UN-REDD
P R O G R A M M E

Food and Agriculture Organization of the United Nations

UNDP

UN environment programme

KEY MESSAGES

- Forests are a crucial part of the climate solution if sustainably managed, and sustainable management requires up-to-date, unbiased, accurate and transparent information.

- National forest monitoring systems (NFMS) are a foundation for national decision-making, monitoring the implementation and effects of forest-policy actions, sustainable forest management, REDD+ and the enhanced transparency framework for action and support of the Paris Agreement under UNFCCC, through the provision of transparent, reliable, relevant, accessible and sustainable forest data.

- Since its inception, the UN-REDD Programme has supported over 50 countries in the development of multipurpose national forest monitoring systems.

- The Programme has helped 30 countries to meet their international reporting requirements under UNFCCC and continues to support the strengthening of national forest monitoring systems to generate data to improve the quality of reporting and enhance transparency.

- To help practitioners to put forest monitoring systems in place, the Food and Agriculture Organization of the United Nations (FAO) has developed a range of supporting materials, including the Voluntary Guidelines for National Forest Monitoring and various free, open-source software tools and platforms, such as Open Foris and SEPAL. Those resources have provided a foundation for UN-REDD capacity development over the past 10 years.

INFO BRIEF

GLOBAL

DEVELOPING CAPACITY FOR NATIONAL FOREST MONITORING SYSTEMS

UN-REDD SUPPORT AND INNOVATIVE SOLUTIONS FOR COLLECTING, MANAGING AND REPORTING FOREST DATA

INTRODUCTION

Climate change is the most serious threat to humanity, both today and in the long term. According to the Intergovernmental Panel on Climate Change, almost one quarter (23 per cent) of anthropogenic greenhouse gas emissions between 2007 and 2016 came from the agriculture, forestry and land-use sector (2019). REDD+ activities have the potential to mitigate a significant portion of the emissions coming from forests.

Under the REDD+ mechanism, both reducing emissions and increasing the removal of greenhouse gases from the atmosphere are incentivized by results-based payments. One requirement for receiving those payments is having in place a national forest monitoring system that provides information that is transparent, consistent and suitable for the measurement, reporting and verification of emissions reduction and removal estimates. Over the past 10 years, the UN-REDD Programme has provided technical assistance and capacity

development related to all aspects of national forest monitoring, including the development of technical and functional capacities for establishing national forest monitoring systems, forest reference emission levels or forest reference levels, satellite land monitoring systems, national forest inventories and greenhouse gas inventories.

Over the past 10 years, capacity development undertaken with support from the UN-REDD Programme has given rise to unprecedented transparency in terms of countries' forest data, with more and more countries able to meet international reporting requirements. The application of national forest monitoring systems goes beyond REDD+ and can be used to meet other international requirements as well as national needs, which helps to ensure the utility, sustainability and country ownership of national forest monitoring systems. Tailored national forest monitoring systems enable countries to inform their land-use planning and forest policymaking with up-to-date, reliable, transparent and accessible information.

The Framework Convention on Climate Change has specific provisions for the REDD+ mechanism (reducing emissions from deforestation and forest degradation, including through the conservation and sustainable management of forests and the enhancement of forest carbon stocks in developing countries), a fundamental element of which is the national forest monitoring system. Decision 11 of the nineteenth Conference of the Parties to the UNFCCC lays out modalities for national forest monitoring systems, stating in paragraph 3 that national forest monitoring systems "should provide data and information that are transparent, consistent over time and are suitable for measuring, reporting and verifying anthropogenic forest-related emissions". With the move to higher climate ambition under the Paris Agreement and the enhanced transparency framework, national forest monitoring systems and the transparent data they can provide are instrumental.

COUNTRY CASE: PROGRESS IN COSTA RICA IN DEVELOPING A NATIONAL LAND-USE, LAND-COVER AND ECOSYSTEMS MONITORING SYSTEM

In Costa Rica, deforestation peaked in the 1980s; at that time, the country had one of the highest rates of deforestation in the world. However, according to the publication by the Food and Agriculture Organization of the United Nations (FAO) entitled State of the World's Forests 2016. Forests and agriculture: land-use challenges and opportunities, thanks to a huge national effort, the country has achieved a 54 per cent increase in its forest area since then, reversing the trend and becoming a global example of reforestation success just over 20 years after its deforestation peaked. Until recently, however, despite those achievements, the country did not have a robust and harmonized monitoring system that would allow it to monitor the evolution of its natural resources in a comprehensive manner.

For many years, monitoring of forest and agricultural resources was carried out in isolation, resulting in inconsistencies and limiting the transparency of the reporting required under various international commitments set out in multilateral agreements related to climate change, biodiversity and desertification.

In order to generate high-quality information to support national political decision-making for the management of natural resources, the National System for Monitoring Land Cover, Land Use and Ecosystems (SIMOCUTE) was developed, setting a new benchmark for innovation in monitoring and reporting. Launched in 2015 with support from the UN-REDD Programme and other partners, SIMOCUTE allows users to monitor changes in land cover and use and analyse the state of ecosystems, biodiversity and agricultural and forestry production. It also took into account existing monitoring systems and initiatives in the country, with the aim of integrating and harmonizing them into a single, more robust system.

"SIMOCUTE is an excellent example of a multi-purpose system supporting both data provision for reporting and supporting national needs for decision-making and land management," says Julian Fox, national forest monitoring team leader. "It provides relevant, transparent, reliable and credible data and makes data accessible to both national and international stakeholders."

The monitoring system also offers educational and vocational training opportunities for students and young experts in the early stages of their careers. Including young experts in the planning and organization of the monitoring system is closely linked to the capacity-building and networking strategies that the country has put in place.

SIMOCUTE will contribute to climate action and to the country's pledges under the Paris Agreement by making available robust and transparent data that will enable the country to make decisions and report on its progress at the international level.

Rafael Monge of the National Center for Geo-environmental Information (CENIGA) highlighted the importance of sharing knowledge and building partnerships in the region and beyond. "We are motivated to continue our work and share our experiences with other countries that may face the same challenges we have had in building a robust national forest monitoring system and generating clearer and more transparent, accessible and accurate forest data from our country."

METHODOLOGY

National forest monitoring is a process that includes generating information to allow for the monitoring of changes and trends in forests over time, usually from cycles of data collection (both remote-sensing and field inventory data). The UN-REDD Programme has supported national forest monitoring capacity development in many countries, including for technical capacities, such as data collection and management, and for functional capacities, such as forest inventory planning and implementation, data management and sharing, quality assurance and continuous improvement.

National forest monitoring remains a male-dominated field, but the Programme has worked to achieve gender parity by striving to ensure that at least 30 per cent of participants in its training events and among those holding professional roles are women. Interestingly, with the shift to online events owing to the coronavirus disease (COVID-19) pandemic, women's participation has increased, a trend which needs to be better understood to help to enable women's participation in the future.

Since its inception in 2008, the UN-REDD Programme has contributed to the development of a variety of technical solutions to assist countries in REDD+ measurement, reporting and verification processes. The cornerstone of those efforts is the collaborative Open Foris initiative, which provides free and open-source software and platforms to support multi-purpose forest inventories and cost-effective land-cover and land-use assessments, based on remote sensing and results dissemination (see table). Open Foris can increase the efficiency, transparency and accuracy of forest and land monitoring, which is fundamental to achieving the goals under the Paris Agreement.

The Programme also supports countries in building web-based geoportals, which can increase data transparency for the public and for national and international reporting; support that comprises consultation, training and the implementation of maintenance plans with local staff, after which the portals are maintained in the country by staff of the national Government or from an associated institution.

Open Foris tools, major applications and maintaining units

Tool	Purpose	Major applications	Maintaining unit
Collect	Easy and flexible survey design and data management	Forest inventories; survey data collection; survey design for Collect Earth; data storage	FAO, Forestry Division
Collect Mobile	Intuitive data collection and validation in the field	Field inventories; survey data collection	FAO, Forestry Division
Calc	Efficient data analysis and results dissemination	Forest inventories; Framework Convention on Climate Change and Forest Carbon Partnership Facility country reports	FAO, Forestry Division
Collect Earth	Innovative land assessment through freely available satellite imagery	Activity data collection for forest reference emission level/forest reference level reporting; land monitoring and change detection; reference data collection; map validation; collaborative data collection	FAO, Office of Climate Change, Biodiversity and Environment
Collect Earth Online	Online land monitoring tool		NASA-Servir
SEPAL	Online system for earth observation, data access, processing, analysis and land monitoring	Image mosaics; land monitoring and change detection; remote sensing data processing	SEPAL project in conjunction with collaborative partners

IMPACT

Since its inception, the UN-REDD Programme has supported more than 50 countries in developing national forest monitoring systems using the above methodology of providing technical support and developing innovative technological solutions to make processes more efficient, transparent and accessible. Twenty-five countries have received support for developing national web portals for their national forest monitoring systems, with 15 countries having launched operational platforms disseminating related information, and more than 20 countries have made progress on their national forest inventories. UN-REDD has provided technical expertise and tools so that countries can generate reliable data for the following purposes:

1. To support the formulation, monitoring and adjustment of subnational and national policies related to forests and forested landscapes, including, increasingly, development and socioeconomic policies;

2. To inform citizens and stakeholders about the status, characteristics and development of national forests and the services they provide;

3. To facilitate discussions and the development of agreements at the international level and submit regular reports;

d. To provide baseline data to enable the measurement of progress towards sustainable forest management.

Typical capacity development interventions have included a range of products and results: preparation of online capacity development material (including e-learning programmes and manuals), mapping of existing institutional arrangements, capacity assessment and gap analysis, greenhouse gas inventory calculations through the use of a number of software packages, and reviews of existing greenhouse gas inventories. To date, some 60 per cent of the 50 countries that submitted forest reference emission levels to the UNFCCC have received support from the UN-REDD Programme.

The adoption and use of the Open Foris software and platforms for forest monitoring has exceeded all expectations and the tools available under the initiative have had a positive impact on country reporting under the UNFCCC: 70 per cent of the 60 REDD+ submissions under the Framework Convention have used Open Foris tools or platforms.

By 2020, Open Foris tools had been used in 31 national forest inventories. Other applications under the initiative include land monitoring, collecting dairy industry data, biomass surveys, forest restoration monitoring, map validation and socioeconomic surveys.

OPEN FORIS IN NUMBERS

• 40,000 downloads of Open Foris tools

• 1,192 active devices using Collect Mobile,

• In 2020, Open Foris web site was visited from 192 countries.

• SEPAL is being used by 7,500 users in 180 countries to create crucial forest and land cover information in their efforts to mitigate and adapt to climate change.

SEPAL has been integrated into FAO's new Hand-in-Hand Geospatial Platform to improve the way users can access, compare, and cross-analyse satellite data from the agriculture, fisheries and forestry sectors. Over 1 million geospatial layers and thousands of statistics series, with over 4,000 metadata records, have been assembled on the Platform to date.

COUNTRY CASE: USING SEPAL TO MAP FOREST DEGRADATION IN UGANDA

The lush tropical jungles, rainforests, savannahs, lakes and rivers of Uganda are home to an astonishing array of biodiversity. Forest resources support wildlife, which is vital for the future of the country's heritage and its tourism industry, and are also essential to local livelihoods. However, valuable forest resources are disappearing rapidly, at a rate of 135,200 hectares per year. If the trend continues, most of the forests in Uganda will be gone within a century.

Forest resource information is therefore essential for effective policymaking, reporting, planning and sustainable management, which are all critical in the battle against climate change. The National Forest Authority of Uganda has been working to develop reliable forest resource information using satellite land monitoring systems, managed by the remote sensing/geographic information system unit, a small, specialized team within the National Forest Authority. With the support of the UN-REDD Programme, the unit is now considered one of the most strategic within the National Forest Authority, providing support in mapping, reporting and data production for various projects across the country, including a woodfuel assessment project conducted under the auspices of FAO and the Office of the United Nations High Commissioner for Refugees that is designed to map land area changes around refugee settlements.

Forest degradation, compared to deforestation, is harder to detect and quantify. However, in the summer of 2019, the remote sensing/geographic information system unit took on the challenging task of assessing forest degradation across Uganda for the first time. With the help of the innovative SEPAL platform created by FAO, the first estimates of forest degradation were generated. SEPAL reports and photographic evidence indicated a high rate of deforestation and forest degradation in the Bugoma Central Forest Reserve, a 41,000-hectare protected area that is home to significant biodiversity, although it faces growing human pressure from a nearby refugee settlement.

"Ugandan people depend on forests and trees for cooking, heating and eating," says Edward Senyonjo, Coordinator of national forestry inventories for the National Forest Authority. "This is why we should guide local communities to better manage their forest resources, to avoid degradation and deforestation and improve sustainability."

John Diisi, Coordinator of the Remote Sensing Laboratory at the National Forest Authority, says, "Mapping is key in addressing forest deforestation in Uganda, since you cannot manage what you don't know. The level of degradation determines where our intervention is most urgent and which areas need more protection or restoration."

Diisi was part of the team that worked on the National Forest Authority report for the period between June 2016 to August 2019. With technical expertise provided by FAO, the report covers data and trends from 2016 to 2019 that will support policymaking and management decisions to protect the Bugoma ecosystem, marking an important strategic step towards the sustainable management of the country's forests. As the first-ever forest degradation report produced in the country, it lays the foundation for similar work to be done in the future in other parts of Uganda.
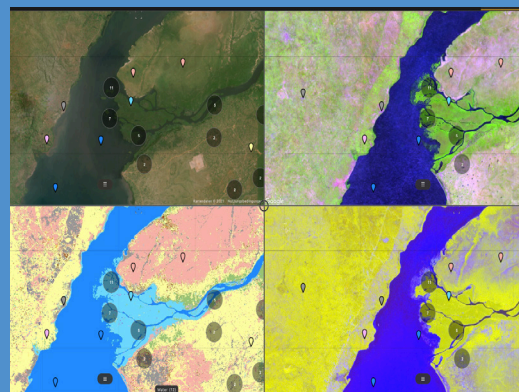
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SUCCESS FACTORS

Successful national forest management can be understood by examining its key requirements. According to the *FAO Voluntary Guidelines on National Forest Monitoring*, the first key requirement of national forest management is to meet multiple information needs, which means that national forest monitoring should produce information that improves the understanding of the role of trees and forests in the relationships and interactions between different land uses. The second requirement is that national forest monitoring should not focus exclusively on land defined as forests, but should include all land that has tree cover and should include not only biophysical data, but also socioeconomic data on the uses of forests and people's expectations in that regard. The inclusion of all forested areas in national forest monitoring enables the effectiveness of potential policies to be better understood and leads to more comprehensive nationally determined contributions and other targets. The third key requirement is that data generated from monitoring should also inform research, including research conducted by national institutions, projects and other collaborators.

The pathway to a successful national forest monitoring system is as follows:

1. The information needs of various stakeholders are determined and set out prior to the creation of inventories to ensure that results match information needs;

2. Data collection, management, processing and dissemination procedures are well designed, implemented and documented. Attention is given to the long-term sustainability of procedures, resources and systems;

3. Records are kept of costs related to the different phases of the work. As technology develops over time, openness is maintained to seek more cost-efficient solutions in the next inventory round;

4. Attention is placed on the impact of national forest monitoring systems, which entails the dissemination of results to decision-makers, counterparts and the public, and ensuring that policy and management decision-makers receive the results in a form that meets their needs;

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5. A mechanism and tools are maintained to track who is using particular results, for what end and how often, including tracking of the ways in which national forest monitoring system information is used in legislation, policies and measures.

Good survey design, field methods and ancillary data are essential for obtaining the most accurate and precise estimates for the state of forest carbon stock and related changes. A well-designed national forest monitoring system can minimize uncertainties by utilizing the data from previous surveys, sampling simulation studies and alternative stratification schemes.

SUCCESS FACTORS

It is acknowledged that national circumstances vary between countries. There is no "one-size-fits-all" approach for national forest monitoring. Instead, national forest management is a long-term process of balancing different and possibly competing technical and policy priorities. As such, there are likely to be trade-offs, as is the case in any national negotiated process.

LESSONS LEARNED

After the implementation of an operational national forest monitoring system, there should be a systematic evaluation that can provide information for lessons to be learned from the whole process and to further improve the system. All actors and stakeholders involved in planning, implementing, analysing and reporting on national forest management results may have relevant observations to share with others.

The principle of developing and sharing free and open-source Open Foris tools has proved successful. However, Open Foris is a collaborative initiative and its effectiveness and impact depend on the activities of committed partners. During the past three years, the collaborative network has expanded quickly, especially among remote sensing experts, but the network needs to grow to strengthen all its measurement, reporting and verification components.

The accessibility and functionality of national forest management tools and platforms need to be continually improved to support the generation of accurate forest information at all scales. Innovation, communication, developing partnerships and incorporating new technologies are key to success. Partnerships will continue to be built and strengthened with public and private sector entities, universities, and technology and international partners.

A national forest monitoring system assessment tool was recently developed. The assessment tool is a practical and quick means for countries to pinpoint gaps and weaknesses in their national forest monitoring systems in order to address their needs in a targeted manner. Changes in working methods brought about by the coronavirus disease (COVID-19) pandemic have entailed the increased use of online learning environments and tools, including topical webinars and collaborative communication software. Work is continuing on updating the national forest management website and the Open Foris support forum in order to provide training, share knowledge, communicate, promote the tools, and gather feedback.

SUSTAINABILITY

Both within and beyond the UN-REDD Programme partnership, national forest management experts continue to organize capacity-building workshops to enhance the capacity of existing national experts, increase the pool of experts and provide a platform for sharing experience and lessons learned. Applications, data, documents, videos and other training materials are available and will increasingly be made available on platforms such as the Hand in Hand geospatial platform, the Global Forest Observations Initiative, GitHub, which is a collaborative code-hosting platform, and Open Foris.

The Open Foris website has an active community support forum that has been successful in providing online technical support to users, and support is also provided by email, through social media and other forms of online communication. As a result, the developers of Open Foris also receive continuous feedback from end users from all over the world.

Open Foris national forest inventory tools are currently being updated and upgraded, and in 2021, a streamlined Open Foris Arena online tool will be launched. The new system will be simple and efficient to use and will offer templates for the most common forest inventory sampling strategies and for data processing and reporting needs, including drop-down species lists to help with tree species identification in the field, which helps to limit the potential for error. The application is designed to operate in the cloud in order to avoid burdensome software installations, although it can also be installed and run locally. Support provided by the UN-REDD Programme for developing national forest monitoring systems is fully adaptable to national needs and priorities, and national forest monitoring systems should be multipurpose and flexible to ensure their continued usefulness well into the future.

COUNTRY CASE: SAFEGUARDING PAPUA NEW GUINEA'S BIODIVERSITY THROUGH A NATIONAL FOREST INVENTORY

With 5 per cent of the world's biodiversity in one per cent of its surface area, the forests of Papua New Guinea are ecological hotspots that are home to more than 13,000 species of plants, 200 species of mammals, 800 species of birds, 300 species of reptiles and 300 species of amphibians. However, scientific understanding of the forests of Papua New Guinea remains weak, and although the country's forests are relatively well-conserved, they are facing increasing pressure from resource extraction through clearing for agriculture and logging.

To address those challenges, between 2014 and 2019, the UN-REDD Programme, FAO and the European Union supported the country's first-ever multipurpose national forest inventory. The ambitious initiative has enabled local scientists to gather important data on the flora, fauna and carbon stock of Papua New Guinea in order to accurately estimate greenhouse gas emissions from deforestation and forest degradation.

"What makes the national forest inventory in Papua New Guinea unique is that in addition to the usual tree enumeration and measurement, we have a comprehensive biodiversity component", says Dr Abe Hitofumi, Chief Technical Advisor of FAO for the national forest inventory project in Papua New Guinea. The project focuses not only on trees, but also on the whole ecological network of interactions through soil science, botany and zoology.

The country's national forest inventory team used Open Foris tools for assessing forest and land-use change. When forestry field officers in provincial offices assessed their provinces, their local knowledge enabled a detailed and accurate interpretation of satellite images. Papua New Guinea has assessed 25,279 points across the country with precise information, including land use, land-use subcategories, year of land-use change and forest canopy cover. That comprehensive data enabled Papua New Guinea to establish a forest reference level for REDD+ in 2017 and to estimate greenhouse gas emissions from land use and land-use change in the forestry sector for the country's first biennial update report in 2019 and to formulate its national REDD+ strategy in 2018.

The national forest inventory project placed particular emphasis on capacity-building through on-the-job training and study tours, and 16 postgraduate students received scholarships. One of them is Redley Opasa, a postgraduate student who recently received a scholarship from the national forest inventory to research and analyse forest data.

Conducting a national forest inventory results in better data, which enables better policies to be put into place to protect the forests of Papua New Guinea. "REDD+ provides that pathway for us. It is a mechanism where we can achieve transformational change within the country and achieve our development aspirations, but in a sustainable way," says Terence Barambi, Manager of the REDD+ branch of the Climate Change and Development Authority in Papua New Guinea.
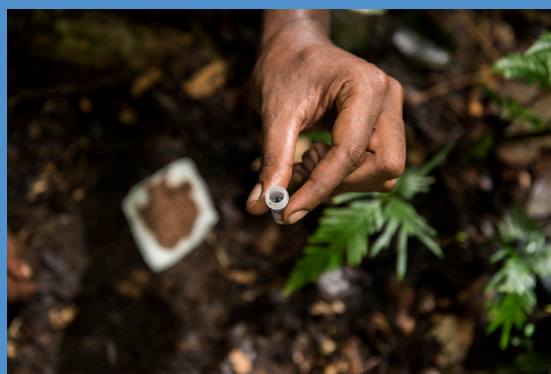
UN-REDD is made up of a pool of experts who work in close cooperation with countries, international and local organizations and private sector partners, and who maintain regular communication with countries, transferring technical knowledge and gathering feedback and information on needs in order to develop user-friendly platforms and tools. Our long-term goal is capacity development in national forest management and national forest monitoring systems that will ultimately support forest-related decision-making at the subnational, national and international levels.

CONCLUSION

With regard to reporting on emissions and emissions reductions, UN-REDD advises countries to follow the guidance from the UNFCCC and the methods and approaches laid out in the guidelines of the Intergovernmental Panel on Climate Change. In its decision 4/CP.15, the fifteenth Conference of the Parties to the Framework Convention requested developing country Parties to establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems that provide estimates that are transparent, consistent and as far as possible accurate, and that reduce uncertainties. In that regard, taking national capacities into account and supporting

countries along a trajectory of stepwise improvements is key to their success. The national forest monitoring system assessment tool can help in that process.

Building a national forest monitoring system is a complex effort that must take into account multiple institutional, technical and financial aspects. The system should increase the transparency and reliability of the information produced and ensure a long-term perspective through participatory processes that include multiple stakeholders with different skills, who must be identified and kept informed throughout the process. Ultimately, a national forest monitoring system can help countries to meet the requirements of the the enhanced transparency framework for action and support of the Paris Agreement under the UNFCCC.

UN-REDD strives to provide countries with the knowledge and tools they need to access cost-efficient technical solutions for enhancing the accessibility, transparency and robustness of forest data and information and to become independent in their forest-monitoring efforts and strategies. The Programme is committed to maintaining and developing innovative technical solutions and providing guidance for countries in the planning and successful realization of all the components of their national forest monitoring.

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TOOLS

- Hand in Hand geospatial platform: http://www.fao.org/hand-in-hand

- Open Foris web site: http://www.openforis.org/

- National forest monitoring system assessment tool: https://www.fao.org/national-forest-monitoring/tools/en/

- National forest monitoring system assessment tool quick guide: http://www.fao.org/3/cb0988en/CB0988EN.pdf

- Measurement, reporting and veri ication geoportals

- Bangladesh: http://geoportal.bforest.gov.bd/

- Bhutan: http://bhutanforestportal.org

- Democratic Republic of the Congo: http://rdc-snsf.org

- Uganda: http://uganda-nfms.org

- Zambia: http://zmb-nfms.org

USEFUL RESOURCES

- FAO's work on National Forest Monitoring: www.fao.org/national-forest-monitoring

- FAO. 2020. Better Data, Better Decisions: towards impactful forest monitoring. Forestry Working Paper No. 16. FAO, Rome. https://doi.org/10.4060/cb0437en

- FAO. 2020. From Reference Levels to Results Reporting: REDD+ Under the United Nations Framework Convention on Climate Change. 2020 update. FAO, Rome. https://doi.org/10.4060/cb1635en

- FAO. 2018. Strengthening National Forest Monitoring Systems for REDD+. National Forest Monitoring and Assessment Working Paper No. 47. http://www.fao.org/3/ca0525en/CA0525EN.pdf

- FAO. 2018. Ten Years of Capacity Development on National Forest Monitoring for REDD+: Much achieved yet more to do. UN-REDD. http://www.fao.org/3/CA1741EN/ca1741en.pdf

- FAO. 2017. Voluntary Guidelines on National Forest Monitoring. http://www.fao.org/3/a-i6767e.pdf

- The work of FAO to enhance national capacities to report on climate change - agriculture, forestry and other land use. http://www.fao.org/3/a-i7210e.pdf

- GFOI. 2016. Integration of Remote-sensing and Ground-based Observations for Estimation of Emissions and Removals of Greenhouse Gases in Forests: Methods and guidance from the Global Forest Observations Initiative. Edition 2.0. FAO, Rome. https://www.fs.fed.us/nrs/pubs/jrnl/2016/nrs_2016_penman_001.pdf

- Open Foris: FAO in collaboration with Google developing innovative technical solutions for catalysing climate action. https://medium.com/@open.foris/openforis-fao-in-collaboration-with-googledeveloping-innovative-technical-solutionsfor-8062f6f4a945

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