation Tool was developed based on the analysis of the data received from the experts in the field of Water Quality/Pollution, Wetland Management and Catchment Management Plans. The analysis has revealed that, data has been being collected at sampling site and based on various indicators based on the type of the components. Then the data were grouped by sampling sites, then by district, then by catchment.

4.2. The system Indicators

The following table shows some of the indicators that guided us to develop the monitoring and evaluation tool for 4 catchments (NNYU, NNYL, NMUK and NAKU) but the system is dynamic to accommodate data from other catchments too.

#	Indicators	Component
1	Conductivity (COND.)	Water Quality/Pollution
2	Total Dissolved Solids (TDS)	Water Quality/Pollution
3	Dissolved Oxygen (DO)	Water Quality/Pollution
4	Potential in Hydrogen (pH)	Water Quality/Pollution
5	Temperature (TEMP)	Water Quality/Pollution
6	Total Suspended Solids (TSS)	Water Quality/Pollution
7	Turbidity (TURB)	Water Quality/Pollution
8	Chemical Oxygen Demand (COD	Water Quality/Pollution
9	Biochemical Oxygen Demand (BOD)	Water Quality/Pollution
10	Dissolved Inorganic Nitrogen (DIN)	Water Quality/Pollution
11	Dissolved Inorganic Phosphorus (DIP)	Water Quality/Pollution

#	Indicators	Component
12	Iron (Fe)	Water Quality/Pollution
13	Managanese (Mn)	Water Quality/Pollution
14	Lead (Pb)	Water Quality/Pollution
15	Zinc (Zn)	Water Quality/Pollution
16	Faecal coliform (F.C)	Water Quality/Pollution
17	Escherishia coli (E.coli)	Water Quality/Pollution
18	Erosion	Wetland Management
19	Flood	Wetland Management
20	Eutrophication	Wetland Management
21	Wetland overharvesting	Wetland Management
22	Infrastructure development	Wetland Management
23	Agricultural activities	Wetland Management
24	Mass movements/landslides	Wetland Management
25	Sedimentation	Wetland Management
26	Seasonal Agriculture	Land Use and/or Land Cover
26	Seasonal Agriculture	Land Use and/or Land Cover
27	Perennial Agriculture	Land Use and/or Land Cover
28	Dense Forest	Land Use and/or Land Cover
29	Sparse Forest	Land Use and/or Land Cover
30	Open Areas or Grassland	Land Use and/or Land Cover
31	Settlements and Buildings	Land Use and/or Land Cover
32	Waterbody	Land Use and/or Land Cover
33	Wetland	Land Use and/or Land Cover
34	Mines	Land Use and/or Land Cover
35	Very Low	Land Use and/or Land Cover
36	Low	Land Use and/or Land Cover
37	Moderate	Land Use and/or Land Cover
38	High	Land Use and/or Land Cover
39	Very High	Land Use and/or Land Cover
40	Very Low Land Degradation	Levels of Land Degradation
41	Low Land Degradation	Levels of Land Degradation

#	Indicators	Component
42	Moderate Land Degradation	Levels of Land Degradation
43	High Land Degradation	Levels of Land Degradation
44	Very High Land Degradation	Levels of Land Degradation
45	Soil between 0 – 15	Levels of Land Degradation
46	Soil between 15 – 30	Levels of Land Degradation
47	Soil between 30 – 60	Levels of Land Degradation
48	Soil between 60 – 100	Levels of Land Degradation
49	Soil Above 100	Levels of Land Degradation
50	Very Low Landslide	Flood and Landslide Hazards Risk
51	Low Landslide	Flood and Landslide Hazards Risk
52	Moderate Landslide	Flood and Landslide Hazards Risk
53	High Landslide	Flood and Landslide Hazards Risk
54	Very High Landslide	Flood and Landslide Hazards Risk
55	Forest Cover (afforestation and reforestation)	*Soil Erosion Control Mechanisms*
56	Terraces	*Soil Erosion Control Mechanisms*
57	Contour Bank Terraces	*Restoration Opportunities*
58	Perennial Crops	*Restoration Opportunities*
59	Grassed Waterways	*Restoration Opportunities*
60	Agroforestry	*Restoration Opportunities*
61	Bench Terraces	*Restoration Opportunities*
62	Water Harvesting Infrastructure	*Restoration Opportunities*
63	Afforestation	*Restoration Opportunities*
64	Reforestation	*Restoration Opportunities*
65	Waterways Infrastructure	*Restoration Opportunities*
66	Hedgerows	*Restoration Opportunities*
67	Bamboo to Close Gullies	*Restoration Opportunities*
68	No-Till	*Restoration Opportunities*
69	Contour Banks	*Restoration Opportunities*
70	None	*Restoration Opportunities*
71	Riverside Bamboo	*Restoration Opportunities*

#	Indicators	Component
72	Shrub Restoration	*Restoration Opportunities*
73	Savannah Restoration	*Restoration Opportunities*
74	Silvo Pastoralism	*Restoration Opportunities*
75	Health Centers	Socio-Economic Infrastructure
76	Trade Centers	Socio-Economic Infrastructure
77	School	Socio-Economic Infrastructure
78	Markets	Socio-Economic Infrastructure
79	Coffee Washing Stations	Socio-Economic Infrastructure
80	Industry	Socio-Economic Infrastructure
81	Tea Factory	Socio-Economic Infrastructure
82	Hydropower Station	Socio-Economic Infrastructure

4.3 Types of Users

The users of the M&E tool are classified in 4 levels:

1. At Catchment level,
2. At District level,
3. At National level and
4. The Overall System Administrators.

Each user should get registered in the system in one of the above levels and get a unique username and password to authenticate with the system. Any person who need access to the system should first be classified in one of those 4 categories. All users have different roles and they have access on their own data, based on the level they belong to.

4.4 Types of Information Reported/Analysed

With this tool, the decision makers will be able to get information on the collected data from all catchments with focus on water quality, wetland management and catchment management plans. They will be able to view data in graphs, be able to view various images and maps developed by the experts in GIS over a period of time, which will help them to perform the trends analysis and take appropriate decisions for environment management. Data can also be downloaded in PDF and in Excel formats for further analysis.

5. The Design of the M&E Tool

5.0 Context Diagram

This design shows how the overview of the Monitoring and Evaluation Tool with focus on the main components technology to be used, types of users and types of reports that can be generated (graphs, tables, Images and Maps)

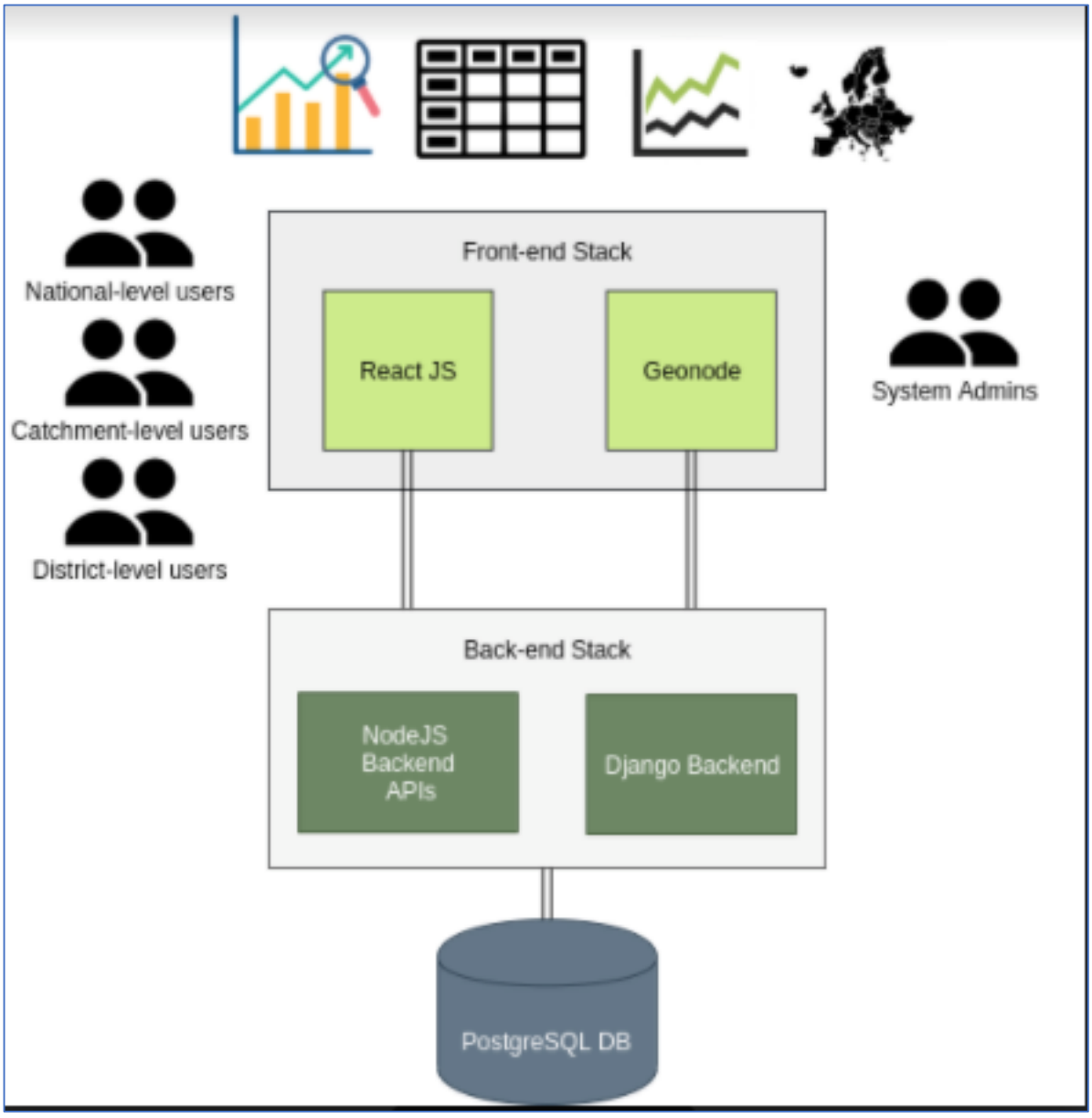


Figure 1: The context Diagram with types of users

5.1 Navigation Map

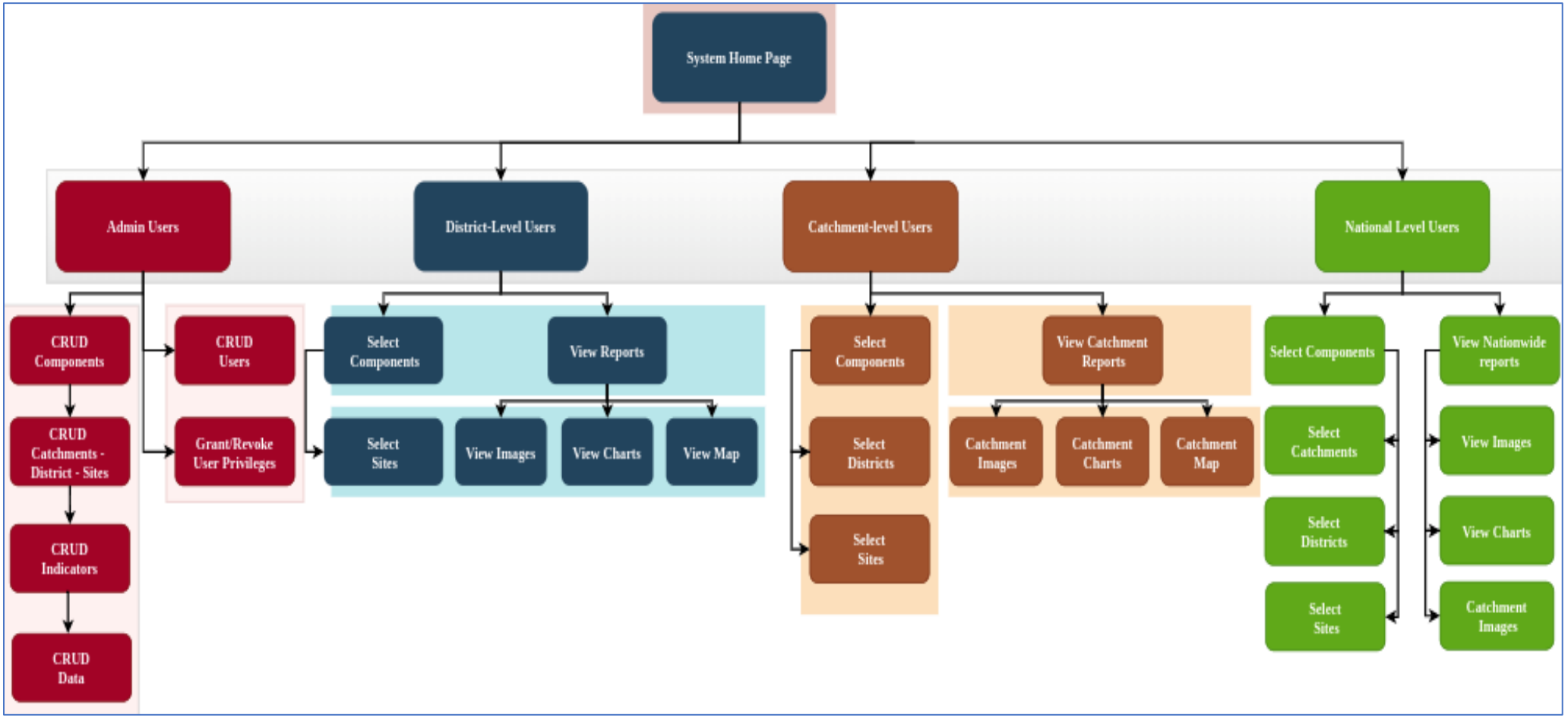


Figure 2: The navigation page with main tasks of the users

5.2 The M&E Entity Relationship Diagram

This figure show how data have been modeled and the relationships between them.

The performance of this tool depends on this model.

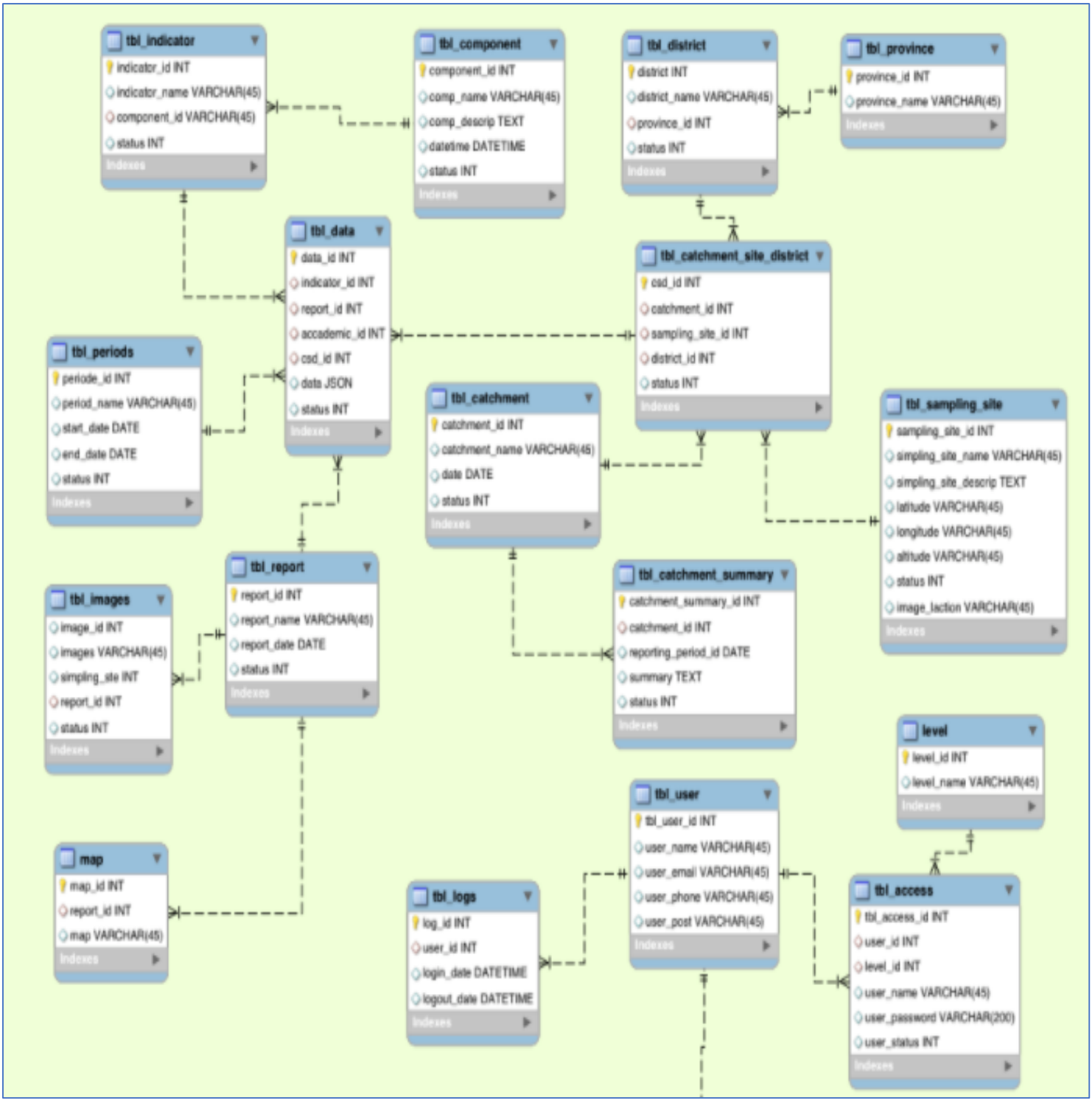


Figure 3: The database Design Diagram

5.3 Main Interfaces of the Monitoring and Evaluation Tool

5.3.1 The landing Page of the M&E Tool.

The M&E tool has the front page with the summary of the information the reader will be able to see once he/she opens the link to this platform. It is a public page and anyone can see this page. To facilitate the partners and stakeholders, the M&E tool will have the link to the existing systems of REMA, and it will have its own domain name, which means it can run independently.

5.3.2. Login Page.

Every user should login in the system through this page. In order to make it easy, the email is considered as the username. The users will get access from the System Administrator.

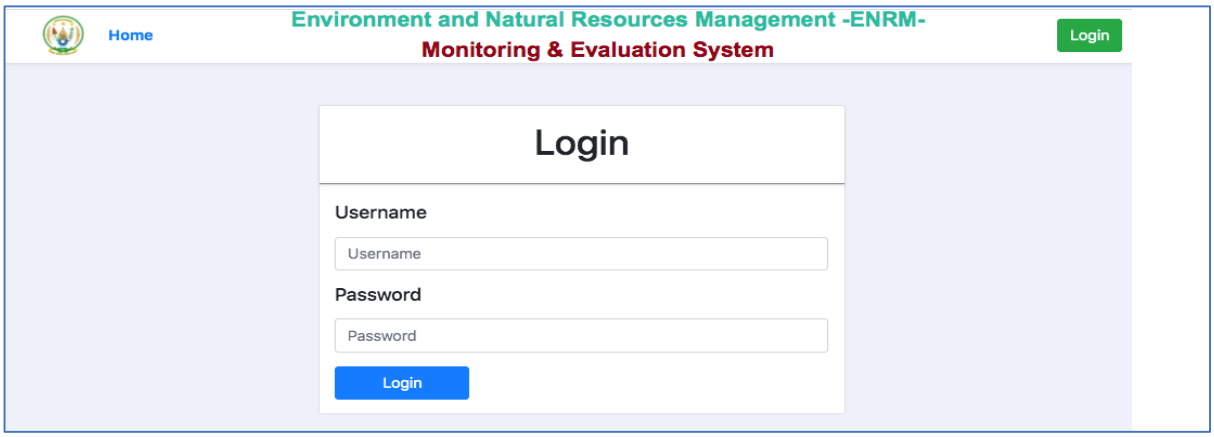


Figure 4: Login Page for Every user

5.3.3. Welcome Page after Login

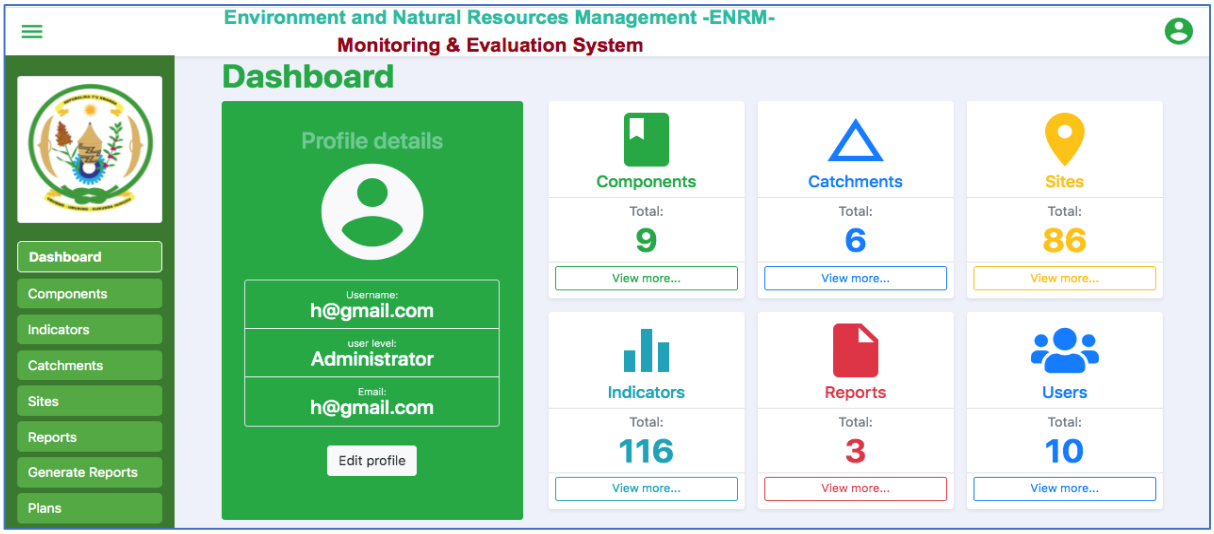


Figure 5: Welcome page after the user login

5.3.4 Reports for Components

This Interface will appear every time the user has selected the component. Then the user will directed to a new page where he/she has the options to select report period. There is also options to Visualise data in various graphs.

The administrator of the system will have more option to add and edit components.

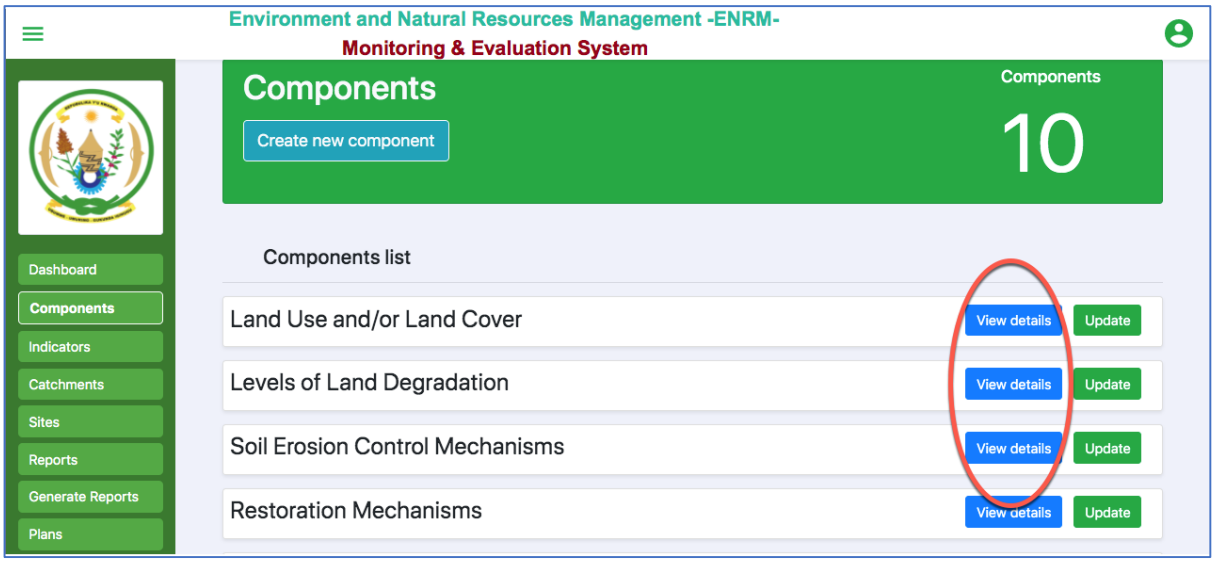


Figure 6: *All Reports by selected Components over various periods*

5.3.5 Customizable Monitoring Page, Data Visualization

This is the interface for data visualisation. It is show all the available possibilities to select any type of report the user needs at a given reporting period, based on the selected indicators for a selected catchment or sites. The data can be visualised in the form of tables, or in the form of graphs.

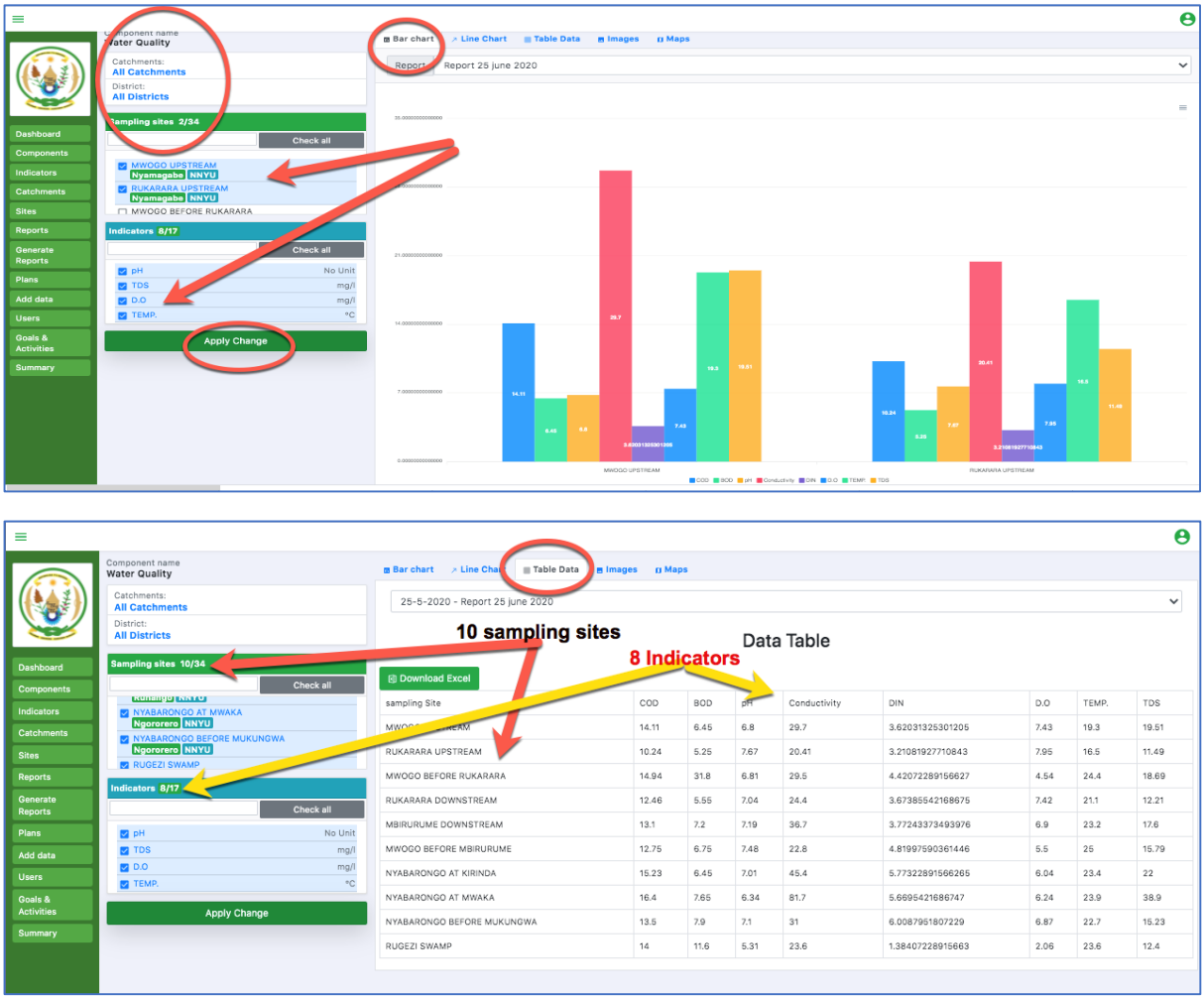
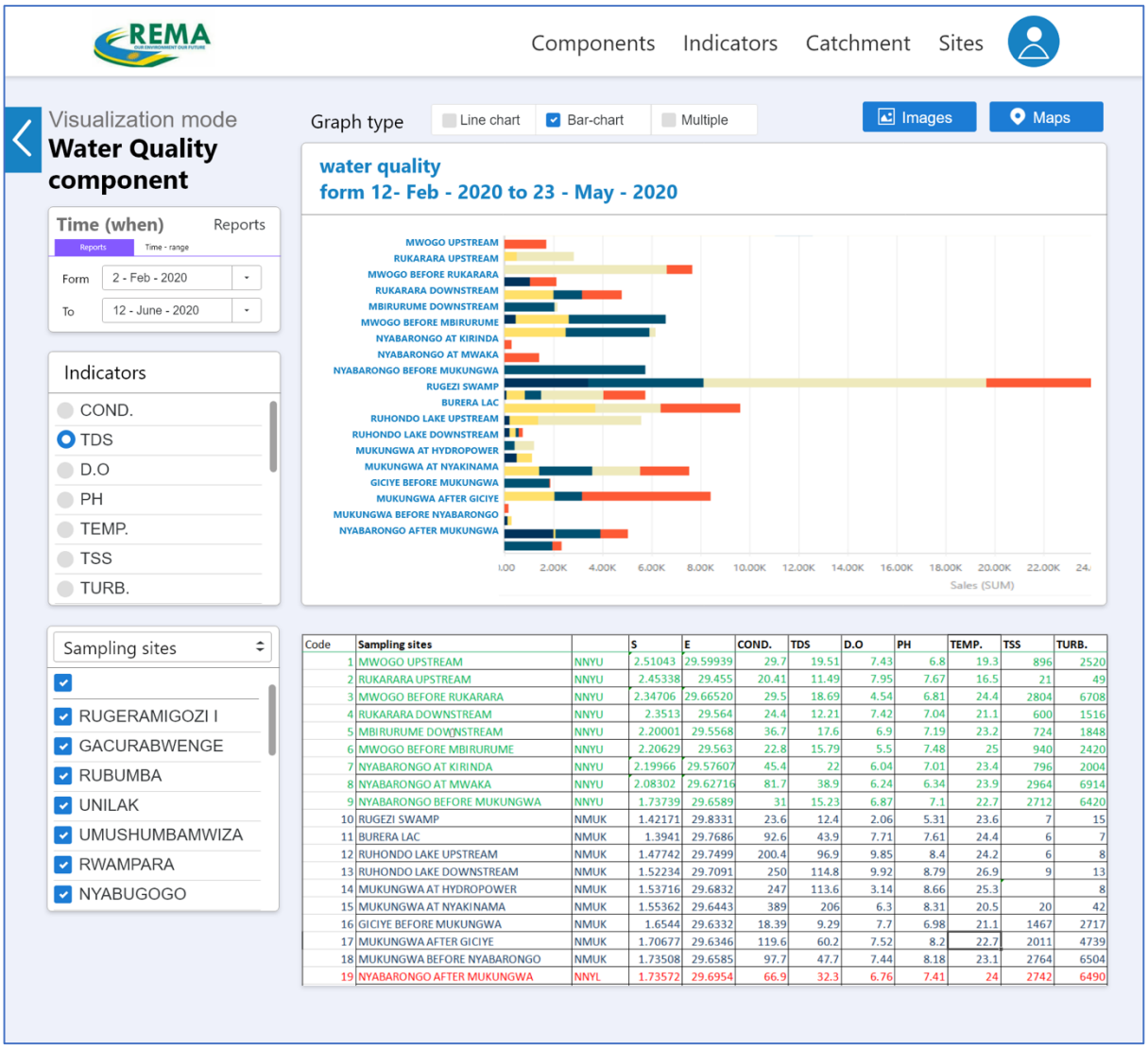


Figure 7: Dynamic page for the Reader to choose what he/she needs

5.3.6 Indicator Monitoring on all Sampling Sites

With this interface, the user will be able to monitor the selected indicators over the sampling sites for a given period of time. The bar chart has been chosen as the best way to monitor the indicator and the user is free to select any number of indicators at the same time. The selected indicators will be shown in the form of table under the graph or in a separate tab and for the selected sampling sites in the selected catchments. The user has the option to view the images and maps related to the selected catchment and component.

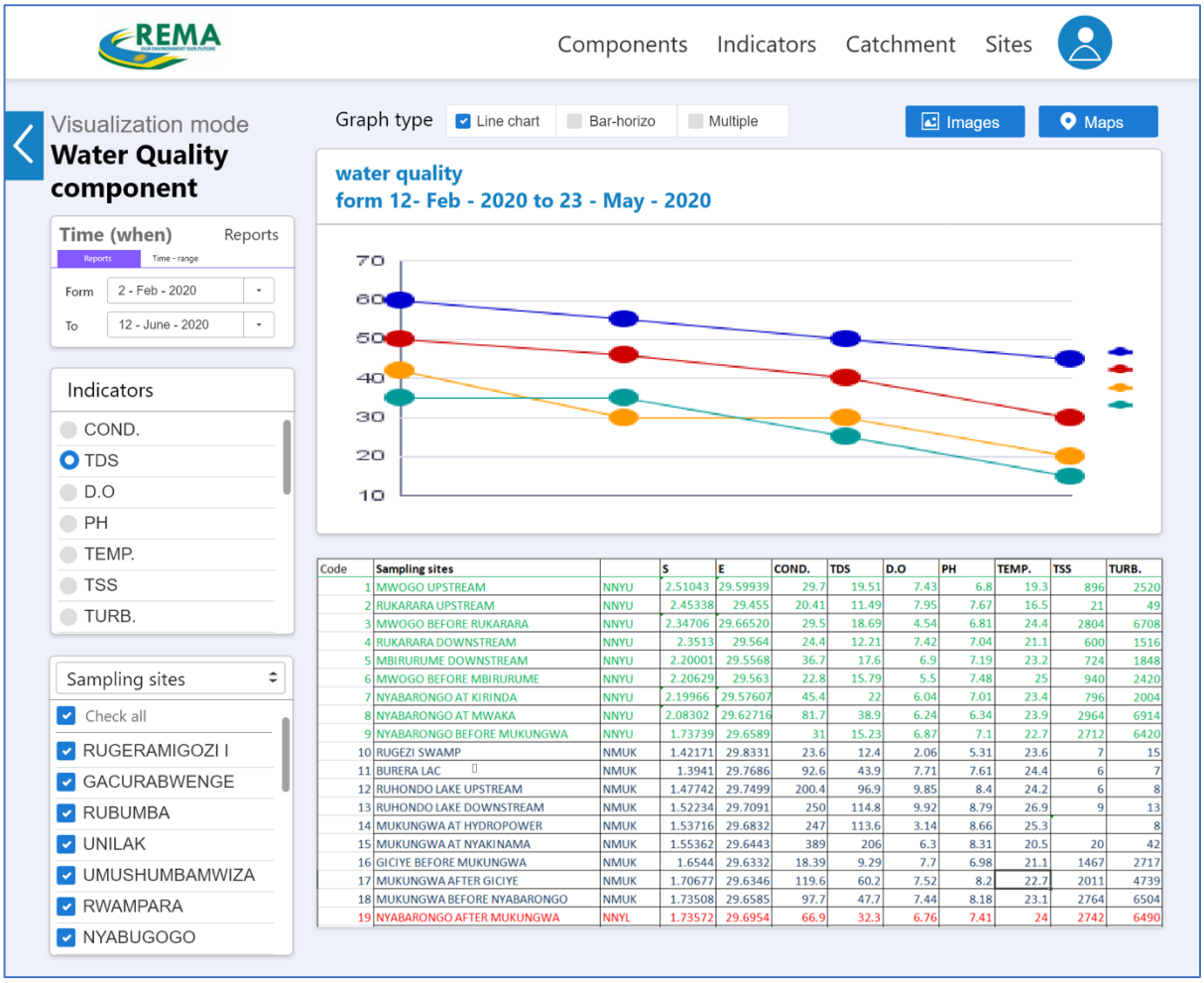


Code	Sampling sites		S	E	COND.	TDS	D.O	PH	TEMP.	TSS	TURB.
1	MWOGO UPSTREAM	NNYU	2.51043	29.59939	29.7	19.51	7.43	6.8	19.3	896	2520
2	RUKARARA UPSTREAM	NNYU	2.45338	29.455	20.41	11.49	7.95	7.67	16.5	21	49
3	MWOGO BEFORE RUKARARA	NNYU	2.34706	29.66520	29.5	18.69	4.54	6.81	24.4	2804	6708
4	RUKARARA DOWNSTREAM	NNYU	2.3513	29.564	24.4	12.21	7.42	7.04	21.1	600	1516
5	MBIRURUME DOWNSTREAM	NNYU	2.20001	29.5568	36.7	17.6	6.9	7.19	23.2	724	1848
6	MWOGO BEFORE MBIRURUME	NNYU	2.20629	29.563	22.8	15.79	5.5	7.48	25	940	2420
7	NYABARONGO AT KIRINDA	NNYU	2.19966	29.57607	45.4	22	6.04	7.01	23.4	796	2004
8	NYABARONGO AT MWAKA	NNYU	2.08302	29.62716	81.7	38.9	6.24	6.34	23.9	2964	6914
9	NYABARONGO BEFORE MUKUNGWA	NNYU	1.73739	29.6589	31	15.23	6.87	7.1	22.7	2712	6420
10	RUGEZI SWAMP	NMUK	1.42171	29.8331	23.6	12.4	2.06	5.31	23.6	7	15
11	BURERA LAC	NMUK	1.3941	29.7686	92.6	43.9	7.71	7.61	24.4	6	7
12	RUHONDO LAKE UPSTREAM	NMUK	1.47742	29.7499	200.4	96.9	9.85	8.4	24.2	6	8
13	RUHONDO LAKE DOWNSTREAM	NMUK	1.52234	29.7091	250	114.8	9.92	8.79	26.9	9	13
14	MUKUNGWA AT HYDROPOWER	NMUK	1.53716	29.6832	247	113.6	3.14	8.66	25.3		8
15	MUKUNGWA AT NYAKINAMA	NMUK	1.55362	29.6443	389	206	6.3	8.31	20.5	20	42
16	GICIYE BEFORE MUKUNGWA	NMUK	1.6544	29.6332	18.39	9.29	7.7	6.98	21.1	1467	2717
17	MUKUNGWA AFTER GICIYE	NMUK	1.70677	29.6346	119.6	60.2	7.52	8.2	22.7	2011	4739
18	MUKUNGWA BEFORE NYABARONGO	NMUK	1.73508	29.6585	97.7	47.7	7.44	8.18	23.1	2764	6504
19	NYABARONGO AFTER MUKUNGWA	NNYL	1.73572	29.6954	66.9	32.3	6.76	7.41	24	2742	6490

Figure 8: Indicator Monitoring for all samplings sites

5.3.7 Trends Analysis for the Selected

This interface shows how the trends analysis can be conducted over the a given period of time. Various indicators may get selected at the same time, and every indicator is represented by a unique color in the graph.



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9	NYABARONGO BEFORE MUKUNGWA	NNYU	1.73739	29.6589	31	15.23	6.87	7.1	22.7	2712	6420
10	RUGEZI SWAMP	NMUK	1.42171	29.8331	23.6	12.4	2.06	5.31	23.6	7	15
11	BURERA LAC	NMUK	1.3941	29.7686	92.6	43.9	7.71	7.61	24.4	6	7
12	RUHONDO LAKE UPSTREAM	NMUK	1.47742	29.7499	200.4	96.9	9.85	8.4	24.2	6	8
13	RUHONDO LAKE DOWNSTREAM	NMUK	1.52234	29.7091	250	114.8	9.92	8.79	26.9	9	13
14	MUKUNGWA AT HYDROPOWER	NMUK	1.53716	29.6832	247	113.6	3.14	8.66	25.3		8
15	MUKUNGWA AT NYAKINAMA	NMUK	1.55362	29.6443	389	206	6.3	8.31	20.5	20	42
16	GICIYE BEFORE MUKUNGWA	NMUK	1.6544	29.6332	18.39	9.29	7.7	6.98	21.1	1467	2717
17	MUKUNGWA AFTER GICIYE	NMUK	1.70677	29.6346	119.6	60.2	7.52	8.2	22.7	2011	4739
18	MUKUNGWA BEFORE NYABARONGO	NMUK	1.73508	29.6585	97.7	47.7	7.44	8.18	23.1	2764	6504
19	NYABARONGO AFTER MUKUNGWA	NNYL	1.73572	29.6954	66.9	32.3	6.76	7.41	24	2742	6490

Figure 9: Trends Analysis for a given indicator

5.3.8 Uploading Data

In order to facilitate the management of collected data, this interface shows how the user will have the option to upload data in the system in the form of excel format or manually if the data to be uploaded is not too much. The template to be used will be provided to the system administrator.

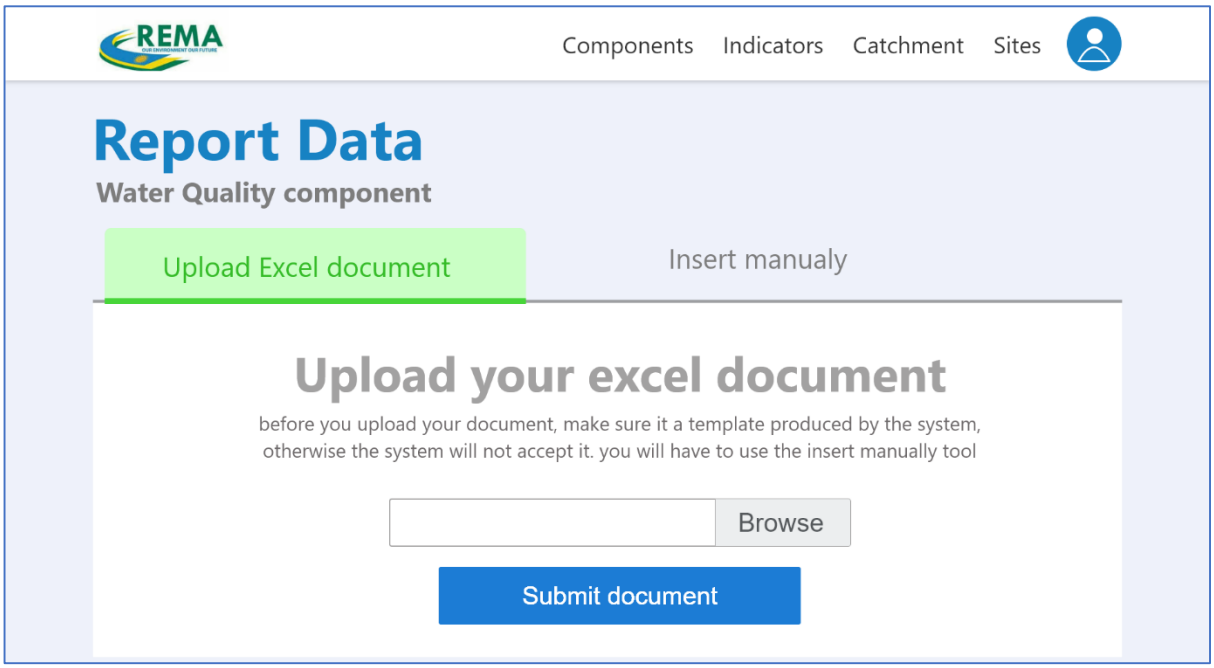

Figure 10: Uploading data in the system

5.3.9 Inserting Data Manually

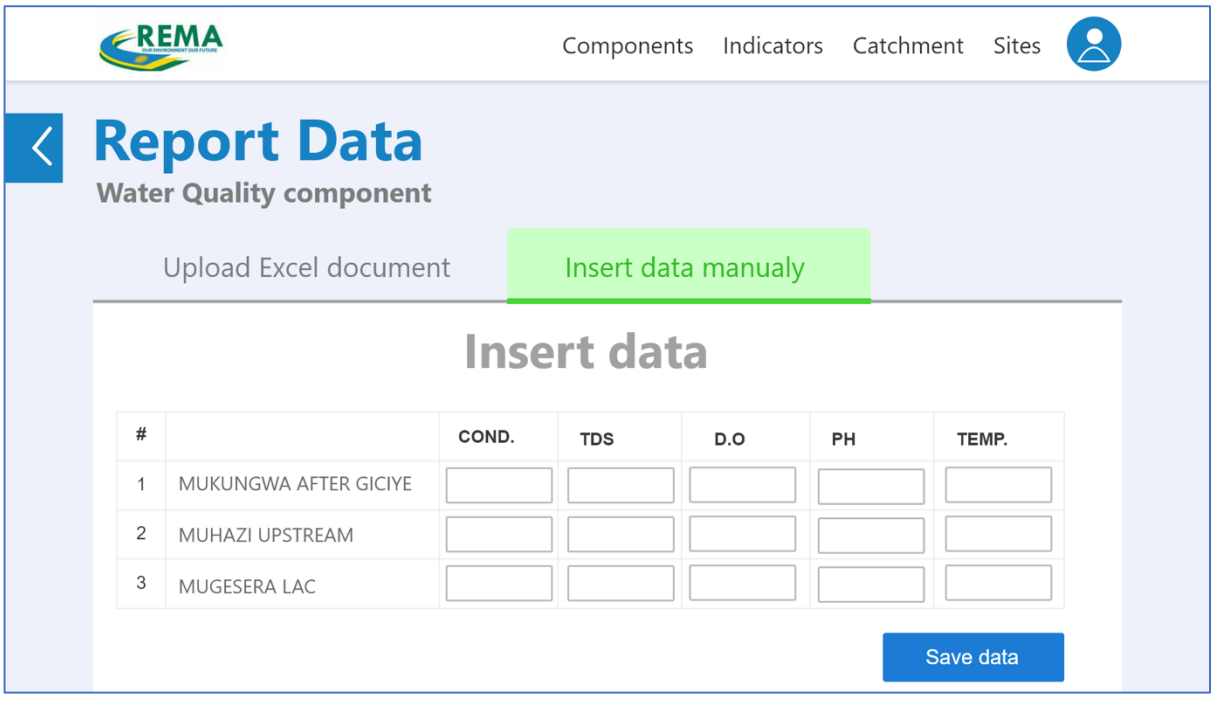

Figure 11: Inserting data manually

5.3.10 Updating Data

This interface shows how the data can get updated in the system

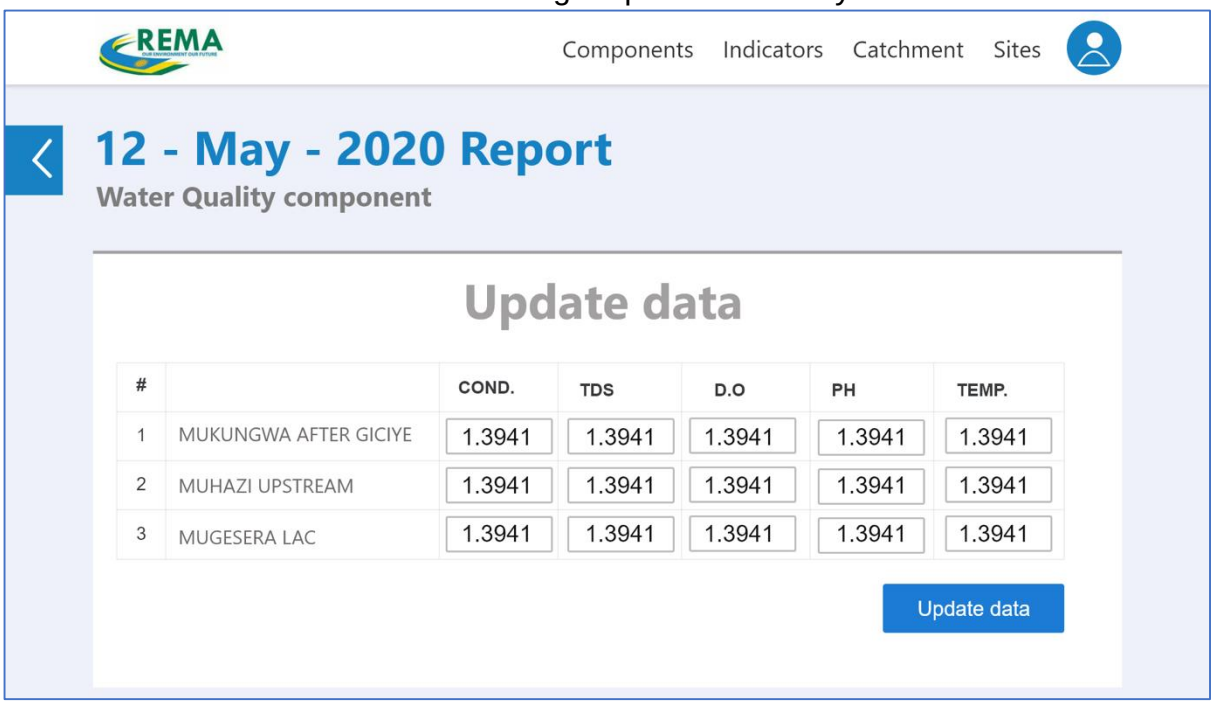

Figure 12: Updating data in the system

5.3.11 View Images

This interface show how the user can view images related to a given indicator in the selected catchment for a given range of time. This helps decisions makers to make the trends analysis on various images uploaded from various periods.

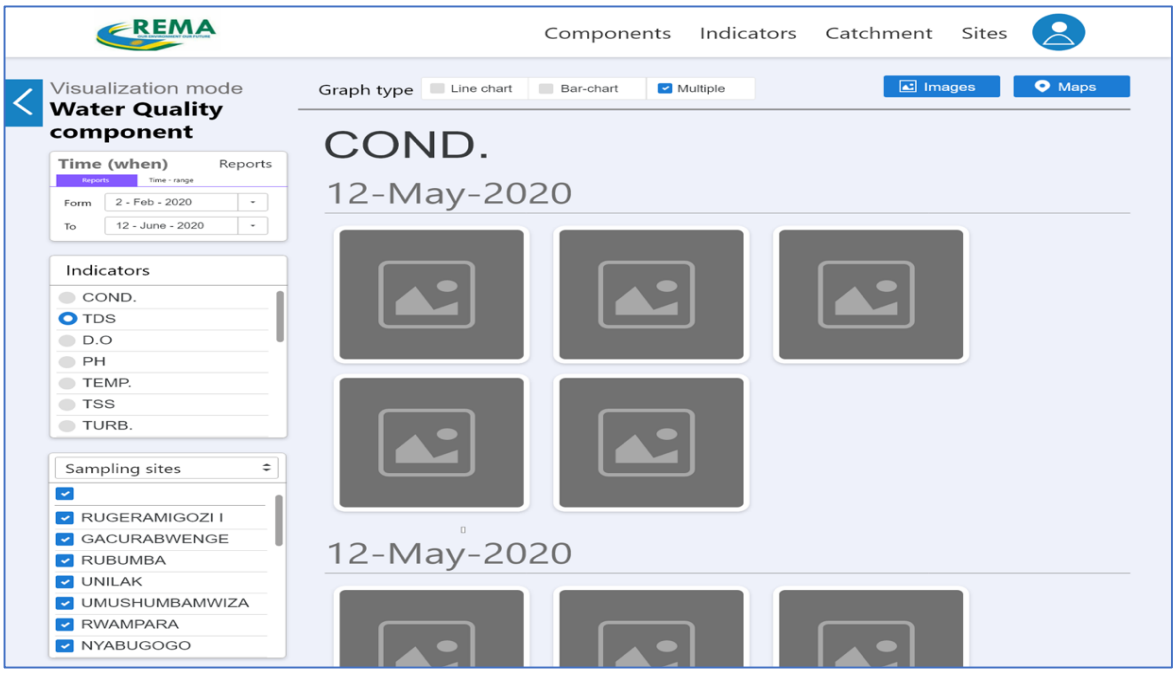

Figure 13: Viewing images at catchment level

5.3.12 View Maps

In order to facilitate the monitoring, the user can navigate through a number of professional maps designed by GIS team. These maps are grouped and viewed at catchment level.

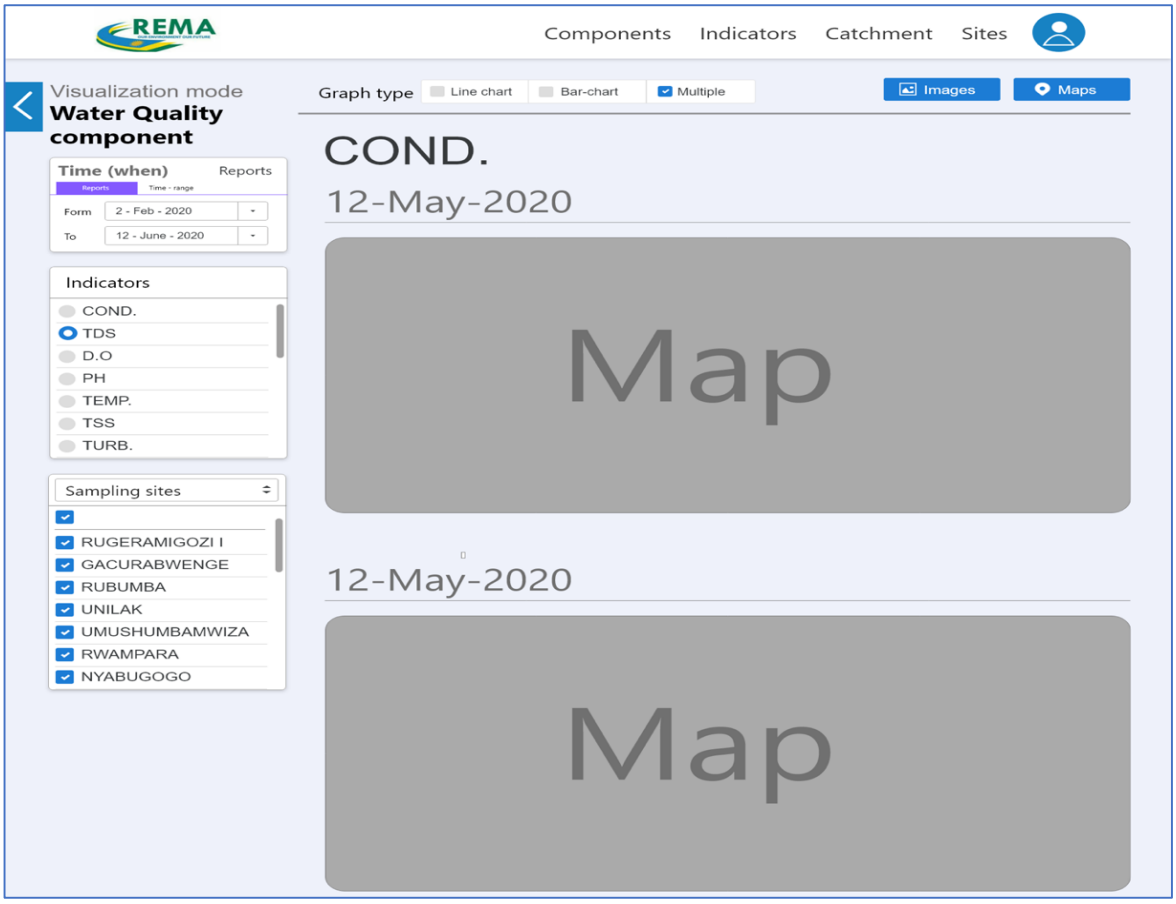

Figure 14: Viewing available maps on the selected catchment

6. The Tasks Checklist.

Systems Platform M & E **In close collaboration with all other teams**	**Status**
Data Analysis focus on Data Flow Diagrams Development && Database Conception, modelling.	Completed 100%
System Design focus on Database Design and Development, Creating data views for front end developers &&	Completed 100%

Systems Platform M & E **In close collaboration with all other teams**	**Status**
Front End Design: The System Interfaces for Look and Feel.	
System Design Presentation with the stakeholders for approval before the development starts.	Presented in the validation workshop held at MUSANZE from 21st to 24th July 2020
Development of the system. Back end development, front end Development, Data Cleaning and data Entry: Adopting Sample data from the IWRM Program on Water Quality Monitoring in Rwanda Final Report April 2019 produced by RWFA	Completed
Prototype presentation for validation as part of project training	Presented in the validation workshop held at MUSANZE from 21st to 24th July 2020
Development of the system with the inputs for improvement received from the project stakeholders	Completed
Second Presentation of the System to all stakeholders	Done on Wednesday 12th August 2020 with the whole to finalize the draft report.
System testing for usability	On going
User manual preparation	On going
Training of the system to the stakeholders of the project	Waiting to confirm the date and the venue with REMA.

7. System Deployments Requirements by Data Centre Services

Hosting Plan, Cloud Computing	VPS (Virtual Private Server)
OS	Ubuntu 18.04
Memory	24 GB of RAM
vCPUs	12 CPU
Transfer	5TB
Disk	900GB of storage
Company	AOS Ltd, TIN: 103173007
Service Levels Subscriptions	Business-Small
AOS Quotation (Monthly Billing)	792,134 (Taxes Inclusive)
AOS Sales Contact Person	Bright BYIRINGIRO, Service Sales Manager **Tel**: + 250 78267210 **Email1**: bright.byiringiro@aos.rw **Emali2**: info@aos.rw **Office**: KBC Building, 3rd Floor Block D. **P.O. Box:** 7411 Kigali **Website**: www.aos.rw

AOS Ltd **Office:** KBC Building, 3rd Floor Block D. **P.O.Box**: 7411 Kigali-Rwanda **Email: info@aos.rw** **Website: www.aos.rw**	**DATA CENTRE SERVICES** **DATE: 1 AUGUST 2020**

MBONABUCYA CELESTIN	**FOR: CLOUD COMPUTING**

Service Portfolio	Service Levels Subscription	Units	Billing Period	Price (RWF)	VAT (18%)	Total Price (RWF)
Cloud computing	Business-Small	1	Monthly	671,300	120,834	**792,134**
Total Amount:						**792,134**
Amount in words: Seven Ninety-Two Thousand One Hundred Thirty-Four Rwandan Francs (VAT Inclusive)						

Payment Terms

- Payment is made to AOS Ltd accounts opened at the Bank of Kigali: **00040 00692165 06 (RWF)** N°: 00040 0692166 07 (USD).
- Quotation validity: 90 days from the date of issue
- Please provide payment slips for proof of payment at AOS Ltd offices located at Kami House KN 5 RD Rukiri 1,7411 Kigali Rwanda. A receipt will be provided to customers as proof of payment.

We thank you for choosing our services. For any inquiry please contact us by Email on:
bright.byiringiro@aos.rw / salesmarketing@aos.rw or call us on (+250) 0782672910

Note: The above hosting credentials are highly needed to upload and test the system before the trainings are conducted.

8. The System Management, Ownership and Monitoring

The system will be owned by Rwanda Water Board and REMA. The training will be provided to different types of users from district level, catchment level and national level. The users' manuals and troubleshooting guide documents have been produced and shared to Rwanda Water Board and REMA.

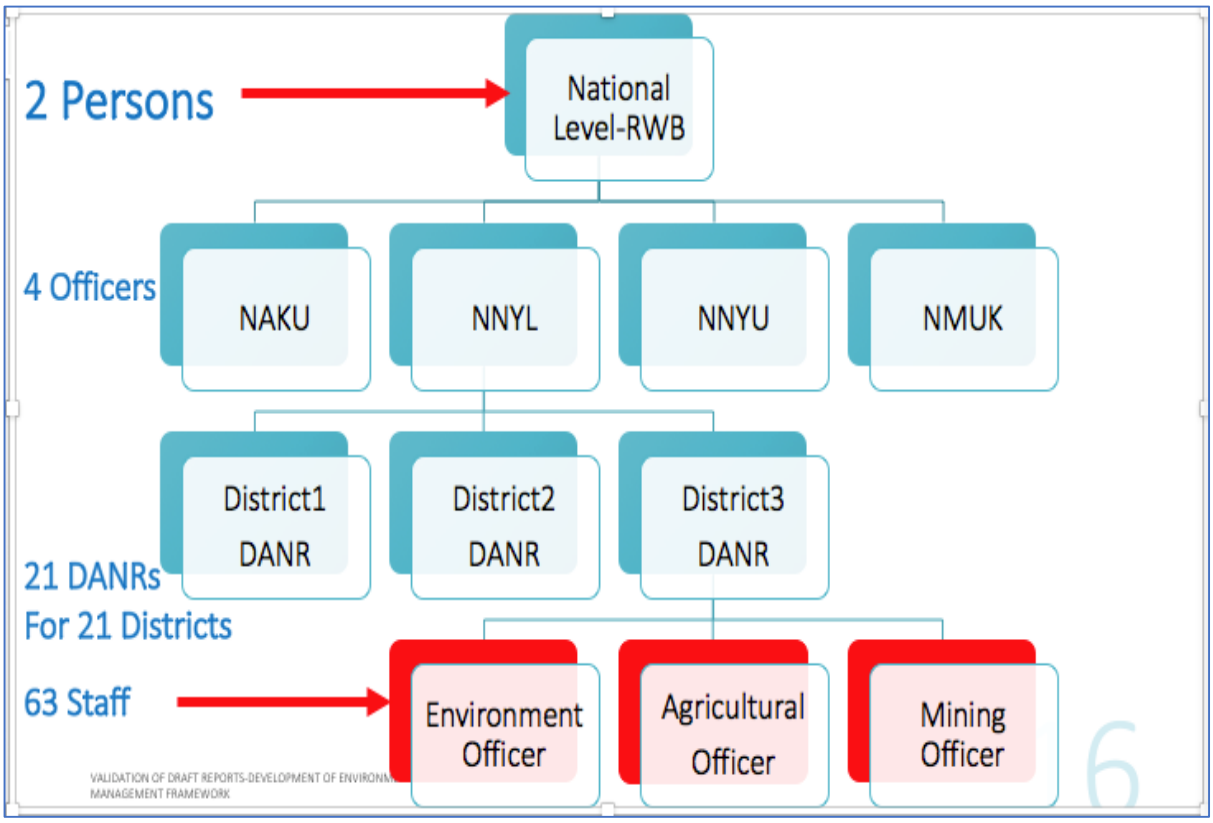

Figure 15: As it was discussed during the Validation Workshop at MUSANZE from 21-24 July 2020

The total of 90 users at different levels will be trained to use the M&E tool for the Environmental and natural resources Management and Monitoring.

- 6 staff at National level 2 from Rwanda Water Board 2 in charge of Environment and 2 from mining board.
- 4 Catchment Officers
- 21 Directors of Agriculture and Natural Resources from 21 districts
- 21 Environmental Officers at district level
- 21 Agricultural Officers at district level
- 21 Mining Officers at district level

8.1 The first users to be trained and their districts.

The targeted users will come from 21 districts, but since the platform will expand to other catchment and districts, RWB and REMA can invite everyone who is considered as the stakeholder for this project and from other districts.

No	Districts	Number of staff
1	Bugesera	4
2	Burera	4
3	Gakenke	4
4	GASABO	4
5	GATSIBO	4
6	Gicumbi	4
7	KAMONYI	4
8	Kayonza	4
9	KICUKIRO	4
10	Kirehe	4
11	Muhanga	4
12	Musanze	4
13	Ngoma	4
14	Ngororero	4
15	Nyabihu	4
16	Nyamagabe	4
17	Nyanza	4
18	Nyarugenge	4
19	Ruhango	4
20	Rulindo	4
21	RWAMAGANA	4

9. Data Gathering and Reporting

The data will be collected and entered in the platform from the end users trained at district levels. These users are the Directors of Agriculture and Natural Resources, the Environmental Officers, The Agricultural Officers and the Mining Officers at district levels. The data can be collected at a defined period of time by a group of researchers and be verified and approved by the trained staff at district levels who upload them in the system as part of reporting process. The data should first get approved at district level before they are uploaded in the system. The DANR will oversee the quality of the data in the system, in case there is anything to change or to update, he will contact the primary users to make changes where it is required.

10. The System Maintenance

The source codes will provided to Rwanda Water Board and to REMA for future updates, upgrades and maintenance. All the system credentials will be provided and the troubleshooting guidelines and the training manuals will be provided. The system is easy to use and it is dynamically expandable to accommodate other types of indicators, components, sites and reports. The system has the user guide for the end users. The University of Rwanda will also be there to support in case the system it is requested mainly during the time to upgrade and expand the system.

11. Conclusion and Recommendations

The developed platform is a web based system, which means that it is accessed everywhere and at any time in the world. The trainings user manual and troubleshooting guides will highly everything related to the management of data and the maintenance of the system.

However, according to the terms of references, the system will be accessed by registered users. This means that, for partners and stakeholders, they should first request the permission to access data from the system administrator.
For later improvements of the Monitoring and Evaluation tool, we recommend that, any user who is registered should leave the feedback targeting to improve the functionalities of this system.

For the sustainability and for the maintenance of this tool, we recommend the strong partnership between University of Rwanda through the Center of Excellence in Biodiversity and Natural Resource Management and the School of ICT, with the Rwanda Environment Management Authority, Rwanda Water Board and with the Ministry of Environment, where the University of Rwanda will keep overseeing the growth of the system hence propose the possible solutions for the improvements and the upgrades of the system.

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