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# Ten years of capacity development on national forest monitoring for REDD+

*Much achieved yet more to do*

Over the last ten years, the governments of developing countries and donors around the world have invested heavily in national forest monitoring systems. This paper investigates how capacities have developed and where gaps remain. For a group of 16 countries, the national forest monitoring systems were assessed at three points in time (2008–2015–2018), using a scorecard with 28 indicators for satellite land monitoring systems, national forest inventories, forest reference (emission) levels and national greenhouse gas inventory systems. Overall, as of 2018, a number of

countries have established significant forest monitoring capacities including for REDD+ purposes. Progress is uneven, however, and room for improvement remains among countries. It varies between the pillars of national forest monitoring systems, as well as between technical and functional capacities, but has gained momentum over time. To advance further, governments will need to pay more attention to building up system maintenance and to improving data collection and methodologies.



# 1. A need to better understand progress in NFMS capacity development

Countries with ambitious climate change mitigation targets in the forest and land-use sector need to build and maintain forest monitoring systems that can accurately and transparently track greenhouse gas (GHG) emissions. Providing technical support on building such national forest monitoring systems (NFMSs) is one of the goals of the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD)<sup>1</sup>, launched in 2008. Through this and parallel efforts, donors have allocated funding and the governments of developing countries around the world have placed forest monitoring high on their agendas.

Significant progress has already been made, for example as many as 34 countries have submitted forest reference (emission) levels (FRELs) to the United Nations Framework Convention on Climate Change (UNFCCC) (FAO, 2018a). At global level, this represents 36 percent of forest area and 66 percent of forest loss. Such apparent progress in terms of a key deliverable (the reference level) creates an interest in understanding the underlying changes in forest monitoring capacity for REDD+.

Development projects usually track advancement following theories of change, the technical intricacies of which are not always easily accessible. And unlike development efforts in other fields (social, environmental, health sector, etc.) the long-term impacts of better forest monitoring are difficult to conceptualize, let alone observe.

Because of its fundamental importance for REDD+ (Reducing Emissions from

Deforestation and Forest Degradation in Developing Countries, as well as conservation, sustainable management of forests and enhancement of forest carbon stocks), there is a need to evaluate forest monitoring capacity development. A better understanding of what has (or has not) been achieved could help to direct strategic resources towards the remaining capacity gaps – and build confidence in the potential of REDD+ to generate measurable, reportable and verifiable results. A thorough evaluation of national capacity for forest monitoring will allow countries and support agencies, such as FAO, to consolidate progress and fill gaps.

This paper analyses a unique dataset to observe progress in forest monitoring capacity development. Ten years after the UN-REDD Programme launch, considerable experience, expertise and data have accumulated that allow a retrospective assessment of progress. FAO believes that this analysis will be useful for governments in developing countries, international donors, and those providing technical support on national forest monitoring, to consolidate their achievements.

This paper includes the following:

- The FAO approach to supporting the development of forest monitoring capacities is explained.
- A forest monitoring scorecard is proposed for tracking forest monitoring capacities over time.
- The development of these capacities over the last ten years is investigated in a group of 16 countries that have benefited from FAO support.
- Finally, conclusions are drawn on the success of capacity development and on filling any remaining gaps.

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<sup>1</sup> Under UN-REDD, FAO works together with the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP).



## 2. Complexities in NFMS capacity development

National forest monitoring requires intricate technical know-how, smooth-running government policies and the willingness of recipient countries to “make room” in the forest sector – often already overloaded with political agendas. FAO’s goal is to support a broad group of countries in developing the national forest monitoring systems required for climate change mitigation.

### National forest monitoring systems

FAO’s approach to national forest monitoring and related capacity development is guided by the approach that relevant, scientifically sound and comprehensive information, if tailored to a country’s needs, can improve policy and strategic decision making: *better data – better decisions – better actions*.

To realize this premise, the dynamics of the policy and decision making for which data and information are provided can be as important for policy choices as the quality of the data. Enabling better actions on the ground depends on an ability and willingness to integrate data and information in decision making, as well as awareness of the limitations of the data and related assumptions.

FAO has conceptualized multipurpose forest monitoring systems that provide data and information both for national needs and international reporting. *Voluntary guidelines on national forest monitoring* (FAO, 2017) and its companion publication (FAO, 2018b) document this approach and lay out how an NFMS can provide data and information suitable for national forest monitoring.

In general, the focus of forest monitoring has evolved over time. From assessments of timber stock and growth in the early days, the perspective has increasingly widened to encompass the collection of information on biodiversity and other environmental indicators, as well as the socioeconomic aspects of multipurpose forest inventories. With the challenges posed by climate change and the opportunities created by REDD+, the dynamics of carbon storage in forests have become an important focus of forest monitoring in developing countries.

The establishment of an NFMS is not only one of the core requirements for countries to participate in REDD+, it also provides important input for national GHG inventory (NGHGI) systems and therefore provides a foundation for reporting on nationally determined contributions to the climate change mitigation targets of the Paris Agreement. Ideally, an NFMS should be robust, flexible, allow for constant improvements, build upon existing systems, and provide data that are transparent, accurate and consistent over time.

Forest monitoring in the context of REDD+ is considered to have three “pillars” (FAO, 2018b). These correspond to the components of the Intergovernmental Panel on Climate Change approach to estimating emissions (i.e. emissions = activity data x emission factor):

- A *satellite land monitoring system* (SLMS) to periodically collect spatial data on land cover and/or land use and its changes, including deforestation and forest degradation – i.e. to supply activity data.



- A *national forest inventory* (NFI) to collect information on forest carbon stocks and changes – i.e., to provide emission factors.
- The *GHG estimates* themselves, notably the forest reference (emission) level (FREL) as a basis for calculating REDD+ results. Such REDD+ reporting should draw on the NGHGI system that compiles anthropogenic GHG emissions and removals, including those that are forest-related.

## Capacity development for national forest monitoring

Establishing and running an NFMS is an organizational and technical challenge for many developing countries. FAO has been supporting forest monitoring in its member countries for decades.

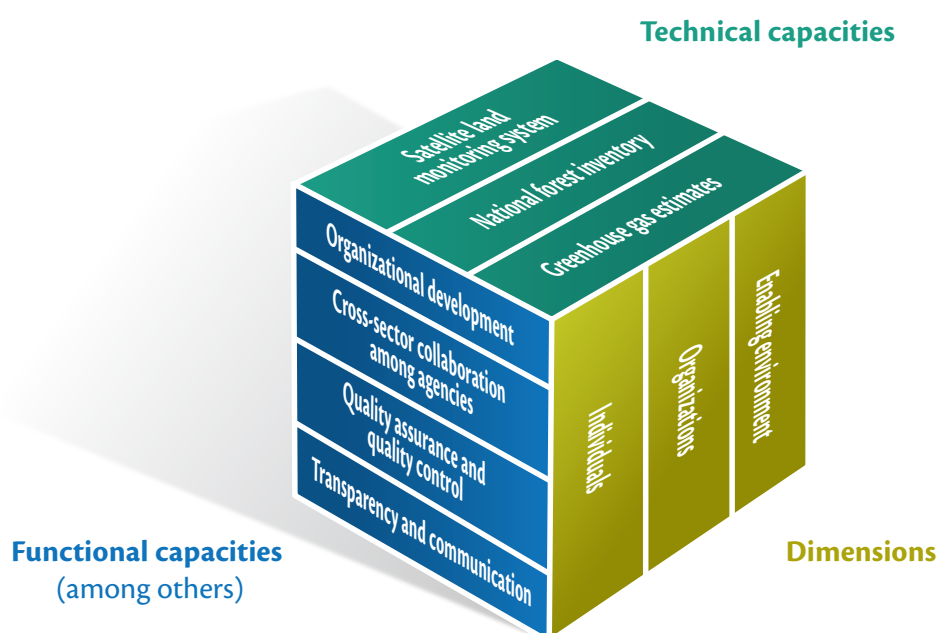
These efforts have concentrated on three interlinked levels. First, technical experts receive training and coaching in data collection and management. Second, organizations, often government agencies, receive advice on developing institutional capacities. Third, an enabling environment is created, such as by raising awareness among senior decision makers on running national forest monitoring systems in the long term (Figure 1).

FAO's preferred method of supporting countries in developing an NFMS consists of a mixture of in-country and remote support. While the focus is always on knowledge transfer in order to capacitate national staff and institutions in a sustainable manner, FAO regularly sets up national programmes and maintains a group of technical experts in-country for several years to interface with government staff on a day-to-day basis. In addition, a team of specialized international staff provides more targeted support on technical topics. These teams

of experts support country governments through a mixture of data provision, training, coaching, technical advice, process advice, as appropriate, depending on country capacities and requests.

Since the UN-REDD Programme was launched in 2008, FAO has been engaged in NFMS capacity development in a REDD+ context. As many as 64 countries have joined the programme, and 26 of these have (or have had) national programmes or targeted support for REDD+ readiness. More recently, FAO has increasingly been replicating its capacity development approach to support REDD+ readiness in other contexts, such as providing technical support to the World Bank Forest Carbon Partnership Facility and the Central African Forest Initiative, among others. These broad experiences have made it possible for FAO to compile the unique dataset that this paper uses to assess NFMS capacity development.

In parallel, FAO has developed innovative open-source software: Open Foris and SEPAL (System for Earth Observation, Data Access, Processing and Analysis for Land Monitoring). These software packages help countries with forest monitoring, offering unparalleled access to satellite data and computing power.



**Figure 1: FAO's capacity-development approach to national forest monitoring systems (based on FAO, 2015a)**

### 3. Tracking capacity development using a forest monitoring scorecard

FAO has developed a forest monitoring scorecard to assess capacity in the three NFMS pillars (Table 1). The scorecard rates a given country's national forest monitoring system relative to an ideal situation. It provides an instant snapshot of the current situation, and a comparison of successive assessments allows progress to be tracked.

This approach was inspired by the concept of the balanced scorecard, a common tool for performance tracking in a business context (Kaplan and Norton, 1996). While development agencies commonly structure interventions according to a theory of change and elaborate causality assumptions, they have recently experimented with scorecards

for progress assessment in capacity development (GEF, 2010; ODI, 2005; TNC *et al.*, 2010; UNDP, 2007). In a closely related context, similar scorecards have been developed to assess NGHGI systems (Neeff *et al.*, 2017). Initial efforts have even been made for national forest monitoring systems (Peneva-Reed and Romijn, 2018).<sup>2</sup>


The scorecard indicators reflect the three pillars of forest monitoring (satellite land monitoring, national forest inventories and GHG estimates). The NGHGI systems and forest reference levels both relate to reporting GHG estimates but are disaggregated separately.

Indicator scores reflect whether a particular pillar of forest monitoring exists or not, and

<sup>2</sup> Although the study for the US Geological Survey (Peneva-Reed and Romijn, 2018) is similar in its basic layout, the forest monitoring score includes a higher level of detail in its indicators and therefore contains more information. Also, this study assesses a much larger group of countries.

**Table 1: Summary of the forest monitoring scorecard (see Annex for details)**

	Satellite land monitoring system
SLMS-1	Have historical remote sensing data been analysed?
SLMS-2	Is there a regular ongoing government programme for land monitoring and mapping?
SLMS-3	Is the geographic information system and remote sensing laboratory well equipped?
SLMS-4	Do relevant agencies effectively collaborate on land monitoring?
SLMS-5	Is an accuracy assessment being carried out?
SLMS-6	Are land monitoring data routinely archived?
SLMS-7	Does the government have the technical capacity to carry out forest land monitoring for REDD+?
	National forest inventory
NFI-1	Has a field-based forest inventory at a national scale been completed yet?
NFI-2	Is there an ongoing programme for periodic inventories with institutional and budgetary provisions?
NFI-3	Has a methodology for a field-based forest inventory been agreed?
NFI-4	Do data include ground-based biomass measurements for non-forest land-cover types?
NFI-5	Are data centrally managed for field-based forest inventories at national scale and for regional inventories?
NFI-6	Are inventory results widely and transparently available?
NFI-7	Does the government have the technical capacity to carry out a field-based forest inventory for REDD+?
	Forest reference (emission) level
FREL-1	Has a FREL been developed and submitted yet to the UNFCCC?
FREL-2	Does ongoing land monitoring allow for change detection based on detailed classification scheme?
FREL-3	Have scope, scale and construction methodology been decided?
FREL-4	Have emission factors been chosen?
FREL-5	Has a forest definition been chosen for the FREL?
FREL-6	Have details on national circumstances been collected?
FREL-7	Does the government have the technical capacity to develop FRELs for REDD+?
	National greenhouse gas inventory
NGHGI-1	Does the government regularly report on land use in the NGHGI including the BUR Annex on REDD+ results?
NGHGI-2	Is there a GHG inventory team available for land use, land-use change and forestry?
NGHGI-3	Is there a functioning data-sharing process between institutions involved in the NGHGI?
NGHGI-4	Is the methodology documented transparently and in detail?
NGHGI-5	Are QA/QC procedures in place and being performed?
NGHGI-6	Are an inventory improvement plan and a key category analysis in place and basis for planning?
NGHGI-7	Does the government have the technical capacity to produce an NGHGI including the BUR Annex on REDD+ results?



to what degree it has been developed. Usually, indicator assessments are not binary in nature but show graduations of achievable progress. Four levels were considered and recorded as stars:

- no ☆ (for example, there may be no government programme for land monitoring at all);
- ★ (for example, there may be irregular land monitoring);
- ★★ (for example, there may be an ongoing land monitoring programme dependent on external resources);
- ★★★ (for example, the ongoing monitoring programme might have regular staff and its own budget allocation).

A unique dataset is required to assess capacity development over ten years in a representative group of countries. FAO examined the 16 countries that had active UN-REDD national programmes at the time of the first assessment in 2015 (when the work on this study began): the Kingdom of Cambodia, the Republic of Colombia, the Republic of the Congo, the Democratic Republic of the Congo, the Republic of Côte d'Ivoire, the Republic of

Ecuador, the Republic of Indonesia, the Lao People's Democratic Republic, the Federal Republic of Nigeria, the Republic of Panama, the Republic of Paraguay, Independent State of Papua New Guinea, the Democratic Socialist Republic of Sri Lanka, the United Republic of Tanzania, the Socialist Republic of Viet Nam and the Republic of Zambia.

To measure progress, information is available on the three points in time 2008–2015–2018, spanning the ten years since the UN-REDD Programme was launched. Collecting information on several points in time required combining data sources (see Annex for details of data sources). Surveys were carried out among FAO staff in 2015 and 2018. For the year 2008, historical FAO assessments and countries' National Communications to the UNFCCC were used, along with other relevant reports. Some of the assessments were validated with government staff.

## 4. What has and what has not been achieved during ten years of NFMS capacity development?

Overall, as of 2018, a number of countries have established significant forest monitoring capacities. Progress is uneven, however, with room for improvement across the board. Moreover, progress varies between the three pillars of forest monitoring, as well as between technical and functional capacities, and has gained momentum over time.

### Progress by country

In 2018, countries score high in the assessment of forest monitoring capacities. As many as 13 out of 16 countries have above 50 percent of their indicators rated as ★★ or ★★★★★. This progress has been achieved starting from a low

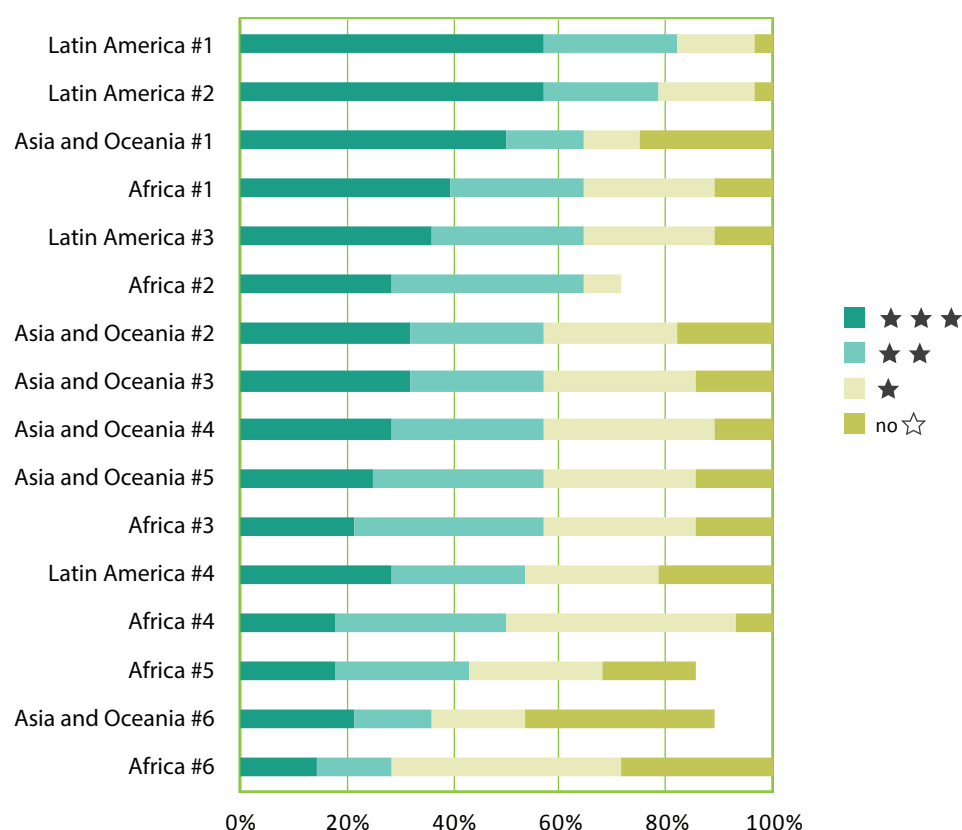
base: in 2008, only three countries had over 10 percent of their indicators rated as ★★ or ★★★★★.

Although, in aggregate, there is clear progress, capacities remain uneven across countries. The countries where data was collected, fall into three distinct groups (Figure 2):

- two countries stand out where around 80 percent of capacity indicators were rated as ★★ or ★★★★★;
- for twelve countries around 40–60 percent of capacity indicators were rated as ★★ or ★★★★★; and
- two countries have less than 40 percent of capacity indicators rated as ★★ or ★★★★★.

### Forest monitoring capacity in 16 countries

Percentage of capacity indicators rated as no ☆, ★, ★★ or ★★★★★ in 2018



Note: Missing values are left blank

Figure 2: Capacity indicator ratings in 2018



The two leading countries happen to be the only ones in the group that are already receiving bilateral or multilateral results-based payments through their REDD+ programmes.<sup>3</sup> Most obviously, this observation might be interpreted as strong forest monitoring capacity being a functional precondition for countries to access results-based payments. But less straightforward conclusions are also possible, such as strong forest monitoring capacity being a key aspect of forest governance that enables mitigation. Such insights into individual country cases need to be understood through detailed country-level evaluation.

Even the strongest countries where results-based payments are already flowing have ample room for developing their capacities. The three best-performing countries have around half the capacity indicators rated as ★★★. The other indicator scores were still only ★ or ★★, so further work should be targeted to improve forest monitoring.

The majority of midfield countries, where most indicators are rated as ★ or ★★, need more capacity development to join the leading

cohort and qualify for results-based payments. And about 20 percent of capacity indicators still had no ☆, so further capacity development is required, focused on the specific indicators that received low scores.

In some countries forest monitoring capacities remain limited. Most indicators are rated no ☆ or ★ only, despite the support provided. Whereas in this paper conclusions cannot easily be drawn on the particular barriers to progress, two of the 16 countries have particularly low mitigation potential and an especially weak forest sector. The specific reasons for lack of progress in these countries could be revealed through a more detailed in-country evaluation.

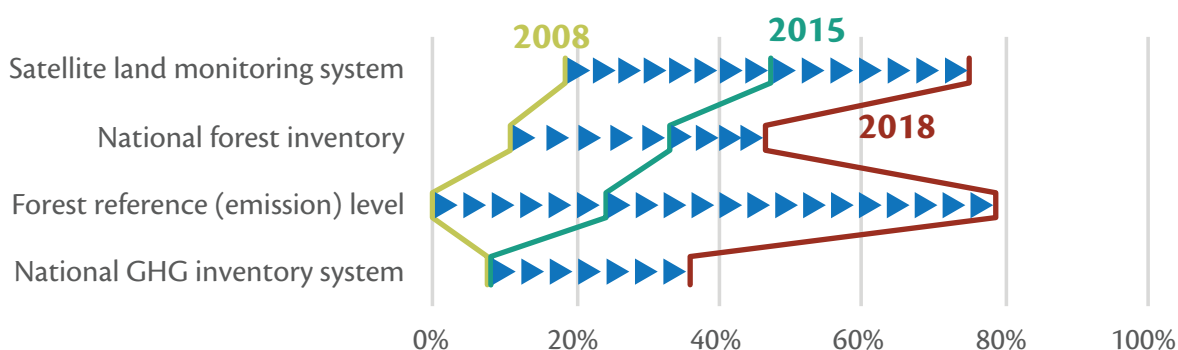
## Progress by NFMS pillar

Progress varies between the pillars of national forest monitoring. Progress is most obvious for forest reference (emission) levels and less so for national forest inventories and satellite land monitoring systems. NGHGI systems still need more investment (Figure 3).

Progress is most obvious for *forest reference (emission) levels* for two reasons. First, the FREL

## Capacity improvement over the last ten years

Capacity indicators rated as ★★ or ★★★, summed for 16 countries



**Figure 3: Progress in ratings of capacity indicators between 2008–2015–2018**

<sup>3</sup> Although some of the other countries have such deals signed, payments have not yet been made.

concept was only recently introduced and consolidated in the 2013 Warsaw Framework, so that progress started from a zero base in 2008. Moreover, the effort required for the development of FREL submissions cannot be compared with that of the underlying data collection. Most FREL indicators are concerned with technical and methodological features and deliverables (e.g. maps), whereas it was not found appropriate to designate an indicator for availability of an ongoing government programme (since the NGHGI system is assessed separately here). In 2018, most of the countries have submitted their FRELs and over 80 percent of capacity indicators are rated as ★★ or ★★★.

Although FRELs and *national greenhouse gas inventories* draw inputs from larger forest monitoring efforts, dedicated capacity is required. This can be seen from the fact that progress on NGHGIs did not parallel that on FRELs, although both are concerned with emissions reporting. In a REDD+ context, NGHGI systems are not a core focus of current FAO support and, in 2018, still only around 30 percent of indicators were rated as ★★ or ★★★.

Building *national forest inventories* takes longer than preparing FRELs and requires more effort. Although progress was harder to achieve, it was significant. On aggregate, countries moved from a base of less than 10 percent of ★★ or ★★★ indicators in 2008 to just under 50 percent in 2018.

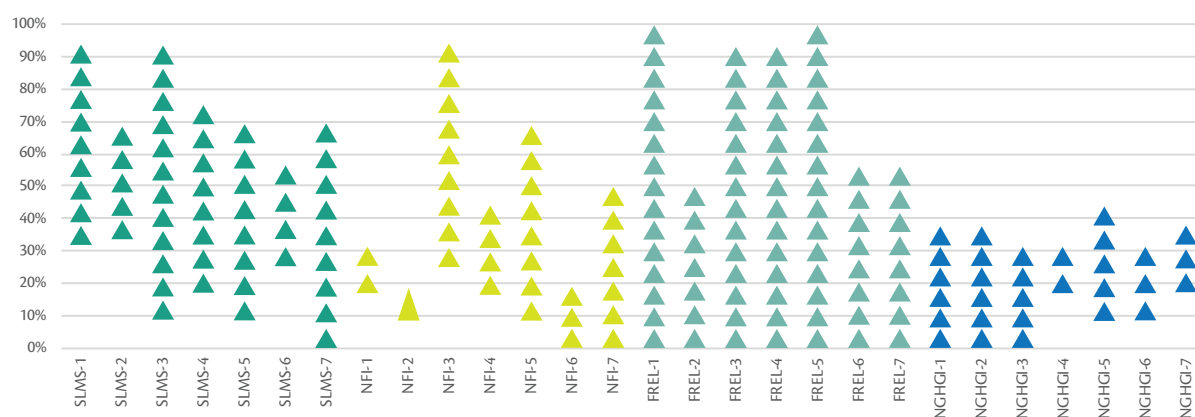
Similarly, while work remains to be done, a good level of technical capacity has already been achieved on *satellite land monitoring systems*. In 2018, close to 80 percent of indicators are rated as ★★ or ★★★, up from just under 20 percent in 2008. In addition to much focus on technical capacity development, the opening of the Landsat archives in 2008, which gave countries free access to high-quality data, may have catalysed progress.

## Progress by deliverables, technical and functional capacities

Examining individual indicator scores sheds light on observed differentiated progress for the three NFMS pillars (Figure 4). The 28 indicators fall into sets of seven that reflect these pillars, covering information on deliverables,

### Breakdown of progress by indicators, 2008–2018

Increase in percentage of capacity indicators rated as ★★ or ★★★, summed for 16 countries



**Figure 4: Progress in ratings of the 28 individual capacity indicators**  
(see Annex for definitions of indicators)

technical and functional capacities, together with miscellaneous information on country progress.

Whereas there was progress on some indicators, it was much slower on others, indicating particular barriers to capacity development. Among those indicators where progress has been slower, SLMS-6 is concerned with archiving systems for land monitoring data. The necessary databases need to be maintained by those government agencies with a mandate to coordinate spatial information, which usually only marginally benefit from capacity development on forest monitoring focused on forest agencies. Indicator NFI-6 is concerned with transparency around inventory data. Detailed documentation and boundaries on the public availability of forest inventory results are both important and difficult to tackle, so that reducing transparency is often the easiest way to avoid misuse. Indicator GHG-4 is concerned with documentation of methodology in GHG inventories. Compiling national inventory reports for this purpose

is an arduous task for the compilers, who are often not free to spend the required levels of time and effort, especially in environments that do not yet fully appreciate the importance of transparency on data sources and methods. (The equally conspicuous indicators NFI-1 and NFI-2 are discussed below.)

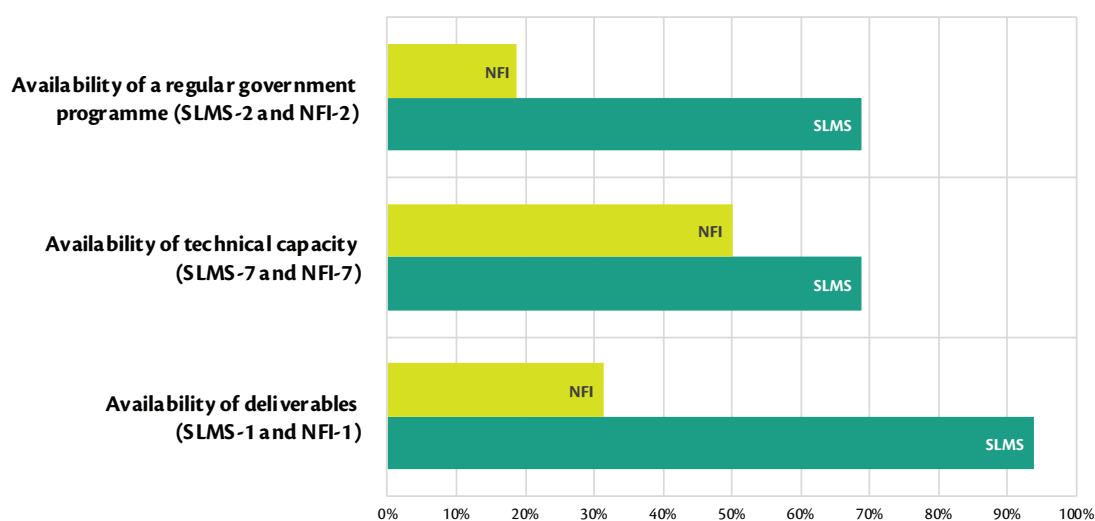
A closer look at the availability of government programmes, indicators for technical capacity and the provision of deliverables explains why overall progress was much better on satellite land monitoring systems than on national forest inventories (Figure 5).

Targeting government staff with technical training has produced consistent results for both satellite land monitoring and national forest inventories. The indicators concerned with technical capacities progressed in around 60 percent of the 16 countries, from no ☆ or ★ in 2008 to ★★ or ★★★ in 2018.

Producing the deliverables (i.e. maps or a national inventory itself), is in turn much easier for satellite land monitoring that relies on often freely available Earth Observation

## Uptake and sustainability?

Percentage of capacity indicators for SLMS and NFI rated as ★★ or ★★★ in 2018, summed for 16 countries



**Figure 5: Ratings of indicators for government programmes, technical capacities and overall deliverables**

data, than it is for national forest inventories that require costly fieldwork. Regarding the deliverables, about 90 percent of the countries achieved ★★ or ★★★ in 2018 for satellite land monitoring, but only about 30 percent for national forest inventories.

In relation to this, many countries have regular programmes for satellite land monitoring, which are also useful for other government functions beyond forests and forestry. Regarding regular government programmes, close to 70 percent of the countries have ★★ or ★★★ in 2018.

But only a few of the countries domestically fund forest inventory programmes, and less than 20 percent have ★★ or ★★★ in 2018. As budgetary requirements are high, maintaining a national forest inventory programme is not an immaterial investment. To support production forestry (e.g. to determine cutting rates), countries may often maintain

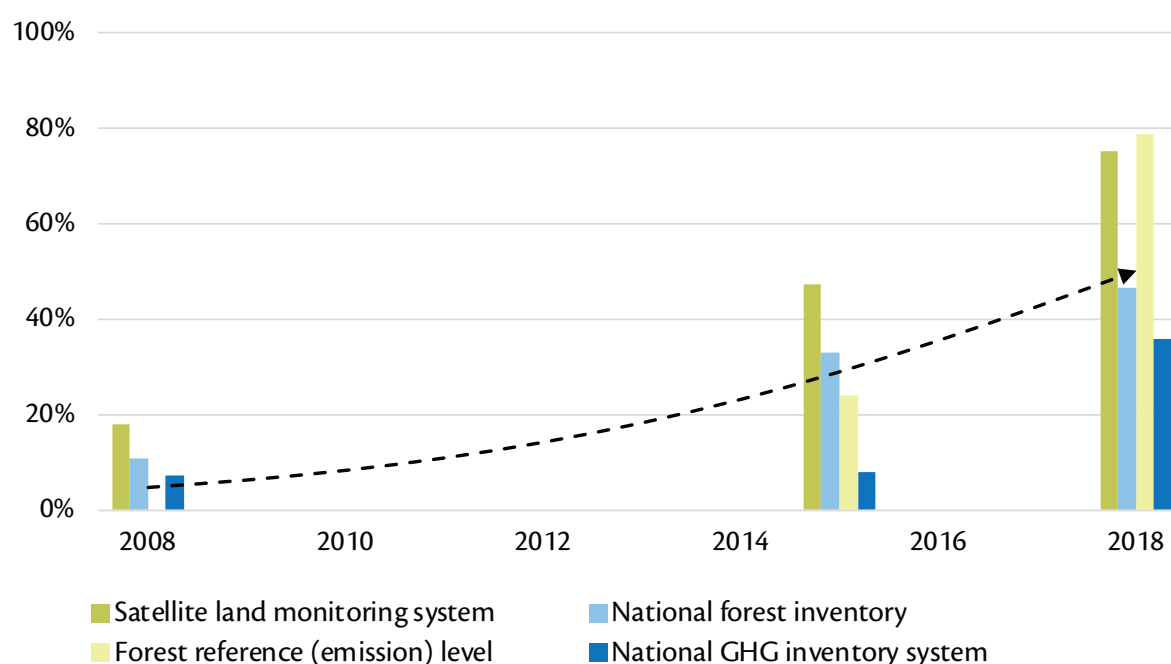
separate inventory arrangements that deliver information at the scale of management units. Forest monitoring for REDD+, in turn, requires broad national averages, but REDD+ prospects have not yet convinced most countries to make available large amounts of domestic funding for national forest monitoring. Investing in an NFI also makes sense for countries that need data to support national forest policy or that see the inventory as a foundation of organized forestry, because it provides the methodological basis for any structured information system, whether for forest management purposes or for international reporting.

## Progress over time

Most of the progress achieved is relatively recent, as it takes time to gain momentum. Starting from a low base in 2008, counts of capacity indicators rated as ★★ or ★★★ had more than doubled by 2015, and then doubled again by 2018, in only three years (Figure 6).


### How capacity gains momentum over time

Percentage of capacity indicators rated as ★★ or ★★★, summed for 16 countries



**Figure 6: Capacity ratings in 2008–2015–2018 with a visually drawn trend line**





In the early days of REDD+, developing a suitable NFMS was particularly difficult. In many countries, there may have been little awareness of the opportunities offered by REDD+ among government technical officers and senior decision makers whose support is instrumental in developing institutions and processes. But even among those providing technical support, whether FAO or other

agencies, it took years to develop conceptual clarity, tools and software packages on NFMS, and build up a pool of specialized staff. Only when the Warsaw Framework for REDD+ was agreed in 2013 did countries have some guidance on how to approach forest monitoring in this context.

## 5. Building on apparent momentum to further strengthen forest monitoring

Much has been achieved – yet there is more to do. On the tenth anniversary of FAO's work to support countries in forest monitoring for REDD+ under the UN-REDD Programme, progress to date and the need for continued investment to maintain momentum and address any remaining gaps are noted.

The data in this paper suggest that countries have made progress in national forest monitoring. Ten years ago, few of the countries FAO assessed had significant capacities in this context. In 2018, most countries collect high ratings according to the NFMS scorecard.

To progress further, governments should pay more attention to building up system maintenance and improving data collection and methodologies. Indicators measuring the institutional aspects of NFMS scored lower than those associated with outputs such as UNFCCC submissions. This observation raises questions on the sustainability of capacities and systems. Despite ample technical support for REDD+ readiness, investment in functional capacities for NFMS may need strengthening, leveraging both national budgets and international support.

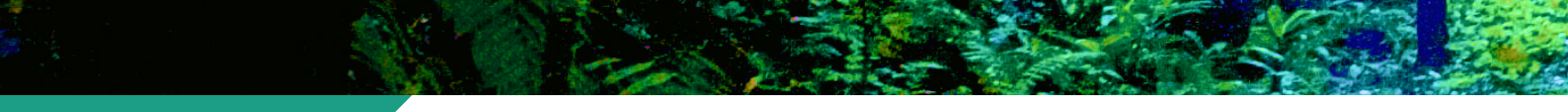
Also, while progress on FRELS has been effective, there is an opportunity to leverage forest monitoring to improve NGHGI systems, which will play a key role in reporting the achievement of nationally determined contributions (specific country climate goals and plans) under the Paris Agreement.

Developing forest monitoring capacities takes time.<sup>4</sup> High-quality data can be bought, technical training can be delivered quickly, but to be durable, an improved NFMS needs streamlined government processes, strengthened institutions, a better basis for trust among those collaborating on forest monitoring, capacities to develop usable information from data, and above all an awareness of the benefits of a high-quality evidence base for better decision making. Sustained technical support is required, alongside efforts to garner the political will to make forest monitoring a priority, and to support systems development and maintenance.

The two countries that scored highest in overall forest monitoring capacity are those already receiving results-based payments. Clearly, a strong NFMS is a functional precondition

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<sup>4</sup> It has often been pointed out that developed countries have taken decades to build their NGHGI systems for Kyoto Protocol reporting (Neeff *et al.*, 2017). Similar observations could also be made for their SLMSs and NFIs.



for access to payments. But the observed coincidence between a well-developed NFMS and results-based payments can also be interpreted differently. Further consideration is required to understand whether countries with conditions conducive to reducing deforestation tend to be the same ones that have better forest monitoring capacities. More generally, FAO is keen to evaluate the contribution to forest governance of enhanced transparency from a well-functioning NFMS.

Quantifying forest monitoring capacities and tracking country progress is difficult but these factors have been found to be measurable. Much thought has been dedicated to forest monitoring in a REDD+ context (some of the literature is referenced in this paper), but actual achievements in capacity development are usually not the focus of attention.

It is hoped that this approach and the evidence presented here will contribute to a better understanding of NFMS capacity development and reassure donors and developing countries alike – helping to increase confidence in REDD+ and its potential to generate measurable, reportable and verifiable results – while supporting country efforts to build an evidence base for improved forest and land management.

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## Annex on methodology

### Development of a scorecard for national forest monitoring capacity

The forest monitoring scorecard was the basis for rating country capacity in forest monitoring. The 28 indicators fall into four sets, which reflect the three NFMS pillars (satellite land monitoring systems, national forest inventories, emissions estimates), where NGHGI systems and forest reference levels are disaggregated separately although they both relate to reporting emission estimates.

Each of the four resulting sets of seven indicators includes one indicator relating to the overarching deliverables (e.g. availability of UNFCCC submissions), one indicator relating to the availability of a government programme (e.g. a domestically funded national forest inventory), several indicators to reflect general quality requirements (e.g. data coverage, quality management systems), and one indicator directly reflecting technical capacities.

The scorecard indicators reflect a common view of good practice for national forest monitoring in the context of international reporting requirements. They were developed over several iterations during 2015–2018 within FAO's national forest monitoring team, which brings together experience from many countries. They are inspired by applicable rules (FAO, 2018a), practical guidance (GFOI, 2016) and other approaches to quantitative scoring of forest monitoring capacities (Neeff *et al.*, 2017; Romijn *et al.*, 2012). The scorecards were tested extensively in country-level capacity assessments, where

they supported the drawing up of technical assistance programmes.

Indicator scores reflect whether a certain NFMS pillar exists or not (e.g. public availability of data, availability of key category analysis, domestic funding for inventories). The scores also reflect to what degree the pillar has been developed, showing graduations of achievable progress, recorded as stars on four levels.

The individual scores deliver the most important information regarding capacity gaps and improvement needs. However, the total counts of star ratings for the various indicators, the three pillars, and even entire forest monitoring systems, also give interesting insights.

Caveats could be offered against the scorecard approach for quantifying capacity development. Observed progress cannot be attributed to FAO support alone, as countries often receive parallel support through various channels, which could all have contributed to realizing the observed capacity improvements. Moreover, the implication is not that (all of) the observed improvements are sustainable, as the scores ultimately reflect no more than a snapshot of capacity at the time of assessment. Lastly, opinions might differ on whether the “right” indicators have been selected to quantify country capacities. Forest monitoring systems are difficult to judge and the breakdown into four capacity levels is necessarily a one-size-fits-all approach that can only incompletely represent complex technical and functional aspects. Clearly, capacity development is difficult to measure.





## Data collection

A unique dataset is required to assess capacity development over ten years in a representative group of countries. Logistical difficulties complicate data collection from many countries, and some of the assessments need to look back in time to establish a reference for progress.

Although a group of only 16 developing countries was assessed, this sample is believed to be sufficiently broad to allow generalizations. The data would therefore reflect trends beyond the countries assessed and allow conclusions to be drawn on forest monitoring progress in general.

Measuring progress requires information at several points in time. This study first collected data on forest monitoring capacities in 2015, then time points for 2008 and 2018 were added to span the ten-year period since the UN-REDD Programme was launched.

Collecting information on several points in time required a combination of data sources. First, a survey was carried out among FAO staff based in the 16 countries. As FAO maintains support programmes for national forest monitoring in those countries, there are specialized technical staff available at all locations. This survey, which assessed current capacities using the forest monitoring scorecard, was carried out twice (2015 and 2018).

Second, additional resources were used to gain a view on historical forest monitoring capacities in 2008. The so-called NFI briefs are a set of country-specific documents compiling information collected from the countries on their activities, capacities and organizational set-up for forest monitoring. They were prepared in 2007 within a

broader effort of mapping country needs on forest monitoring. These assessments were complemented by the analysis of National Communications to the UNFCCC and other relevant reports, if applicable and pertinent.

## Data validation

The dataset was carefully validated to gauge its robustness. For a group of five countries (Cambodia, Democratic Republic of the Congo, Papua New Guinea, Paraguay, Viet Nam), scorecard ratings were also obtained from government officials involved in forest monitoring for REDD+. This allowed a contrast to be made between their perception of current capacity development over the last ten years and the views of FAO experts.

The good correspondence between both datasets at the level of individual indicator scores and at the level of average scores increased our confidence in the available dataset. For individual indicators, FAO's assessment directly matched the country's self-assessment for 60–70 percent of indicators. Correspondence was as high as 100 percent for some countries on the FREL pillar, which allows for more specific indicators. On average, results show very similar scores, indicating that overall the perception of capacity development efforts and achievements is the same for government officials and for FAO in-country experts.

Table 2: Forest monitoring scorecard

	Satellite land monitoring system	No ☆	★	★★	★★★
	Overarching deliverable				
SLMS-1	Have historical remote sensing data been analysed?	No national scale analysis carried out yet	Assessment available for one point in time, but no change assessment	Assessment available for one point in time and change assessment	Consistent assessments available for several time points and a change assessment
	Regular government programme				
SLMS-2	Is there a regular ongoing government programme for land monitoring and mapping?	No regular ongoing government programme	Irregular land monitoring and mapping	Ongoing land monitoring programme with regular staff but dependent on external resources	Ongoing land monitoring programme with regular staff and budget allocation
	Technical and functional aspects				
SLMS-3	Is the geographic information system and remote sensing laboratory well equipped?	No laboratory available	Laboratory not well equipped	Hardware and software available with slow internet	Fully equipped laboratory with fast internet
SLMS-4	Do relevant agencies effectively collaborate on land monitoring?	No effective data sharing, inconsistent land classification schemes	Ad hoc data sharing, but inconsistent land classification schemes	Ad hoc data sharing and official land classification scheme	Data are collected according to official land classification scheme and flow freely between several agencies based on regulations or Memoranda of Understanding
SLMS-5	Is an accuracy assessment being carried out?	Accuracy assessment not carried out	Based on same data source	Based on independent data of similar quality	Through independently collected field data or high-resolution imagery

SLMS-6	Are land monitoring data routinely archived?	No routine archiving, data scattered between several agencies and projects	Summary list available, but no central data management	Centralized data management, but data not fully digitized	Centralized data management and digital archive, possibly integrated with regular statistical systems
	Technical capacity				
SLMS-7	Does the government have the technical capacity to carry out forest land monitoring for REDD+?	Limited technical capacity	Medium technical capacity, requiring ongoing external assistance	Medium technical capacity, occasionally requiring external assistance	High technical capacities with limited need for external assistance
	National forest inventory	No ☆	★	★★	★★★
	Overarching deliverable				
NFI-1	Has a field-based forest inventory at a national scale been completed yet?	Not available or with limited coverage or without full government ownership	Once at national scale under government leadership	Several times but with incompatible methodologies	Several times with compatible methodologies, at national scale and under government leadership
	Regular government programme				
NFI-2	Is there an ongoing programme for periodic inventories with institutional and budgetary provisions?	Not available or only for one-off inventory	Institutional mandates and plans but reliance on external funding	Institutional mandates and plans and significant national funding available	Budget allocation and institutional mandates for inventory cycle
	Technical and functional aspects				
NFI-3	Has a methodology for the NFI been agreed?	Not available, only incomplete and inconsistent datasets available	Methodology available but outdated	Agreed and up-to-date methodology available, but datasets only partially compliant	Agreed and up-to-date methodology available and consistently implemented
NFI-4	Do data include ground-based biomass measurements for non-forest land-cover types?	No national scale forest inventory data available	In forest land only	Also in grasslands with varying tree cover	Comprehensive measurements across all types of land cover

NFI-5	Are data centrally managed for field-based forest inventories at national scale and for regional inventories?	Data scattered between several agencies and projects	Summary list of field-based forest inventories available, but no central data management	Centralized data management available, but data not fully digitized	Centralized data management and digital archive, possibly integrated with regular statistical systems
NFI-6	Are inventory results widely and transparently available?	Only summary information publicly accessible	Analytical reports publicly accessible	Analytical reports publicly accessible and rudimentary web interface	Analytical reports publicly accessible and detailed web interface
	<b>Technical capacity</b>				
NFI-7	Does the government have the technical capacity to carry out an NFI for REDD+?	Limited technical capacity	Medium technical capacity, requiring ongoing external assistance	Medium technical capacity, occasionally requiring external assistance	High technical capacities with limited need for external assistance
	<b>Forest reference (emission) level</b>	No ☆	★	★★	★★★
	<b>Overarching deliverable</b>				
FREL-1	Has a FREL been developed and submitted yet to the UNFCCC?	Not yet available and not yet submitted	FREL under development	FREL developed and submitted, but not yet undergone technical assessment	FREL developed and submitted and undergone technical assessment
	<b>Regular government programme (not available)</b>				
	<b>Technical and functional aspects</b>				
FREL-2	Does ongoing land monitoring allow for change detection based on detailed classification scheme?	No change detection, or includes only deforestation	Only changes between forest and non-forest	Changes between six IPCC classes	Detailed classification scheme
FREL-3	Have scope, scale and construction methodology been decided?	No active discussions or decisions	Ongoing discussion, scope already defined	Ongoing discussion, scope and scale already defined, but not yet on the construction methodology	Decisions reached and justified on activities, pools, gases, national or subnational scale, reference period and construction methodology



FREL-4	Have emission factors been chosen?	No active discussions or decisions	Ongoing discussion on emission factors	Emission factors have been chosen but do not fully effectively draw on forest inventory results	Emission factors have been chosen and effectively draw on forest inventory results
FREL-5	Has a forest definition been chosen for the FREL?	No active discussions or decisions	Ongoing discussion on the forest definition for the FREL	Forest definition chosen, but not fully consistent with forest definition for SLMS, NFI and NGHGI	Forest definition chosen and fully consistent with forest definition for SLMS, NFI and NGHGI
FREL-6	Have details on national circumstances been collected?	National circumstances not yet analysed	Either trends analysis or quantitative drivers analysis available	Both trends and quantitative drivers analysis available	Detailed trends and quantitative drivers analysis available, justifying the construction methodology
	Technical capacity				
FREL-7	Does the government have the technical capacity to develop FRELs for REDD+?	Limited technical capacity	Medium technical capacity, requiring ongoing external assistance	Medium technical capacity, occasionally requiring external assistance	High technical capacities with limited need for external assistance
	National greenhouse gas inventory system	No ☆	★	★★	★★★
	Overarching deliverable				
NGHGI-1	Does the government regularly report on land use in the NGHGI including the BUR Annex on REDD+ results?	No National Communications or Initial National Communication only	Several National Communications or BURs submitted, but contain only rudimentary land-use NGHGI	Several National Communications or BURs submitted, including a detailed land-use NGHGI	BUR Annex on REDD+ results submitted
	Regular government programme				
NGHGI-2	Is there a GHG inventory team available for land use, land-use change and forestry?	Not available, mainly done by external consultants	Available and consisting of permanent staff, but without clearly defined roles	Available and consisting of permanent staff with clearly defined roles	Available and consisting of permanent and well-trained staff with clearly defined roles

	Technical and functional aspects				
NGHGI-3	Is there a functioning data sharing process between institutions involved in the NGHGI?	Data sharing ad hoc or data concentrated at one agency only	Through Memoranda of Understanding across several agencies, but not yet effective use of forest inventory and land monitoring results for the NGHGI	Through Memoranda of Understanding across several agencies and effective use of forest inventory and land monitoring results for the NGHGI	Legally assigned roles across several agencies, and effective use of forest inventory and land monitoring results for the NGHGI
NGHGI-4	Is the methodology documented transparently and in detail?	Only rudimentary documentation within National Communication	Some documentation within National Communication, but not fully transparent or insufficient detail	National inventory report available as part of the National Communication or BUR	Detailed and high-quality national inventory report available as part of the National Communication or BUR
NGHGI-5	Are QA/QC procedures in place and being performed?	QA/QC not being performed	Either QA or QC being carried out, but no general procedures	QA/QC carried out ad hoc, but no general procedures	Protocols with assigned roles in place for QA/QC and being performed
NGHGI-6	Are an inventory improvement plan and a key category analysis in place and basis for planning?	Not in place	Both in place but not connected and not basis for planning	Both in place and connected, but not basis for planning	Both in place and connected, and effectively being acted upon
	Technical capacity				
NGHGI-7	Does the government have the technical capacity to produce an NGHGI including the BUR Annex on REDD+ results?	Limited technical capacity	Medium technical capacity, requiring ongoing external assistance	Medium technical capacity, occasionally requiring external assistance	High technical capacities with limited need for external assistance



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