How countries link REDD+ interventions to drivers in their readiness plans: implications for monitoring systems

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Abstract

Countries participating in the REDD+ scheme are in the readiness phase, designing policy interventions to address drivers of deforestation and forest degradation (DD). In order for REDD + interventions to be effective, it is essential that they take into account the specific drivers that they aim to address. Moreover it is crucial to design systems that monitor the effectiveness of the planned interventions. In this article we provide a comprehensive and comparative assessment of interventions proposed by 43 REDD+ countries in 98 readiness documents. We summarize the types of interventions and assess if they are formulated referring to the drivers of DD that they are aiming to address. Based on this assessment we consider the implications for systems for monitoring effectiveness of proposed interventions. Most countries reviewed link proposed interventions to specific drivers of DD. The majority of the countries making this link have better driver data quality, in particularly those that present their data in ratio or ordinal terms. Proposed interventions focus not only on activities to reduce deforestation, but also on other forest related REDD+ activities such as sustainable forest management, which reduce forest degradation and enhance forest stocks. Moreover, driver-specific interventions often relate to drivers not only inside but also outside the forest sector. Hence we suggest that monitoring systems need to assess not only deforestation rates through remote sensing, but also degradation and other carbon stock changes within the forest, using more detailed ground level surveys and measurements. In addition, the performance of interventions outside the forest need to be monitored, even if the impacts of these cannot be linked to specific changes in forest carbon stock in specific locations.

Keywords: drivers of deforestation and forest degradation, monitoring systems, proposed REDD + interventions, REDD+, readiness documents

1. Introduction

In recent years the *Reducing emissions from deforestation and forest degradation, conservation of forest carbon stocks,* *sustainable management of forests and enhancement of carbon stocks* (REDD+) scheme has gained increased attention in the policy arena. REDD+ represents a potentially valuable incentive for developing countries to reduce greenhouse gas (GHG) emissions and promote sustainable forest management. Nevertheless, issues related to the implementation of the REDD+ scheme are numerous, including how to enhance its effectiveness in addressing the drivers of deforestation and

degradation (Angelsen, 2010). Following the UNFCCC requirements for REDD+ implementation, countries should implement a shift from business as usual through activities in the following areas: (i) reducing emissions from deforestation, (ii) reducing emissions from forest degradation, (iii) conservation of forest carbon stocks, (iv) sustainable management of forests and (v) enhancement of carbon stocks. These activities can be implemented through aggregates of concrete interventions that result in verifiable REDD+ through a three-phased approach (UNFCCC 2011). Most countries are still in the first, preparatory or 'readiness' phase, designing a national strategy aimed at tackling drivers of deforestation and forest degradation (DD) (Korhonen-Kurki *et al* 2014). The second phase focuses on the implementation of a REDD+ strategy, supported by grants or other financial support for capability building and enabling policies. During the third phase REDD+ activities will be implemented using performance-based compensation (UNFCCC 2010).

Strategizing REDD+ interventions requires consideration of the drivers of deforestation/degradation (SBSTA 2013). Drivers of deforestation/degradation are complex to study because they are related to multiple biophysical, social and economic factors that are interdependent, and which result in dynamic land use patterns (Mohamed 2000). These factors include the multiple and often conflicting interests of different stakeholders, which in turn are influenced by other factors such as existing national policies, regional trade, power dynamics, subsistence forest dependency, resource and technology access, population growth and poverty (Angelsen and Kaimowitz 1999). A distinction can be made between direct and underlying drivers of deforestation and forest degradation (DD) (Geist and Lambin 2002, De Fries 2002). Direct drivers are human activities and actions that directly impact forest cover and result in loss of carbon stocks. Underlying drivers are complex interactions of social, economic, political, cultural and technological processes that affect the direct drivers of DD. They act at multiple scales: international (markets, commodity prices), national (population growth, domestic markets, national policies, governance) and local (subsistence, poverty) (Rudel *et al* 2009, Boucher *et al* 2011). Clearly, for effective REDD+ interventions both direct and underlying drivers need to be taken into account.

REDD+ interventions can be divided into direct and enabling activities. Direct interventions are specific, often local activities which result in a direct change in the carbon stock (i.e. reforestation, protected area strategies, agricultural intensification to reduce pressure on forests). Enabling interventions are aimed at facilitating the implementation of direct interventions (i.e. improved law enforcement against illegal logging, and land tenure regulation). Hence direct interventions are more directly linked to direct drivers and are focused on local, context-specific activities. REDD+ strategies that focus solely on direct drivers to demonstrate quantifiable emissions reductions may place less emphasis on addressing the critical underlying drivers. It is crucial that these are also addressed if interventions are to succeed in achieving the emissions reductions (Kissinger *et al* 2012).

Despite the importance of designing interventions that address specific drivers of DD, there is very little literature available on how different countries are selecting and designing interventions. Questions also remain about how countries prioritize different interventions, given their analysis of what the drivers are. However, some information on this can be found in documents prepared by countries in their readiness phase, such as readiness preparation proposals (R-PPs), and UN-REDD National Programme Documents, as well as documents prepared by research organizations and country partner organizations, such as REDD+ country profiles by the Centre for International Forestry Research (CIFOR). These documents, referred to as 'readiness documents' in this paper, are an interesting source of data to be analysed with a view to assessing how countries are linking drivers and interventions.

We build upon these considerations stating that monitoring systems are needed to assess the effectiveness of interventions in addressing drivers of DD (Romijn *et al* 2012). Monitoring drivers of DD is needed for several reasons: to understand their importance and processes at work, to attribute emissions to specific causes (i.e. nationally), track their activities over time, to design dedicated mitigation actions that address them, and to assess the impact of these (Herold and Skutsch 2011). Monitoring drivers that lead to DD provides essential information for keeping track of the effectiveness of direct REDD+ interventions. However, current REDD+ monitoring efforts are largely focused to meet international reporting needs and thus are concentrated on the assessment of change in forest area (deforestation) and related carbon emissions, while in only a few cases is the forest area change analysed by linking it to specific driver activities and follow-up land use (GOFC-GOLD 2011, Herold *et al* 2011). In Mexico for example a deforestation threat map has been developed by correlating past deforestation with social and agricultural data available in secondary sources at the county level (INECC 2012). Nevertheless such analyses rarely incorporate underlying drivers, as they are usually not readily detectable using remote sensing and forest inventory data and would require monitoring capacities beyond these techniques. Moreover, some underlying drivers are not represented in existing databases and their analysis would require more detailed socio-economic data. Others relate to sectoral policies and to conditions in domestic and international markets (Kissinger *et al* 2012), which are generalized and difficult to connect with specific land cover changes in particular locations.

The above-mentioned three elements (drivers, interventions and monitoring capacities) are interlinked through a logical chain: in order for REDD+ interventions to be effective, they need to be developed with an understanding of specific drivers of DD that they aim to address. Improving monitoring capacities should provide data of progressively better quality and hence increasingly detailed information about drivers, allowing the (re)design of REDD+ policy interventions which are more appropriate to the local conditions and hence more effective. This logic has been described by the Forest Carbon Partnership Facility (FCPF) as follows:
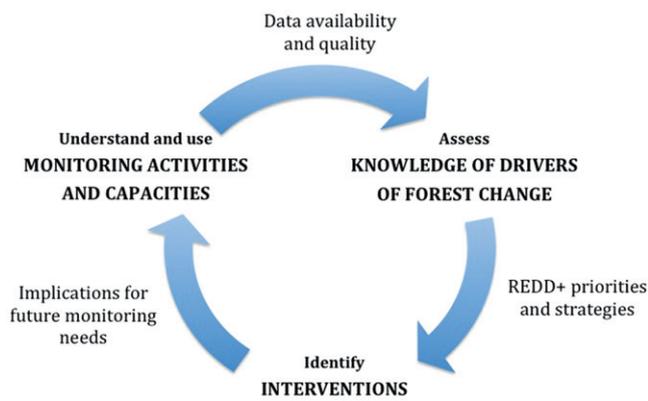
Figure 1. Linkages between knowledge of drivers, interventions and monitoring capacities in the context of national REDD+ schemes.

'countries are realizing that the objective of reference level analyses is to better understand and to quantify the relationships among the driver activities of DD, and historical and potential future emissions. The logical chain of: (1) driver analysis, (2) REDD+ strategy development, (3) reference emission levels (REL) exploration, and (4) measurement, report and verification (MRV) design is strongly interlinked. Nevertheless this logical chain has been weak in most RPPs to date' (FCPF 2010). Perhaps one reason for this is that only limited scientific research has focused on these interlinkages. Given the current gap in current knowledge and understanding of the above-mentioned issues, this article focuses on three main objectives: (i) synthesize the direct and enabling REDD+ interventions proposed by each countries, (ii) assess whether the proposed interventions take into account current knowledge of drivers of DD, (iii) reflect on possible implications for future systems to monitor the effectiveness of the proposed interventions (figure 1). The structure of the article reflects these three objectives, as it first presents an analysis of readiness documents and identifies the direct and enabling interventions proposed by different countries.

This is followed by a second part focussing on the objective to assess to what extent countries explicitly relate interventions considering existing knowledge about DD drivers. In particular, we assessed whether proposed interventions refer to both the relevant direct and underling drivers. Interventions that are proposed to address specific direct drivers of DD have been summarized. The discussion section deals then with possible implications for future monitoring systems, in particular how they could monitor the effectiveness of the proposed interventions. In a concluding section suggestions are made about how to expand monitoring systems beyond the forest sector, through a landscape approach.

2. Materials and methods

Countries participating in REDD+ are being assisted during the readiness phase by two main initiatives: the UN-REDD Programme and the World Bank FCPF. The UN-REDD Programme supports 15 countries, while FCPF assists a total

of 36 countries (13 in Africa, 15 in Latin America, and 8 in Asia) following a review of their Readiness Preparation Idea Notes (P-PIN), of which 33 countries have taken the next step by submitting more detailed R-PP (FCPF 2013). A number of bilateral programs including Norway's Government International Climate and Forests Initiative (NICFI) (Ministry of Norwegian Environment 2009) are facilitating the REDD+ readiness process in some countries, such as Indonesia and Brazil. Another source of information used for this paper to add qualitative analysis are country profiles prepared by CIFOR and REDD+ country partners, which followed specific guidelines to analyse contextual conditions that affect the REDD policy environment in each country, and which in particular looked at the politico-economic conditions that drive DD in the respective countries (Brockhaus *et al* 2012).

The authors reviewed a total of 98 readiness documents of 43 countries: 35REDD+ R-PPs, 15 UN-REDD National Programme Documents and six CIFOR-country profiles (appendix A), available at the websites of World Bank FCPF (http://forestcarbonpartnership.org/), UN-REDD (http://un-redd.org/) and CIFOR (http://cifor.org/) respectively. Six countries (see appendix A) submitted R-PPs to the FCPF as well as documents to the UN-REDD-National Programme. In this study more focus has been given to R-PPs because they contain a more extensive explanation of the proposed interventions, which allowed a more consistent analysis.

Readiness documents have been reviewed to analyse the strategy that each country proposes to address DD based upon their initial knowledge of both direct and underling drivers. The review has been done by identifying and listing all the interventions proposed in all the readiness documents. This list has been used to build intervention categories of enabling and direct interventions.

Readiness documents were evaluated to meet the following objectives:

1. Synthesize the direct and enabling REDD+ interventions proposed by each countries
2. Assess whether the proposed interventions take into account current knowledge of drivers of DD; in particular:
   a. Assess whether the proposed interventions refer to both relevant direct and underling drivers
   b. Summarize the interventions that are proposed to address specific direct drivers of DD
3. Reflect on possible implications for future systems to monitor the effectiveness of the proposed interventions.

These objectives expand on the work carried out by Kissinger *et al* (2012), who made a preliminary analysis of drivers and interventions described by REDD+ countries in 46 Readiness documents.

2.1. Synthesis of the direct and enabling REDD+ interventions

To meet the first objective, 98 readiness documents were reviewed to synthesize the direct and enabling REDD+ interventions that each REDD+ country is proposing. Particular attention has been given to the section 'REDD+ Strategy

Table 1. Description of categories and subcategories of interventions proposed by 43 REDD+ countries.

Main category	Subcategories for objective 2.1	Subcategories for objective 2.2
Interventions with linkage: includes countries that propose interventions referring to drivers	(i) *Interventions aimed to address both direct and underling drivers* (ii) *Interventions aimed to address only the direct drivers*	*Group 1 and 2*
Interventions without linkage: includes countries that propose interventions without referring to drivers	(iii) *Interventions aimed at increasing carbon stocks* (iv) *No linkage reported*: includes the remaining countries of category (iii)	*Group 2*

Table 2. Percentage of reviewed countries pursuing direct interventions as part of REDD+.

Direct interventions	
Sustainable forest management	62%
Fuel wood efficiency/cook stoves	47%
Agroforestry	44%
Protected areas strategies	41%
Afforestation/reforestation	38%
Agricultural intensification/permanent agriculture	38%
Plantations establishment/management	29%
Livestock/rangeland management	27%
Rehabilitation of degraded land	23%

Options' of the R-PPs, the section 'Draft REDD+ Strategy and Implementation Framework' of UN-REDD National-Programme-Documents and the section 'Future REDD+ policy options and processes' of CIFOR country profiles.

2.2. Assessment of the linkage between intervention and current knowledge of drivers

The second objective aimed at assessing if countries design interventions taking into account their current knowledge of drivers of DD. This objective has been met through two analyses. The first analysis focused on assessing whether the strategies proposed refer to specific drivers that they are aiming to address. To this aim countries have been classified in two main categories: *interventions with linkage and interventions without linkage* (column 1 of table 1), which were further subdivided in two subcategories: (i) interventions aimed to address both direct and underling drivers, (ii) interventions aimed to address only the direct drivers, (iii) interventions aimed at increasing carbon stocks and (iv) no linkage reported (column 2 of table 1).

These subcategories were created for two purposes. The first one was to assess whether countries are able to propose interventions linking them to specific drivers of DD; the second one was to assess whether the ability to make this link is related with the current knowledge about drivers.

The quality of data on drivers has been used as an indicator of current knowledge about drivers of DD. This data were derived from the work carried out by Hosonuma *et al* (2012), who classified data on drivers of DD as reported by countries using a scale which reflects the form in which this data were reported: Ratio scale (quantitative information about drivers), Ordinal scale (ranking of importance of drivers) and Nominal scale (simply listing drivers).

The second analysis aimed at assessing the types of direct interventions proposed to address specific direct drivers of DD. To this aim readiness documents that explicitly link the intervention to each direct driver of DD (for instance using a table) have been further analysed. The countries that made this explicit link (a total of ten countries, appendix A) have been grouped into a subcategory of countries (called Group 1), which is a subset of the main category '*interventions with linkage*' (table 1). The interventions proposed by Group 1 have been compared to interventions proposed by all the other countries, which we grouped into a second subset of countries (called *Group 2*).

2.3. Implications for future monitoring systems

The third objective was approached by considering and discussing implications of the findings of this article in the light of current literature on systems for monitoring the implementation of the proposed interventions. In particular we reflect on the importance of monitoring activities not only in the forest sector but also outside of it. We suggest a conceptual method/framework to link interventions with their possible impacts on carbon stocks.

3. Results

3.1. Synthesis of the direct and enabling REDD+ interventions

3.1.1. Direct interventions. Sustainable forest management is the most commonly identified direct intervention, proposed by 62% of countries, followed by fuel wood efficiency/cook stoves and agroforestry (table 2).

This is perhaps not surprising given the fact that this term is used to cover a wide range of different interventions including sustainable yield management, and can be applied to different organizational forms of forestry, from government led to community led. A substantial number of countries also place emphasis on interventions appropriate to mosaic landscapes, such as *agroforestry*, It appears to be seen as useful in addressing the range of drivers that persist in many tropical frontier landscapes, particularly in mosaic and multiple-use landscapes.

Afforestation/reforestation and *livestock/rangeland management*. *Agroforestry* was identified by 44% of countries as part of their REDD+ strategy. About 38% of countries include

afforestation and reforestation in REDD+ strategies. These countries recognize afforestation and reforestation as essential strategies to address demand for fuel wood and construction materials, to increase carbon stocks and to restore degraded lands. *Livestock/rangeland management* has been proposed by 27% of countries as a strategy to improve agricultural production and lower forest degradation. Finding solutions to the fuel wood driver of forest degradation is a clear priority for 47% of countries reviewed, which seek to find alternatives to fuel wood, and more efficient cooking stoves. While a number of countries seek REDD+ finance to support *agricultural intensification* (38%) and promote *rehabilitation of degraded land* (23%), no country explicitly ties these two strategies together.

In many cases of course countries propose not just one but several interventions to deal with a specific driver. For instance, of the countries that propose agriculture intensification 30% propose also agroforestry and improvement of livestock management, 20% propose sustainable forest management while 10% of them combine it with rehabilitation of degraded land. This indicates the understanding of countries that drivers are complex and require multiple approaches.

Most direct interventions proposed focus on forest related activities to reduce mainly forest degradation rather than deforestation. This might be due to the fact that deforestation is much more difficult to tackle since it is mostly caused by large commercial actors, which often are capable to lobby the State for favourable decisions about the use of land, e.g. concessions (Rudel *et al* 2007, Angelsen and Rudel 2013). Hence reducing deforestation would imply interference with decision-making and rent-seeking at levels remote to the locality in which the deforestation activity occurs, and which are linked to political and economic forces that are often the main underling drivers of deforestation (Di Gregorio *et al* 2012). In contrast measures to reduce forest degradation can be justified politically as being beneficial for local communities through interventions (such as more sustainable land use and agroforestry) that are already known and partially implemented.

3.1.2. Enabling interventions.

Reported enabling interventions have been grouped in 12 main categories (table 3). The complete list of interventions can be found in appendix B. A large amount of countries (83%) propose interventions to address weak forest sector governance, through strategies aimed at improving governance. However, these proposals remain rather vague and explicit linkages to existing or planned policies and national development programmes that are potentially driving deforestation are rarely made as stated in the country profiles provided by CIFOR. For instance we find that proposed enabling interventions have little concrete proposals to remove perverse incentives that drive deforestation such as ranching in Brazil, palm oil development in Indonesia, and tackle large scale drivers such as timber extraction through concessions in Cameroon, cross border trade in Mozambique,

Table 3. Main categories of enabling interventions expressed in percentages of reviewed countries ($N = 43$). Subcategories are listed in appendix B.

Enabling interventions	
Good governance	83%
Policies	51%
Stakeholder involvement	46%
Tenure and rights	43%
Financial incentives	40%
Land management	34%
Technology improvements	31%
Institutional capacity	31%
Benefit sharing	26%
Appropriate disincentives	17%
Promote complementary voluntary private sector initiatives	14%
Addressing leakage	9%

or supply and demand gaps in industrial timber processing in Vietnam (Dkamela 2011, May *et al* 2012, Sitoe *et al* 2012, Pham *et al* 2012, Di Gregorio *et al* 2012, Brockhaus *et al* 2013). Concerning policy development, countries are candid about the need for governance (83%) and policy reform (51%) as a key strategy to address drivers, and this is a core component of country readiness activities to prepare for REDD+.

Stakeholder involvement is also mentioned as a key enabling intervention (46%), which includes various forms of community-based forest management approaches (appendix B), often tied to REDD+ benefit-sharing arrangements. Tenure and rights of access is a priority for 43% of countries. Depending on the national and regional circumstances, this may relate to benefit-sharing and/or community forest management. Those few countries that articulate cross-border approaches (related to commercial agriculture and illegal/legal wood flows) express interest in information sharing with neighbouring countries, particularly for tracking leakage effects (9%).

3.2. Assessment of linkages between interventions and current knowledge of drivers of DD

3.2.1. Interventions proposed referring to direct and underling drivers.

The majority of countries (68%) are aware of the importance of designing interventions that are specifically linked to the drivers of DD that they aim to address (figure 2). About 48% of the countries fall into subcategory (i) *interventions aimed to address both the direct and underling drivers* and 20% belong to subcategory (ii) *interventions aimed to address the direct drivers*. The minority of countries (32%) propose interventions without referring to the drivers (category *interventions without linkage*). In this category 12% of the countries belong to subcategory (iii) *interventions mainly aimed at increasing carbon stocks* and 20% belong to subcategory (iv) *no linkage reported*. Concerning the linkage between the category of interventions and the quality of national driver data, within category *Interventions with linkage*,
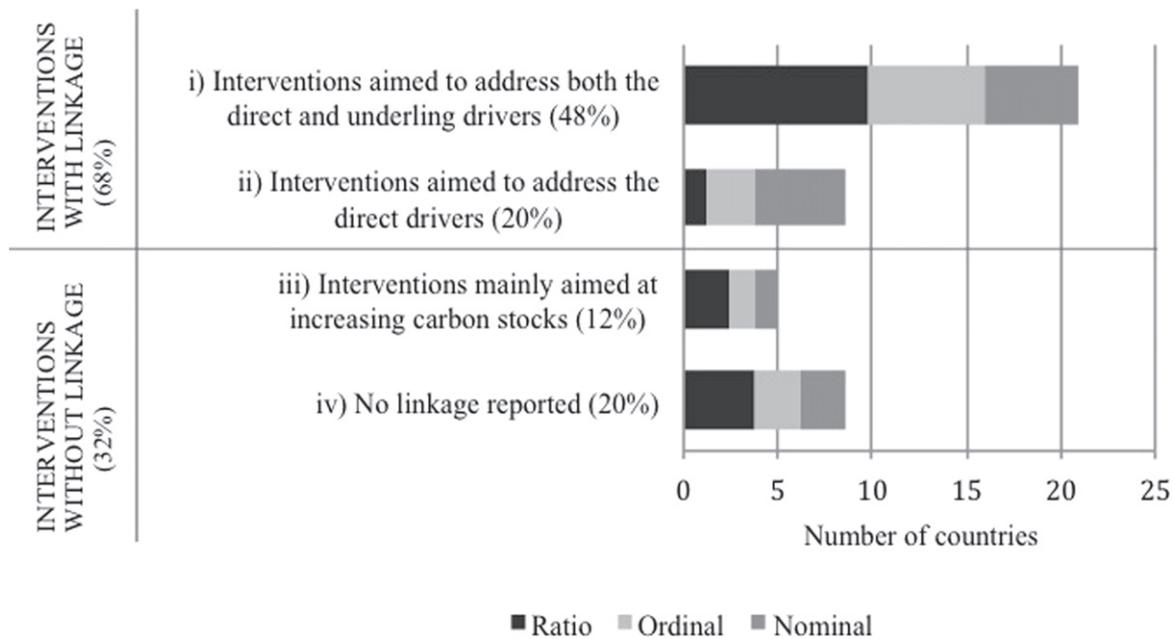
Figure 2. Number of countries proposing different types of interventions divided based upon driver data quality (Ratio scale: quantitative information about drivers; Ordinal scale: ranking of importance of drivers; Nominal scale: listing of drivers).

about half of countries of subcategory (i) have good-quality driver data (Ratio scale). A different trend is shown in subcategory (ii) to which belong countries which propose interventions that refer to specific direct drivers, and where the majority have low data quality (Nominal scale). Although the pattern is not very clear, there is tendency that countries with better quality driver data also do a better job in aiming to link both drivers, direct and underlying, with interventions. There are also a number of countries that have low quality driver data but are still able to link the interventions to drivers. This raises the question whether the proposed interventions based on lower quality data will be targeting the highest priority drivers. It can be expected that these countries will build monitoring capacities to gain better understanding on drivers if this is properly considered and integrated in their REDD+ readiness program. There are also countries that have good quality driver data but it seems these were not used when designing their interventions. In this case countries should be encouraged to better use their available data for their REDD+ intervention planning.

3.2.2. Direct interventions proposed to address specific direct drivers. Out of the ten countries that have provided information on linking direct drivers and interventions, *agricultural intensification* is the most common intervention proposed to address agriculture as a driver, followed by *agroforestry* and *improvement of livestock management* (table 4). Improving charcoal efficiency use has been proposed by 30% of countries to address unsustainable production of biomass energy and firewood harvesting, followed by sustainable management of forests/woodlands for biomass harvesting (30%) and increasing biomass/trees on farmland (20%). Interventions to address timber harvesting are mentioned by a minority of countries, while the most common interventions

to address unsustainable/illegal logging are forest plantations and sustainable forest management.

3.2.3. Comparison of types of interventions proposed by countries in different groups. As figure 3 shows, interventions proposed by countries of Group 1 (described in paragraph 2.2) are mentioned by a different percentage than the interventions proposed by countries in Group 2. In particular the majority of interventions proposed by Group 1 tend to be related to the non-forest sector (livestock/rangeland management, agricultural intensification), while the majority of countries in Group 2 propose mainly forest-related interventions (sustainable management of forest, protected areas strategies, afforestation/reforestation). This result is not surprising since Group 1 countries take into account the drivers while developing interventions. Since most drivers of DD originate outside the forest sector (Hosonuma *et al* 2012, Kissinger *et al* 2012), it stands to reason that these interventions will focus on non-forest sector strategies. Countries that don't consider their drivers, might not have this insight, and focus more on forest sector interventions. It should be noted however that neither group provides much evidence in their documentation about track record of these different strategies in their countries, and whether they are in reality likely to be effective.

4. Discussion

4.1. Implications for future REDD+ monitoring

4.1.1. Monitoring systems for forest based interventions will have to be ground based. As table 2 shows, most of the direct interventions proposed by all countries focus on forest-

Table 4. List of main drivers and direct interventions described in readiness documents and percentage of countries proposing each intervention. The driver 'agriculture' includes livestock management activities.

Main driver	Specific intervention	
Agriculture	Agricultural intensification	50%
	Agroforestry	40%
	Improvement of livestock management	40%
	Sustainable forest management	30%
	More efficient land use	20%
Unsustainable production of biomass energy +	Improve charcoal efficiency use	50%
	Sustainable management of forests/woodlands for biomass harvesting	30%
	Alternative renewable energy sources (wind, solar, biogas)	30%
	Increase biomass/trees on farmland	20%
Firewood harvesting	Expansion of electrification network	10%
	Community-based use of biofuels for lighting and cooking thus reducing demand for fuel-wood	10%
	Plantation establishment of fast growing fuel wood	10%
	Agroforestry	10%
Timber harvesting	Forest management planning (zone and protect timber production that meets demand and restock for future)	10%
	Increase timber stocks in natural forests	10%
Unsustainable/ illegal logging	Forest plantations to avoid deforestation of primary forests	30%
	Sustainable forest management	30%
	Strengthen urban planning and zoning	20%
	Afforestation/reforestation	10%
Urban development	Minimizing conversion of forests during construction	10%
Mining	Sustainable mining	20%
	Protected areas and buffer zones	10%
Forest fires	Fire management and control plan	20%

related activities designed to reduce forest degradation, rather than deforestation, such as promoting sustainable forest management, efficient fuel-wood use, agroforestry and protected area strategies. Many of these REDD+ activities are likely to have a relatively low carbon impact per unit area but can have large cumulative effects over vast areas. Hence monitoring the related change in carbon stocks to obtain emissions factor data will be relatively costly and challenging since annual changes tend to be small (Herold *et al* 2011,

GOFC-GOLD 2012). Such data cannot easily be obtained using common remote sensing time series (De Sy *et al* 2012), hence different approaches are needed to obtain activity data. For instance household surveys and interviews with local experts can provide information about the specific location of activities that result in changes in stocks within the forest. If this current priority intervention list (table 2) were to become reality in terms of actual REDD+ mitigation activities, the implications for monitoring are that it would have to be much more focused on assessing small-scale impacts at ground level, and this would results in higher monitoring costs per unit area (Pratihast *et al* 2013).

4.1.2. Activities on non-forest land should also be monitored, but in terms of performance, not in terms of carbon impacts in the forest. Table 4 shows how most of *driver-specific interventions* are associated with driver activities that relate not only to the forest sector (logging, firewood and timber harvesting, forest fires) but also to a large extent to the non-forest sector (agriculture, urban development and mining). However current efforts are focused on monitoring carbon dynamics within forest stands to meet national and international reporting requirements (Romijn *et al* 2012). While this is essential for REDD+ monitoring and MRV (Sanchez *et al* 2013), we suggest that countries extend monitoring systems beyond the forest sector, to monitor the effectiveness of policy interventions in addressing drivers of DD. This would allow tracking activities and provide feedback to policy makers to improve their policies and making them more appropriate to the local conditions and hence more effective. Table 5 lists examples of possible performance indicators to monitor common interventions outside forests. For example, improved agricultural practices (such as sustainable agriculture intensification) which are intended to reduce pressure on the forests could be monitored using indicators such as increase of yield production/hectare, which indicates not the impact on the forest carbon but rather whether the intervention has been effectively implemented or not.

Nevertheless there are limitations in the use of these performance indicators that should be taken into account. In fact a certain activity implemented to reduce DD might itself cause emissions or induce DD. For instance if increased crop yields occur due to water or fertilizer use, degradation might occur due to a change of water quality and quantity downstream as well GHG emissions.

Moreover there are issues relating performance indicators with the effectiveness of interventions in terms of forest carbon. For instance the change in yield gap could indicate the successful implementation of intensive agriculture but it does not easily translate into forest-related GHG emissions: although agricultural intensification may be expected to lower deforestation rates, the locations of the related avoided deforestation and the resulting carbon impacts will be very difficult to assess. This implies that it can be almost impossible to attribute specific reductions in forest emissions to REDD+ activities outside forests. The results of such
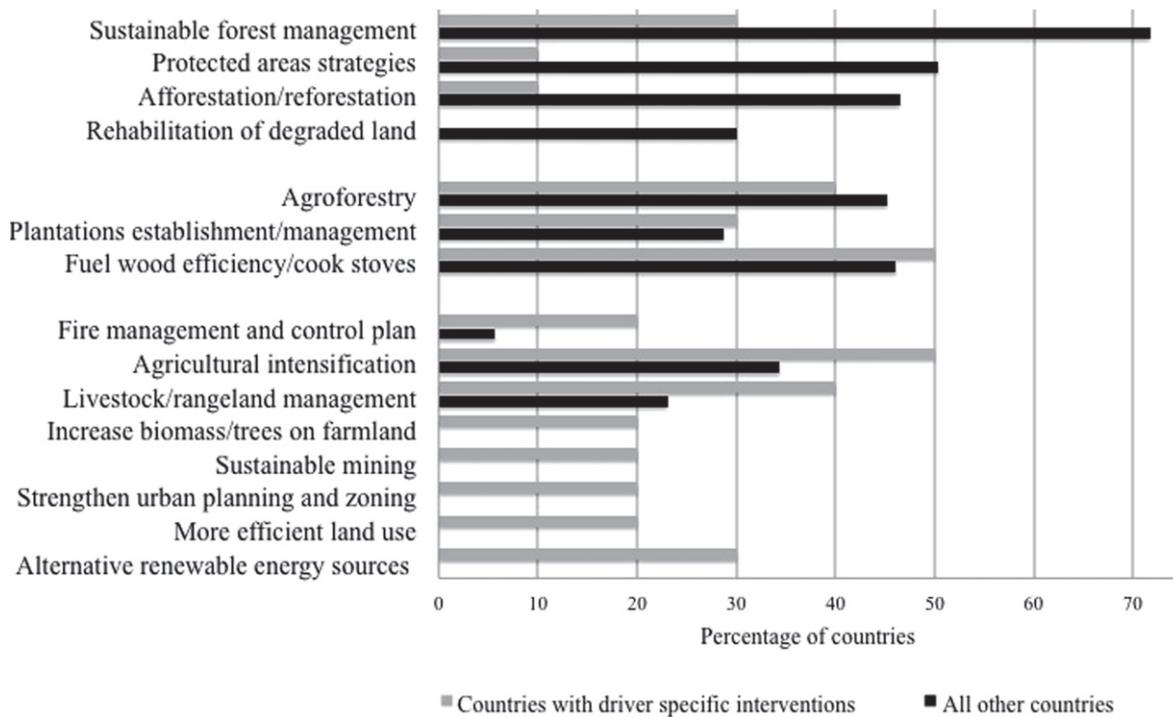
Figure 3. Comparing the percentage of interventions proposed by *Group 1 countries (Countries with driver-specific interventions*; $N = 10$) and *Group 2 countries (All other countries*; $N = 33$).

activities can only be registered in their cumulative effect through national forest monitoring, and the question on what activity and which actors have generated how much carbon credit is very difficult to be answered. This fact may have important implications for the distribution of REDD+ benefits (Skutsch *et al* 2013).

Moreover, besides measuring performance indicators, in the process of assessing the effectiveness of interventions, robust policy analysis should be carried out to assess the issue of attribution. In fact, performance indicators and measurements of carbon stock changes do not provide insights into causal linkages between drivers, interventions, and outcomes: while change may occur, actually attributing it to the intervention can be complex. For instance a newly passed law restricting harvesting in certain areas may appear to be highly successful: however, the effect might alternatively be due to a quite different stimulus, such as an economic slowdown. Hence robust policy analysis is important to carefully collect all relevant information and further explore these aspects.

5. Conclusions

This study provides a comprehensive overview of the current strategies for addressing drivers of DD as presented by 43 REDD+ countries in 98 readiness documents. The analysis allowed for a deeper understanding of implications for monitoring systems. We build our assessment upon a logical interaction between identified (and reported) drivers of DD, proposed REDD+ interventions and systems to monitor the effectiveness of interventions. In order for REDD+

interventions to be effective they should be directly linked with the drivers of DD that they aim to address. The effectiveness of interventions in addressing drivers should be monitored systematically. Improving monitoring capacities provides data of progressively better quality and hence increasingly detailed information about drivers, allowing to (re)design REDD policy interventions, so that they will be more suited to the local conditions and hence more effective.

We explored the elements of this logical chain in three steps. Firstly we synthesized information on the direct and enabling interventions proposed by countries wishing to participate in REDD+; secondly we assessed to what extent countries propose interventions by taking into account what they know (and report) about drivers of DD; thirdly we considered the implications for future monitoring of the effectiveness of interventions.

Results show that the interventions proposed by many countries focus less on activities to reduce deforestation, but rather on those that should result in reducing forest degradation and enhancing forest carbon stocks. These results indicate a need for a deeper understanding of why countries tend to focus in their proposals on tackling forest degradation instead of deforestation, and the possible implications for effectiveness of proposed interventions if further evidence on drivers of DD indeed suggest a mismatch. The currently proposed measures do have already strong implication for monitoring systems. While monitoring deforestation greatly relies on remote sensing time series, monitoring other forest-related activities relies more on ground level approaches, such as interviews with local experts, who can provide information about the location of activities such as fuel-wood use, forest degradation and tree planting. These monitoring approaches

Table 5. Non-forest related indicators to monitor the effectiveness of the interventions (derived from table 3) and the expected impact in forest-land (carbon stock).

Sector	Direct interventions	Possible performance indicators
Non-forest sector	Agricultural intensification	Increase in yield productivity/hectare
	More efficient land use	Increase in productivity/hectare
	Improve livestock management	Improved livestock yield/hectare
	Agroforestry	Increase in yield production, more trees and carbon stocks on farmland, less extraction and carbon loss from neighbouring forests
	Increase biomass/trees on farmland	Increased number of trees and enhanced carbon stocks on farmland
	Improve charcoal efficiency use	Number and use of functioning energy-saving stoves
	Alternative renewable energy sources (wind, solar, biogas)	Installation and operation of alternative energy-sources (windmills, solar panels, biogas harvest)
Forest sector	Forest plantations to avoid deforestation of primary forests	Increased carbon stock in forest + lower deforestation and degradation rate for (fire)wood collection
	Sustainable forest/woodland management	

will be much more focused on assessing smaller-scale impacts, which generally tend to be more costly.

In addition, most of the driver-specific interventions proposed address drivers not only inside but also outside the forest sector. However current monitoring efforts are focused on monitoring carbon dynamics within forest stands to meet national and international reporting requirements. These findings suggest that REDD+ monitoring should be extended by looking at effectiveness of REDD+ activities also outside the forest sector, including agriculture and other land use changes. This is important for two main reasons. Firstly it helps to capture interactive effects: where for instance agriculture is driving forest loss and where management (such as agroforestry) is driving carbon sequestration. Secondly it addresses confusion over boundaries—where one land use begins and another ends, what is forest and what is not. This is important because shifts in boundaries can result in large shifts in carbon accounting over time or across countries.

Nevertheless developing capacities to extend monitoring systems beyond the forest sector implies the use of additional resources for monitoring, which already accounts for a large part of countries' REDD+ readiness activities (Romijn et al 2012). Hence REDD+ countries should carefully

evaluate how to employ their resources in such a way that is cost-effective. One way in which this could perhaps be done is by involving local communities in monitoring, which is also vital to increase the quality and quantity of data and at the same time might empower local communities and generates local employment opportunities (Danielsen et al 2011).

Concerning enabling interventions, a large number have been described, of which the most common are *stakeholder involvement, tenure and rights regularization* and *policy and governance reform*. Proposed enabling interventions remain rather vague and explicit linkages to existing or planned policies and national development programmes that are potentially driving deforestation are rarely made. Moreover, for enabling interventions to be effective, they need to be bundled. For instance agricultural intensification should be combined with zoning, protected areas or rehabilitation of degraded lands to prevent further forest clearing. Only few of the readiness-documents reviewed explicitly mention the importance of implementing interventions in a combined way, and countries may need to give more attention to this.

Appendix A. Readiness documents per country reviewed.

All countries (43)	FCPF* (34)	UNREDD** (15)	CIFOR*** (6)	Group N
Argentina	June 2010			1
Bolivia		March 2010		2
Brazil			2012	2
Burkina Faso	June 2012			2
Cameroon	January 2013		2011	2
Cambodia	March 2011	May 2011		2
Central African Republic	September 2011			2
Chile	January 2012			2
Colombia	September 2011			1
Congo, Democratic Republic of	July 2010	March 2010		2
Costa Rica	August 2010			2
El Salvador	June 2012			1
Ethiopia	May 2011			1
Ecuador		March 2011		2
Ghana	December 2010			2
Guatemala	March 2012			1
Guyana	April 2010			1
Indonesia	May 2009	May 2009	2012	2
Kenya	August 2010			2

(Continued.)				
All countries (43)	FCPF* (34)	UNREDD** (15)	CIFOR*** (6)	Group *N*
Laos Democratic Republic	October 2010			1
Liberia	June 2011			2
Madagascar	October 2010			2
Mexico	June 2011			2
Mozambique	March 2012		2012	1
Nepal	October 2010		2013	2
Nicaragua	June 2012			2
Nigeria		October 2011		2
Panama	May 2009	January 2010		2
Papua New Guinea	February 2013	January 2011		2
Paraguay		November 2010		2
Peru	March 2011			2
Solomon islands		July 2011		2
Sri Lanka		November 2012		2
Suriname	January 2010			2
Tanzania	October 2010	October 2009		1
Thailand	February 2013			2
The Philippines		November 2010		2
Uganda	June 2011			1
Vanuatu	September 2012			2
Vietnam	November 2011	August 2009	2012	2
Zambia		March 2010		2

*http://forestcarbonpartnership.org/redd-country-participants
**http://un-redd.org/PublicationsResources/tabid/587/Default.aspx
***http://cifor.org

Appendix B. Complete list of enabling interventions, grouped in 12 main sub-categories. The right column lists the percentage of countries proposing each intervention.

Good governance	83%
Improved governance	34%
Improved law enforcement	31%
Environmental and social impact assessment	17%
EU Voluntary Partnership Agreements-FLEGT	17%
Improve transparency (against corruption)	14%
Policies	51%

(Continued.)	
Policy and governance reform	43%
Promotion of alternatives to deforestation (including alternative land use)	26%
Cross-sectoral coordination	31%
Harmonization of policies	23%
Promotion of alternatives to wood fuel (energy sector)	14%
Stakeholder involvement	46%
Community forest management/participatory forest management	46%
Stakeholder involvement/participatory planning	17%
Tenure and rights	43%
Tenure and rights regularization	43%
Financial incentives	40%
Financial incentives (agriculture sector)	26%
Payments for ecosystem services (PES)	26%
Financial incentives for re-/af-forestation	11%
Land management	34%
Land use planning/zoning	34%
More intensive agriculture and livestock practices	9%
Agriculture sustainable practices and deforestation planning	3%
Reduce emissions from other biomes	3%
Deal with settlement/displacement and infrastructure	3%
Shifting expansion to/reforestation on degraded lands	26%
Technology improvements	31%
Capacity building for improved agriculture techniques	29%
Improve agricultural, silvicultural, livestock technologies and productivity	23%
Assess other renewable energy sources, energy efficient stoves	6%
Institutional capacity	31%
Institutional (re)organization/strengthening	31%
Decentralization	6%
Benefit sharing	26%
Poverty reduction/pro poor benefit	26%
Appropriate disincentives	17%
Finance/credit disincentives	17%
Elimination of incentives aimed at agricultural expansion	6%
Changes to pricing and export policies (also to minimize leakage)	3%
Promote complementary voluntary private sector initiatives	14%
Improvement/establishment of wood certification	14%
Addressing leakage	9%
Assessment of leakage risk potential related to interventions	9%
Collaboration with bordering countries to lower leakage risk	6%

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