

Article Id
AL04298

DATA MANAGEMENT IN NATIONAL FOREST INVENTORY

Email

rishavchatterjee20000@gmail.com

Rishav Chatterjee

Molecular Biology & Biotechnology, CPGS-AS, Umiam, CAU, Imphal, India

Forests are commonly known as the lungs of the earth because they have a vital role in maintaining ecological balance and sustaining life on our planet. It is no small task understanding the dynamics of these vast ecosystems, and that is where National Forest Inventory (NFI) programs become important. In the digital era, effective data management forms the bedrock of successful NFIs, enabling informed decision-making, sustainable forest management and environmental conservation. This article examines the complex world of data management in National Forest Inventory with a focus on data models, collection tools, methodologies, and the use of data dashboards and portals.

Information and Communication Technology (ICT)

Information and communication technology (ICT) is an umbrella term that includes the design, development, implementation, support and management of computer-based information systems. In essence, ICT deals with the use of computers and software to convert, store, protect, process, transmit and retrieve information.

Data Integrity

The term data integrity refers to the accuracy and consistency of data. When creating databases, attention needs to be given to data integrity and how to maintain it. A good database will enforce data integrity whenever possible.

For example, a user could accidentally try to enter a vegetation type code into a date field. If the system enforces data integrity, it will prevent the user from making these mistakes, through a warning or error message when wrong data is entered into a specific field. This is one of the advantages of using online field forms in the field data collection. Of course, not all erroneous input can be identified by this formal check.

Database and Database Management System (DBMS)

A database is a collection of data held in a computer system in an organized form for easier access and management. Databases are basically containers for data. In NFIs, databases are used to manage and archive field inventory data, field photographs, maps and remote sensing data, and related documents (such as field manuals, guidelines, inventory reports).

Database Management Systems, commonly referred to as DBMS, are software that allows us to perform various operations on databases. DBMS enable users to access databases, as well as manipulate, report, and represent data. They also help control access to the database. Some examples of popular database software or DBMSs include MySQL, Microsoft Access, Microsoft SQL Server, PostgreSQL, FileMaker Pro, Oracle Database, and InterBase.

Requirements for Forest Information Systems

Forest information systems provide a platform to offer decision-makers with high-quality and comprehensive information that has undergone quality control processes. NFIs and other forest inventory data can be seen as essential elements within this concept.

A modern system for managing forest resource information requires the following:

- Adaptability to different hardware and software environments, different conditions, and different geographical scales of inventory.
- Ability to use existing data in all the phases of inventory.
- Scalability of being transferrable to a larger operating system where it can take full advantage of the larger operating system in terms of performance.
- Flexibility to accommodate diverse data models.
- Adaptability to host data from repeated NFIs with possibly changing variable lists and other adaptations.

In addition, the system should be secure, user-friendly, accessible online and offer flexible reporting tools. The documentation of systems and their procedures needs to be transparent and allow accommodating future improvements.

Choosing ICT Tools for Forest Inventory Data Management

Forest inventory field teams perform most of their tasks outdoors, exposing their equipment to variable weather conditions and rough handling. Because of this, rugged computers are an advantage to work with. However, rugged devices are usually more expensive than standard devices.

Using touchscreen technologies

There are two varieties of touchscreen technologies that are currently in demand—resistive touch, that uses the pressure of the human body as an input, and capacitive touch, that uses the electrical properties of the human body as inputs. While choosing between these two technologies, consider the environment your device will be in.

If your device will be used in more rugged and rainy conditions, that may require wiping the screen repeatedly, a resistive touch panel may work better, as you can use it with both gloved hands and a stylus.

If on the other hand, you are using the device for more sophisticated applications, go for a capacitive touch panel. With capacitive touch panels, multi-touch is not a problem, you can scroll with ease and have excellent sensitivity.

Data Collection for NFIs

Field data can be collected and recorded using electronic devices or printed field forms. Mobile data loggers have been used in NFIs since the late 1980s, and nowadays, rugged tablets or smartphones are commonly used in collecting field data. Data input—into a computer after the field assessment—may be done manually (with a keyboard), via a cable or wirelessly from an electronic device. It is advantageous to perform data entry as soon as possible (in terms of time and space) to where the data is generated.

Data flow from the field into a clean database ready for analysis.

- **Field form data**

While processing field form data, it is recommended to keep photocopies of the field forms at a local office, if possible. The field forms are transferred to the main office, and data is entered manually into the database.

- **Data in PDA/Smartphone**

There are two options in which data can be transported to the main database.

Option 1: After a working day, data is exported from the tablet and copied onto a computer. A 'safety copy' of the data is stored. The data file is then sent to the main office via email, cloud storage or carried by USB memory.

Option 2: Data can also be sent to the server directly from the tablet.

- **Main data**

The main data comprises:

Entry data: This is validated, the 'error list' is removed, and all wrong entries are checked.

Validation data: All mistakes are fixed, and the data is cleansed. It is then ready to move to the next stage.

Analysis data: Clean data is ready for analysis.

Data Transfer and Input

Data transfer from tablets or smartphones can be organized in many ways.

- In cloud applications, data is automatically stored in the cloud server.
- Suppose the offline data is collected first and the device has Internet data connection. In that case, the data can be stored into the cloud server (Google Drive, OneDrive, DropBox etc.) or transferred by email to the office.
- In some systems, collected data can also be exported first into the tablet's storage and then copied or sent wirelessly (e.g., using Bluetooth) to a laptop and transferred later to the central database.
- In some systems, the data can also be sent directly to a network server via a mobile phone network.
- The conventional use of paper field forms requires that the field officer delivers the forms to the office, where they are inputted manually into the main database.

Data Management for NFIs

Specific requirements of ICT systems for forest inventory and monitoring

Here are some typical considerations for a workable information system for NFI:

- The requirements for data, analysis, and reporting are determined by the varying information needs that exist for different situations. Forests are complex, so the DBMS can contain data about trees, other vegetation, fauna, soil characteristics, water flows, etc. Also, spatial information needs to be collected (such as coordinates of attributes).
- The results of a data requirements analysis can usually include topics such as objects, data, relationships, processes, access paths, data integrity, information design, data sharing and data security.
- Governmental regulations, standards, and reporting commitments need to be considered while building these systems.
- These systems usually contain data on changes in the environment and multi-temporal datasets.

Data Dashboards and Portals

Dashboards and portals have the same functionality but different uses. Portals provide a centralized repository for key information for an organization or the public, and they typically contain rich text, shortcuts, interactive images and maps. Some portals can provide real time analysis of the underlying data.

Dashboards, on the other hand, provide quick visibility in order to facilitate understanding, with easy access to the most frequently needed charts, graphs and reports. Furthermore, as a rule, portals produce static representations of results in pre-defined tables and maps, while all dashboards provide more dynamic content by using data models and real time data analysis.

Conclusion

In the scope of National Forest Inventory, effective data management is not only a technical necessity but also an enabler of informed decisions and sustainable forest management practices. Data models, collection tools, and methods constitute the heart of NFIs as they provide strong foundation for understanding the intricacies of forest ecosystems.

Integration of data dashboards and portals ensures that gathered information is not restricted to scientific research but made available for all actors in order to foster collective responsibility over our most valuable natural resources. Yet even as we grapple with environmental conservation, it is the role played by data within National Forest Inventory that point us towards a future in which we can maintain for generations to come, the fine balance between mankind and nature.

Reference

- Freiberg, M., Winter, M., Gentile, A. et al. (2020) *LCVP*, The Leipzig catalogue of vascular plants, a new taxonomic reference list for all known vascular plants. *Sci Data* 7, 416.
- Fridman J., Holm S., Nilsson M., Nilsson P., Ringvall A.H., Ståhl G. (2014) Adapting National Forest Inventories to changing requirements – the case of the Swedish National Forest Inventory at the turn of the 20th century. *Silva Fennica* vol. 48 no. 3 article id 1095. 29 p.
- Tokola, T., Turkia, A., Sarkeala, J. and Soimasuo, J. (1997) An entity-relationship model for forest Inventory. *Canadian Journal of Forest Research* 27: 1586-1594.