The Final Report

Development of a Web Driven Information Management System for
Tanzania Nature Forest Reserves

August 2016
Executive Summary

This report presents the output of the consultancy service commissioned by Tanzania Forests Services (TFS) Agency, through efforts of the project “Enhancing the Forest Nature Reserves Network for Biodiversity Conservation in Tanzania”, financed by Global Environmental Fund (GEF) through United Nations Development Programme (UNDP). The report entails background of the assignment, objectives, methods adopted, conclusion and specific recommendations for the proper uses and future improvements of the system.

The consultancy service aimed at establishing a web-driven information management system that will ensure the Tanzania Nature Forest Reserves are marketed and well-coordinated as a network.

To meet objectives and intended outputs of the assignment, the consultant adopted standard approach and methods for system development. The consultant employed the agile scrum methodology for the Software Development Life Cycle (SDLC); which provides a flexible, iterative development lifecycle, allows for a highly transparent and cooperative process with the stakeholders, providing a better sense of work progress than a more traditional waterfall approach. The TFS staff and key stakeholders were fully involved during execution of the assignment. Specifically, the following activities were undertaken during execution of the assignment; namely: Inception work (consultative meetings and discussion, literature review, inception workshop), System Development (system design, prototyping, implementation & testing), Documentation (preparation of report & manual) and System rolling out (deployment, training & commissioning).

The consultant has completed execution of the assignment successfully; the developed system is ready for intended uses, one can be access it online via www.nature-reserves.go.tz. The system is developed purposely to ensure that Tanzania forest nature reserves are marketed and well-coordinated as a network of forest nature reserves. It’s a relational web driven management
system with the graphical user friend interface, capable to perform data entry and uploading, storage, query and manipulation, data transfer and reports generation. In design, it consists of two main parts; namely: front-end and back-end part, each consisting of sub-parts.

The system has potential and wide uses at different levels. Internally, the system will enable the TFS agency to manage information and have a continuous watch on planned activities with the Nature Forest Reserves as well as planning, reporting and decision making. Globally, this web driven system will facilitate marketing of tourism attractions within Nature Forest Reserves, in Tanzania.

Based on stated objective, issues aroused during the execution of the assignment and lesson leant from the assignment, the consultant would like to recommend that TFS agency should; (i) make sure that the system’s users adopt application of the system accordingly, (ii) conduct a periodic training to data collectors and clerks from each nature forest reserves and system administrator(s) at TFS agency headquarter, and (iii) equip each nature forest reserves with reliable and stable internet facility.
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<tr>
<th>Acronyms</th>
<th>Definition</th>
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<tr>
<td>GEF</td>
<td>Global Environmental Facility</td>
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<td>NFR</td>
<td>Nature Forest Reserve</td>
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<td>SLDC</td>
<td>System Development Life Cycle</td>
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<td>TFS</td>
<td>Tanzania Forest Services</td>
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<td>UNDP</td>
<td>United Nations Development Programme</td>
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Acknowledgements

In foremost, we wish to thank the TFS Agency for commissioning the consultancy services for development of the electronic system for Tanzania Forest Nature Reserves.

Also, we wish to express our most sincere gratitude to Mr. Gerald J. Kamwenda (The Project Coordinator) for guidance and assistance provided to the team of the experts during the execution of the assignment.

We are grateful to the conservators and representatives from 12 NFRs for their considerable assistance in the course of data and information collection. We are very grateful to Ms. Hadija Kijaz (Conservator-Amani NFR), Ms. Getrude Nganyagwa (Conservator-Magamba NFR), Mr. Sosy Rwamugira (Conservator-Chome FNR), Mr. Fabian Mukome (Conservator-Nilo NFR), Karani Seketi (Conservator-Uluguru NFR), Abeid Kindo (Conservator-Mkingu NFR), Mr. Elia Mndeme (Conservator-Kilombero FNR), Mkiramweni E.N. (Conservator-Uzungwa NFR), Richard Tarimo (Conservator-Rondo NFR), and Innocent Lupembe (Conservator-Rungwe NFR), Mr. Bernard Mwigulu (Conservator-Minziro NFR) and Mr. Noel Meeda (Conservator-Mount Hanang NFR).

We are also grateful to Prof. Neil Burgess (Head of Science at UNEP-WCMC) for his valuable technical assistance and guidance provided to us during the execution of the assignment.

Finally, we would like to thank all other people who in one way or another assisted towards the successful completion of this assignment. Thank you all.
1.0. Background of the Assignment

Tanzania Forest Services (TFS) Agency, through the project titled “Enhancing the Forest Nature Reserves Network for Biodiversity Conservation in Tanzania” financed by GEF through UNDP, intended to establish an information management tool to ensure that Tanzania Nature Forest Reserves (NFRs) are highly marketed and well-coordinated as a network. This intention lead into need for development of a web-driven information management system capable to handle information, integrate, publish, share and disseminate the information on twelve NFRs; Namely: Amani, Nilo, Chome, Magamba, Uluguru, Mkingu, Kilombero, Uzungwa, Rondo, Mount Rungwe, Minziro and Mount Hanang. It was therefore envisaged that the system will be used to market NFRs’ tourism attractions locally and worldwide. At central level, this system is envisaged to streamline management of information, enhance management capacity through transparency, accountability, flexibility, adaptability, participation, predictability and continuity, and enable planning and decision making.

1.1. Objectives of the Assignment

1.1.1. The Main Objective

The main objective of the assignment was to develop a web-driven system that will ensure the Tanzania forest nature reserves are marketed and well-coordinated as a network.

1.1.2. Specific Objectives

Specifically, the consultant was required to:-

i. Identify and prioritize critical information needed to support the planning and management of NFRs

ii. Source and validate existing electronic or hard of NFRs-related information

iii. Convert hard copy information (wherever this is practicable and cost-effective) into an electronic format
iv. Design, implement, test and install a functioning web-driven system to facilitate the storage, retrieval and analysis of NFRs information

v. Advice and support the acquisition of the institutionally compatible hardware and software required to host the electronic information management system

vi. Establish data access and data maintenance protocols for NFRs information

vii. Prepare a complete technical documentation and user manual

viii. Impart knowledge and skills to the NFRs staff member on the developed system

1.3. Key Deliverables

The following key deliverables were envisaged:

i. Inception report

ii. A draft final report.

iii. A fully functional system for Tanzania nature forest reserves

iv. Full documentation (hard and soft copies of the technical and user manual)

v. Training of the functional system to the TFS staff (Conservators and super users).
2.0. Approach and Methodology Used to Performing the Assignment

In order to meet objectives and intended outputs of the assignment, the consultant adopted standard approach and methods for system development. The consultant employed the agile scrum methodology for the Software Development Life Cycle (SDLC); which provides a flexible, iterative development lifecycle, allows for a highly transparent and cooperative process with the stakeholders, providing a better sense of work progress than a more traditional waterfall approach. The TFS staff and key stakeholders were fully involved during execution of the assignment. Specifically, the following activities were undertaken during execution of the assignment; namely: Inception work (consultative meetings and discussion, literature review, inception workshop), System Development (system design, prototyping, implementation & testing), Documentation (preparation of report & manual) and System rolling out (deployment, training & commissioning).

2.1. The Inception (Preparatory) Work

The inception work involved undertaking of all necessary preparatory and planning activities required in order to perform the assignment successfully. This involved the following activities;

2.1.1. Initial Consultative Meetings and Discussions

As a starting point of the execution of the assignment, the consultant conducted consultative meetings with TFS management, conservators from each NFRs and key stakeholders in order to gather broad views, suggestions, observations and perceptions on proposed system. The output of this activity brought in-depth understanding of the assignment, familiarization and a common understanding of the assignment among consultant and TFS agency; hence paved a way for successful execution of the assignment.

2.1.2. Desk Review

The consultant sourced, critically reviewed and analyzed the existing information and situation so as to study the current needs, implemented activities and potentials planned. Specifically, the
consultant looked on existing data types, data collection tools, methods of data collection, hardware, software (application and operating software) and human resources capacity. Further, the consultant explored existing systems with the view of understanding their structure, types of information contained, functions performed, and relations with the proposed system. Also, the consultant reviewed relevant systems include; Nilo website, NAFORMA database, NAFORBEDA, TFS M&E database, Epicor etc. All information gathered were synthesized to provide input for the development of a newly NFRs web driven system.

2.1.2. Preparation and Presentation of Inception Report
Based on the information gathered from consultative meetings and desk review, the consultant prepared an inception report, which was presented to TFS for approval. This report summarized the consultant’s state of mobilization, proposed methodology and approaches, equipment, personnel and work plan for the assignment.

2.2. Development of the System
The system development involved the following standard processes;

2.2.1. System and User Requirement Analysis
This process involved studying and exploring the needs of the system’s users and system itself. The consultant sourced and analyzed requirements, including data types, data relationships (entities relationships), data flow, report types and format, report frequencies as well as capability and interoperability of the proposed system with the other systems. Further, the consultant conducted a thorough study on proposed system to understand its principles and operations. All information obtained (user and system requirements) were synthesized to provide inputs for design and implementation of the proposed system.
Table 1: Minimum requirements and specifications for the system

<table>
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<tr>
<th>S/No.</th>
<th>Basic Requirements</th>
<th>Description/Specifications</th>
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<tr>
<td>1.</td>
<td>Server hardware</td>
<td>Type: Dell Edge R520</td>
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<td></td>
<td></td>
<td>Hard Disk: 5 X SAS 300GB 10K RPM</td>
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<td></td>
<td></td>
<td>RAM: 32GB</td>
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<td></td>
<td></td>
<td>Processor: Xeon 2GHZ 6 Core (20MB Cache)</td>
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<td></td>
<td></td>
<td>Duo Power supply</td>
</tr>
<tr>
<td>2.</td>
<td>Client software</td>
<td>Operating System: <em>Windows 7 or above version</em></td>
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<td></td>
<td></td>
<td>Client Applications: Internet Explorer, Mozilla Firefox, Google Chrome and other available browsers</td>
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<td>3.</td>
<td>Hosting infrastructure</td>
<td>At least internet bandwidth of 512 KBPs</td>
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<td></td>
<td></td>
<td>The system be hosted at TFS Headquarter, and accessed via web pages</td>
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<td>4.</td>
<td>Database Management System (DBM) model</td>
<td>Relational Database Management System (RDBM)-MySQL</td>
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<td>5.</td>
<td>Client Computer Hardware</td>
<td>Hard Disk: 100 GB and above</td>
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<td>RAM: 1GB or above</td>
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<tr>
<td></td>
<td></td>
<td>Processor: Core to Duo @ 1.5GHz</td>
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<tr>
<td></td>
<td></td>
<td>Web Server: Apache Tomcat 7 or above</td>
</tr>
</tbody>
</table>

The following were the main components of system, identified from the system analysis.

![Diagram](image)

**Figure 1: Main components of the system**

### 2.2.2. System Design

This process involved description and conceptualization of the system interfaces/front-end and back-end, business rules, process diagrams, data collection tools and methods, data flow and information sharing. The system was designed in a way that it interoperates with other existing
systems, and allows the future improvement. The design of each system module followed the following process:

- Identification and documentation of various system components
- Defining and documenting the interfaces between the each component
- Doing object oriented design
- Review, change and/approve module design
- Design user prototype interface
- Review, change and/approve user prototypes with TFS project team
- Document final design

2.2.3. System Prototyping

System prototyping is the process of building a typical model of a desired system. It’s a partial translation of the system design. Adhering to this procedure, the consultant developed a system prototype, followed by system full coding.

2.2.4. System Coding

This process involved the full realization of a system design (technical specifications and algorithms) as a computerized system through coding (command lines). The following key technologies were applied to develop the system; (i) Web technology: For development of system interfaces/front-end and (ii) Relational database management system: For development of system back-end. The system back-end was developed in MySQL while front-end and linkage was implemented in PHP.

2.2.5. System Testing

Before deployment of the system, the consultant tested and evaluated the system to ascertain its capacity to perform the intended operations. For testing purpose, sample information from each NFR were used to test and evaluate performance of the system. This procedure brought all the
pieces of system together into a special testing environment to check for errors, bugs, logics, and ascertain if the business flow is captured end to end.

2.3. **System Security Setup**

Security and performance was highly considered as important aspects during development of the system. The consultant recognized that, for any sensitive and valuable system, the aspect of system and data security is very important. To realize this aspect, consultant set system security setup to restrict unauthorized people as well as avoid improper use of the system. To ensure adequate security, routines for identification of users were inbuilt at each level of the system use. In application, every user and administrator of the system has to be assigned a unique identity and password. Authorized users will login system in accordance with assigned permissions and rights. Every data input will be appropriate to that user’s category and assigned rights.

2.4. **Data Quality Control Mechanism**

The protocols for data entry, spot checking, processing and cleaning was also highly considered during system development. This included; data entry range restrictions and consistency checks to appropriate values and violations checks leading to an immediate and transparent message sent to the key puncher, along with a practical method for correcting or overriding key punch errors and documenting any answers that violate the range and consistency check rules. Moreover, the consultant recognized mechanism to support data back-up and periodically archived.

2.5. **Stakeholders’ Workshop**

The consultant in collaboration with TFS organized and conducted a stakeholders’ workshop aimed for validation of the system, and providing training to users. During the workshop, the system was demonstrated, discussed, and training provided to TFS staff. At the end of the workshop, the consultant incorporated the final inputs that led to finalization of the system.
2.6. Preparation of a Report and Manual

The preparation of a final report and system manual came after completion of the assignment. The report gives details of the entire assignment, including: background of the assignment, objectives, system development and practical recommendations; while a system manual describes system design, use, operation help and maintenance procedures.

2.7. System Rolling Out

2.7.1. Deployment of the System

The consultant in collaboration with TFS Agency has put in use the system following its development processing and testing. This activity involved uploading of the system files and contents, and hosting. The system can be accessed by internal users and public via web interfaces. The consultant anticipates that, each NFR’s office will be equipped with all necessary resources, including, human resource, computers and reliable and stable internet facility to facilitate effective and smooth use of system. The system is centralized at TFS headquartered in Dar es Salaam, Tanzania.
2.7.2. Training

Impart knowledge and skills on the developed system, the consultant therefore prepared and conducted a comprehensive training programme to TFS staff including, data clerks, end users and system administrator. Some of the key areas covered in training include; system login and setup, data entry, uploading, updating, system administration, data quality control, queries, reporting etc.

Photo Plate 2: Training to TFS staff

2.7.3. Data Collection, Access and Management

Nature Forest Reserves
Data collection, Entry & access

At TFS Hq/Central Level
-Data approval, Management, Dissemination of information
-System Administration & Maintenance,

Public (Local, National & Global Level)
Information view & access

Figure 2: Data collection, Access and Management
2.8. Workflow Chart

The logic workflow chart (Figure 3) summarizes the main lines of thinking during the execution of assignment.

Inception Work: Planning & Design:
- Consultative meetings
- Desk work
- System & User’s requirements analysis
- Preparation of an inception report

System Development:
- System design
- Prototyping
- Full implementation/coding
- Testing
- Deployment

Documentation:
- User manual
- System manual

Workshop:
- System demonstration & Discussion
- Training

Submission of deliverables:
- Developed system
- System manual
- General report

Figure 3: Workflow chart
3.0. Output of the Assignment: Nature Forest Reserves Web-Driven System

This chapter presents the output of the commissioned assignment. The consultant has completed execution of the assignment successfully. The developed system (Nature Forest Reserves Web-Driven System) is now online, ready for intended uses. The system is a relational web driven management system developed purposely to ensure that Tanzania forest nature reserves are marketed and well-coordinated as a network of forest nature reserves. Through its graphical user friend interface, the system is capable to perform data entry and uploading, storage, query and manipulation, data transfer and reports generation. The system consists of two main parts; namely: front-end and back-end part, each consisting of sub-parts.

3.1. System Front-end

The system front-end (web home page) consists of the web pages with command lines. These are: About Nature reserve, Nature Reserve, Data View, Galleries, Contacts and Site Map (Figure 4).

![System Home Page](image_url)

Figure 4: System Home Page

i. About Nature Reserve: A menu with a command line to open general information on forest nature reserves

ii. Nature Reserve: A menu with a command line to navigate to a specific forest nature reserve page e.g. Amani NFR
iii. Data View: A menu with a command line to open information on; NFRs, Tourism attractions, Fees and Resources within each NFR

iv. Galleries: A menu with a command line to navigate to photos and videos uploaded
v. Contacts: A menu with a command line to navigate to contacts of each NFR

vi. Site Map: A menu with a command line to navigate to geographical location of each NFR via Google map
3.2. System Back-end

The system back-end (relational database) consists of the storage tables linked with front-end. The back-end comprises the following main tables to capture: FNRs, Attractions, Fees, Revenues, Budget, METTs and Resources. Also, the back-end part contains the data and system setup tables.

Each table in back-end has respective:

i. Data entry interface for data entry, editing, approval, queries and generation of reports.

ii. Queries for data filtering/sorting and manipulation

iii. Reports for systematic presentation of filtered data in a standard form

Other tables include:

- Registration for enrolling of system users and administrator(s)
- System Setup for system administrator to fix the constant parameters, and managing system users. It comprises of the following sub-menus: System user, User roles & Change password
- System Security for restricting unwanted users and improper use of the system
4.0. Conclusion and Recommendation

The developed web driven system is ready for its intended uses; available online via [www.nature-reserves.go.tz](http://www.nature-reserves.go.tz). The system has potential and wide uses at different levels. Internally, the system will enable the TFS agency to manage information and have a continuous watch on planned activities with the Nature Forest Reserves, as well as facilitating planning, reporting and decision making. The system is capable to track and manage data for the regular and periodic assessment of NFRs’ performance, efficiency and impacts measurement against agreed targets/stated objectives. Globally, this web driven system will facilitate marketing of tourism attractions within nature forest reserves, in Tanzania.

Based on stated objective, issues aroused during the execution of the assignment and lesson learnt from the assignment, the consultant would like to recommend that the following:

i. TFS agency should make sure that the system’s users adopt application of the system accordingly.

ii. TFS agency should emphasize and conduct a periodic training to data collectors and clerks (Nature Forest Reserves) and system administrator(s) at TFS agency headquarter.

iii. Each Nature Forest Reserves must be equipped with reliable and stable internet facility.
Appendixes

Appendix 1: System and Users Requirements Analysis Tools

1.1. Existing Systems (Software & Database)

<table>
<thead>
<tr>
<th>S/No.</th>
<th>Name of Existing System</th>
<th>Development Environments/Technologies</th>
<th>Location (TFS Hq., Zone, Station etc)</th>
<th>System Main Uses</th>
<th>Accessibility (Online, Offline/Standalone)</th>
<th>Data Communication Protocols (HTTP, FTP, WAN, LAN, SMTP and TCP/IP)</th>
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</table>
1.2. **Specifications of Existing Server, PCs/Laptops and Internet Facility**

<table>
<thead>
<tr>
<th>S/No.</th>
<th>Basic Requirements</th>
<th>Description/Specifications</th>
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<tbody>
<tr>
<td>1.</td>
<td>Server specifications (if available):</td>
<td>Type:</td>
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<td></td>
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<td>HD:</td>
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<td></td>
<td></td>
<td>RAM:</td>
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<td>Processor:</td>
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<td>2.</td>
<td>PCs/Laptops</td>
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<td>Processor:</td>
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<td>3.</td>
<td>Internet facility at Hq. and stations:</td>
<td>Bandwidth:</td>
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<td>etc</td>
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1.3. **Users Requirements**

<table>
<thead>
<tr>
<th>S/No.</th>
<th>Name of Nature Reserve</th>
<th>Data/File name (to be uploaded)</th>
<th>Data Format (Text, Numeric, Picture, Map)</th>
<th>Data Source(Hq., Station, FNR)</th>
<th>Data Capturing Method</th>
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