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COMMITTEE ON FORESTRY

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Digital innovation for data collection and dissemination on forest resources, their management and uses

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I. Background

1. During its 25th Session (COFO25), the Committee on Forestry requested FAO to identify and promote new technologies and digital innovation for data collection and dissemination on forest resources, their sustainable management and use - including livelihoods and socio-economic data - as well as on forest products, in synergy with other relevant data-related initiatives of FAO such as the Hand-in-Hand (HiH) Initiative, and provide a background document for the consideration of the 26th Session of the Committee on Forestry[1] (COFO26).

2. The 165th Session of the FAO Council endorsed the recommendations contained in the Report of COFO25, and specifically requested FAO to identify new technologies and digital innovation for the data collection on sustainable forestry management and use, as well as on forest products and to continue to prioritize normative and technical work and put emphasis on data, under the Strategic Framework 2022-31.

3. This document presents the status of FAO's use of modern techniques and digital innovations in FAO-led forest data collection, reporting and dissemination activities and provides insight into some future plans for their use. In addition to the FAO Strategic Framework 2022-31, the work presented here contributes to the implementation of the recently endorsed FAO Science and Innovation Strategy[2] and FAO Strategy on Climate Change 2022-2031[3].

II. Introduction

4. Relevant, accurate, up-to-date and transparent information on forests contributes to better reporting, policy formulation and decision-making at different levels. FAO supports Members in the collection, use and management of forest and forestry data and information for policy and decision-making at global, national, and local levels.

5. At the global level, FAO compiles annual statistics on production, import/export, and consumption of forest products (FAOSTAT-Forestry[4] and FAO Yearbook of Forest Products[5]); pulp and paper production and production capacities, and information about the production of recovered wood and paper; and every five years a Global Forest Resources Assessment[6] (FRA) report on forest resources, their management and uses. Furthermore, FAO gathers data on the conservation, use and development of forest genetic resources for monitoring the implementation of the Global Plan of Action (every five years) and preparing the State of the World's Forest Genetic Resources reports[7] (every ten years).

6. One important part of FAO's work is capacity development that takes place at regional, national and community levels. This includes support on reporting on forest product and resources statistics, strengthening forest monitoring and assessment capacity, and cooperation in supply logistics, verification of legality/carbon neutrality and other matters. FAO also supports the generation of local data through community-based forest and land monitoring, aiming to support decision making for the planning and sustainable management of community territories, and for local climate action.

7. At all levels of interaction, the importance of producing systematic, useful data and information is at the forefront of FAO's efforts. The continuous development of new tools, platforms, algorithms,

[1] Report on 25th Session of the Committee on Forestry, paragraph 13; https://www.fao.org/3/ne205en/ne205en.pdf
[2] Appendix D of the Report of FAO Council 170th Session: https://www.fao.org/3/nj485en/nj485en.pdf
[3] Appendix C of the Report of FAO Council 170th Session : https://www.fao.org/3/ni706en/ni706en.pdf
[4] https://www.fao.org/faostat/en/#data
[5] https://www.fao.org/forestry/statistics/80570/en/
[6] https://www.fao.org/forest-resources-assessment/en/
[7] https://www.fao.org/policy-support/tools-and-publications/resources-details/en/c/453621/

and computing resources enables new possibilities that were unimaginable in the past. Data access and analysis in the "cloud", mobile connectivity, drones, hyperspectral and Light Detection and Ranging (LIDAR) imagery with high resolution, artificial intelligence, business intelligence digital data dashboards, and distributed ledger technologies, are only some of the new resources available.

8. Concurrent with the increasing application of available technology, FAO has continuously worked to improve the collection, management, and dissemination of data and information to support Members. In today's world, this means the application of digital technologies to address these key elements. As such, the development of tools and platforms including the Open Foris[8], the FRA Platform[9], the HiH Geospatial Platform[10], and others that are similar, have provided new opportunities for practitioners to leverage the best available methods and data for forest and land measurement and monitoring.

III. Current and forthcoming FAO Forestry work on Digital Innovation for data collection and dissemination

9. The following sections outline the ongoing and forthcoming efforts of FAO to further enhance countries' access to affordable digital technologies for more efficient and transparent data collection and dissemination.

A. Open Foris

10. Since 2011, FAO has been working on a set of free and open-source solutions for environmental data collection and monitoring under the Open Foris Initiative. While the initial focus of the initiative was on field data collection, it now covers most, if not all of the needs of both field and remote sensing based data collection and analysis.

11. Open Foris is a collection of innovative, open-source software that helps countries measure, monitor and report on forests and land use. The tools were developed in close collaboration with 40 countries and partners. They were designed to make the processes of data collection, analysis and reporting more accessible, accurate and transparent and are helping more than 30 000 people across 180 countries to collect, analyse and report forest-related data and information for various national and international needs.

12. The latest improvements in the Open Foris software include the introduction of Open Foris Arena: a novel platform for data collection, analysis, storage, and dissemination. Arena combines the functionalities of several existing Open Foris tools (i.e. Collect and Calc) into a seamless cloud-based system. It eases the management of field data, by enabling users to fully customize the inventory design, structure, variables, data checks as well as analyse the collected data. Arena does not require user installation and all data are stored on a secure "cloud" server. A mobile version of Arena will become available at the end of 2022. Open Foris Arena is focused on field data collection and analysis, and contributions to FAO's Hand-In-Hand Geospatial Platform and the Digital Public Goods Alliance will be explored (see paragraph 14).

13. FAO has also continued enhancing the System for Earth Observation Data Access, Processing and Analysis for Land Monitoring (SEPAL)[11], a free and open-source cloud computing platform for geospatial data access and processing. SEPAL empowers users to process satellite data, create maps, detect land cover and land-use change, and provides many other functions critical to effective land management. SEPAL's latest improvements include the release of a "mobile friendly" version of the platform, improved visualization functionalities and the provision of very high spatial resolution optical data. In addition to common geospatial processing tasks, SEPAL features novel dedicated

[8] https://openforis.org/
[9] https://fra-data.fao.org/
[10] https://data.apps.fao.org/
[11] https://sepal.io/

modules for specific applications, including for monitoring of forest and landscape restoration, and for monitoring fires in real-time, and for running large-area, dense, time-series analyses. Recently, the SEPAL Platform has also been integrated with FAO's HiH Geospatial Platform.

14. In support of FAO's membership of the Digital Public Goods Alliance[12], and as a part of FAO's commitment to the development and championing of digital public goods that will help contribute to the Sustainable Development Goals (SDGs). Open Foris has recently been evaluated by the Digital Public Goods Alliance[13] and formally certified as a Digital Public Good.

B. The Global Forest Resources Assessment (FRA) Platform

15. FAO released the FRA Platform in early 2018 for FRA 2020 data entry, review and validation. The platform's functionalities reduced the reporting burden on countries, increased consistency of reported data, facilitated interaction between the National Correspondents and report reviewers and streamlined the report approval and validation processes. The platform functions also as a dissemination tool, offering public access to all data and metadata that the countries reported to FRA 2020, including for two Sustainable Development Goal 15 indicators (15.1.1 "Forest area as a proportion of total land area" and 15.2.1 "Progress towards sustainable forest management") and most of the indicators of the Global Core Set (GCS)[14] .

16. Since its release, FAO has continuously improved the platform's dissemination functionalities based on the users' feedback to enhance data visualization of and access to country and region-specific data. This includes hosting the quantitative pan-European indicators for sustainable forest management that were collected jointly by FAO, FOREST EUROPE and the United Nations Economic Commission for Europe (UNECE). The collaboration in joint data collection will be further strengthened by integrating the quantitative questionnaire fully into the platform.

17. The foreseen short-term improvements of the platform will focus on the data entry and review functionalities needed during the FRA 2025 data collection phase. The enhancements will include revised validation checks and the addition of observation status flags to reported data. In addition to that, a new generation of easy-to-use geospatial tools will be developed, the platform will be integrated into the HiH Geospatial Platform and the data repository will be improved to further expand the platform functionalities for a multitude of users.

18. The FRA 2025 data collection will start after the FRA expert consultation and nominations of the National Correspondents, both foreseen for the second half of 2022. The National Correspondents and their alternates will receive an invitation to the platform and have access to pre-filled reports with all relevant data and metadata from the previous reporting cycle. This will reduce the reporting burden tremendously and allow allocation of the saved time and resources for further improvement of the consistency of the reports and documentation of the underlying data sources and methodologies. In 2024, FAO will initiate a more flexible reporting process and countries having new data available can request FAO to open their on-line reports for voluntary updates.

C. Forest Product Statistics

19. Migration of the forest product statistics database[15], including annual data on forest product production and trade since 1945, to the FAO corporate Statistical Working System (SWS) was a significant step toward digitalization. The system increased efficiency because it is faster and enables automated data upload and validation, allowing simultaneous improvement of data quality. The

[12] https://www.fao.org/newsroom/detail/bringing-the-benefits-of-digital-agriculture-to-all-fao-joins-the-digital-public-goods-alliance/en
[13] https://digitalpublicgoods.net
[14] https://doi.org/10.4060/cb9963en
[15] https://www.fao.org/faostat/en/#data

availability of online documentation has also enabled a more transparent and replicable system. Finally, the harmonization across various administrative units has allowed FAO and partners to collaborate more effectively both in data processing and data release.

20. This migration has allowed two new and important functionalities. First, the database is now on the "cloud" and can therefore be accessed remotely. The ability to enter, clean, process and even release data from any location has been essential for maintaining data production and the integrity of this long-time series during the COVID-19 pandemic. Second, data on forest product production and trade are now produced in the same format and aligned with all other data available on the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), allowing data-users to download forest product data that are already merged with, for example, information by country and year on the human population, greenhouse gas emissions, or sustainability indicators. In consideration of the improved opportunities for digital dissemination, the Forest Product Statistics Yearbook was produced only in digital format.

21. With the migration to the SWS, there are opportunities for advanced digitalization, including increasing the transparency of the data collection and estimation process; raising data influence by providing more expert insights; improving data communication and perception via an updated data dashboard; strengthening FAO's reputation and partnerships by allowing an online dialogue with data users; and introducing advanced predictive analytics.

22. FAO's work on the Statistical Data Warehouse (SDW) will allow a better integrated and harmonized system of data dissemination across FAO, enabling internal and external users to query, analyse, compare and link forest product statistics across various statistical domains. In 2021, FAO also digitalized its capacity development programme on forest product statistics by conducting the first-ever online capacity-building workshops focused on them.

D. The Hand-in-Hand Geospatial Platform and the Framework for Ecosystem Restoration Monitoring

23. Forest data is included in the HiH Geospatial Platform, the central analytic platform supporting FAO's HiH initiative, and has linkages to platforms such as Open Foris, SEPAL and FRA.

24. Based on the geospatial architecture of HiH Geospatial Platform, FAO has worked across its technical divisions to create a geospatial dissemination platform in support of the monitoring of ecosystem restoration.

25. Under the UN Decade on Ecosystem Restoration a Task Force on Monitoring[16] (led by FAO) will be supporting national and other stakeholders to monitor and report on the progress and achievements of ecosystem restoration through the Framework for Ecosystem Restoration Monitoring (FERM)[17]. FERM is an umbrella framework for tracking the progress of efforts to restore degraded ecosystems in the context of the UN Decade on Ecosystem Restoration building on existing country reporting under the SDGs.

26. The FERM Platform[18] provides an integrated technical solution for restoration monitoring and reporting, providing a wide range of restoration stakeholders with access to up-to-date geospatial data across ecosystems as well as functionality to share their own restoration progress. The FERM intends to enable knowledge and technology transfer and the development of capacity for people, communities, and countries to monitor their own restoration progress, supporting the creation of information by those who are undertaking restoration. The FERM also provides linkage to Open Foris tools such as SEPAL for creating custom geospatial data related to restoration.

[16] https://www.fao.org/3/cb0424en/cb0424en.pdf
[17] https://www.fao.org/national-forest-monitoring/ferm
[18] http://data.apps.fao.org/ferm/

E. Open Data Task Force Initiative and Food and Agriculture Microdata Catalogue

27. Simultaneously, and with increased support for digital data collection, FAO has invested in improved availability, accessibility, usability and transparency of forest-related data and information. To help overcome obstacles to sharing forest data openly and enhance the transparency required by national and international processes, FAO has established an Open Data Task Force to develop open science and data policy guidelines that encourage and promote the principles of open science and data to continue to work on increasing transparency in the forest sector[19].

28. Key FAO forestry databases have been published under an open data license[20]. In addition, FAO has recently supported the inclusion of microdata and metadata from National Forest Inventories in the FAO Food and Agriculture Microdata (FAM) Catalogue by three different countries as a pilot programme to attract others towards releasing their forest data while guaranteeing national data confidentiality concerns and FAO's statistical regulations on data dissemination[21]. The FAM's Forest Inventories section aims to be a one-stop shop containing metadata and provide direct access and/or links to forest microdata through a vetted process that communicates with data providers and data users fluidly.

F. Socio-economic data and livelihoods

29. Based on guidance from the 2019 expert workshop on the Global Core Set of Forest Related Indicators (GCS),[22] the methodology for GCS indicator 13 "Number of forest-dependent people in extreme poverty" has advanced towards the application of geospatial techniques to estimate the number of Forest Proximate People (FPP), as a proxy to forest dependency. FAO worked with the group of scientists who produced the 2012 estimations for Forest Proximate People (Newton et al. 2020) to produce updated estimations of the number of people that live in and around forests. This work combined forest cover and human population density data to map the spatial relationship between people and forests on a global scale. The next step is to add poverty data to further improve the methodology. All programming codes necessary to reproduce the maps in Google Earth Engine will be made freely available together with the data.

30. In 2022, FAO published customizable Open Foris (Arena, Collect, Collect Mobile) data collection templates for the socio-economic survey modules developed earlier[23] currently available in three languages (English, French, Spanish)[24]. In addition, FAO developed separate Open Foris "Village survey" and "Household survey" templates. These surveys are part of a broader package of local-level socioeconomic methods designed to determine the proximate and underlying drivers of forest change in the Congo Basin and they will be tested in the field and published at the Open Foris website later in the year.

G. Blockchain

31. Distributed ledger technologies (DLTs), such as blockchain, have the potential to bring greater efficiency, transparency, and traceability in many areas of forestry. A blockchain is a digital ledger of transactions that is duplicated and distributed across a network of computer systems (often called nodes). It is a decentralized and immutable database that provides transparency, trust, traceability, consensus, accountability, and disintermediation.

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[19] https://www.fao.org/in-action/boosting-transparency-forest-data/en/
[20] https://www.fao.org/3/ca7570en/ca7570en.pdf
[21] For more info, please see "Towards open and transparent forest data for climate action: experiences and lessons learned": https://doi.org/10.4060/cb8908en
[22] https://www.fao.org/3/cb6330en/cb6330en.pdf
[23] https://www.fao.org/publications/card/en/c/I6206E/
[24] https://openforis.org/materials/

32. Blockchains are already being used for some forestry applications, such as tracing and verifying forest-based products and their origin, and have great potential for other sustainable forestry applications, such as reduction of illegal logging and wildlife trade[25] and biodiversity conservation[26].

33. In collaboration with partners, FAO is exploring possibilities of using blockchain technologies for forest management and child labour monitoring and remediation. In 2022, FAO will hold the first virtual fair on blockchain for forestry, where existing initiatives in the sector can share their experiences and innovations. It is expected that the conclusions and outcomes of this event will provide a roadmap for FAO's work on blockchain for sustainable forest management.

H. Modern technologies in field data collection

34. In coordination with partners and Members, FAO has been promoting new tools and technologies for data collection in field inventories. The use of handheld computers or tablets for field inventories in countries such as Ecuador, Equatorial Guinea, Guatemala, Panama and Serbia as well as in Kosovo[27] are good examples of FAO capacity development support. Additionally, FAO has built countries' capacity to use multi-constellation Global Navigation Satellite System, high-precision laser rangefinders, and other devices to improve the accuracy of field plot locations and estimation of critical variables such as tree heights.

35. FAO has also promoted the use of drone aircrafts for data collection and monitoring. For example, in Panama, Indigenous Peoples received training on the use of drones to protect and manage the forest[28]. In Azerbaijan and Kosovo, drones were used for forest inventories and monitoring. Drone demonstration was an integral part of the field visits conducted in the context of FRA remote sensing survey training workshops. As part of multi-disciplinary activities for integrated forest and fisheries management, three drones were purchased for groups in Zambia and a drone pilot training course was successfully carried out, resulting in six licensed drone pilots.

IV. Future aspects

36. Access to data and associated metadata as well as a complete description of the methods used to collect, process and analyse the data are key requirements for transparency, reproducibility and credibility of both data and results. Transparency is also one of the key concepts within the Paris Agreement in the new Enhanced Transparency Framework (ETF) and National Forest Monitoring Systems as well as Measurement, Reporting and Verification processes are required to gain access to performance-based payments in the context of Reducing Emissions from Deforestation and Forest Degradation (REDD+), and other results-based payment schemes.

37. Digitalization of forest data and metadata collection and dissemination can make a significant contribution to increasing transparency and openness of forest information. It can also improve the quality of the data, reduce the reporting burden, facilitate the dissemination of reported data and information, and provide fast and equal access to these resources for all users.

38. To exploit the full potential of digitalization, FAO will continue active collaboration with Members to support transparent reporting of forest-related national level statistics and metadata through relevant FAO reporting processes and, in line with the FAO Strategy on Climate Change 2022-2031, continue building on science-based evidence, including open science and data. Furthermore, FAO will continue supporting collaboration and communication across government sectors as well as through different focal points and experts, to identify and share more detailed spatial

[25] https://wwf.panda.org/wwf_news/?3933466%2FInnovative-Regulatory-Technology-RegTech-firms-work-to-prevent-illegal-financial-flows-from-the-illegal-wildlife-trade
[26] https://www.mdpi.com/2076-3417/12/8/3723/pdf
[27] *References to Kosovo shall be understood to be in the context of Security Council resolution 1244 (1999)*
[28] http://www.un-redd.org/news/indigenous-people-use-drones-protect-and-manage-forest-panama

and tabular data and metadata, gathered through field inventories and remote sensing, on the FRA Platform, HiH Geospatial Platform, Food and Agriculture Microdata Catalogue and other dissemination tools in line with relevant FAO policies, licenses, and practices.

39. Finally, FAO will work in close collaboration with Members to further develop, improve, test and use efficient modern and innovative technologies, such as Open Foris, HiH Geospatial Platform and the FERM Platform, among others, for monitoring the environment, and especially forests and design and implement dedicated capacity development modules to support these efforts.