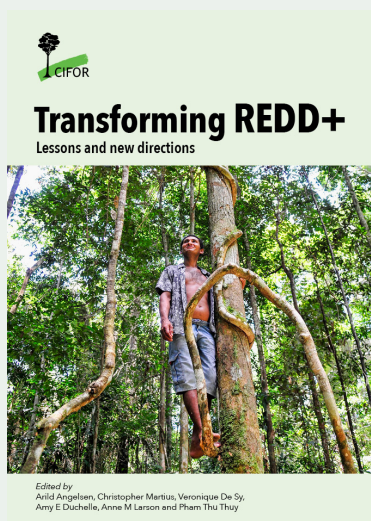# Chapter 5

Information and policy change
Data on drivers can drive change – if used wisely

Veronique De Sy, Martin Herold, Maria Brockhaus, Monica Di Gregorio and Robert M Ochieng

Information and policy change
Data on drivers can drive change – if used wisely

Veronique De Sy, Martin Herold, Maria Brockhaus, Monica Di Gregorio and Robert M Ochieng

Key messages

- Information use throughout the REDD+ policy process is influenced by interests of powerful agents of deforestation and forest degradation. Actors have different capacities and resources to access, process and provide information, as well as to contribute to policy decisions about REDD+.

- Information on direct drivers and underlying causes of tropical forest change is improving with new technologies and data sources. However, guidance and (financial) support are needed to move from technical data to actionable information, and ultimately effective REDD+ interventions.

- New information technologies offer new opportunities, but also come with diverse implications and new risks. National forest monitoring systems will need to address participation, transparency, accountability and coordination to counteract the differences in the capacities, resources and powers (decision-making or political) of various stakeholders.

Information-driven REDD+ in a nutshell

Collecting, analysing and sharing information on forest and land use changes, consequences and causes of forest change can support the REDD+ policy process.

Deriving information on drivers of tropical forest loss is complex but essential. Information is improving with new technologies and data sources.

National monitoring and international tracking of drivers are limited by a persistent lack of data on how various drivers of land-use change affect forest emissions.

Powerful deforestation agents heavily influence information on drivers, including how this information is generated and how visible it is.

Monitoring systems should include mechanisms for participation, transparency and accountability to counteract the differences in capacities, resources and power of stakeholders.

Recent developments in machine learning algorithms, processing capabilities and cloud-based services (FAO SEPAL, Google Earth Engine) enable more efficient mapping of forest and land use change.

Advances in mobile technology, and interactive monitoring solutions are also promising for monitoring drivers of forest change.

5.1 Introduction

Collection, analysis and sharing of information on forest cover and carbon stocks is a core component of REDD+. Robust and transparent national forest monitoring systems for measurement, reporting and verification (MRV) activities (UNFCCC 2009, Decision 4; UNFCCC 2011, Decision 1) allow countries to track their progress in reducing emissions from deforestation and forest degradation and enhancement of carbon stocks. In addition, information about the extent and state of forests, consequences of forest loss, causes of deforestation and forest degradation, policy options and their impact, can assist in the design, implementation and evaluation of dedicated mitigation actions to tackle these activities (Chapter 6). As such, information is an important element for effective policy change away from business-as-usual practices that directly or indirectly support deforestation and forest degradation (Brockhaus and Angelsen 2012).

The reality on the ground shows a lack of information-driven REDD+ policy change. While forest conversion to commodity-driven agriculture is an important cause of forest emissions, REDD+ strategies are often focused on approaches such as fuelwood efficiency, alternative livelihood programmes, and other interventions targeting smallholders (Kissinger *et al.* 2012; Salvini *et al.* 2014). The creation, selection and interpretation of information to support REDD+ policy change is not a neutral technical endeavour; it has a strong political dimension in that actors tend to select and use information in ways that reflect their interests (Brockhaus and Angelsen 2012). In addition, actors have different capacities and levels of financial resources to access, process and provide information, as well as to contribute to platforms where policy decisions about REDD+ are made (Brockhaus and Angelsen 2012; Gallemore *et al.* 2015).

Our objective is to explore opportunities and obstacles for information-driven policy change throughout the REDD+ policy process. We focus on information about the drivers of deforestation and forest degradation to illustrate that, while information itself can be a tool for transformational change, its generation, presentation and use are part of a political process – and often a power game. We first identify ways to assess drivers of deforestation and forest degradation; then we discuss the role of information gained through this assessment, as well as the main obstacles to the effective use of information at various stages of policy processes, and the political dimensions of how information is used (or not).

5.2 Assessing drivers of deforestation and forest degradation

The term 'driver' is used in multiple ways, and different conceptual frameworks exist (Angelsen and Kaimowitz 1999; Geist and Lambin 2002). When assessing and monitoring drivers to support the design and implementation of REDD+, it is important to make a distinction – within the common use of the term – between direct (proximate) drivers, underlying causes, and agents of deforestation and

forest degradation. *Direct drivers* are human activities or immediate actions that directly impact forest cover and result in a loss of carbon (e.g., agriculture expansion, infrastructure extension and wood extraction). *Underlying causes* are complex interactions of social, economic, political, cultural and technological processes that are often distant from their area of impact (e.g., rising global market prices, national policies that provide incentives for agricultural expansion, and public resettlement schemes) (Geist and Lambin 2002; Rudel *et al.* 2009a; Boucher *et al.* 2011). *Agents* of deforestation and forest degradation are individuals, households or companies linked to both the direct drivers and the underlying causes (e.g., farmers, mining companies, governments and consumers).

Improved spatial assessments using remote sensing and ground data (e.g., national forest inventories) have proven useful for assessing direct drivers by linking forest-cover change and related emissions to specific land-use activities. These assessments can provide information on region-specific direct drivers (Figure 5.1) and on their spatial and temporal dynamics (De Sy *et al.* 2015; Graesser *et al.* 2015; Curtis *et al.* 2018; Stickler *et al.* 2018). Remote sensing can provide information on the intensity, shape and pattern of land-use and forest-cover change, and can be enriched with data obtained through local and community-based monitoring (Torres and Skutsch 2015). Recent developments in machine learning algorithms, processing capabilities and cloud-based services (e.g., FAO's System for Earth Observation Data Access, Processing and Analysis for Land Monitoring [SEPAL], Google Earth Engine) enable more efficient mapping of forest and land-use change (e.g., detection of direct drivers) (Bey *et al.* 2016; Petersen *et al.* 2018). Interactive monitoring solutions and advances in mobile technology (Pratihast *et al.* 2016) are also promising for on-the-spot monitoring of direct drivers of deforestation and forest degradation. These can be integrated into online portals and databases (e.g., Global Forest Watch, CIFOR's Atlas of Deforestation and Industrial Plantations in Borneo), making them increasingly accessible to a wider, non-expert audience (Petersen *et al.* 2018).

Underlying causes of forest change across multiple scales, and their relative contribution and interaction, are often analysed with: statistical studies (e.g., spatially-explicit econometrics); place-based empirical studies; value chain analysis; and economic simulation models using political, economic and social indicators (Kissinger *et al.* 2012; Meyfroidt *et al.* 2013; Goetz *et al.* 2015). A persistent methodological challenge is finding causal attribution and quantifying the impact of various underlying causes and agents on land use (change) and forest emissions, especially since local land use is increasingly influenced by global socioeconomic and political processes (Meyfroidt *et al.* 2013; Efroymson *et al.* 2016).

Integrating assessments of direct drivers and underlying causes into ongoing national forest/land-use monitoring systems will make them more relevant for policy development and assessment. While a number of studies have assessed
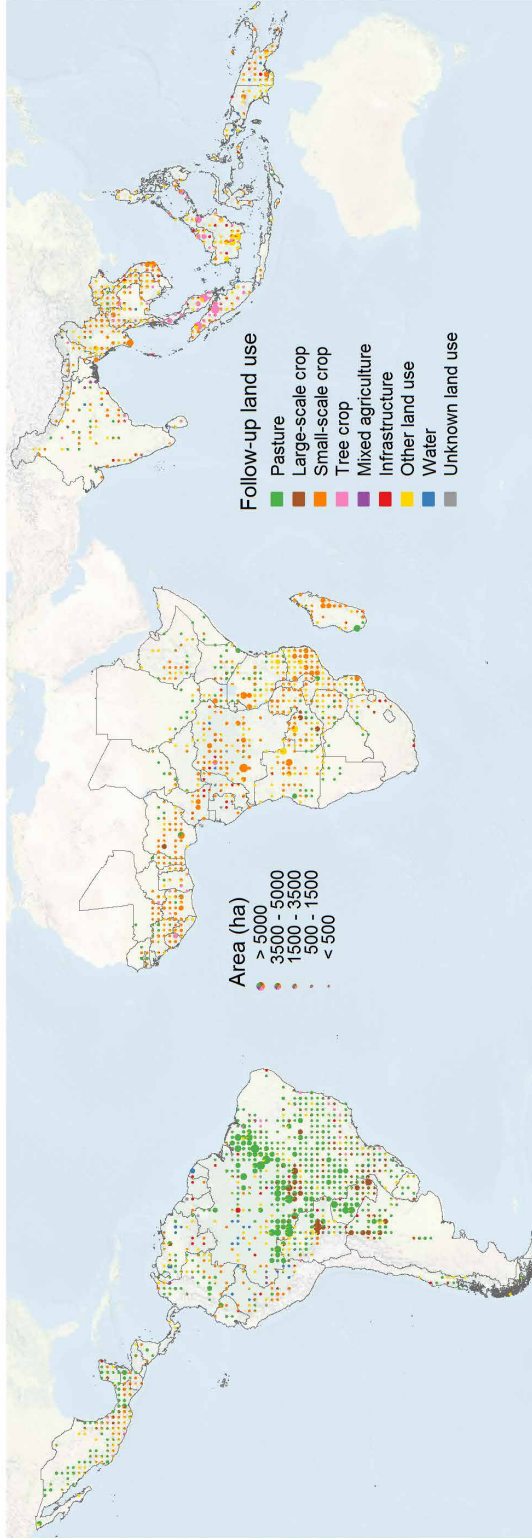
Figure 5.1 Direct drivers of deforestation in the tropics (1990–2005): Forest area (in ha) lost to different subsequent land uses

Source: De Sy et al. (2015) for South America; similar method was used to extend analysis to Central America, Africa and Asia

direct drivers and underlying causes in an integrated and systematic manner (Müller *et al.* 2013b; Khuc *et al.* 2018), appropriate methods for national-scale monitoring of drivers and causes are still limited (De Sy *et al.* 2012). Incorporating the assessment of these drivers and causes into national forest/land-use monitoring systems will likely add complexity and increase monitoring costs. As such, financial support and guidance on how REDD+ countries can develop cost-effective and policy-relevant operational monitoring of different types of drivers is essential.

The increasing interconnectedness of underlying causes of forest change (e.g., globalisation of trade, and international political forces) can result in the displacement of land use – i.e., a migration of land-use activities from one country to another (Meyfroidt *et al.* 2013). This shows that global monitoring and tracking of direct drivers and underlying causes are also needed. Periodic comparative global assessments of direct drivers (De Sy *et al.* 2015; Curtis *et al.* 2018) provide a way to assess the effectiveness of efforts to curb national and global forest change emissions. Additionally, information on how forest change is linked to international trade and investment patterns and related commodity supply chains is essential (Zaks *et al.* 2009; Karstensen *et al.* 2013) because it enables civil society actors to call for action on tackling these drivers (agenda setting) and to assess the sustainability efforts of those who have committed to specific targets (implementation and evaluation of policies). Box 5.1 provides an example of tracing soy supply chains in Brazil with an open-access supply chain transparency platform.

5.3 Information on drivers of deforestation and forest degradation in the REDD+ policy process

All stages of the REDD+ policy process – from agenda setting to policy design to implementation to formal and informal policy evaluation – require reliable information on drivers of deforestation and forest degradation in order to effect changes in existing policies. The REDD+ policy arena is characterised by a multitude of international, national and local actors who operate within existing institutions and who may have different interests and ideas about how to manage forests. Information is an inherent part of these institutions, interests and ideas (i.e., the 4Is political economy framework, Brockhaus and Angelsen 2012). Information is used selectively, it can be biased and it might be ignored; in itself, information is a fundamental power resource that actors use to advance their own interests in the policy process.

REDD+ monitoring systems are generally seen as being mostly technical and thus impartial, outside the domain of politics (Gupta *et al.* 2012). However, many researchers question this framing, arguing that what should be measured, reported and verified, how and by whom, are fundamentally political questions (Gupta *et al.* 2014). Ochieng *et al.* (2016) argue that national monitoring systems

Box 5.1 Tracing soy supply chains in Brazil with Trase

Toby Gardner

Agricultural expansion to produce commodities such as soy, palm oil, timber and beef is driving two thirds of tropical deforestation worldwide. Yet the complexity and opacity of supply chains are major barriers to improving the sustainability of production and trade in these commodities. It is very hard to take action if trading companies and consumer markets don't know where their supply chains start or end, who is involved in them, or whether they are exposed to risks as a result.

Trase is an open-access supply chain transparency platform (www.trase.earth) designed to address this problem, using publicly available data to map the links between consumer countries, via trading companies, to the places of production, in unprecedented detail. Trase combines detailed per-shipment customs data with other supply chain information to show how commodity exports are linked to agricultural conditions – including specific environmental and social risks – in the regions where they are produced, and identifies the exporting and importing companies along the way.

Of all the forest-risk commodities, the most traded in international markets is soy – including soybeans, oil and cake. In 2016, three South American countries – Brazil, Argentina and Paraguay – together produced almost 50% of the world's soy, with Brazil poised to overtake the United States as the world's largest producer of soy. Soy production is linked to substantial direct and indirect deforestation and habitat conversion of some of South America's most iconic biomes, particularly the Brazilian Cerrado and the Gran Chaco in Argentina, Paraguay and Bolivia. The majority of Brazilian soy is produced for export, with expansion driven by demand from overseas consumers, particularly in Europe and China.

Trase data show that around 60% of Brazilian soy exports in 2016 went to China, and that these exports were associated with approximately half of the total deforestation risk associated with exported soy. While many European countries imported much smaller amounts of soy than China, Trase's high-resolution supply chain maps show that these imports were often associated with a higher deforestation risk per tonne.

The blanket transparency of subnational commodity supply chains provided by Trase is also key to being able to assess and monitor the effectiveness of zero-deforestation commitments. Yet data published in the 2018 Trase Yearbook show that, during the last decade, soy traders in the Brazilian market with zero deforestation commitments have been associated with similar levels of deforestation risk as companies that have not made such commitments – demonstrating the scale of the challenge ahead.

By linking soy traders and buyers to the places where soy is grown, Trase is starting to be used, alongside other information, by both companies and investors to filter and identify risks, highlight opportunities for new partnerships and investment to improve sustainability, and monitor progress over time.

require mechanisms (e.g., institutional arrangements, procedures for conflict resolution and data exchange) for coordination, participation, transparency and accountability. Such mechanisms could help to ensure the credibility and legitimacy of measured and reported REDD+ carbon impacts and drivers of forest change in the eyes of all stakeholders, and to counteract their differences in capacities, resources and power.

Table 5.1 The role of information on drivers of deforestation and forest degradation in REDD+ policy processes and main obstacles to effective information use

Stage in policy process	Role of information about drivers of deforestation and forest degradation	Main obstacles to effective use of this information	
Agenda setting	To identify key drivers and attribute emissions to specific causes and agents.	Limited (operational) methods and data for systematic analysis of drivers and for attribution of emissions to drivers; Powerful influence of dominant business-as-usual interests on policy agenda through media and policy coalitions.	
Policy design	To inform design of appropriate policies aimed at key drivers and agents of forest change; To inform design of national forest monitoring and MRV systems.	Lack of (sub)national socioeconomic data and information on underlying causes of forest change; Selective use of information on drivers to protect interests; Lack of dialogue between monitoring experts, policy-makers and civil society.	Different capacities and resources to access and provide information and to contribute to policy decisions; Lack of mechanisms in national forest monitoring systems to ensure: • coordination and data exchange between ministries and across sectors; • transparency and timely access to information; • stakeholder participation.
Policy implementation	To implement effective MRV systems of REDD+ activities on the ground; To enable law enforcement.	Lack of resources to act on information; Lack of trust and cooperation of government agencies, forest communities and civil society.	
Policy evaluation	To set FRELs; To evaluate impacts of REDD+ activities and policies on forest emissions, and adapt policies accordingly; To enable accountability.	Selective use of information (e.g., on FRELs) to demonstrate success; Ignoring information to avoid effective REDD+ activities and protect business-as-usual interests; Lack of powerful coalitions and (access to) information to hold agents of deforestation accountable.	

Table 5.1 gives an overview of the role of information about drivers of deforestation and forest degradation at each stage of political process, along with the main obstacles hampering effective use of this information.

5.3.1 Agenda setting

A robust assessment of the key direct drivers and underlying causes of forest change is essential for countries during agenda setting. Such an assessment can help attribute emissions to specific causes and agents, to inform REDD+ priorities and scope.

Even in the presence of sufficient information, policy agendas are influenced by certain drivers that gain prominence over others. In the agenda-setting phase, different actors compete to frame REDD+ in their preferred way. For instance, actors often form policy coalitions around a common understanding of REDD+ and use the media to draw public attention to a particular interpretation of who and what is causing deforestation and forest degradation, as well as possible solutions. Comparative research indicates that the policy coalitions that are most prominent in the media do not challenge business-as-usual trajectories (Luttrell *et al.* 2013; Brockhaus *et al.* 2014; Brockhaus and Di Gregorio 2014; Cronin *et al.* 2016; Khatri *et al.* 2016; Gebara *et al.* 2017; Pham *et al.* 2017a). For example, in Indonesia and Papua New Guinea the most vocal coalition, dominated by state actors, largely focuses on issues of funding for REDD+ activities by industrialised countries (Brockhaus *et al.* 2014). Calls for transformational change, often led by civil society organisations, are overpowered and silenced by those supporting business-as-usual practices in many REDD+ countries (Di Gregorio *et al.* 2013, 2015).

5.3.2 Policy design

Current national forest monitoring systems often lack not only information on direct drivers and agents driving forest change, but also basic socioeconomic and other data on underlying causes of forest change. Such information is relevant for national policy design to gain a deeper understanding of how, for example, national-level economy and policies affect the direct drivers and agents. Incorporating information on underlying causes adds complexity to REDD+ monitoring and requires a higher degree of coordination of monitoring activities across government agencies and sectors (Chapter 7).

Even when information on the direct drivers or underlying causes of forest change is available, it is not necessarily incorporated into national strategies. Direct interventions in national REDD+ readiness plans have often focused on reducing forest degradation (e.g., sustainable forest management, fuelwood efficiency) rather than deforestation driven by, e.g., large-scale agriculture or infrastructure development (Kissinger *et al.* 2012; Salvini *et al.* 2014), which might even be supported through other policies and perverse incentives (Di Gregorio *et al.* 2012). This illustrates that policy action tackling larger, more powerful agents of

forest change is often discouraged, and information about commodity-driven deforestation is ignored or not produced. At the same time policy action against smallholder practices such as shifting cultivation might be highlighted, because it supports established policy approaches and legal norms. Such selective use of information about direct drivers of forest change risks justifying attempts by the state to gain control over forested land and disempower smallholders (Box 5.2) (Fox *et al.* 2009; Moeliono *et al.* 2017; Pham *et al.* 2018). Similarly, some stakeholders would argue, that Indonesia's One Map Policy – which aims to integrate existing maps of regions across the archipelago into a single map to help resolve land conflicts – does not provide a comprehensive view of land use and rights by all stakeholders, since indigenous land claims remain excluded from the initiative (Jong 2018).

Analysis of the process of developing the MRV system in Peru (Kowler and Larson 2016) demonstrates that the complex technical nature of monitoring systems has hindered the interest, participation and inclusion of actors such as regional governments and forest communities. While experts play an important role in the design of monitoring systems, policy-makers and civil society actors also need to understand and have a voice in the monitoring decisions that affect them. The design process should also facilitate dialogue and communication, to stimulate mutual trust and the legitimacy of the monitoring system (Kowler and Larson 2016).

5.3.3 Policy implementation

Information on the spatial distribution, intensity and type of direct drivers and on the underlying causes that lead to forest change can provide an essential data stream for countries to implement effective REDD+ activities on the ground, and track progress. Timely information on forest change and associated direct drivers can assist law enforcement agencies in monitoring compliance with forest policies.

Both government agencies and civil society show strong interest in the use of near-real time forest alert or early warning systems to detect illegal logging and forest conversion, e.g., the Brazilian Ministry for Science and Technology's Real Time System for Detection of Deforestation (DETER) and Amazon Conservation and partners' Monitoring of the Andean Amazon Project (MAAP) in Peru (Early Warning Working Group 2018). Local and indigenous communities can also use early warning alerts to identify threats to their territories and share information with local authorities. Identification of the direct driver (e.g., mining, palm oil plantation) is a key step in early warning systems to determine the appropriate follow-up actions and government agencies to involve (Finer *et al.* 2018). Yet multiple challenges, such as the lack of cooperation between agencies, limited resources to act on information, lack of trust between civil society and law enforcement, lack of political will, corruption and other governance issues, hamper the effective use of early warning information (Mora 2018). Effective government institutions, coordination and clear responsibilities to process and respond to this kind of information are essential to convert data into action (Finer *et al.* 2018).

Box 5.2 Shifting cultivation: The importance of information and perception

Moira Moeliono

REDD+ targets areas of remaining tropical forests, where shifting cultivation is often the basis of local livelihoods. The shifting cultivation system is characterised by a rotational farming technique where land is cleared for cultivation (frequently by fire) and then left fallow to regenerate for several years. If the fallow period is sufficiently long, this can be a productive and sustainable adaptation to challenging environmental conditions. CO_2 emitted during burning can be more than offset by the sequestration in vegetation regrowth during the fallow phase.

The case of Vietnam shows how information and misinformation about shifting cultivation determines how it is treated. At national level, shifting cultivation is considered the main direct driver of tropical deforestation and forest degradation. This results in national policies aimed at its eradication, while information on other direct drivers such as large-scale conversion of forest to plantations is less acknowledged in policy documents and debates. Defining shifting cultivation as an unproductive and destructive practice is also used to legitimise centralised forest management and top-down claims on land, thereby ignoring local management systems and imposing conservation programmes. At provincial level, persistence of shifting cultivation is considered a failure of policy performance and therefore no data are collected, thereby rendering the practice invisible to the state. At district and community levels, it is more important to maintain security rather than risk protest by 'ethnic' communities, so the practice is ignored and allowed to continue (Pham *et al.* 2018).

Shifting cultivation is thus a political issue with different interpretations and conflicting perspectives at different levels of government and stakeholders. The politics are shaped by institutional 'stickiness' (i.e., resistance to change), interests and ideas at each level. More importantly, by focusing on shifting cultivation, the other major drivers of deforestation are not addressed in policy.

5.3.4 Policy evaluation

Information on agents and drivers of deforestation and forest degradation plays multiple roles in policy evaluation. It gives more insight into the extent to which a particular policy has been effective in reducing forest emissions that are connected to particular agents or drivers, with the aim of revising the policy if needed. In the context of results-based payment for REDD+, it can provide valuable information for setting forest reference (emission) levels (FRELs/FRLs) (Chapter 4). Information on agents of deforestation and forest degradation can also be a powerful tool for civil society to hold these agents accountable for their actions, and to demand that drivers be addressed (e.g., commitments made by state and non-state actors in the New York Declaration on Forests).

As actors can show success or results in this stage to gain or maintain financial or popular support, they may use or bias information to their advantage. FRELs, for example, are the basis for evaluation of REDD+ results, and will thus affect payment opportunities and levels. This makes the very definition of FREL highly political

in nature. Evidence suggests that countries (those paying and those delivering results) may 'cherry pick' and negotiate the information that is most beneficial for their situation (Chapter 4). While information on drivers can support more targeted and effective REDD+ policy action, such actions can trigger resistance and counter-actions to avoid disturbing the status quo. Powerful actors may try to use policy revisions to their advantage to protect business-as-usual interests. The revision of the Brazilian Forest Code in 2012, for example, ended up weakening forest protection, and is seen as a victory of larger-scale business-as-usual interests driving deforestation and forest degradation (May *et al*. 2016).

Holding state and businesses accountable often requires strong civil society organisations and other independent agencies (Weber and Partzsch 2018). Indicators of accountability include clarity of roles, clear reporting, frequent monitoring and clear rationales for decision-making (Secco *et al*. 2014). For most REDD+ countries, there are no clear roles for these stakeholders in REDD+ MRV, nor are there reporting channels between MRV participants (Ochieng *et al*. 2016). In order to enforce accountability, coalition-building with powerful agents of change is a strategic action, but access to information is a prerequisite (Di Gregorio *et al*. 2012; Brockhaus *et al*. 2014; Korhonen-Kurki *et al*. 2017, 2018).

5.4 Lessons and ways forward

Building national and international capacities for assessing and tracking drivers of forest change is a complex but crucial undertaking. A wide variety of spatial and non-spatial information, coming from different sources and involving many stakeholders, will have to be integrated if an information system is to be adequate to support decision-making and evaluate the effect of interventions. While data availability has improved significantly in recent years, the chain from technical data to actionable information – and ultimately effective interventions – needs to be strengthened. Research institutes and REDD+ countries need to work together towards operational and integrated monitoring of different types of drivers, to support the REDD+ policy processes.

More systematic and transparent assessments of direct drivers and underlying causes of forest change at national and international levels can leverage action against business-as-usual practices at the global level. Experiences of REDD+ policy processes have shown that information and discourses about drivers of forest change are often purposely hidden or neglected by powerful agents, hindering the transformational changes needed to change behaviour in business-as-usual land-use decisions. Thus, paying attention to implementing mechanisms – institutional arrangements, procedures and tools – for coordination, participation, transparency and accountability in REDD+ monitoring systems, and supporting stakeholders who want to use information to strengthen policies and actions addressing drivers, are crucial for information-driven policy change.

References

Angelsen A, and Kaimowitz D. 1999. Rethinking the causes of tropical deforestation: Lessons from economics models. *The World Bank Research Observer,* 14(1): 73–98.

Bey A, Díaz ASP, Maniatis D, Marchi G, Mollicone D, Ricci S, Bastin JF, Moore R, Federici S, Rezende M, Patriarca C, Turia R, Gamoga G, Abe H, Kaidong E, and Miceli G. 2016. Collect earth: Land use and land cover assessment through augmented visual interpretation. *Remote Sensing,* 8(10): 807.

Boucher D, Elias P, Lininger K, May-Tobin C, Roquemore S, and Earl S. 2011. *The root of the problem: What's driving deforestation today?* Cambridge, MA: Tropical Forest and Climate Initiative, Union of Concerned Scientists (UCS).

Brockhaus M and Angelsen A. 2012. Seeing REDD+ through 4Is: A political economy framework. *In* Angelsen A, Brockhaus M, Sunderlin WD, and Verchot LV, eds. *Analysing REDD+: Challenges and Choices*. p. 15–30. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Brockhaus M and Di Gregorio M. 2014. National REDD+ policy networks: From cooperation to conflict. *Ecology and Society,* 19(4): 14.

Brockhaus M, Di Gregorio M, and Mardiah S. 2014. Governing the design of national REDD+: An analysis of the power of agency. *Forest Policy and Economics,* 49: 23–33.

Cronin T, Santoso L, Di Gregorio M, Brockhaus M, Mardiah S, and Muharrom E. 2016. Moving consensus and managing expectations: Media and REDD+ in Indonesia. *Climatic Change,* 137(1–2): 57–70.

Curtis PG, Slay CM, Harris NL, Tyukavina A, and Hansen MC. 2018. Classifying drivers of global forest loss. *Science,* 361(6407): 1108–1111.

De Sy V, Herold M, Achard F, Asner GP, Held A, Kellndorfer J, and Verbesselt J. 2012. Synergies of multiple remote sensing data sources for REDD+ monitoring. *Current Opinion in Environmental Sustainability,* 4(6): 696–706.

De Sy V, Herold M, Achard F, Beuchle R, Clevers JGPW, Lindquist E, and Verchot L. 2015. Land use patterns and related carbon losses following deforestation in South America. *Environmental Research Letters,* 10(12): 124004.

Di Gregorio M, Brockhaus M, Cronin T, and Muharrom. 2012. Politics and power in national REDD+ policy processes. *In* Angelsen A, Brockhaus M, Sunderlin WD, and Verchot LV, eds. *Analysing REDD+: Challenges and Choices*. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Di Gregorio M, Brockhaus M, Cronin T, Muharrom E, Santoso L, Mardiah S, and Büdenbender M. 2013. Equity and REDD+ in the media: A comparative analysis of policy discourses. *Ecology and Society,* 18(2): Art. 39.

Di Gregorio M, Brockhaus M, Cronin T, Muharrom E, Mardiah S, and Santoso L. 2015. Deadlock or transformational change? Exploring public discourse on REDD+ across seven countries. *Global Environmental Politics,* 15(4): 63–84.

Early Warning Working Group. 2018. Event Report – International Forum on Forest Early Warning Systems, July 9–10, 2018. Lima, Peru: Early Warning Working Group.

Efroymson RA, Kline KL, Angelsen A, Verburg PH, Dale VH, Langeveld JWA, and McBride A. 2016. A causal analysis framework for land-use change and the potential role of bioenergy policy. *Land Use Policy,* 59: 516–527.

Finer M, Novoa S, Weisse J, Petersen R, Souto T, Stearns F, and Martinez RG. 2018. Combating deforestation: From satellite to intervention. *Science,* 360(6395): 1303–1305.

Fox J, Fujita Y, Ngidang D, Peluso N, Potter L, Sakuntaladewi N, Sturgeon J, and Thomas D. 2009. Policies, political-economy, and swidden in Southeast Asia. *Human Ecology,* 37(3): 305–322.

Gallemore C, Di Gregorio M, Moeliono M, Brockhaus M, and Prasti HRD. 2015. Transaction costs, power, and multi-level forest governance in Indonesia. *Ecological Economics,* 114: 168–179.

Gebara MF, May PH, Carmenta R, Calixto B, Brockhaus M, and Di Gregorio M. 2017. Framing REDD+ in the Brazilian national media: How discourses evolved amid global negotiation uncertainties. *Climatic Change,* 141(2): 213–226.

Geist HJ and Lambin EF. 2002. Proximate causes and underlying driving forces of tropical deforestation. *BioScience,* 52(2): 143–150.

Goetz SJ, Hansen M, Houghton RA, Walker W, Laporte N, and Busch J. 2015. Measurement and monitoring needs, capabilities and potential for addressing reduced emissions from deforestation and forest degradation under REDD+. *Environmental Research Letters,* 10(12): 123001.

Graesser J, Aide TM, Grau HR, and Ramankutty N. 2015. Cropland/pastureland dynamics and the slowdown of deforestation in Latin America. *Environmental Research Letters,* 10(3): 034017.

Gupta A, Lövbrand E, Turnhout E, and Vijge MJ. 2012. In pursuit of carbon accountability: The politics of REDD+ measuring, reporting and verification systems. *Current Opinion in Environmental Sustainability,* 4(6): 726–731.

Gupta A, Vijge MJ, Turnhout E, and Pistorius T. 2014. Making REDD+ Transparent: The politics of Measuring, Reporting and Verification. *In* Gupta A, and Mason M, eds. *Transparency in global environmental governance: Critical perspectives*. Cambridge, MA: MIT Press. 181–201.

Jong H. 2018, 10 August 2018. Indonesia's 'One Map' database blasted for excluding indigenous lands. Mongabay. Menlo Park, CA: Mongabay. [accessed 25 November 2018].https://news.mongabay.com/2018/08/indonesias-one-map-database-blasted-for-excluding-indigenous-lands

Karstensen J, Peters GP, and Andrew RM. 2013. Attribution of CO_2 emissions from Brazilian deforestation to consumers between 1990 and 2010. *Environmental Research Letters,* 8(2): 024005.

Khatri DB, Pham TT, Di Gregorio M, Karki R, Paudel NS, Brockhaus M, and Bhushal R. 2016. REDD+ politics in the media: A case from Nepal. *Climatic Change,* 138(1): 309–323.

Khuc QV, Tran BQ, Meyfroidt P, and Paschke MW. 2018. Drivers of deforestation and forest degradation in Vietnam: An exploratory analysis at the national level. *Forest Policy and Economics,* 90: 128–141.

Kissinger G, Herold M, and De Sy V. 2012. Drivers of Deforestation and Forest Degradation: A Synthesis Report for REDD+ Policymaker. Vancouver, Canada: Lexeme Consulting.

Korhonen-Kurki K, Brockhaus M, Muharrom E, Juhola S, Moeliono M, Maharani C, and Dwisatrio B. 2017. Analyzing REDD+ as an experiment of transformative climate governance: Insights from Indonesia. *Environmental Science and Policy,* 73: 61–70.

Korhonen-Kurki K, Brockhaus M, Sehring J, di Gregorio M, Assembe-Mvondo S, Babon A, Bekele M, Benn V, Gebara MF, Kambire HW, Kengoum F, Maharani C, Menton M, Moeliono M, Ochieng R, Paudel NS, Pham TT, Dkamela GP, and Sitoe A. 2018. What drives policy change for REDD+? A qualitative comparative analysis of the interplay between institutional and policy arena factors. *Climate Policy*. doi: 10.1080/14693062.2018.1507897

Kowler LF and Larson AM. 2016. *Beyond the technical: The politics of developing the MRV system in Peru*. CIFOR Infobrief No. 133. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Luttrell C, Loft L, Fernanda Gebara M, Kweka D, Brockhaus M, Angelsen A, and Sunderlin WD. 2013. Who should benefit from REDD+? Rationales and realities. *Ecology and Society*, 18(4):Art 52.

May P, Gebara MF, Barcellos LMd, Rizek MB, and Millikan B. 2016. *The context of REDD+ in Brazil: Drivers, actors and institutions – 3rd edition*. Occasional Paper No. 160. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Meyfroidt P, Lambin EF, Erb KH, and Hertel TW. 2013. Globalization of land use: Distant drivers of land change and geographic displacement of land use. *Current Opinion in Environmental Sustainability,* 5(5): 438–444.

Moeliono M, Pham TT, Bong IW, Wong GY, and Brockhaus M. 2017. Social forestry-why and for whom? *Forest and Society,* 1(2): 1–20.

Mora B. 2018. *User needs assessment for forest change early warning systems*. GFOI (Global Forests Observations Initiative) Early Warning Working Group report. Rome: Global Forests Observations Initiative (GFOI) [accessed 25 November 2018] http://www.gfoi.org/wp-content/uploads/2018/07/UNA_Early-Warning-systems_final-published.pdf

Müller R, Pistorius T, Rohde S, Gerold G, and Pacheco P. 2013b. Policy options to reduce deforestation based on a systematic analysis of drivers and agents in lowland Bolivia. *Land Use Policy,*30(1): 895–907.

Ochieng RM, Visseren-Hamakers IJ, Arts B, Brockhaus M, and Herold M. 2016. Institutional effectiveness of REDD+ MRV: Countries progress in implementing technical guidelines and good governance requirements. *Environmental Science and Policy,* 61: 42–52.

Petersen R, Davis C, Herold M, and De Sy V. 2018. Tropical forest monitoring: Exploring the gaps between what is required and what is possible for REDD+ and other initiatives. Washington, DC: World Resources Institute (WRI).

Pham TT, Di Gregorio, M.; Brockhaus, M. 2017a. REDD+ politics in the media: A case study from Vietnam. *International Forestry Review* 19(Supplement 1): 69–80.

Pham TT, Moeliono M, Wong GY, Brockhaus M, and Dung LN. 2018. The politics of swidden: A case study from Nghe An and Son La in Vietnam. *Land Use Policy*. doi: 10.1016/j.landusepol.2017.10.057

Pratihast AK, DeVries B, Avitabile V, de Bruin S, Herold M, and Bergsma A. 2016. Design and implementation of an interactive web-based near real-time forest monitoring system. *PloS one,* 11(3): e0150935.

Rudel TK, Defries R, Asner GP, and Laurance WF. 2009a. Changing drivers of deforestation and new opportunities for conservation. *Conservation Biology,* 23(6): 1396–1405.

Salvini G, Herold M, De Sy V, Kissinger G, Brockhaus M, and Skutsch M. 2014. How countries link REDD+ interventions to drivers in their readiness plans: Implications for monitoring systems. *Environmental Research Letters,* 9(7): 074004.

Secco L, Da Re R, Pettenella DM, and Gatto P. 2014. Why and how to measure forest governance at local level: A set of indicators. *Forest Policy and Economics,* 49: 57–71.

Stickler CM, Duchelle AE, Ardila JP, Nepstad DC, David OR, Chan C, Rojas JG, Vargas R, Bezerra TP, Pritchard L, Simmonds J, Durbin JC, Simonet G, Peteru S, Komalasari M, DiGiano ML, and Warren MW. 2018. *The State of Jurisdictional Sustainability*. San Francisco, CA, USA; Bogor, Indonesia; Boulder, CO, USA: Earth Innovation Institute; Center for International Forestry Research; Governors' Climate and Forests Task Force.

Torres AB and Skutsch M. 2015. Special issue: The potential role for community monitoring in MRV and in benefit sharing in REDD+. *Forests,* 6: 244–251.

UNFCCC (United Nations Framework Convention for Climate Change). 2009. Methodological guidance for activities relating to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries. FCCC/SBSTA/2015/L.5. Bonn, Germany: UNFCCC.

UNFCCC (United Nations Framework Convention for Climate Change). 2011. The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperation Under the Convention. Decision 1/CP.16. Report of the Conference of the Parties on its Sixteenth Session, Cancun, 29 November–10 December 2010. FCC/CP/2010/7. Bonn, Germany: UNFCCC.

Weber A-K and Partzsch L. 2018. Barking up the right tree? NGOs and corporate power for deforestation-free supply chains. *Sustainability,* 10(11): 3869.

Zaks DPM, Barford CC, Ramankutty N, and Foley JA. 2009. Producer and consumer responsibility for greenhouse gas emissions from agricultural production – a perspective from the Brazilian Amazon. *Environmental Research Letters,* 4(4): 044010.

cifor.org/gcs   **forestsnews.cifor.org**