



Global progress toward sustainable forest management [☆]



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ABSTRACT

Sustainable forest management (SFM) is many things to many people – yet a common thread is the production of forest goods and services for the present and future generations. The promise of sustainability is rooted in the two premises; first that ecosystems have the potential to renew themselves and second that economic activities and social perceptions or values that define human interaction with the environment are *choices* that can be modified to ensure the long term productivity and health of the ecosystem. SFM addresses a great challenge in matching the increasing demands of a growing human population while maintaining ecological functions of healthy forest ecosystems. This paper does not seek to define SFM, but rather provides analyses of key indicators for the national-scale enabling environment to gain a global insight into progress in implementing enabling and implementing SFM at the national and operational levels. Analyses of the Global Forest Resources Assessment 2015 (FRA) country report data are used to provide insights into the current state of progress in implementing the enabling conditions for SFM. Over 2.17 billion ha of the world's forest area are predicted by governments to remain in permanent forest land use, of which some 1.1 billion ha are covered by all of the SFM tools investigated in FRA 2015. At the global scale, SFM-related policies and regulations are reported to be in place on 97% of global forest area. While the number of countries with national forest inventories has increased over that past ten years from 48 to 112, only 37% of forests in low income countries are covered by forest inventories. Forest management planning and monitoring of plans has increased substantially as has forest management certification, which exceeded a total of over 430 million ha in 2014. However, 90% of internationally verified certification is in the boreal and temperate climatic domains – only 6% of permanent forests in the tropical domain have been certified as of 2014. Results show that more work is needed to expand the extent and depth of work on establishing the enabling conditions that support SFM over the long term and suggests where those needs are greatest.

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1. Introduction

Forests cover some 30% of the world's land area (Keenan et al., 2015) and it is difficult to think of individuals that do not depend on forest products and services in some form on a regular basis. In addition a large number of people depend on forests for at least part of their livelihood and well-being (EC, 2003; FAO, 2006; Jacek et al., 2005; UNFF, 2007).

Forests can make significant contributions to the economy and provide multiple products and services that support livelihoods

and protect the environment. However, the challenge is to manage the forest's regenerative capacity in a way that produces benefits now without compromising future benefits and choices. This idea is at the core of most views of SFM. Recognition that the production and protection functions of forests must be sustained by sound management practice is not new. From the earliest times, thoughtful people have encouraged the wise use of forests. Emperor Da Yu was the first Chinese emperor of the Xia Dynasty (21st century BC) to pay special attention to the sustainable management of natural resources and forests (Anonymous). In seventeenth century Europe, Evelyn (1664) and Colbert (1669 as reported in Brown, 1883) noted the negative influence of forest over-utilization on sustained provision of forest goods and services. The tax accountant von Carlowitz (1713) describes how

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Saxonian forest regulation was used as an important principle of forest management in the early 18th century. Hartig (1795) described sustainable yield based on the quantity of increasing timber volume which was an important step in the quantitative regulation of harvest volumes. In the early 20th century, Gifford Pinchot recognized that clear and convincing evidence was needed to demonstrate that sustainable forest management would return a profit. He also noted that sustainable forestry was not possible without the consent and active participation of the public (Schmithüsen, 2013). Zon and Sparhawk (1923) demonstrated how globally available data on forest resources provides professionals and the public with information vital to effective strategies for sustaining forest values. They also note the gaps in this data that constrain management – some of which remain unfilled in the early 21st century. The Global Forest Resources Assessment (FRA) was created to provide a continuing assessment of forest resources and how they are changing (MacDicken, 2015).

SFM has been encouraged as an important guiding principle in managing forests (ITTO, 2006; EC, 2003). The concept provides guidance on how to manage forests to provide for today's needs (as best as possible) and not compromise (i.e. reduce) the options of future generations (Forest Principles, UN Rio, 1992). The tools available for encouraging SFM begin with policy and regulations that support those who are practicing forest management. They also include inventories, monitoring, forest management certification, stakeholder involvement and forest management plans. Where there is a clear understanding of the ecological circumstances of the forests being managed an appropriate regulatory framework can establish the enabling conditions for SFM.

Criteria and indicators (C&I) of SFM have been developed through the work of many actors – including governments, research organizations, non-governmental organizations and private companies (MCPFE, 2001; Prabhu et al., 1998). This includes work by countries involved in the Montréal Process (MP), FOREST EUROPE (FE), the International Tropical Timber Organization (ITTO) and the Food and Agriculture Organization (FAO). These C&I are used to define SFM and to measure and report progress towards its implementation (Canadian Council of Forest Ministers, 2008). These international and regional initiatives and research efforts have made good progress in using science, commerce and social values to devise their indicators. Supportive national legal, policy and institutional frameworks can make SFM practices cost-effective and when effectively applied encourage the practices needed for SFM (Keeton and Crow, 2009; FAO, 2010; Lovrc et al., 2010). Forest management certification provides independent, third-party verification of adherence to a defined set of management standards that promote and measure SFM (CEPI, 2006).

The main focus of this paper is to present factors that are needed for and provide support to long-term sustainable forest management. By presenting a sub-set of data relevant to SFM derived from the Global Forest Resources Assessment 2015 (www.fao.org/forestry/fra) the reader is provided with information that can help determine where and how much progress is being made towards establishing and maintaining the enabling conditions for SFM. FRA 2015 was designed in part to provide this information by asking questions under two broad categories:

Enabling environment (national scale):

- What forest policy and regulatory framework exists to support implementation of sustainable forest management?
- Is there a national platform that promotes stakeholder participation in forest policy development?
- What is the forest area intended to be in permanent forest land use now and how has it changed over time?
- How is progress toward SFM measured and reported?

Operational scale progress toward SFM

- What is the area of forest under a forest management plan and how is this monitored?
- How are stakeholders involved in management decisions for publicly-owned forests?
- What is the area of forest under one or more independently verified forest certification schemes?

2. Methods

The methods, definitions and approaches used in FRA 2015 are discussed and referenced in greater detail in MacDicken (2015) and www.fao.org/forestry/FRA/2015/Methods. FRA 2015 data were extracted from the Forest Resources Information System (FRIMS) as described in www.fao.org/forestry/fra2015. All data used in this paper except international forest management certification was provided by countries or through desk studies carried out by FAO. Other than for international certification, country reports from government-appointed National Correspondents contributed data representing some 99% of global forest area. International certification data was provided by the Forest Stewardship Council (FSC) and the Programme for Endorsement of Forest Certification (PEFC) for July in each of the reporting years¹. Enabling environment-related data were collected on policies, legislation and regulations supporting SFM, presence of a national stakeholder platform and the types of forest resource monitoring information and progress reporting available. Progress at the operational level was measured as forest area under Forest Management Plans (FMP), including an assessment of how the content of these plans are monitored and how frequently and if stakeholder inputs are required and the extent of both international and domestic forest management certification. Statistical summaries and analyses were done for all variables using Microsoft Excel and Systat (Ver. 13) and relationships described by national income category, climatic domain and sub-region (see MacDicken, 2015). Reported values were clustered into four nested categories: legal framework, national data reporting, management planning and stakeholder involvement plus certified forest area.

3. Results and discussion

3.1. When do the conditions exist to enable sustainable forest management?

It depends on where you set the threshold – if the presence of a regulatory framework is deemed adequate, then the conditions exist when policies and regulations are in place. The most rigorous set of enabling conditions includes the legal framework, national data reporting, the availability of quality forest inventory data, management planning, effective stakeholder involvement and regular monitoring and reporting. Measuring and reporting these data at the national scale and sharing the results through the FRA is an important step in understanding progress to SFM and where it or is not occurring.

Using the SFM related data collected through FRA 2015, it is possible to begin with the area of permanent forest land² and evaluate how much forest land is covered by successive indicators. Fig. 1 presents this progression of the application of these “SFM

¹ July was used as a mid-point for the annual data and is important because monthly certification values change throughout the year as additional forest area is certified or previously certified forest are decertified.

² Permanent forest land is defined in FRA 2015 as the area of state-owned forest designated to remain permanently as forest (i.e. the permanent forest estate) plus an estimate by governments of the portion of privately-owned forest expected to remain permanently in forest land use.

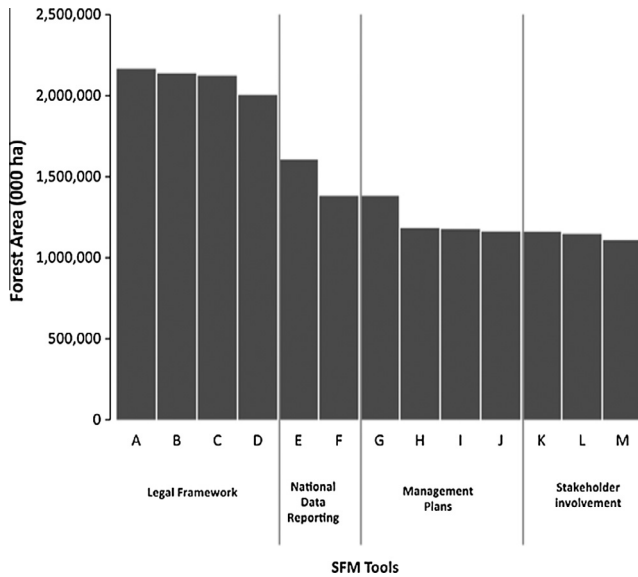


Fig. 1. The area of permanent forest use as modified by other elements of the SFM enabling environment: (A) Permanent forest use; (B) Policies; (C) Legislation; (D) Stakeholder platform; (E) Forest inventory; (F) National reporting; (G) Forest management plans; (H) Soil and water conservation; (I) High conservation value forest; (J) Social engagement; (K–M) Stakeholder involvement in operational planning, operations and review.

tools". It begins from the left, showing how forest area changes with the level and presence of enabling conditions for SFM. Moving from left to right the area of permanent forest subject to each of the indicators listed on the horizontal axis is given. This reduction is based on the global extent of supportive legal, data availability, management planning and stakeholder involvement in operations. In those countries with permanent forest, some 98% of permanent forest land is covered by policies, laws and regulations in support of SFM. This indicates a broad intention on the part of governments to support SFM into the future on some 2.2 billion ha (55% of global forest area in 2015). When all of the SFM tools are included, the area decreases to 1.11 billion ha globally.

When examining the application of each of the SFM tools to the forest by climatic domain (Fig. 2), all domains experience a decrease in area as the number of SFM tools applied increases (from left to right on the x axis). Overall the temperate domain shows the least decrease in forest area as the number of SFM tools increases, followed by the boreal, tropical and sub-tropical domain in order. It can be noted that each decrease identifies a need to increase investment required to apply a given tool(s).

The area under FMP in the Boreal domain drops by nearly 200 million ha once soil and water conservation objectives are included as requirement in forest management plans. In the tropical domain, the permanent forest area covered by inventories is 309 million ha less than the area covered by legal frameworks supporting SFM. The tropical domain area that does not include national reporting, nor management plans nor stakeholder involvement drops this by an additional 123 million ha. In the subtropics only 14% of permanent forest area is covered by forest reporting, management plans and stakeholder involvement in operations.

This difference between domains illustrates the need for greater investment in forest reporting, management planning and stakeholder involvement in operations if the area of SFM is to be increased.

The following discussion covers each of the SFM related indicators measured through the FRA with analyses by one or more of the categorical variables: climatic domain, national income category or sub-region.

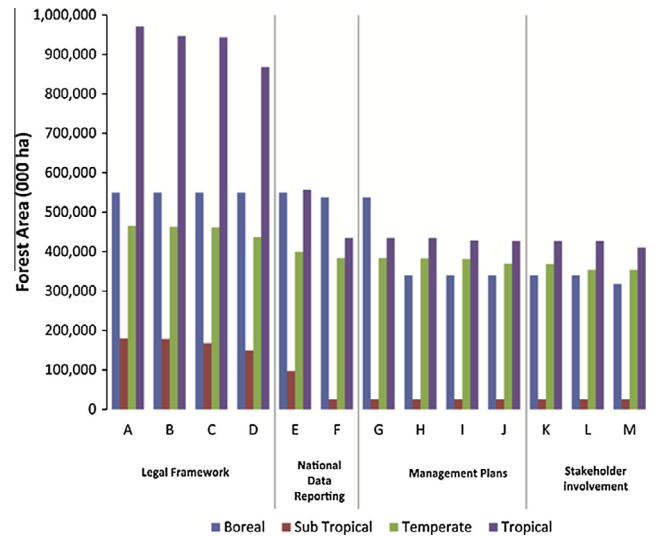


Fig. 2. The area of permanent forest use as modified by other elements of the SFM enabling environment by climatic domain: (A) Permanent forest use; (B) Policies; (C) Legislation; (D) Stakeholder platform; (E) Forest inventory; (F) National reporting; (G) Forest management plans; (H) Soil and water conservation; (I) High conservation value forest; (J) Social engagement; (K–M) Stakeholder involvement in operational planning, operations and review.

3.2. Legal framework

3.2.1. Permanent forest land

The area of permanent forest land indicates the area of forest likely to remain as forest, including both the permanent forest estate and privately owned forest land expected by governments to remain in forest land use (see [www.fao.org/forestry/FRA2015/Terms and Definitions](http://www.fao.org/forestry/FRA2015/Terms%20and%20Definitions) for additional details). The permanent forest estate is state-owned and is mandated to remain as forest. The term permanent forest land is used to describe the sum of government estimates of non-state owned land intended to remain in permanent forest use plus the permanent forest estate. The intent to retain these areas as forest is the starting point for forest area that is managed sustainably – they are in principle those forest lands for which a commitment has been made to sustaining forest values well into the future.

In 1990 the area reported as permanent forest estate was 1.4 billion ha (FRA 2010) or 34% of total forest area while in by 2010 this went to 1.7 billion or 43% of total forest area (as assessed in FRA 2015). The total amount of forest land intended to be permanent forest was 2.17 billion ha or 54% of total forest area in 2010. The difference between these two numbers comes from private forest lands intended to remain in forest. Fig. 3 shows the distribution of permanent forest area by income category – of which some 82% is in upper middle and high income countries. Privately-owned forest is important in sustaining future forest area in the high, upper middle and lower middle income category and of almost no importance in low income countries where state ownership dominates.

3.2.2. Policies and legislation supporting SFM

The practice of sustainable forest management is enhanced by the effective application of a national legal, policy and institutional framework. Countries that had either policies and or legislation that support sustainable forest management cover 99% of global forest area (Table 1). This is an increase in the area reported in FRA 2010 which reported coverage of about 70% of global forest area under forest policy and legislation. Countries reporting only

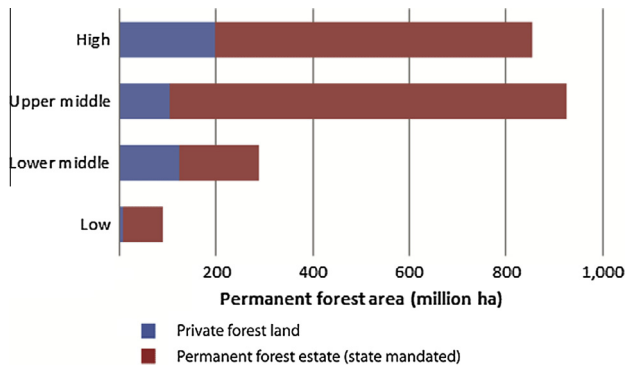


Fig. 3. Permanent forest land by income category and ownership type.

legislation at national level in 2015 cover 97% of global forest area. Most policies and legislation were at the national level, although more than half of the countries had also invested in provincial and local level policies/regulations covering about 80% of the forest area. This demonstrates the degree with which devolution and decentralisation of regulatory framework for forest management has occurred.

There were no major differences in the proportion of countries and forests covered in terms of presence of policies versus legislation (Table 2). The presence of policies and legislation were sharply skewed to the national level, particularly in the Caribbean, Central America, Europe, South and Southeast Asia and West Central Asia where the proportion of countries investing in subnational policies and or legislation was well below 50%. More than 90% of the countries in Africa indicated they had policies and/or legislation supporting SFM covering 94% of the forests in the region. Each sub-region had more than 90% of the forests covered by policies and/or legislation except for West and Central Asia that was just below 80%.

Analysis by climatic domain revealed no difference in the degree of SFM-supportive policy and legislation across domains.

Presence of legislation and or policies did not vary significantly across income groups. The geopolitical analysis revealed that countries in the lower income categories invested more in national level policies while higher income category countries investing in SFM policies across all levels of governance (Fig. 4).

3.2.3. National stakeholder platforms

FRA 2015 defined national stakeholder platforms (NSP) as the presence of a recognized procedure that a broad range of stakeholders can use to inform the national policy process through their opinions, suggestions and analysis. Significant progress has been made in allowing or encouraging stakeholder inputs into forest policy processes – countries indicated that 94% of global forest area is covered by national stakeholder platforms, although the extent

Table 1
Policies/Regulations supporting SFM at different geopolitical scales.

Scale	Policies		Legislation		Both policies and legislation	
	Forest area (000 ha)	% of total forest area	Forest area (000 ha)	% of total forest area	Forest area (000 ha)	% of total forest area
National	3,919,285	99	3,857,743	97	3,857,427	97
Regional	2,639,784	67	2,209,200	56	2,196,123	55
Provincial/ State	3,225,986	81	3,347,715	84	3,185,833	80
Local	3,177,901	80	3,343,715	84	3,113,346	78

Table 2

Proportion of forest area covered by policies and or legislation supporting SFM by region and sub-region.

Region	Sub region	% of countries in the sub-region	% forests in the sub-region	
Africa	Eastern and Southern Africa	90	95	
	Northern Africa	86	100	
	West and Central Africa	92	93	
	Regional total	90	94	
	Asia	East Asia	100	100
Asia	South and Southeast Asia	100	100	
	West and Central Asia	58	78	
	Regional total	79	99	
	Central and North America	Central America	100	100
		Caribbean	43	90
North America		80	100	
Regional total		59	100	
Europe	Europe	88	100	
Oceania	Oceania	33	97	
South America	South America	93	100	

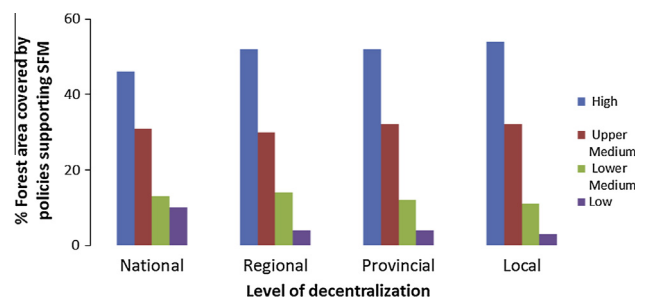


Fig. 4. Forest area covered by policies supporting SFM by income category and level of decentralization.

and success of these platforms certainly varies substantially. In part the inclusion of stakeholders is the result of widespread promotion of stakeholder participation in forest policy development (FAO, 2009). Stakeholder engagement can help mitigate conflicts, enhance cooperation across stakeholder groups and improve the quality of national forest policy – although it can be a difficult and complex process to implement effectively (FAO, 2009). The functionality of reported NSPs was not investigated but their presence is a positive starting point for most countries.

3.3. Data availability and reporting

3.3.1. Measuring the forest resource

Forest resource change measurement generally includes forest characteristics such as species composition, area, age class, volume per hectare growth rates and site class. This forest inventory data provides essential information as an early step towards national-scale planning and support of SFM policies, regulations and practices.

There has been a remarkable and recent increase in the area of forest for which National Forest Inventories (NFI) have been undertaken. In 2010, less than 50 countries reported having an NFI. As of 2014, 112 countries were conducting forest inventories that cover 3,242,197,000 ha or 81% of the total global forest area. Over 70 countries received support for either national forest inventories

or national forest monitoring programs for climate change mitigation purposes or both.³

Geographically the degree of NFI coverage varies across sub-regions with most of the world's forest area (77%) in sub-regions with high levels of NFI coverage (Table 3). Four percent of the world's forest were in sub-regions with lower (40–79%) NFI coverage. West and Central Africa have coverage of only 10% of sub-regional forest area, presenting a significant challenge to future governments to enhance forest management based on NFI data. Considering the importance of the forests in these sub-regions to the well-being of people and the biodiversity found there, these data support the need for strategic investment in those sub-regions most lacking in NFI coverage – particularly countries in West and Central Africa.

There was a very strong relationship between national income and forest area covered by forest inventory – as national income increases, so does the proportion of forest area covered by a national forest inventory (NFI) (Table 4). High income countries reported 98% of the forest area covered by national forest inventories. Low income countries had national inventories covering 37% of the forest area within this grouping suggesting this should be considered as a priority group of countries for additional NFI investment due to the highest annual forest loss rates (–0.6%) reported for any income category (Keenan et al., 2015) and a lack of reliable inventory data on forest change.

3.3.2. Forest inventory characteristics

Nearly all NFI used ground plots (96%) with repeated inventories conducted or planned on some 94% of the total inventoried area (Table 5). The use of aerial imagery or remotely sensed imagery is reported on some 70% of inventoried land of which 29% was sample based, 19% was full coverage and 22% utilized both sampling approaches.

3.3.3. National forest resource reporting

In many cases knowing the characteristics of the forest resource and how it is changing is of little value unless this information is shared through reporting. Countries were asked to describe how they report national forest data from among three choices; criteria and indicator (C&I) reporting, periodic state of the forest reports and “other” reports that describe some aspect(s) of the forest at the national level. The least helpful in determining progress to SFM are reports in the “other” category. National periodic state of the forest type reports can be more helpful providing data needed in determining progress to SFM by providing consistent details about the forest resource over time. C&I reports are purposefully designed to provide comprehensive information on social, economic and environmental aspects of a nation's forest that, when considered together over time, can provide insight into that country's progress towards SFM.

The data show a significant commitment by countries to report on their forests. Most countries (60%) use a periodic state-of-the-forest type of report, globally covering 89% of forest area (Table 6). Criteria and indicator reports were drafted by 86 countries that together covered 77% of total forest area and sixty-nine countries used “other” report formats mostly in combination with the other reporting types.

There were 41 countries that produced all three types of report, representing 67% of global forest area. It is important to note that

Table 3
Forest Inventory coverage by sub-region.

Sub-region	% of sub-region area with forest inventory	Area of sub-region inventoried (000 ha)	Total forest area of sub-region (000 ha)	Area inventoried as % of global forest area
<i>Sub-regions with (80% or more NFI coverage)</i>				
Central America	90	76,614	86,290	1.9
East Asia	93	239,509	257,047	6
Europe	97	993,878	1,015,482	24.9
North America	100	655,789	657,167	16.5
Oceania	96	166,863	173,376	4.2
South America	80	678,096	842,132	17.1
South and Southeast Asia	80	234,374	292,804	5.9
Total		3,045,123	3,324,298	77
<i>Sub-regions with (40–79% NFI coverage)</i>				
Caribbean	48	3530	7328	0.1
East and Southern Africa	49	126,317	274,866	3.2
North Africa	53	19,651	36,217	0.5
West and Central Asia	50	19,898	39,711	0.5
Total		169,396	358,122	4
<i>Sub-region with <40% NFI coverage</i>				
West and Central Africa	10	32,678	312,997	0.8

Table 4
Income grouping and national forest inventory.

Income category	% of forest area with NFI	Area with inventory (000 ha)	Total area of forest (000 ha)
High	98	1,807,621	1,830,480
Upper middle	80	985,556	1,224,998
Lower middle	55	290,440	532,705
Low	37	146,809	398,135

Table 5
NFI characteristics as percentage of total NFI area.

Inventory/sampling type	% of total area under NFI
Continuous forest inventory	36
Periodic forest inventory	10
Combination of continuous and periodic	48
Single inventory event	6
Ground plots used	96
Permanent ground plots	37
Temporary ground plots	8
Both permanent and ground plots	51
No use of ground plots	4
Aerial imagery or remote sensing used	70
Sample based	29
Full coverage	19
Combination of sample and full coverage	22

the 22% of the global forest area that was not the subject of C&I reporting is located within 107 countries, many of which have little or no forest area. The 11% of the global forest area not having periodic state of the forest reporting was within 77 countries and the 28% of the global forest area not reported within “other” reports were found across 124 countries. No reports were produced by 38 nations that represented 5% of the global forest area.

Nearly all of the forest area in the high, upper middle and lower middle income countries were covered by C&I reporting (Table 7).

³ NFI support has included Algeria, Angola, Bangladesh, Brazil, Cameroon, Comoros Island, Congo, Costa Rica, Ethiopia, Gambia, Guatemala, Honduras, Kenya, Kyrgyzstan, Lebanon, Nicaragua, Panama, Paraguay, Peru, Philippines, Tanzania, Uruguay, Viet Nam, Zambia (Source: National Forest Monitoring Programme, FAO). UN REDD has provided country support for forest monitoring in 58 countries (I. Jonckheere, pers. com.).

Table 6
Forest reporting types by number of countries and global forest area coverage.

Report type (n = 193)	Number of countries	% countries with report	% of global forest area covered	Area reported (000 ha)
C&I	86	44	77	3,077,951
State of forest	116	60	88	3,519,677
“Other”	69	39	71	2,847,485

Table 7
Forest area reported through C&I reporting by income category.

Income category	# Countries in group with no reporting	# Of countries in category	Area of income category that is unreported (000 ha)	% of income category area that is unreported
High	12	62	5895	0.3
Upper middle	7	48	5062	0.4
Lower middle	4	40	4508	0.8
Low	4	30	168,260	42.3

The low income category contains 30 countries and accounts for 10% of global forest area. Four of the 30 low income countries do not report on 168.2 million ha representing 42% of the forest area in this income group. Combined with the lack of NFI coverage among low income countries there is a clear opportunity for countries to improve their capacity to manage their forests in the long-term with better quality inventory and reporting.

3.4. Forest management planning

In the 1953 World Forest Inventory some 27% of forests *in use* (considered equivalent to the FRA definition of production forests) were covered with *working plans*. In 2010 the equivalent proportion was 70% percent of forests with management plans in 2010 – a dramatic increase. The total area under Forest Management Plan (FMP) in 2010 was 2.1 billion ha or 52% of the total forest area (Table 8). An important change since the 1950s is the significant increase in forest with management plans for conservation purposes. In 2010 the area with management plans for production and conservation purposes were nearly equal.

Geographically, most forests in Europe, Asia, North and Central America were reported to be covered by a FMP (Fig. 5) while South America and Africa had the least coverage (<30% of sub-regional forest area).

The boreal and temperate domains reported high proportions of area under FMP (87% and 63% respectively) in contrast with the tropical and subtropical domains both of which had 28% under FMP (Table 8). Values for the boreal domain were also provided without Russia because Russia reports 100% of its forest under FMP while the rest of the boreal domain averages 63%. The total area reported with FMPs for production and conservation was very

Table 8
Forest area with FMP by climatic domain.

Domain	Forest with FMP		FMP for production		FMP for conservation	
	Area (000 ha)	% of domain forest area	Area (000 ha)	% of domain forest area	Area (000 ha)	% of domain forest area
Tropical	509,761	28.2	191,267	10.6	203,787	11.3
Temperate	424,971	63.1	175,516	26.1	209,428	31.1
Boreal	1,073,801	87.7	442,734	36.1	401,497	32.8
Boreal without Russia	258,656	63.1	21,243	5.2	7,852	1.9
Sub-tropical	91,131	28.5	36,505	11.4	28,678	8.9
Total	2,099,664		846,021		843,391	

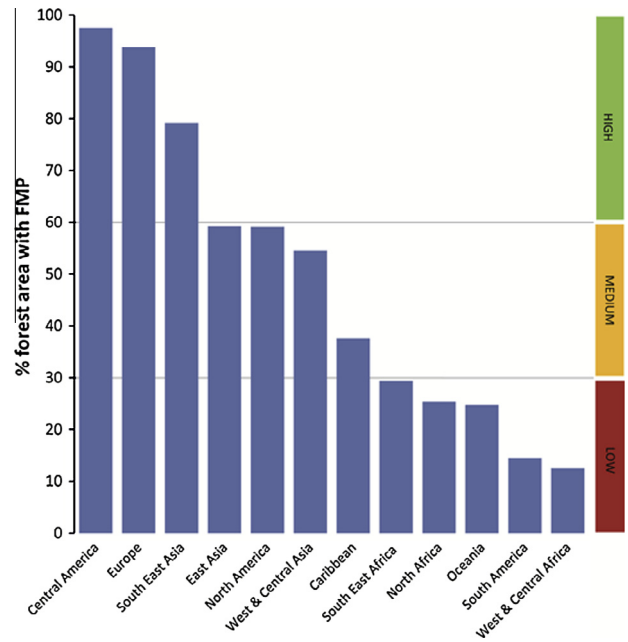


Fig. 5. Proportion of forest area covered by forest management plans by sub-region. Low, medium and high labels are categories of relative proportion covered by FMP.

similar globally, but varied substantially by climatic domain. The boreal domain without Russia showed low proportions of the domain with FMP for production and conservation in large part because Canada did not classify forest as production and conservation for FRA reporting, but included most of its forest area as multiple use. Some countries, such as Canada, reported only total area with FMP without separate values for production and conservation.

The presence of an FMP does not guarantee that the plans are implemented effectively, however the presence of a FMP is a positive step in establishing the enabling conditions for SFM. Likewise, the absence of FMP does not prevent the successful long-term, sustainable forest management – for example, multi-generational family management of private forest occurs without a written management plan. Monitoring of FMP implementation by governments is an important means of improving compliance with plans. Forty percent of FMPs were monitored annually in the tropical climatic domain, followed by boreal (38%) and temperate (32%) domains (Fig. 6). Only 22 percent of FMPs were monitored annually in the subtropical domain. This represents a high frequency of monitoring events – for example, FMP in the tropics FMPs were reported on average to be monitored once every 2.5 years. In reality many governments with limited resources are unable to meet this monitoring schedule: 29% of countries with FMP reported no monitoring of the plans and some governments with planned monitoring intervals are unable to financially support the mandated frequencies.

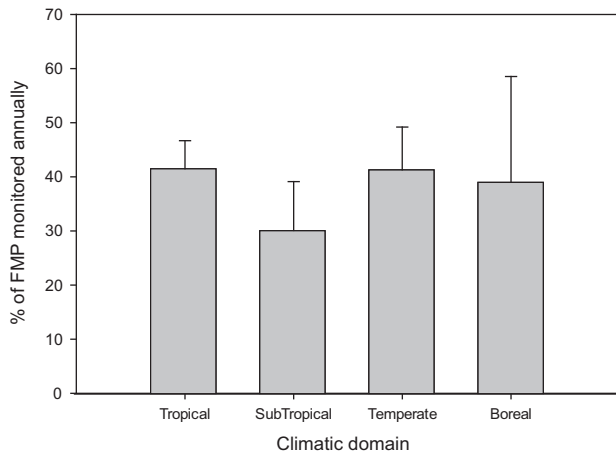


Fig. 6. Average proportion of forest management plans monitored annually by climatic domain (bars are the standard error of the mean).

Table 9

Required components in forest management plans.

Requirement	Does requirement exist?	
	Yes (million ha)	No (million ha)
Soil and water management	2698	1066
Social considerations/community involvement	3526	253
High conservation value forest delineation	3500	251

Countries reported on whether soil and water management, social considerations/community involvement, or high conservation value forest delineation were required as part of FMP. Just over two-thirds of forest area with FMP required soil and water management as part of the plan, while over 90% of FMPs require

social considerations/community involvement and high conservation value forests (HCVF) (Table 9).

The components required in FMP vary substantially by country (Fig. 7). All of North America and most of Asia require soil and water, social considerations and HCVF delineation while Europe, South America, Africa and Oceania have countries with varying requirements.

3.5. How are stakeholders involved in the management decision making stages for public forests?

Stakeholder inputs into operational decision making for public forests is part of criteria and indicator schemes for SFM (Montréal Process, 2009; ITTO, 2005). Stakeholder inputs can help mitigate conflicts, enhance communication and cooperation across stakeholder groups, improve the quality of forest operations and contribute to nation forest policy – although it can be a difficult and complex process (Beckley et al., 1995). Fig. 2 demonstrates that stakeholders have the opportunity to provide inputs into management decisions in all climatic domains on approximately the same forest area covered by FMP with requirements for stakeholder inputs. Stakeholders were allowed to be involved in the planning, operations and review of between 85% and 95% of forest area under management plans in all climatic domains. The extent to which these opportunities are used by stakeholders is not easily measured and was not measured in FRA 2015.

3.6. Forest certification

Criteria and indicators used for SFM and for forest management certification are closely connected (ITTO, 2007; Rametsteiner and Simula, 2003) – and forest certification is a reasonable indicator of trends in SFM, independent of the other indicators reported in this paper. International forest certification is not limited to the Forest Stewardship Council (FSC) and Programme for

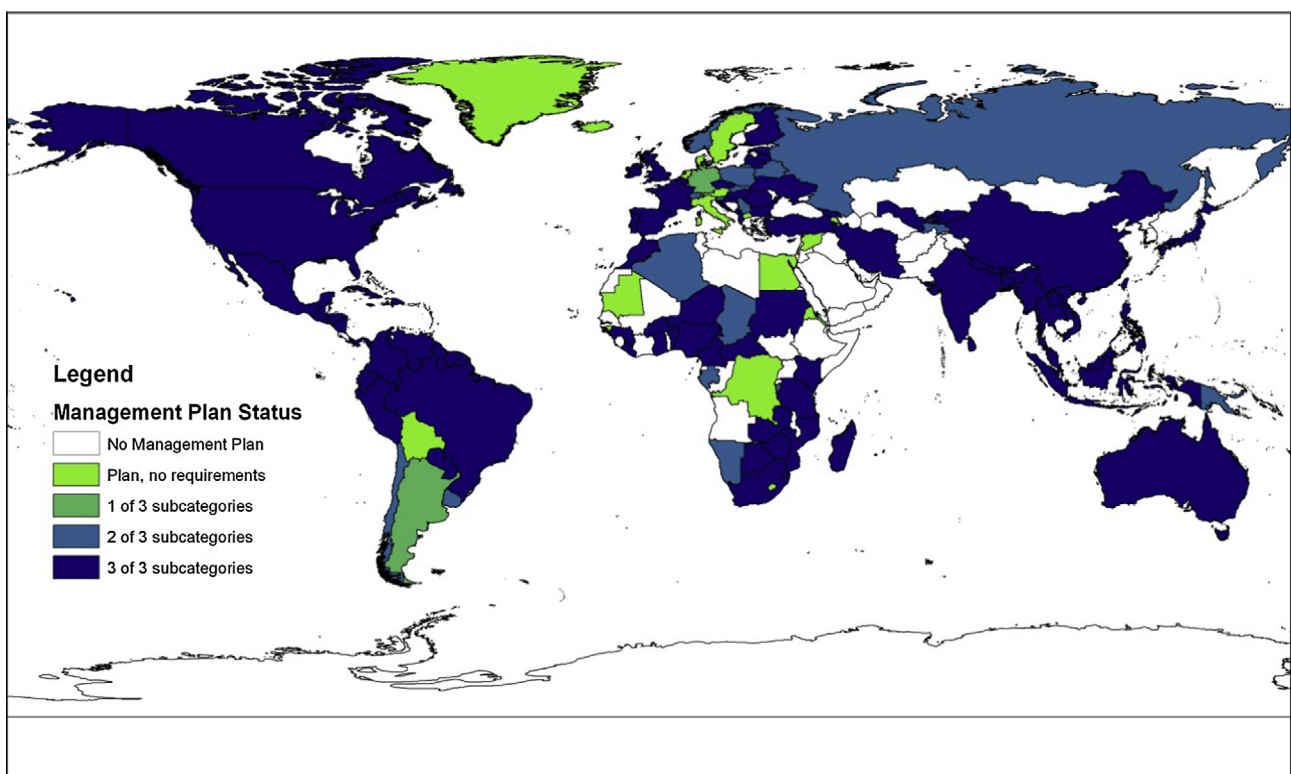


Fig. 7. Countries with required inclusion of soil and water management, stakeholder inputs and high conservation value forest designations in forest management plans.

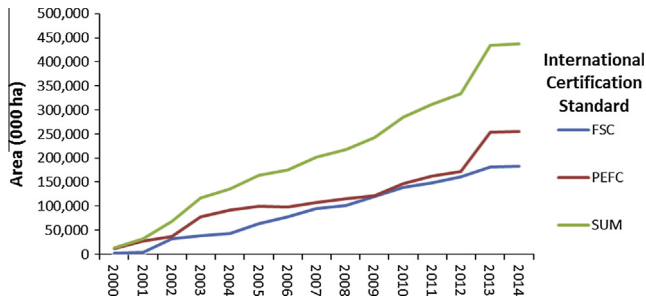


Fig. 8. Change in internationally certified forest area (2000–2014).

Endorsement of Forest Certification (PEFC), but these two systems dominate in terms of the area covered and are the only two international systems reported in the FRA (CEPI, 2006; Walter, 2008). In most cases, forest management certification is voluntary and is often driven by company or investor policy as a means of accessing forest product markets that require third-party certification.

3.6.1. International forest management certification

The total area of internationally certified forest (PEFC and FSC) went from approximately 13.8 million ha in 2000 to 437.5 million ha in 2014 (Fig. 8) representing an annual average increase of some 30 M ha.

Growth in internationally certified forest management has been continuous for both certification schemes between the years 2000

and 2014, although taking place at differing rates (Fig. 8). As of 2014 over 436 million ha of forest land were certified in these two schemes, although Fernholz and Kraxner (2012) estimated that there was double certification between schemes on about 1.7% of the area certified as of 2011, most of which was in Europe.

Global growth has been uneven when viewed by income category and climatic domain. International forest certification has always been most extensive in the high income category countries (Fig. 9), where 88% of the growth in certified area has occurred. Ten percent of the total area change (2000–2014) was in upper middle income countries, with only two percent change in the lower middle income countries. There has been a slow decline in certified forest area in low income category countries (from 315,000 ha in 2002 to 255,000 in 2014).

International certification was by far the highest in boreal and temperate domain countries – 90% of all internationally certified forest area. Historically they also account for the most rapid and sporadic growth in certified area (Fig. 10). As of 2014 certification in the tropical domain accounted for only 6% of the total certified forest spread across 38 countries.

3.6.2. Domestic certification systems

Ten countries reported the use of a domestic certification system in 2012, compared with just three in 2000 (Canada, Guadalupe and Tajikistan). The area included in domestic schemes peaked in 2008 at around 90 million ha (Fig. 11), followed by a decline that may be attributed to domestic schemes

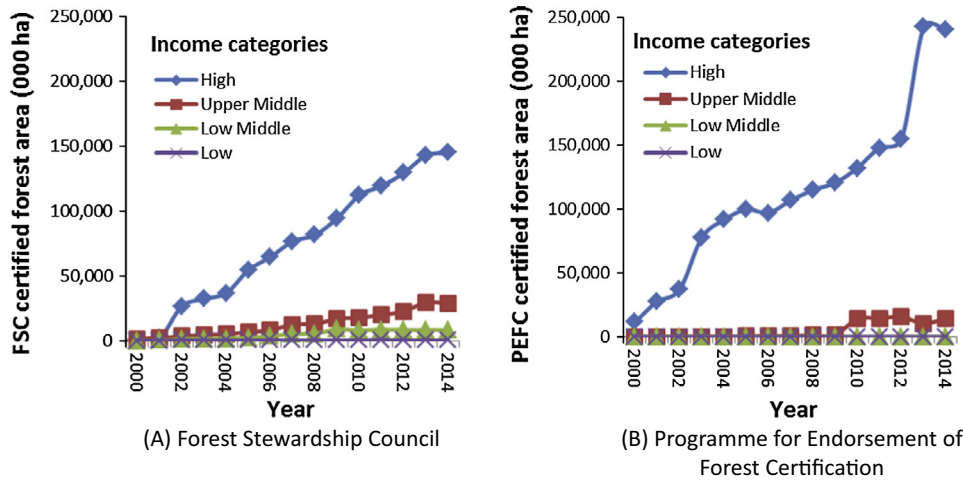


Fig. 9. Forest certification by income category.

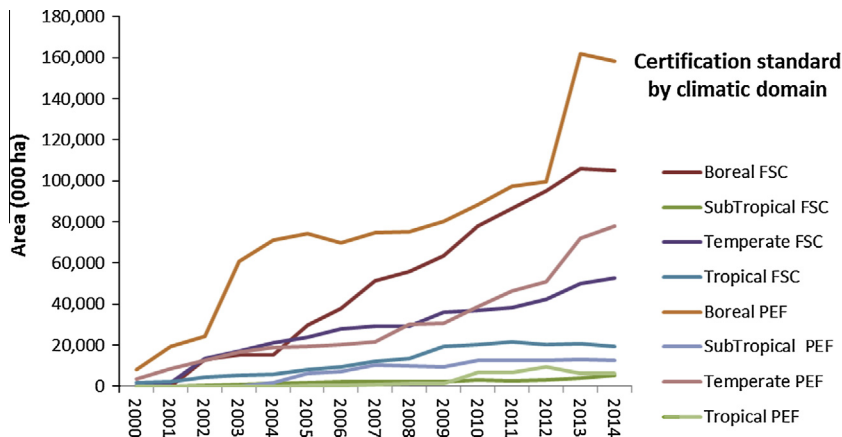


Fig. 10. Changes in area of forest management certification by climatic domain.

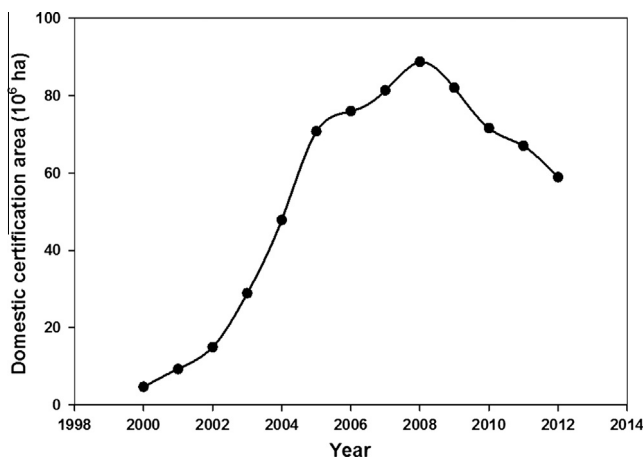


Fig. 11. Forest area covered by domestic forest management certification.

converting to international standards. Use of the sum of international and domestic certification areas is not recommended as there is an unquantified potential for double counting with lands in both domestic and international certification schemes. Five countries had reported the use of only a domestic certification scheme: China, Israel, Cuba, Tajikistan and Guadalupe (France).

4. Conclusions

Determining progress toward SFM at the global scale is challenging. This is in part because the definition of what makes forest management sustainable is not universally agreed (CBD, 2009). FRA 2015 presents data that allows users to evaluate different pieces of the SFM puzzle separately – or to integrate the information as they see fit. These pieces of the puzzle are certainly not all inclusive – but they are a start in understanding progress in both the enabling environment and operational scales. These insights inform investors and professionals where it is most likely that the enabling conditions for SFM are or are not in place – and points the user in the direction of more detailed country analyses.

By integrating the enabling conditions for SFM measured through FRA 2015 there are over 1.1 billion ha of permanent forest land on which all of the tools potentially apply. The presence of enabling conditions does not guarantee effective SFM practices but their presence can be viewed as a positive development and in many places the practice of SFM is confirmed by certifiers. Not all of the land with enabling conditions will be managed sustainably, nor is the application of SFM tools evenly applied. Certainly there are also sustainably managed forests in countries that lack the enabling SFM tools. While policies and legislation supporting SFM are being applied over all climatic domains, others such as management plans and stakeholder involvement in forest operations are not as widespread. In other cases, such as forest lands that have been privately owned for multiple generations, clearly not all of the national-scale elements apply.

It is clear that progress in establishing the conditions for SFM is being made: policies and legislation are generally in place over most of the global forest area, stakeholders are involved in various roles in recommending policy change and in forest operations planning, forest management plans have broad coverage and are more frequently monitored, there are dramatic increases in the area covered by national forest inventories and forest management certification. The links between SFM and maintenance of ecological functions have long been recognized (Goodland et al., 1991; Kimmons, 1997) and demonstrated through operational practices that are a result of application of many of the SFM tools described in this paper (Holmes et al., 2002; CBD, 2009; West et al., 2014).

The state of the enabling environment for SFM and progress made at the operational level demonstrates commitment to sustainable forest management by governments, industry and communities. At the same time further investment in addressing these limitations is clearly needed to promote and support SFM – particularly in low income forest countries and in large parts of the tropical climatic domain. Overall, the evidence shows a trend favourable to SFM globally that will help ensure forests remain a valued part of our common future.

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