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World Bank

Open-Source Tools and Collaborative Platforms to Support National Greenhouse Gas Inventories in the AFOLU Sector

Workshop Report

March 28, 2019

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This report provides a summary of the proceedings and the conclusions from the workshop “Open-Source Tools and Collaborative Platforms to Support National Greenhouse Gas Inventories in the AFOLU Sector,” held in Guadalajara, Mexico, October 29–November 1, 2018. The workshop was a collaboration between the World Bank, CONAFOR, AMEXCID, USAID, U.S. Forest Service, and SilvaCarbon.

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Background

The main objective of the workshop was to identify an open-source and collaborative technological solution for preparing, improving, and replicating in a consistent way the agriculture, forestry, and other land uses (AFOLU) greenhouse gas inventories (GHGi). To be selected, solutions had to be in line with the following:

- Country needs: National and program area accounting standards and methods must be met.
- Program needs: International programs rewarding GHG emissions reductions have set reporting requirements and methodological frameworks.
- Facility Management Team needs: The organizations receiving the country reports need to be able to use the same tool to verify reports and to monitor progress at the portfolio level.

Country needs include the following:

- National GHGi producing reports that can be included in the national communications and biennial update reports (BUR) submitted to the United Nations Framework Convention on Climate Change (UNFCCC).
- Country-specific needs that differ from country to country, requiring the proposed solutions be flexible and adaptable.
- Countries must have the capacity to sustain the solutions and the national technical teams must have access to training, allowing them to share and integrate their own developments.

Program needs include the following:

- Meeting the Intergovernmental Panel on Climate Change (IPCC) guidelines for national GHGi and other relevant United Nations Framework Convention on Climate Change (UNFCCC) documents and decisions.
- The Forest Carbon Partnership Facility (FCPF) requires accuracy at the level that allows for performance-based payments. Measurements must meet the criteria of the FCPF Carbon Fund (CF) Methodological Framework. The same method must be used for measurements and the reference level. Various reports must be consistent, including national communications and the biennial reports to the UNFCCC.
- The BioCarbon Fund Initiative for Sustainable Forest Landscapes (ISFL) requires the ability of the same system to report on deforestation and forest degradation, and sustainable agriculture, as well as smarter land use planning, policies, and practices. The ability to get indications for enhancing agricultural productivity and improving livelihoods and local environments would be desirable.

Facility Management Team needs include the following:

- The solution needs to be able to replicate the results submitted by the countries accurately and quickly. This requires consistency of emissions estimates over time and comparability between countries.
- The solution must meet the criteria and methodology stipulated by the emissions reduction programs described and have the flexibility to meet the conditions defined in the Emission Reductions Payment Agreement (ERPA).

Participants

Representatives from the following countries participated in the workshop: Argentina, Belize, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay.

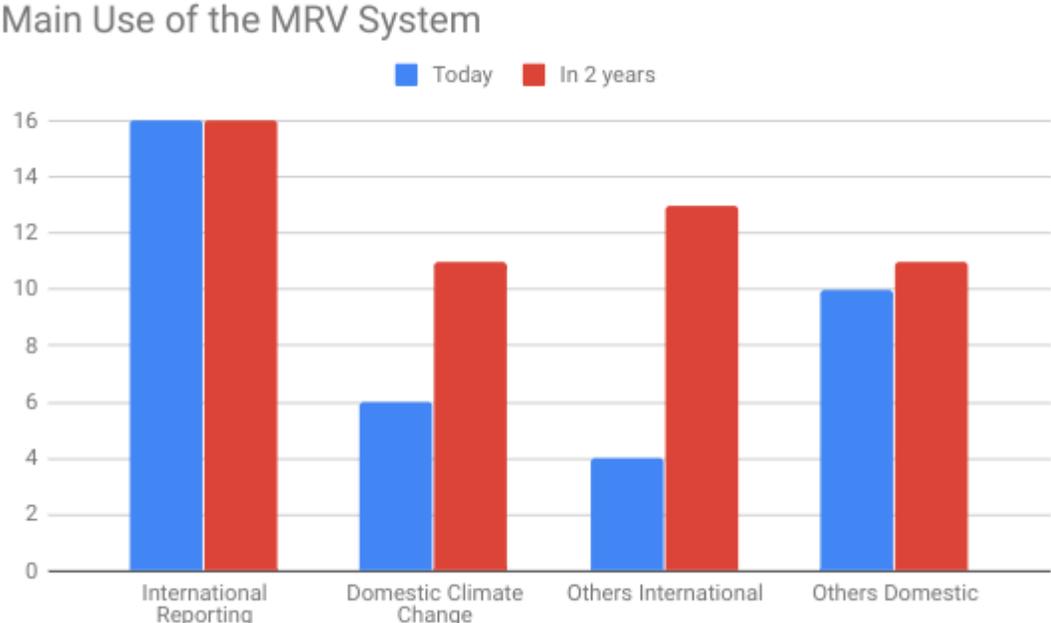
Additional participants were able to follow the workshop remotely because CONAFOR streamed the workshop.

Review of Readiness as Reported by Participants

Participants shared their experience with the goals, status, and methods of their measurement, reporting, and verification (MRV) system. Each country presented their national experience to the whole group.

A detailed overview of the MRV system in each country can be found in annex B and will be updated continuously in consultation with the countries. The below figure shows an aggregate impression of the status of MRV in Latin America.

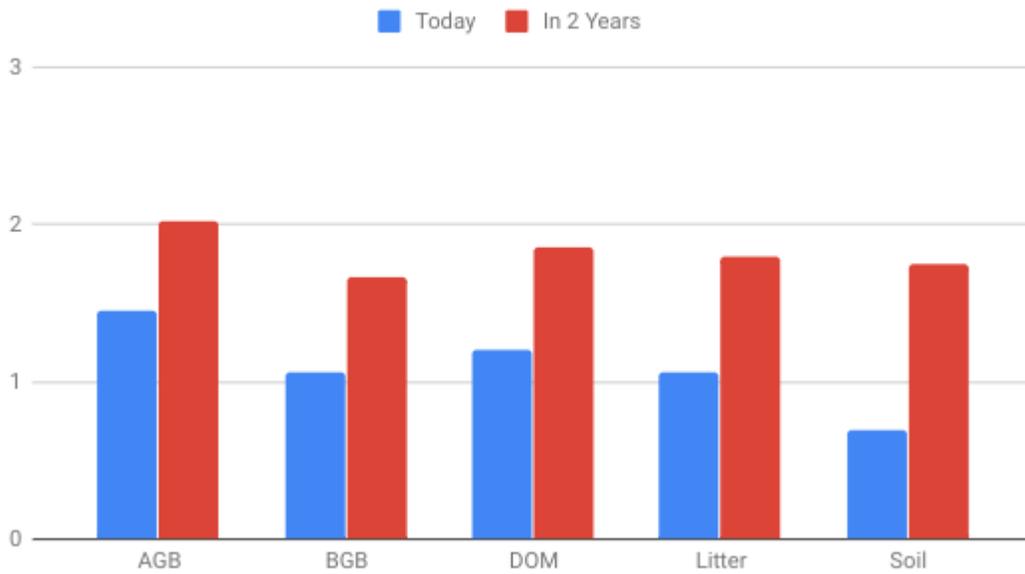
Countries in Latin America mainly use their MRV system to comply with international reporting obligations (national communications, biennial update reports, forest reference emission level/forest reference level, FCPF). More advanced MRV systems are used for informing domestic policy development.



The figure above also shows that countries seem to be moving from reporting to planning: In two years' time, the countries hope to have upgraded their MRV systems so they can make a contribution to the planning of climate-related projects at home and to report on safeguards and sustainable development to international partners.

Most countries have focused on reporting aboveground biomass (AGB) and AGB is reported at the highest tier for all countries, as shown in the figure below. Other pools are reported at Tier 1 by most countries, if they are reported at all.

Average Tier Reported

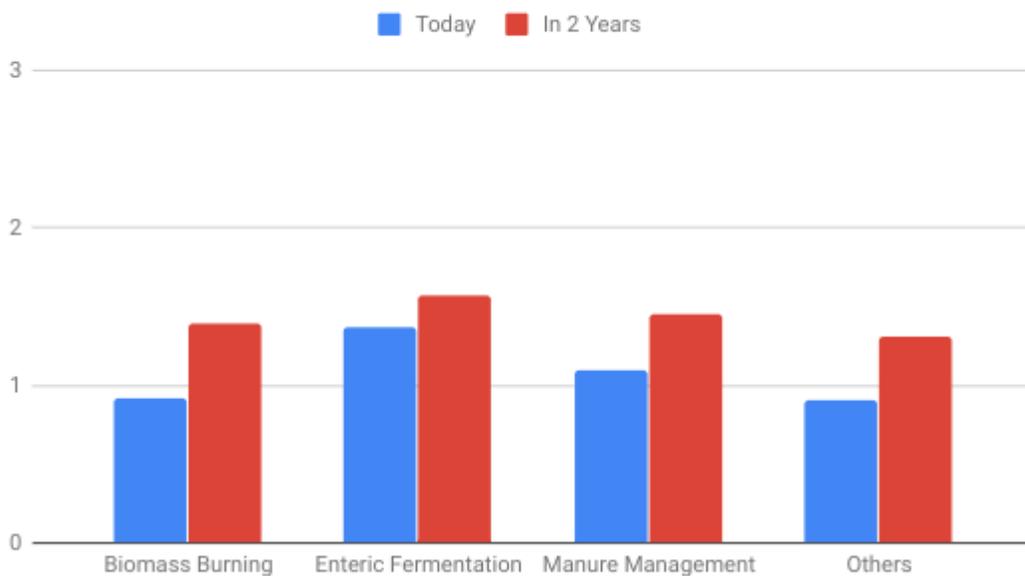


Note: AGB = Aboveground biomass, BGB = Belowground biomass, DOM = Dead organic matter.

The ambition over the next two years is clearly to catch up on all other carbon pools. The tier at which soil carbon is reported will jump up the most. This is understandable as soils are important carbon pools but are hard to track.

Other emissions are much less reported and at much lower average tiers, as shown in the figure below.

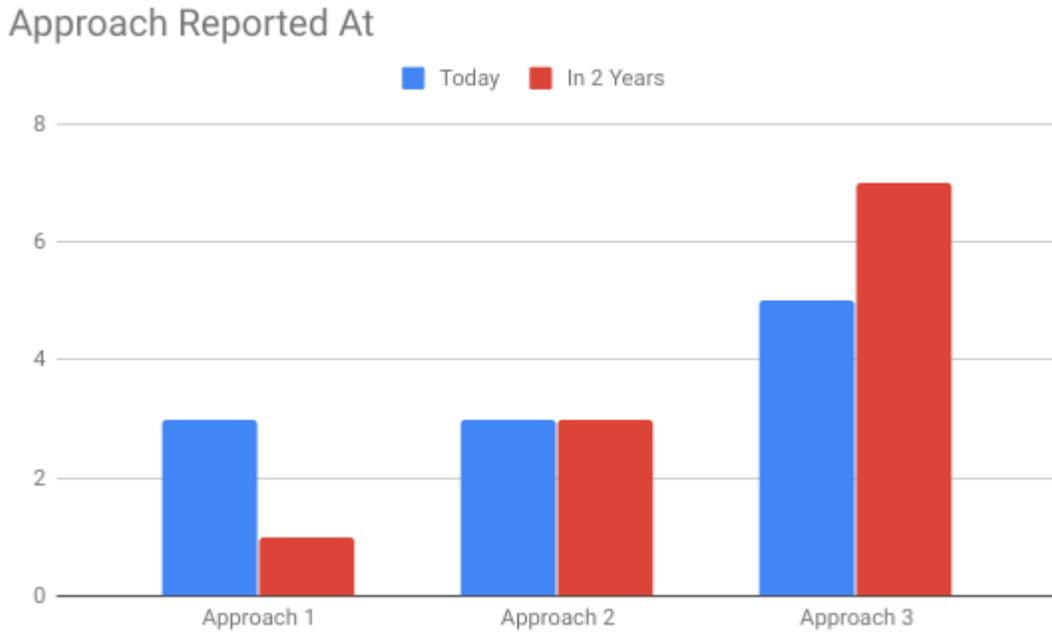
Tier for Other Emissions



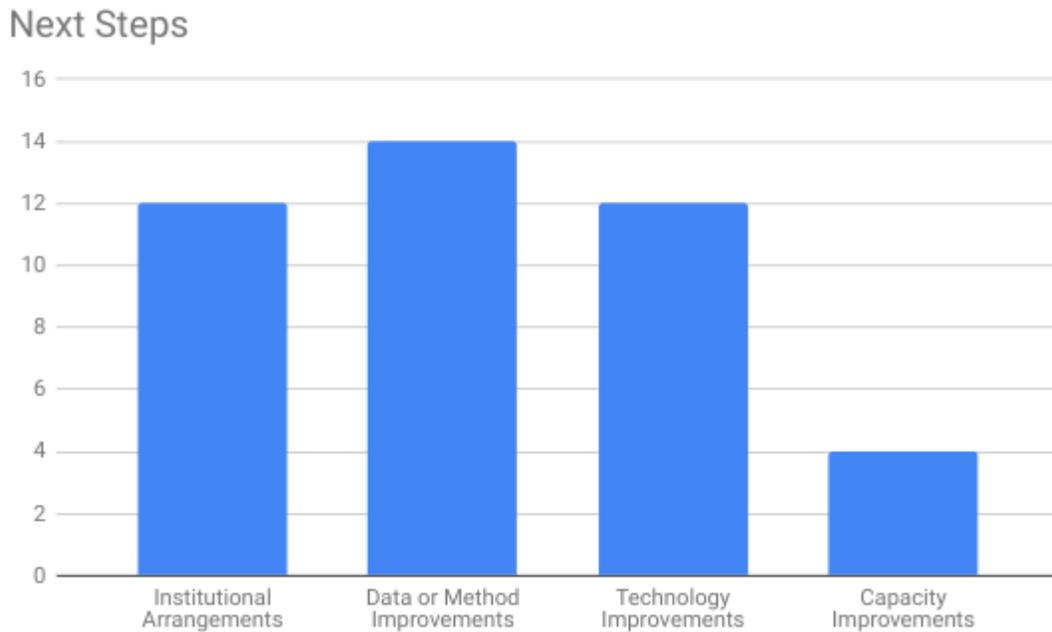
While those countries that do report other emissions plan to improve the tier level, ambition in the next two years is modest with some exceptions: Grassland burning and enteric fermentation of grazing cattle will move

up a tier in many countries.

Many countries already report at Approach 3 and the number will increase over the next two years, as shown in the figure below.



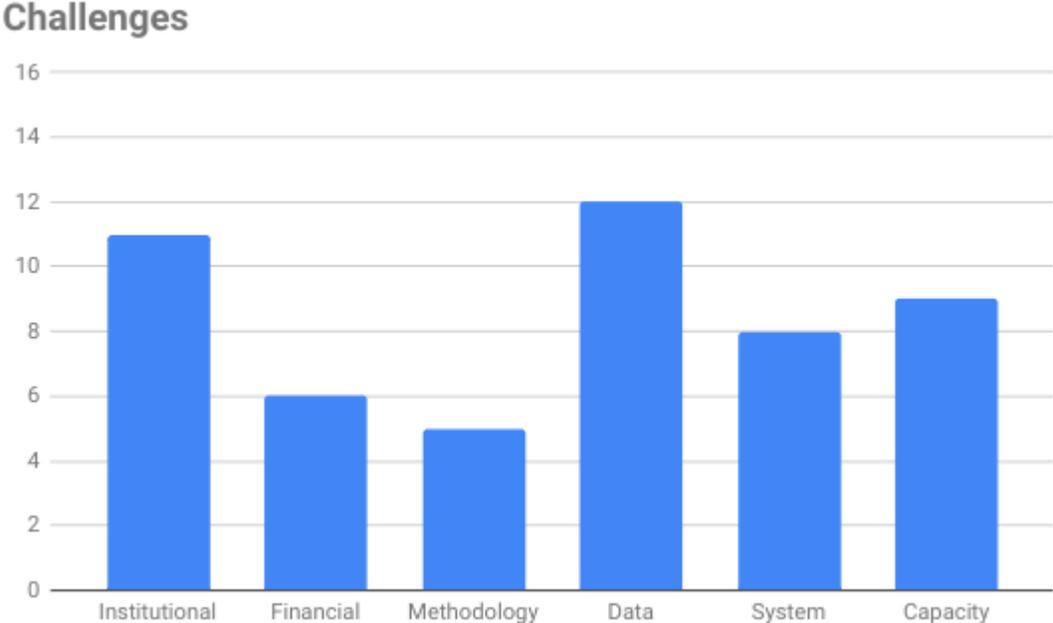
Most countries have a considerable list of improvements planned, as shown in the figure below.



Institutional arrangements, data/methods, and technology improvements are on the list of most countries. Capacity improvements are often not part of the plans even though they are reported as a challenge.

Within each of these themes there are discernable trends: The most common institutional priority is the transition to an AFOLU system, which requires the involvement of many more institutions. The most common data/method priority is calculation and reduction of uncertainty. The most common technological priority is the automation of calculations.

Finally, countries report a range of challenges in the development of the MRV system. Institutional arrangements and data are the most common challenges, followed by capacity (see figure below).



The most common institutional challenge is coordination between agencies and the institutionalization of the contributions across these agencies. Financial sustainability is a concern in almost half the countries. Consistency between methods applied by different agencies is a frequent challenge. Data challenges are mostly related to land cover maps. Various system-related challenges were reported. And under capacity, the most common challenge is a lack of technical expertise in the MRV team.

Overview of Materials Presented in the Workshop

The workshop was very practical and participatory and required intense work from the participants for four days. The agenda is attached in annex A.

At the start of the workshop, the IPCC guidelines and the system requirements established by the FCPF CF and BioCF ISFL were repeated.

Throughout the workshop, the participants of each country had the opportunity to present their experience with the development of their MRV system. Numerous exercises allowed the participants to deepen this exchange with participants from countries in their region as well as with the whole group.

At the beginning of the workshop, the organization moja global was introduced. Open-source contributions from users are crucial to ensure that software responds to the needs on the work floor. But contributions are voluntary so enlightened self-interest must convince users to make a contribution. The role of moja global is to

ensure that countries are happy to make a contribution. This can only be achieved by making sure that moja global's only objective is to support the users. To this end, moja global has a very narrow scope of work—that is, support collaboration. Moja global does not engage in country implementation or other activities that might taint its impartiality or openness.

The remainder of the workshop was structured to mirror the roughly eight-step process a country would go through when designing an MRV system. Each step is briefly discussed below. In the workshop, each step was illustrated with exercises and demonstrations.

Step 1: Evaluate Which Questions Policymakers Need to Answer to Inform Their Decisions

The key lesson from the workshop is that MRV is a technical solution to respond to a policy question, not an end in itself. Therefore, the design of an MRV system needs to start with the policy needs first and then deduce the MRV capabilities from them. It was observed that in Latin America many countries were working on data collection and data products like land cover change maps, but they had not yet reviewed how these products would support their countries' policy and reporting needs.

Using Australia as an example, participants identified key policies and reporting mechanisms that their countries had in place and the objectives that those policies contained. Examples of policies include deforestation policies, results-based payments, nationally determined contributions (NDCs), climate action plans, and so on. Each of these policies has a number of objectives. An MRV system can be used to monitor progress toward these objectives or to weigh various options to achieve them.

Step 2: Define the Capabilities an MRV Needs to Answer the Policy Questions

Each country defined the capabilities of their MRV system by analyzing their policy questions. The participants identified the required information to answer their policy questions, the audience, the frequency at which the questions need to be answered, and the quality standards the answers have to meet. The exercise resulted in a set of minimal capabilities for the MRV system. MRV systems serve various purposes, and as mentioned above the reports for each of these purposes have to be consistent. Using the same system to answer all questions will increase consistency. Too often MRV systems are designed for a single purpose and are then changed each time a report is due or a policy question is asked. A Full Lands Integration Tool (FLINT)-based system is flexible and can be upgraded continuously. A good understanding of the requirements is essential to ensure one system can be used for all questions and effort is invested in priority capabilities.

The participants answered the following questions for each of their policy needs, to determine the minimum capability of their MRV system:

- What Information is needed? (for example, GHG emissions, area, yield)
- What land uses or activities are included under this policy?
- How frequent is the information needed? (monthly, annual, biennial, periodic)
- How far back do you need to go? (for example, 1990, 2000, 2005)
- Is scenario analysis needed?
- What is the minimum mapping unit/finest scale for tracking land? (for example, compartment, forest, state, national)
- Will you need to report at different scales? (for example, project, state/district, national)
- What management, climate, or natural processes need to be addressed? (for example, harvesting, fire, fertilizer application, herd management)
- What IPCC tier should you report at?

- What IPCC approach should you use?

Step 3: Identify Integration, or How Various Types of Data Can Be Combined With Modules to Build the Necessary MRV Capability

Integration is the combination of various types of data (spatial and nonspatial) and calculation methods (modules) to obtain the answers policymakers need. Integration can be illustrated with a simple example: Imagine that a country wants to estimate carbon stocks in its forests. After reviewing all available information, it turns out there are no sampling plots available providing an estimate of forest carbon in various parts of the country. Hence, a different approach needs to be taken, using the information that is available: land cover maps indicating where forests are, Food and Agriculture Organization (FAO) climatological zones, and formulas for maximum carbon stocks for forests by climatological zone. Integrating this information would mean to combine climatological zones of the country with maximum carbon stocks to get a potential carbon stock map for the country. By combining this information with the forest maps, it is possible to select only those areas that are actually forests to get a geospatial map of the carbon stocks in the country. This type of combination of data and formulas allows for more accurate, more consistent, cheaper, more efficient estimations without double counting.

The participants formulated combinations of data that could result in MRV estimations at the frequency and accuracy required by their policymakers. This exercise only served to provide an insight into the design process of a FLINT-based MRV system. A final design would require additional time to consider carefully all data and formula combinations. The final integration combination would need to be coded into a country-specific module.

Step 4: Identify the National Data Already Available and Which Open or Generic Data Can Be Used as a Placeholder Until More Specific Data Are Available

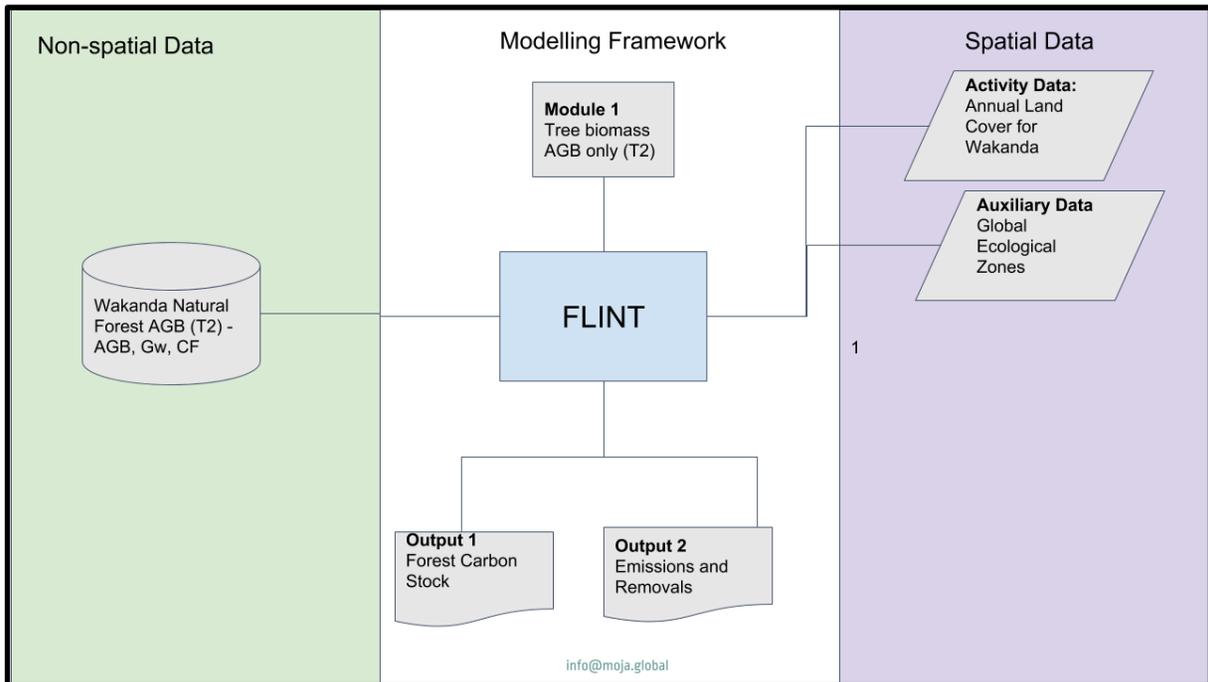
Only at this stage were participants invited to review what country-specific data and generic, open data are available to feed the integration system they designed. This triggered surprise from most participants because working on data products is often the first step in the process of MRV design. This has often led to MRV systems being driven by the available data rather than by country needs.

Several participants indicated that the data products they had been working on did not really fit the needs of the policy questions. For example, land use change products comparing two observations are less useful than a time series of land cover maps.

Step 5: Use a Framework to Build a First Version of the MRV System

Using a graphic interface, participants translated their integration approach into a framework of data, modules, and output formats that can be processed by the FLINT. All participants managed to design a framework for their country. Several participants indicated that they had never brought together all the components for their MRV system into a single framework and that the framework provided a useful overview of the way different activities fit together.

Below, the simple example of the imaginary country Wakanda is provided.



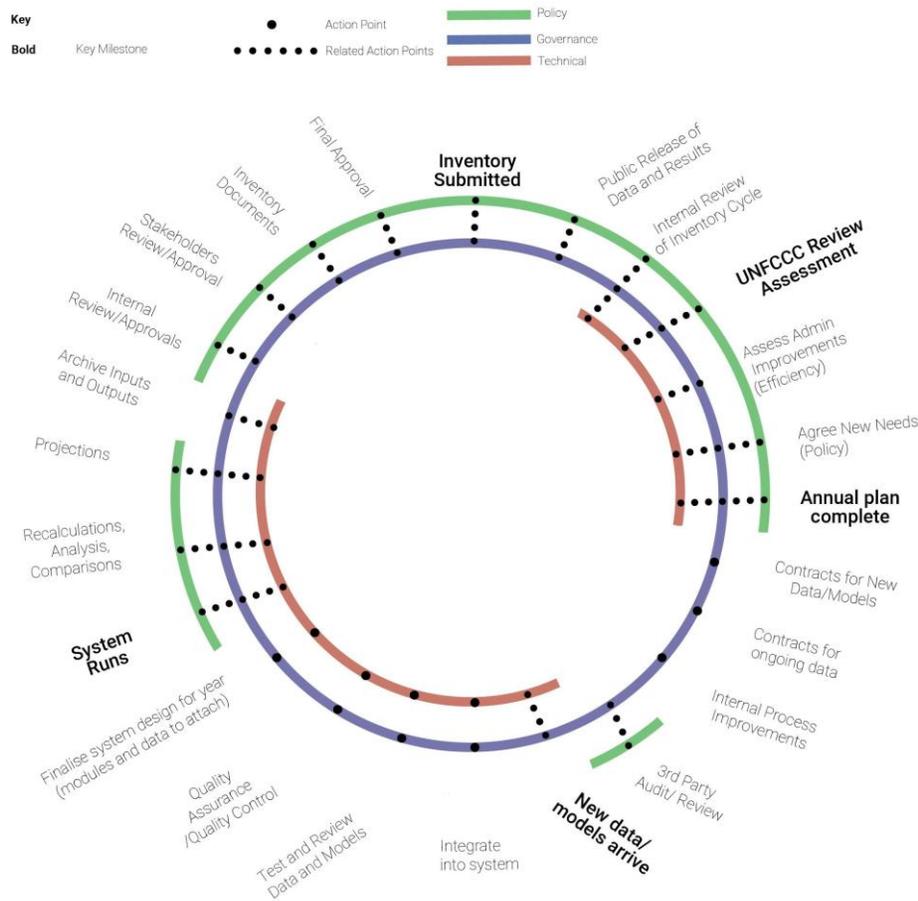
Step 6: Continue to Use the Framework to Improve the MRV System Through Regular Cycles

The importance of a framework for continuous improvement was demonstrated. Each component of the framework can be upgraded without having to redesign the framework. So the framework gives structure to the system and defines how the different elements of an MRV system come together, while each of the components can be improved over time, depending on need and availability of resources. For example, while data on soil are being collected, default soil maps can already be used to produce results. These results will be upgraded when the soil data become available.

Using the same framework as designed in Step 5, participants moved from a Tier 1 to a Tier 2 system for forest growth by swapping some components.

Step 7: Organize MRV Operations as a Continuous Operational Cycle

MRV systems need to provide answers to recurrent policy questions—for example, annual reports, biennial update reports, national communications, and so on. Too often, the next report is driving the development of the MRV system. Most participants indicated that they are overwhelmed with work to meet reporting requirements. When MRV units constantly need to respond to urgent requests, there is no time to plan and implement improvements of the MRV system.



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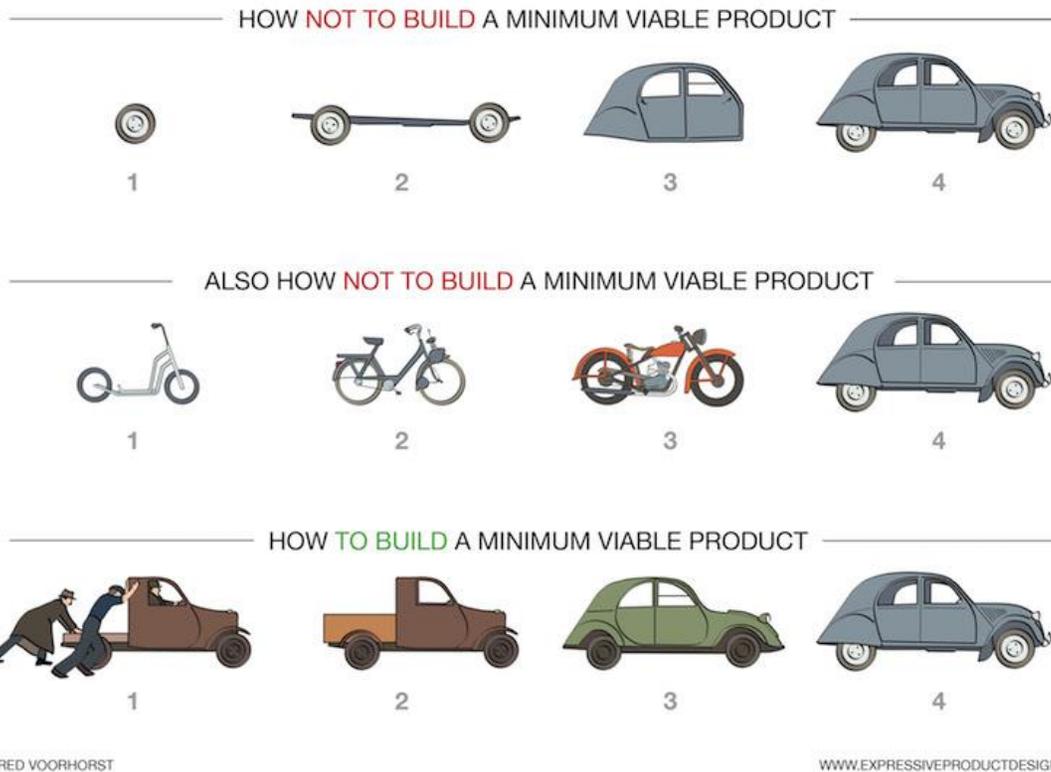
It is therefore recommended that countries institutionalize an MRV cycle of regular (annual or biennial) steps that produce emissions estimates that can be used for all reports. This results in a more structured approach that produces more consistent reports.

Step 8: Organize MRV Improvement Using an Agile Approach

While the MRV team is running through the cycle illustrated above to produce results, continuous improvements to the cycle are necessary to ensure accuracy meets policy requirements or to respond to new policy needs.

The participants were introduced to an agile way of system improvements: Upgraded systems are “released” on a regular basis (for example, every four or six months). The results of the upgraded system are evaluated and presented to the policymakers. Using feedback from the policymakers, targets for the next upgrade (in, for example, four or six months) are set and a new cycle of improvement can start.

Agile continuous improvement starts with a minimum viable product as illustrated below. Each improvement cycle will gradually improve each component of the system. Using a framework as illustrated in Step 5 above is essential to achieve continuous improvements.



Results by Country

An overview by country is provided in annex B, giving the background of each country’s current MRV system, the identified challenges, the priority policies, the MRV requirements, and a possible approach for the first iteration of a FLINT implementation. Here, only the overview table of MRV requirements is featured.

MRV Requirements

	Output indicators ^a	AFOLU / forestry ^b	Frequency ^c	Base year	Projections	Mapping unit (ha)	Nesting	Management / events ^d	Max tier	Max approach
Argentina	1	2	3	1990	Y		Y	3	3	3
Belize	1	2	3		Y	0.3	Y		3	3
Chile	5	2	1	2000	Y	0.5	Y	3	3	3

Colombia	1	1	2	1990	Y	1.0	Y	2	3	3
Costa Rica	1	2	4	1995	Y		Y	3	3	3
Dominican Republic	4	2	1	1995	Y	0.5		3	2	3
Ecuador	5	2	3	1990	Y		Y	3	3	2
El Salvador	5	2	3	1980	Y	0.5	Y	1	3	3
Guatemala	4	1	3	2000	Y		Y	1	3	3
Honduras	1	2	3	2000	Y	1.0	Y	2	3	3
Mexico	1	2	3	2000	Y		Y	2	3	2
Nicaragua	5	2	1	2000	Y	0.5	Y	3	3	3
Panama	4	1			Y			1		2
Paraguay	5	2			Y			3	3	3
Peru	3	2	3	2000	Y		Y	3	3	3
Uruguay	5	2	4	2012	Y	0.5	Y	2	3	3

a. Output indicators: 1 = Only GHGi; 2 = GHGi is priority; 3 = GHGi and biodiversity; 4 = GHGi, biodiversity, and ecosystem service; 5 = GHGi, biodiversity, ecosystem service, and more.

b. AFOLU / forestry: 1 = Forestry only; 2 = AFOLU.

c. Frequency: 1 = Monthly; 2 = Quarterly; 3 = Annual; 4 = Biennial; 5 = Other.

d. Management / events: 1 = Focused, 2 = Average, 3 = All.

Conclusion

All Participants Want to Test the FLINT in Their Country

All participants considered the workshop useful and indicated interest in testing the FLINT in their country if they can obtain the necessary permissions.

The most frequently cited reason to adopt a FLINT-based system is the possibility to automate the processing of data. Countries using a manual system indicate that their systems have become too complex and are prone to human errors.

Other common reasons given for choosing a FLINT-based system: (1) the possibility to adjust the system to country-specific circumstances, which results in higher accuracy; (2) the spatially explicit processing of data, which allows for the identification of trends and drivers; and (3) the possibility to project emissions into the future, which assists with policy development.

The expressions of interest by the participants are of course conditional on the support from decision-makers at their home institutions. In addition to such approvals, participants see shortages of time, capacity, and resources as the most likely obstacles to the successful implementation of a FLINT-based system. Most MRV units are already stretched to deliver on the reporting obligations. This leaves very little room for capacity development and system improvement. Most countries require additional human resources to make upgrading the MRV system possible.

Different Levels of Support Are Needed to Enable Countries to Install the FLINT

Since the FLINT is an open-source tool, anybody can download and install the software. Some scientific and computer knowledge is necessary, however, to understand the code and various modules. For interested users lacking the level of expertise to install the system, two levels of assistance are available: First, the country can run the FLINT with the support of international experts, allowing the country team to learn by doing; and second, a team of international experts runs the FLINT for the country (that is, FLINTpro), allowing the country team to focus on operating the system rather than on building it.

During the start-up phase, only Colombia and Chile indicated that they would prefer to install the system using their own expertise. All the other countries indicated that they would like to receive technical support: Seven countries want to run the FLINT themselves with support from international experts; the other seven want international experts to run the FLINT for them (FLINTpro) so they can focus on operating the system.

Over time, however, all but the Dominican Republic want to build their own capacity so they can improve and upgrade their own configuration of the FLINT. Five countries believe that they can reach a level of expertise that allows them to run and upgrade their system themselves. Ten countries expect that they will still need international experts to support them with upgrading their FLINT configuration.

	Initial	In two years
Argentina	FLINTpro	Supported
Belize	Supported	Self-run
Chile	Self-run	Self-run
Colombia	Self-run	Self-run
Costa Rica	FLINTpro	Supported
Dominican Republic	FLINTpro	FLINTpro
Ecuador	Supported	Supported
El Salvador	FLINTpro	Supported
Guatemala	FLINTpro	Supported
Honduras	Supported	Supported
Mexico	Supported	Supported
Nicaragua	FLINTpro	Self-run
Panama	Supported	Supported
Paraguay	Supported	Self-run

Peru	Supported	Supported
Uruguay	FLINTpro	Supported

Modules Needed

A FLINT-based system will combine national data with modules that are calibrated for country-specific circumstances. Participants indicated that over time they want to include all modules: land cover, all gases, all events. They identified the following as immediate priorities:

- Most countries are primarily focused on forest carbon and would consider a Tier 3 forest module as the highest priority (including deforestation, reforestation, degradation and recovery).
- As a result of the importance of livestock in the region, wooded grasslands, enteric fermentation, grasslands, and manure management were all identified as priority modules.
- The need to move to an AFOLU system is clearly on the agenda of the participating MRV units because agricultural soils, perennial crop, and annual crop modules are also considered a priority.
- All countries want to have a Monte Carlo uncertainty module because it is a requirement.
- The capability to make rules-based projections was identified as a priority. This underlines again the importance that MRV systems must be able to inform policy decisions.
- Of the non-GHG measurements, biodiversity is considered by far the most important, followed by crop and timber yield modules.

Priority modules

- Forest
- Wooded grasslands
- Enteric fermentation
- Dead organic matter (litter, deadwood)
- Agricultural soils
- Grasslands
- Perennial crop
- Fire (including savanna burning)
- Manure management
- Harvested wood products
- Annual crop

Next Steps

Follow-up can be divided into two key components: Developing FLINT-based systems for countries that participated in the workshop and developing a FLINT-based system for the Facility Management Team (that is, the World Bank).

Development of a Facility Management Team Verification Tool

A FLINT-based system to verify country reports would be valuable for the World Bank. The system would replicate the calculations done by the countries using the same data and modules.

The Bank is the Facility Management Team of various funds that provide results-based payments. Achievements

reported by countries need to be verified by the Facility Management Team before payments for emissions reductions can be approved.

The Bank does not have the ambition to develop the internal capacity to audit the emissions reports submitted by the countries. Contracting auditors to review each report would be time-consuming and costly.

A FLINT-based system could replicate results submitted by the countries accurately and quickly. The Bank would request the reporting country to submit the results it has calculated using the country's MRV system as well as all the data used to calculate those results. If the country uses a FLINT-based system, the country will be requested to communicate which modules it used in its calculations. The following steps would need to be taken to verify the results:

1. The configuration used by the reporting country is replicated on an independent FLINT platform for verification.
2. The configuration is reviewed against the criteria and methodology stipulated by the emissions reduction program.
3. The configuration is reviewed against the conditions agreed in the ERPA.
4. The data are reviewed using agreed sampling methods and control algorithms. If the reporting country does NOT use a FLINT-based system, the data might have to be reformatted.
5. Either the same modules as used by the country will be used for the verification or, if the country does not use a FLINT-based system, modules that are as close as possible to that of the country system. The modules were already verified by a panel of scientists before they were released by moja global so they do not need to be reviewed during the verification process. The calibration of the model (if any) might, however, need verification.
6. The data are run using the same configuration as used in the country (or as closely as possible if the country does not use a FLINT-based system) but on a Bank-contracted FLINT platform.
7. The results generated by the Bank and those submitted by the reporting country have to be within acceptable error margins.

Here are the next steps for setting up a World Bank verification system:

1. Facilitate the adoption of FLINT-based systems by all countries participating in the emissions reduction trust funds. Setting up and running a verification system is relatively simple for countries that also use a FLINT-based system because such systems can be easily replicated and the data are ready to be read by the system. Thus, helping countries to install a FLINT-based system is a win-win.
2. Test replication of existing systems on a FLINT platform. To ensure that it is possible to verify non-FLINT systems on the Bank FLINT-based platform, it is useful to try to replicate all systems in advance of the verification. This not only saves time during the verification phase, but it also will identify issues with systems that might need improvement. Such issues can either be included in the trust fund guidance and methodology or in the specific agreements with the countries concerned.
3. Design a concept for verification that ensures segregation of duties and meets Bank guidance and methodology. The verification system needs to meet the criteria defined by the trust fund and this has to be established by an independent expert. Moreover, the process of verification must ensure that the operators of the Bank FLINT platform are independent. Alternatively, a system of operators appointed by both parties can be considered. The concept for the procurement and operation of the verification system needs to be approved in line with the trust fund rules.
4. Write procurement documentation: Since the Bank is not aspiring to develop the internal capacity to install and operate the verification system, the Bank will procure a Software as a Service (SaaS) solution combined with a range of operators who are qualified and independent from the SaaS provider.
5. Procure SaaS provider and operators.

Development of Country-Level FLINT-Based MRV Systems

Moja global and its partners are promoting an approach to MRV development that focuses on the needs of the policymakers. Therefore, the design of an MRV system needs to be country specific and has to start with the policy needs, following a proposed series of steps. (They are the same steps as have been taken during the workshop, but the steps will be more comprehensive during the actual design. Still, the explanation provided in the workshop report above are useful to understand each step of the process.)

1. Evaluate which questions policymakers need to answer to inform their decisions.
2. Define the capabilities an MRV needs to be able to answer the policy questions.
3. Identify how various types of data can be combined with modules to build the necessary MRV capability (that is, integration).
4. Identify which national data are already available and which open or generic data can be used as a placeholder until more specific data are available.
5. Use a framework to build a first version of the MRV system.
6. Continue to use the framework to improve the MRV system through regular cycles.
7. Organize MRV operations as a continuous operational cycle.
8. Organize MRV improvement using an agile approach.

Before the process outlined above can start, it might be necessary to get buy-in from policymakers and MRV operators for the new approach.

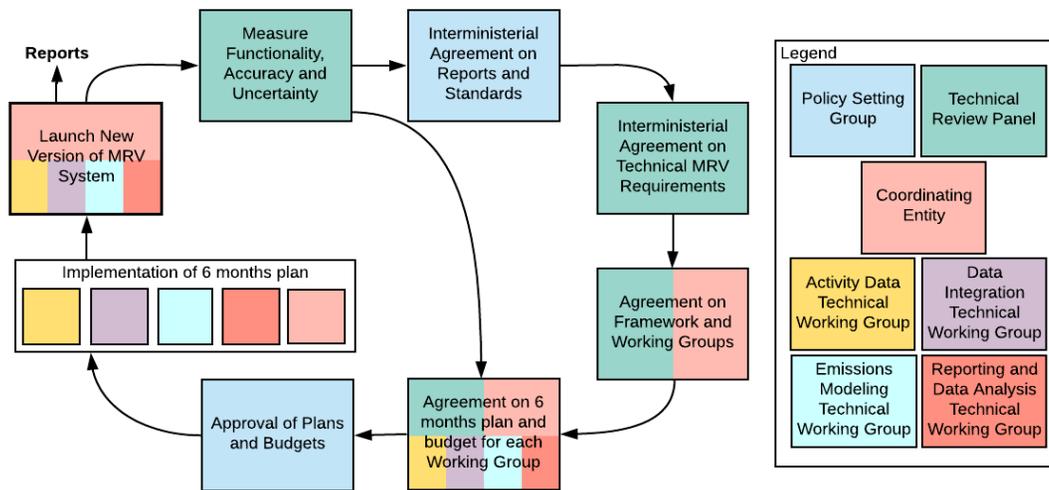
1. Presentations to policymakers and workshops for the operators are necessary to ensure there is full support for the change process.
2. Replicating the current system on a FLINT-based platform will help policymakers and operators better understand FLINT and it will ensure that they feel reassured that their work to date will not be discarded when a new system is adopted. (As indicated above, replication of the current system is also a good way for the World Bank to prepare the verification process. So this step is again a win-win.)
3. While replicating the system, specific tasks are implemented by different institutions. This is a good moment to establish working groups that consist of representatives of different institutions, collaborating to improve a particular aspect of the MRV system. Typical working groups could be, for example, around activity data, integration, reporting, or modeling. (See also the diagram below.)
4. Comparing the results of the existing system, the FLINT-based replication, and the FLINT run using the Hansen data will reveal strengths and weaknesses of the different systems. Reporting the conclusions to policymakers and decision-makers will inform the decision to proceed with a FLINT-based system or not.
5. The replication of the existing system will also highlight potential areas of improvement. The list of potential improvements is prioritized based on the capabilities an MRV needs to answer the policy questions. (See standard process above.)

Using the current system replicated on a FLINT platform as a starting point, a cycle of continuous improvement is started. The cycle goes through the following steps:

1. Select areas of improvement at the top of the priority list. (As mentioned in point 5 in above list.)
2. Set targets for each working group to achieve this improvement: For example, moving from Tier 1 to Tier 2 will require changes in modules, changes in input data, and possibly changes in auxiliary data.
3. Include targets for capacity building and governance in each cycle. It might be useful to consider establishing separate working groups on these issues to ensure targets are met.
4. Map how improvements will come together in next run and agree on the date for the next run of the complete system.
5. Implement improvements: Each working group works on the improvements as agreed.

6. Run new configuration: All improvements are brought together into a new configuration and the system is run.
7. Compare with previous run and explain differences.
8. Identify priorities for improvement. The uncertainty analysis can be used to identify which improvement has the biggest impact on the accuracy of results.
9. Report results to stakeholders.

Steps in the Agile MRV Improvement Cycle



Capacity building and governance need to be included in each cycle. This example does not have separate working groups for capacity building and for governance. This is, however, highly recommended.

Annex A. Workshop Agenda

Background

The Forest Carbon Partnership Facility is a global partnership of governments, businesses, civil society, and indigenous peoples focused on REDD+ activities.

One of the FCPF's four strategic objectives is to pilot a performance-based payment system for these activities. Countries that have made significant progress in their REDD+ readiness endeavors (Readiness Fund Mechanism) could be selected to participate under the Carbon Fund mechanism to pilot incentive payments for REDD+ policies and measures. The Carbon Fund's payments are intended to provide an incentive to the recipient countries and the various stakeholders—including forest-dependent indigenous peoples, other forest dwellers, and the private sector—within each of these countries, to achieve long-term sustainability in financing forest conservation and management programs. This would help reduce the negative impact on the global climate from the loss and impoverishment of forests.

The implementation of these programs and the corresponding result-based payments involve the preparation of a forest reference emission level and/or forest reference level (FREL/FRL) (expressed in tonnes of carbon dioxide equivalent per year), which serves as a benchmark for assessing each country's performance in implementing REDD+ activities. The actual emissions during the implementation period (defined in the Emission Reductions Payment Agreement) are compared with the FREL/FRL (the business-as-usual scenario without the implementation of the mitigation activities) and the measured, reported, and verified emissions reductions are transferred to and paid by the Carbon Fund participants.

The FREL and/or FRL must meet a set of criteria and indicators described in the FCPF CF Methodological Framework. According to Indicator 10.3, the emissions reduction program must explain what steps are intended for the reference level to achieve consistency with the country's existing or emerging greenhouse gas inventory. Once this methodological consistency (activity data methods and emission factors) is achieved, the monitoring reports during the ERPA should be also consistent with national communications and biennial update reports to the UNFCCC.

The multilateral BioCarbon Fund Initiative for Sustainable Forest Landscapes is a fund, supported by donor governments and managed by the World Bank, promotes reducing greenhouse gas emissions from the land sector, from deforestation and forest degradation in developing countries (REDD+), and from sustainable agriculture, as well as smarter land use planning, policies, and practices. The ISFL has a geographically diverse portfolio of large-scale programs that can have significant impact and transform rural areas by protecting forests, restoring degraded lands, enhancing agricultural productivity, and improving livelihoods and local environments.

The fund provides technical assistance and investment to support the implementation of programs that impact multiple sectors of the economy and results-based payments to incentivize and sustain program activities.

The ISFL supports countries with an upfront finance to make improvements to their enabling environment for sustainable land use, piloting of activities and key partnerships (including engagements with the private sector), and providing countries with resources to develop systems for monitoring, reporting, and verifying reductions in GHG emissions to prepare jurisdictions for payments.

In a second phase, a results-based finance will incentivize to shift to a sustainable development trajectory in each jurisdiction, using the payments to sustain successful interventions to sustainable land use in each jurisdiction.

The implementation of these results-based finance programs (emissions reduction programs at landscape scale) requires reporting of AFOLU-related emissions and removals for the program area identifying relevant subcategories. For this purpose, it will compile/adapt data from the national greenhouse gas inventory to the program-level area and identify subcategories that are eligible to receive result-based payments under the ISFL and the accounting of emission reductions by comparing monitored emissions and removals with a baseline (with the same principles that we described for the Carbon Fund Emissions Reduction Program). The requirements for both ISFL reporting and accounting are built on the IPCC Guidelines for National Greenhouse Gas Inventories and other relevant UNFCCC documents and decisions.

Results from the national greenhouse gas inventories are included in the national communications and biennial update reports submitted to the UNFCCC; they should align with the measured emissions from the forest sector in the CF Emissions Reduction Program area and with the measured emissions from the AFOLU sector in the BioCF ISFL Emissions Reduction Program area. Improvements in the development of national GHG inventories could represent an opportunity to generate more objective information and in a more systematic and replicable way for the countries to fulfill the reporting requirements to the UNFCCC and the reporting and accounting requirements to the FCPF CF and BioCF ISFL.

In this context, some tools and platforms can support the preparation of the AFOLU GHGi, systematizing the measurement and validation of the emissions from the necessary basic information collected from the national monitoring systems (activity data and emission factors) and making it replicable in a consistent manner in the future.

Within the framework of the two emissions reduction programs described (FCPF CF and BioCF ISFL), and once the monitoring events have been defined during the ERPA term and the measurements have been made, their verification by an accredited auditor is a necessary critical phase before the titles associated to the emissions reductions can be issued. The systematization and streamlining of this verification phase with the use of this type of tools and platforms can represent a great advantage to the process. From the point of view of the country, the use of these tools shortens the term to issue and transact the titles and therefore to receive the payments after the measurements. From the point of view of the verifier of the monitoring reports, these tools and platforms can be a great help for the revision of inputs, calculations, and results; from the point of view of the Facility Management Team of the funds, they are effective tools for the analysis and generation of statistics and reports at the regional or portfolio level.

It is an indispensable requirement to guarantee the sustainability of the systems in development countries (GHGi) that these tools are open-source and the national technical teams are trained in the preparation and modification of associated and collaborative code, allowing them to share and integrate their own developments.

As a tool or platform for verification or for portfolio monitoring purposes, this tool/platform could be customized to issue the necessary outputs and reports.

"Open-Source Tools and Collaborative Platforms to Support National Greenhouse Gas Inventories in the AFOLU Sector" Workshop

Place: Headquarters of the National Forestry Commission (CONAFOR), Zapopan, Jalisco, Mexico

Date: October 29–November 1, 2018 (4 days)

Objective: Identify an open-source and collaborative technological solution for preparing, improving, and replicating in a consistent way the AFOLU GHG inventories and adapt it to

- The country needs for national and program area accounting and national and international reporting requirements; and
- The Facility Management Team needs to support the verification process and for monitoring purposes at the portfolio level

Specific objectives:

1. To share experiences (South-South knowledge exchange) between Latin American countries in the different processes of building national and program GHG inventories in the AFOLU sector.
2. To present and discuss IPCC methods and program methods and requirements (FCPF CF/BioCF ISFL) for AFOLU categories and subcategories to prepare baselines, to estimate potential emissions reductions, to measure emissions, and to analyze the associated uncertainty.
3. Discussion and establishment of the basic conditions (criteria definition) of this open-source tool and collaborative platform. For this purpose, a survey by country to gather information on the current status of the GHG inventories and FCPF CF and BioCF ISFL programs' status will be circulated in advance.
4. Presentation of the basic conditions (criteria definition) of a customized tool for the facility management team to support the verification process and for monitoring purposes at the portfolio level.
5. Presentation of open-source integration software and collaborative platforms. General and detailed explanation, technical analysis, and improvement and customization policies. Discussion and establishment of an adaptation plan: to the country needs for national and program area accounting and national and international reporting requirements (open-source software and collaborative platform are available for free, but customization of it is required), and to the Facility Management Team needs to support the verification process and for monitoring purposes at the portfolio level (customized version).
6. Practical exercises using national data sets that will be gathered and prepared in advance. GHG emissions calculations for the main pre-identified categories and subcategories in the AFOLU sector.
7. Definition of a budgeted action plan for adapting, customizing, and training on the GHG software and platform.

Co-organization and Funding

Regarding the partners that co-organize and fund this workshop:

The **World Bank Group** is a unique global partnership: five institutions working for sustainable solutions that reduce poverty and build shared prosperity in developing countries. Specifically, the World Bank assumes the functions of Facility Management Team and secretariat of the FCPF (Readiness and Carbon Fund) and BioCF, supporting the countries in the preparation, design, and implementation of their related emissions reduction

programs, including their MRV systems.

SilvaCarbon is an interagency technical cooperation program of the U.S. government to enhance the capacity of selected tropical countries to measure, monitor, and report on carbon in their forests and other lands. The program provides targeted technical support to countries in the process of developing and implementing national forest and landscape monitoring systems. SilvaCarbon leverages state-of-the-art science and technology to advance the generation and use of improved information related to forest and terrestrial carbon.

AMEXCID is the Mexican Agency for International Development Cooperation. The agency shares successful experiences, strengthens capacities, and exchanges human, technical, and financial resources with developing countries, particularly in Central America and the Caribbean. It focuses on a policy of international cooperation for development and technical and scientific cooperation, establishing as a priority to promote integration and achieve shared development in Mesoamerica and the Caribbean.

CONAFOR, Mexico's National Forestry Commission, is a decentralized public organization with the objective to develop, favor, and promote productive activities, conservation, and restoration in the forestry sector, and to participate in the formulation of plans and programs and in the application of sustainable forestry development policy. CONAFOR is the workshop's host institution.

USAID, the U.S. Agency for International Development, is an independent agency of the U.S. government; it is primarily responsible for administering civilian foreign aid and development assistance. In support of America's foreign policy, USAID leads the U.S. government's international development and disaster assistance through partnerships and investments that save lives, reduce poverty, strengthen democratic governance, and help people emerge from humanitarian crises and progress beyond assistance.

USFS, the U.S. Forest Service, is a multifaceted agency that manages and protects 154 national forests and 20 grasslands in 43 states and Puerto Rico. The agency's mission is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. It has an elite wildland firefighting team and the world's largest forestry research organization. Its experts provide technical and financial help to state and local government agencies, businesses, and private landowners and work government to government with tribes to help protect and manage nonfederal forest and associated range and watershed lands.

Attendees: Two experts each from the national MRV units in Argentina, Belize, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay.

Streaming service will be provided via CEV.

DRAFT AGENDA

Day 1 Matorral Room

Session 1: Introductions, National and Program GHG Inventories. Moderator: Craig Wayson – SilvaCarbon		
Schedule	Activity	Speaker
9:00-9:30	Registration	All
9:30-9:45	Welcome and introductions (CONAFOR short institutional presentation 5 min)	CONAFOR
9:45-10:00	Workshop Objectives and Agenda	World Bank (Julian Gonzalo) and SilvaCarbon (Craig Wayson)
10:00-10:30	Institutional Presentations (5 mins): World Bank (The Global Forest Observation Initiative, SSKE) – SilvaCarbon – AMEXCID. Short discussion with other GFOI partners, agencies, donors: FAO, USAID, USFS, Norway, United Kingdom, etc.	WB-GFOI (Julian Gonzalo)/SilvaCarbon (Craig Wayson)/AMEXCID
10:30-10:45	Importance of GHG Inventories as public policy planning tools	CONAFOR
10:45-11:00	Group picture	All
11:00-11:15	Coffee break	All
11:15-12:15	Guidelines and methodological frameworks: IPCC guidelines and FCPF CF and ISFL BioCF MF and requirements for national and program GHGi	WB (Julian Gonzalo) – CONAFOR
12:15-12:30	Summary of common MRV status, methods, and goals	World Bank (Guy Janssen) and moja global team
12:30-13:00	Country presentations on the current status of MRV for GHG inventories, FCPF CF and BioCF ISFL programs based on standard format provided prior to workshop	4 national teams; 5 minutes per team plus 10 minutes questions
13:00-14:00	Lunch	All

Session 2: Introduction to moja global and FLINT Moderator: Julian Gonzalo – World Bank		
14:00-14:45	Introduction to moja global and FLINT <ul style="list-style-type: none"> • What is open source? • Purpose and role; what is FLINT? • How to participate • Current status and future plans 	moja global team/World Bank
14:45-15:00	Activity – Discussion in country team - complete section in Country Workshop Presentation and Workshop Report <i>15 minute activity</i> <ul style="list-style-type: none"> • What are the most important advantages of open source for your department or country? • Describe how your department or country could interact with the moja global community 	National teams - coordinated by moja global team and World Bank

	<ul style="list-style-type: none"> How can this interaction be made easier? 	
15:00-15:15	Coffee break	All
15:15-15:30	Activity – Presentation by each country of previous exercise on open-source within subgroups	All
15:30-16:15	FLINT demonstration	moja global team
16:15-17:00	Country presentations on the current status of MRV for GHG inventories, FCPF CF and BioCF ISFL programs based on standard format provided prior to workshop	5 national teams; 5 minutes per team plus 20 minutes questions

Day 2 Matorral Room

Session 3: Policy and reporting needs and system design		
Moderator: Oswaldo Carrillo – CONAFOR		
9:00-9:15	Summary of Day 1 (presentation)	Oswaldo Carrillo – CONAFOR
9:15-9:30	Country presentations on the current status of MRV for GHG inventories, FCPF CF and BioCF ISFL programs based on standard format provided prior to workshop	2 national teams; 5 minutes per team plus 5 minutes questions
9:30-10:00	Policy and reporting needs <ul style="list-style-type: none"> Key policy and reporting elements High-level country examples Examples from the FCPF and ISFL 	moja global team
10:00-10:30	Activity – Discussion in country team - complete section in Country Workshop Presentation and Workshop Report Group session: Four subgroups of four countries. <ul style="list-style-type: none"> Identify high-level policies and/or programs that need to be supported by a land sector MRV system Describe the key objectives (primary and secondary) of each policy 	National teams - coordinated by moja global team
10:30-10:45	Coffee break	All
10:45-11:15	Activity – Presentation of previous exercise on policies and programs within subgroups. Summary of identified policy and reporting needs: Each group presents their conclusions (5 min each). 10 min of discussion and overall conclusion.	Country groups
11:15-11:45	Matching system design to policy needs and reporting guidelines <ul style="list-style-type: none"> Designing a system that meets current and future needs 	moja global team
11:45-12:15	Activity – Discussion in subgroups - complete section in	National teams - coordinated by moja

	<p>Country Workshop Presentation and Workshop Report</p> <p>Group session: Four subgroups of four countries.</p> <ul style="list-style-type: none"> • What are the information requirements for your policy and reporting priorities? • What does this mean for your system design? • What are the performance criteria? • Types and frequency of outputs? • What are the priorities? • What type of system? 	global team
12:15-13:00	Country presentations on the current status of MRV for GHG inventories, FCPF CF and BioCF ISFL programs based on standard format provided prior to workshop	5 national teams; 5 minutes per team plus 20 minutes questions
13:00-14:00	Lunch	All

Session 4: Integration and background to the FLINT		
Moderator: Craig Wayson – SilvaCarbon		
14:00-14:15	Summary (presentation) of Day 2 morning	To be confirmed
14:15-15:00	<p>What is integration and why do it?</p> <ul style="list-style-type: none"> • Policy drivers and reporting needs • Data sources and data volumes • Examples 	moja global team
15:00-15:30	<p>Activity – Discussion in subgroups - complete section in Country Workshop Presentation and Workshop Report</p> <p>Group session: Four subgroups of four countries.</p> <ul style="list-style-type: none"> • Describe integration methods being used at the moment • What questions have you needed to answer but couldn't with your current system? • What issues are currently being faced? 	National teams - coordinated by moja global team
15:30-15:45	Coffee break	All
15:45-16:30	<p>Introduction to the FLINT</p> <ul style="list-style-type: none"> • Background to design and development <ul style="list-style-type: none"> ○ FLINT, modules, implementations • Links to data and other tools • Current applications and processes • Example implementation 	moja global team

16:30-17:00	<p>Activity – Discussion in subgroups - complete section in Country Workshop Presentation and Workshop Report</p> <p>Group session: Four subgroups of four countries.</p> <ul style="list-style-type: none"> • Explore the issues previously identified and note which could be facilitated by using an integrated spatial system • What would be needed in a FLINT implementation to address these issues? 	National teams - coordinated by moja global team
19:30	Group dinner	All

Day 3 Matorral Room

Session 5: FLINT as a framework for continuous improvement, practical exercises, developing data to meet MRV requirements Moderator: Julian Gonzalo – World Bank		
9:00-9:15	Summary of Day 2 (presentation)	To be confirmed
9:15-9:30	Introduction of the FLINT as a framework for continuous improvement	moja global team
9:30-10:15	Activity – Country teams use schematic of MRV framework to build a visual representation of an MRV system configured for the needs of their country	National teams - coordinated by moja global team and World Bank
10:15-10:30	Coffee break	All
10:30-11:15	Developing data options to meet the policy and reporting requirements of MRV	moja global team
11:15-11:45	<p>Activity – Discussion in subgroups - complete section in Country Workshop Presentation and Workshop Report</p> <p>Group session: Four subgroups of four countries.</p> <ul style="list-style-type: none"> • What data are needed for your MRV system configuration? • Which agencies need to be involved to get the data? 	National teams - coordinated by moja global team
11:45-12:15	Presentation – One person from each subgroup presents to group a summary of their data requirements and institutions involved	Country groups
12:15-13:00	Presentation of FLINT application in Mexico	Mexico and moja global teams
13:00-14:00	Lunch	All

Session 6: FLINT country demonstration activity and Facility Management Team verification requirements		
Moderator: Oswaldo Carrillo – CONAFOR		
14:00-15:30	Running the FLINT (using FLINTpro) <ul style="list-style-type: none"> • Description of system operation • Demonstration using global data and Tier 1 methods Group work – In country teams, on your own laptop <ul style="list-style-type: none"> • Use the default system for their country and look at results <ul style="list-style-type: none"> ○ Load data, select simulation, view results 	moja global team
15:30-15:45	Activity – Group discussion Group feedback on first session: thoughts and issues	National teams – coordinated by moja global team
15:45-16:00	Coffee break	All
16:00-17:00	Presentation of the basic conditions (criteria definition) of a customized tool for the Facility Management Team to support the verification process and for monitoring purposes at the portfolio level	World Bank (Julian Gonzalo)

Day 4 Matorral Room

Session 7: Defining operational systems, governance and institutional arrangements		
Moderator: Craig Wayson – SilvaCarbon		
9:00-9:15	Summary of Day 3 (presentation)	To be confirmed
9:15-10:00	Presentation of FLINT application in Colombia	Colombia and moja global teams
10:00-10:45	Presentation – What makes a system operational? Aspects of what it means to be operational: cyclical operation, technical requirements, processes, governance, continuous improvement process	moja global team
10:45-11:00	Coffee break	All
11:00-11:30	Activity – Discussion in subgroups - complete section in Country Workshop Presentation and Workshop Report Group session: Four subgroups of four countries. Describe what operational means in your country	National teams - coordinated by moja global team
11:30-12:15	Governance and institutional arrangements (45 mins)	World Bank (Guy Janssen)
12:15-12:45	Activity – Discussion in subgroups - complete section in Country Workshop Presentation and Workshop Report Group session: Four subgroups of four countries. <ul style="list-style-type: none"> • Describe existing structures 	moja global team

	<ul style="list-style-type: none"> • Possible future structures? • Which are the key agencies to involve? • What processes to use? • What capacity is available, what needs to be added? 	
12:45-13:00	<p>Introduction to the afternoon session:</p> <ul style="list-style-type: none"> • What are the FLINT system requirements of your country that are common to the other countries? • What do you think will need to be unique for your country? 	National teams - coordinated by moja global team
13:00-14:00	Lunch	All

Session 8: Action Plan Moderator: Julian Gonzalo – World Bank		
14:00-15:00	<p>Activity – Discussion in subgroups and then the whole group to identify common requirements.</p> <p>How to develop a FLINT Implementation to meet the common needs of countries with respect to new modules, including calculation modules and functionality modules</p> <p>Subgroup work:</p> <ul style="list-style-type: none"> • Module requirements <ul style="list-style-type: none"> ○ Based on the policy and information requirements, identify modules required ○ What are your country priorities? ○ What are the data requirements for these? • Subgroup discussions <ul style="list-style-type: none"> ○ Identify common modules ○ What are the priorities for the group as a whole? ○ Identify nationally specific modules <p>Whole group</p> <ul style="list-style-type: none"> • Identify the common modules for the group as a whole • How can we prioritize the development of each of the modules? 	World Bank, all
15:00-15:15	Coffee break	All
15:15-16:15	<p>Activity – Develop a workplan using template provided</p> <p>Definition of six monthly budgeted action plans for adapting, customizing, and training in the GHG software and platform linked to a timeline that is in line with country priorities</p>	World Bank, all
16:15-17:00	End of workshop / surveys / certificates	CONAFOR/World Bank

Annex B. Overview of MRV Situation and Needs by Country

Quick links and overview of key MRV requirements

	Output indicators ^a	AFOLU / forestry ^b	Frequency ^c	Base year	Projections	Mapping unit (ha)	Nesting	Management / events ^d	Max tier	Max approach
Argentina	1	2	3	1990	Y		Y	3	3	3
Belize	1	2	3		Y	0.3	Y		3	3
Chile	5	2	1	2000	Y	0.5	Y	3	3	3
Colombia	1	1	2	1990	Y	1.0	Y	2	3	3
Costa Rica	1	2	4	1995	Y		Y	3	3	3
Dominican Republic	4	2	1	1995	Y	0.5		3	2	3
Ecuador	5	2	3	1990	Y		Y	3	3	2
El Salvador	5	2	3	1980	Y	0.5	Y	1	3	3
Guatemala	4	1	3	2000	Y		Y	1	3	3
Honduras	1	2	3	2000	Y	1.0	Y	2	3	3
Mexico	1	2	3	2000	Y		Y	2	3	2
Nicaragua	5	2	1	2000	Y	0.5	Y	3	3	3
Panama	4	1			Y			1		2
Paraguay	5	2			Y			3	3	3
Peru	3	2	3	2000	Y		Y	3	3	3
Uruguay	5	2	4	2012	Y	0.5	Y	2	3	3

a. Output indicators: 1 = Only GHG; 2 = GHG is priority; 3 = GHG and biodiversity; 4 = GHG, biodiversity, and ecosystem service; 5 = GHG, biodiversity, ecosystem service, and more.

b. AFOLU / forestry: 1 = Forestry only; 2 = AFOLU.

c. Frequency: 1 = Monthly; 2 = Quarterly; 3 = Annual; 4 = Biennial; 5 = Other.

d. Management / events: 1 = Focused, 2 = Average, 3 = All.

Argentina

Current System

Argentina is developing an MRV system for its mitigation measures, with a focus on GHG emissions and co-benefits. Currently, the focus is on agreeing on the definitions of forests, pastures, wetlands, and crop lands (including with subnational level) as well as on consistent land cover mapping. In parallel, the exact scope of the MRV system and its required data are being negotiated between the institutions. In addition to climate-related indicators, a wide range of environmental information is published on a national platform that is available to the general public.

Biomass (above- and belowground) is reported at Tier 2 for forest and at Tier 1 for grass and crop land. For the latter two, soil is also reported at Tier 1. Enteric fermentation, manure management, and manure in pastures are reported at Tier 2 for cattle and Tier 1 for other livestock. Some agricultural emissions and biomass burning are also reported at Tier 1.

Challenges

The coherent representation of the land use requires agreed definitions between ministries and 23 provinces.

The MRV system for AFOLU needs to be consistent and compatible with the wider national GHG inventory.

Key Policies and Objectives

- BUR: The third BUR is due in 2019. The MRV needs to contribute to a systemic and comprehensive national GHG inventory.
- FREL: FREL is presented in 2019. The MRV is expected to produce reliable baseline data.
- Sectoral plans for mitigation measures: The MRV is expected to compare scenarios and monitor progress consistent with the national GHG inventory.
- National Climate Change Cabinet (GNCC): The MRV is expected to project the effect of measures and policies on GHG emissions.
- National Adaptation and Mitigation Plans (PNA/PNM): The MRV is expected to project effect of plans and monitor progress.

MRV Requirements

- **GHGi:** While there are some references to co-benefits, the current need is GHG emissions.
- **AFOLU:** Reporting already covers the AFOLU sector.
- **Annual:** Reporting on progress for most policies will require at least annual updates.
- **1990:** The base year is 1990.
- **Projections:** Scenario analysis is necessary for GNCC and National Mitigation and Adaptation Plans.
- **Minimum mapping unit:** Will be determined by the forest definition.
- **Nesting:** Provincial reporting (and possibly reporting at project level) needs to be combined at national level, so the MRV system needs to have a nesting capability.
- **All management, all events:** The GNCC requires the MRV to be able to deal with all management activities and all events. The silvopastoral activities require specific attention.
- **Approach 3:** In order to facilitate nesting of provinces and projects into national accounts, Approach 3 is necessary.
- **Tier 2 or 3:** Tier 2 is planned, but options are still being evaluated in order to achieve accuracy and transparency.

Proposed Approach

The design of the national MRV system is ongoing. Once definitions of different land uses have been agreed, an agile approach could be recommended as it can deal with complex system development between various institutions at the national level and 23 provinces. Developing all aspects at the same time, starting from a minimum viable product, might result in the fastest possible progress toward a national MRV system for the AFOLU sector. FLINTpro would be a logical option to produce results until the necessary structures are in place.

Belize

Current System

Belize has been relying on consulting inputs to produce its international reports. The reports have used Approach 3. The focus has been on forest AGB and REDD+, which have been reported up to Tier 3. All other land uses have been reported at Tier 1.

In collaboration with the FAO, Belize has recently developed land cover maps using Collect Earth. These maps are the first structural embedding of international reporting into the national administration.

Challenges

The limited institutional arrangements of MRV is probably the biggest challenge. But it is equally essential. Moving from a consultancy-based system to the public administration–based MRV has to happen to update, implement, and monitor NDCs and the National Strategic Plan to Combat Climate Change. Belize will need to establish a formal division of labor and reporting relationships between the institutions involved in MRV. Once the roles are clearly defined, capability and capacity need to be brought up to the necessary level.

But this transition requires time and resources, while various international reports are asking for all the attention of the public officials. Belize has produced three national communications to the UNFCCC; the last one was submitted in 2016 and the next one is planned for 2021. Its FREL and its first BUR are due in the beginning of 2019.

Key Policies and Objectives

- The BUR and FREL are due in beginning 2019. The MRV system will need to provide the GHGi baseline data for the AFOLU sector. These reports will also provide essential input into the REDD+ strategy below.
- The REDD+ strategy is due mid-2019. The MRV needs to support the implementation of result-based payments.
- The NDCs update in 2020. The MRV needs to project the impact of policies on emissions to link specific emission targets to its updated NDCs. The AFOLU sector is the leading emitter in Belize, so MRV for the land sector is key. The MRV also needs to track progress toward these objectives.
- National Climate Change Policy & Strategic Action Plan 2020: The MRV system will need to provide comparable projections for forest and agriculture mitigation policies. The MRV will also be used to monitor the actual effect of various policies.
- Fourth National Communication 2021: The MRV is a target in itself and should be run by the public administration by the time the next national communications are submitted. The MRV system will also produce the GHG inventory and mitigation action projections for the report.

MRV Requirements

- **GHGi:** The MRV needs to produce information about GHG emissions primarily. Since indigenous communities own part of the forest payment for ecosystem services might come up as an important measurement.
- **AFOLU:** Strategic Action plan is for the AFOLU sector and hence all land uses will have to be covered by the MRV system.
- **Annual:** Reporting on progress toward NDCs and Climate Change Policy objectives will require at least annual updates. Most likely, the frequency will have to increase over time to quarterly to allow for policy adjustments.
- **Projections:** Scenario analysis to determine NDCs and Climate Change Policy requires the MRV system to have a rules-based projections capability.
- **0.3 hectare minimum mapping unit:** This is in line with the national forest definition.
- **Nesting:** Depending on the arrangements for results-based payments and local payments for ecosystem services, it will be necessary to share payments on the basis of results achieved at the subnational level. This in turn requires nesting of local project results into the national GHGi.
- **Management info:** Further analysis will determine what events and management the MRV system needs to address. Most likely the key events (harvesting, fire, fertilizer application, herd management) need to be covered.
- **Approach 3:** Belize already uses Approach 3 for its MRV.
- **Tier 2 or 3:** To reach a level of accuracy necessary for results-based payments in the AFOLU sector, country-specific estimates of GHG emissions are necessary. It might be easier to jump directly to a Tier 3 system, depending on the data available.

Proposed Approach

Considering that several international reports are due and that capacity and capability are key challenges, the best way to introduce the MRV system is to focus each sprint/iteration on the delivery of a specific report or milestone. The first sprint could focus on the FREL and deliver a minimum viable product that will provide the structure for future improvement through subsequent sprints.

Chile

Current System

National System of Greenhouse Gas Inventories of Chile (SNICHILE) produces an inventory update on a biennial basis. All land uses and other sources of emissions (livestock, fertilizer, enteric fermentation, agricultural soils, manure management, urea application, rice cultivation, liming, and biomass burning) are reported using Approach 3. All REDD+ indicators (deforestation, degradation, reforestation, regeneration, conservation) are reported at Tier 2 or 3. Forest fires are a key event.

Chile has just submitted its third BUR (December 2018).

Chile has developed a framework for a centralized MRV system linking all sectors including AFOLU. The implementation of this system includes a National Forest Monitoring System.

Challenges

The Ministry of Agriculture and the National Forestry Corporation (CONAF) are focusing on the implementation of the MRV framework and the establishment of the FREL/FRL.

Institutions and capacity are strong. This provides a solid basis for the institutionalization of the new MRV system and the related exchange of data.

Key Policies and Objectives

- **Native Forest Law:** The MRV system is expected to deliver forest monitoring and detect land use changes. In addition, the MRV is expected to monitor subsidized forest activities.
- **Climate Change Law:** The MRV is expected to identify land use changes and project environmental and social vulnerability.
- **National Strategy on Climate Change and Vegetational Resources (ENCCRV):** The MRV is expected to contribute to the progress monitoring.
- **Adaptation Plan to Climate Change:** The MRV is expected to project effect of intervention options.

MRV Requirements

- **GHGi, LUC, social and environmental indicators:** The Climate Change Law requires projection of indicators for social and environmental vulnerability, in addition to land use change and emissions.
- **AFOLU:** The current system already reports all land uses and all other sources of emissions.
- **Monthly:** The Climate Change Law requires monthly updates.
- **2000:** Most policy priorities require a start date of 2000.
- **Projections:** Scenario analysis is required for the ENCCRV, the Climate Change Law, and the Adaptation Plan.
- **0.5 hectare minimum mapping unit:** As required by the Native Forest Law. In addition, there is the ambition to link emissions to individual properties.
- **Nesting:** All policies require some level of nesting, either between subnational and national administrative areas or of projects into a wider program.
- **All events, all activities:** The current system already reports on all events and activities.
- **Approach 3:** Approach 3 is necessary to nest project areas into a coherent national account.
- **Tier 2 or 3:** To reach a level of accuracy necessary for results-based payments in the AFOLU sector, country-specific estimates of GHG emissions are necessary. It might be easier to jump directly to a Tier 3 system, depending on the data available.

Proposed Approach

Considering the advanced level of the current MRV system and the high level of capacity in government agencies, the best approach is to provide access to the training and documentation provided by the Canadian Forest Service. This will allow the Ministry of Agriculture and the National Forestry Corporation to evaluate whether a FLINT-based system would have added value to the MRV framework.

Colombia

Current System

The Colombian MRV system is one of five components of action within the Colombian strategy of low carbon development (ECDBC). It is led by the Climate Change Directorate (DCC) of the Ministry of Environment and Sustainable Development (MADS) and operated by the Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM), using Colombian expertise only. Two subdirectorates of IDEAM work on AFOLU MRV: (1) Ecosystems and Environmental Information, and (2) Environmental Studies.

The AFOLU MRV feeds into the Colombian Unified MRV (including non-land related): SINGEI - Sistema de Nacional de Inventarios de GEI (National Inventory System for Greenhouse Gases).

The current system reports at Tier 2 for AGB and BGB; dead organic matter (DOM) and soil are reported at Tier 1 and litter is not reported. Biomass burning is reported at Tier 1. Enteric fermentation is reported at Tier 1 or 2. Rice is reported at Tier 2. Some fertilizer is reported at Tier 1. The system uses Approach 1 or 2.

Colombia is working on its fourth national communication and its third BUR.

Challenges

Colombia is continuing the conceptualization of its AFOLU MRV system by better defining its components and the interactions between the components. A joint vision of the overall MRV system will create synergy between the different units and facilitate the strategic investment of limited resources. The vision can also clarify the links between the AFOLU MRV and other systems, like the National Register for Emissions Reductions (RENARE) and SINGEI.

IDEAM runs the national AFOLU MRV system, but it relies heavily on international funding, which can be unpredictable. Keeping staff and investing in capacity is a challenge when working conditions are uncertain. In addition, various donor funds result sometimes in diverging priorities.

Key Policies and Objectives

- **Forest Policy:** This policy has three objectives: (1) sustainable use of forests (and watersheds), (2) incorporation of the forestry sector in the national economy, and (3) improve the quality of life of the population. The MRV needs to monitor the first and third objective.
- **National Development Plan:** The MRV system needs to monitor indicators related to forests.
- **Forests Territories of Life:** This is a comprehensive strategy to control deforestation and improve forest management. The MRV system needs to monitor implementation and progress.
- **Amazon Vision:** This is an Integral Strategy for Control of Deforestation and Management of Amazonic Forests. It has a community monitoring component that feeds into the MRV system to monitor progress.

MRV Requirements

- **GHGi:** The MRV needs to produce information about GHG emissions, all REDD+ indicators, wood yields, watersheds, and community ecosystem services.
- **Forest:** The emphasis is on forest-related monitoring and all transition to and from forest. AFOLU elements related to livestock will also be addressed.
- **Quarterly:** Reporting on progress under the National Development Plan is quarterly.
- **1990:** The Forest Policy requires a start date of 1990.

- **Projections:** Scenario analysis is required for the programs Forests Territories of Life and Amazon Vision.
- **1 hectare minimum mapping unit:** This is in line with the national forest definition.
- **Nesting:** All policies require some level of nesting, either between subnational and national administrative areas or of projects into a wider program.
- **Fires, fertilizer, livestock, management info, wood products:** Each policy priority has slightly different requirements.
- **Approach 3:** Approach 3 is necessary to nest project areas into a coherent national account.
- **Tier 2 or 3:** To reach a level of accuracy necessary for results-based payments in the AFOLU sector, country-specific estimates of GHG emissions are necessary. It might be easier to jump directly to a Tier 3 system, depending on the data available.

Proposed Approach

Colombia has an advanced system and high levels of expertise in IDEAM. Introducing continuous improvement using an agile approach would be beneficial. The first sprint could focus on introducing FLINT as the calculation engine of the MRV system, replacing the spreadsheets now used. Using uncertainty analyses will help identify key areas of improvement of the system.

Costa Rica

Current System

AGB is reported at Tier 2; other pools are reported at Tier 1. All indicators related to REDD+ are reported for all pools (except soil) at Tier 1 or 2. Soil and wood products are being added to the AFOLU MRV system. Uncertainty analysis is planned as well as is the alignment of REDD+ activities with the NDCs.

The second FREL/FRL is being developed and the United Nations Development Programme (UNDP) has received Global Environment Facility (GEF) funds to support the next national communication. GEF also provided funds to the Tropical Agricultural Research and Higher Education Center (CATIE) for the development of a comprehensive National System for Monitoring Coverage and Land Use and Ecosystems (SIMOCUTE). Recently, emissions reductions for the agricultural and livestock sector were agreed, including banana, coffee, livestock, rice, and sugarcane.

Challenges

Challenges include the collection of activity data for agriculture and forestry as well as the development of country specific emissions factors and Tier 3 models for emissions and sinks in the AFOLU sector. Gender equity is recognized as a challenge. At the institutional level, budgets and incentives remain the main problems. But staff and capacity shortages are also slowing progress.

Key Policies and Objectives

- FREL and fourth national communication: The MRV needs to produce GHGi for the AFOLU sector.
- National Policy for Adaptation to Climate Change: The MRV needs to project expected emissions for various scenarios.
- National Climate Change Strategy and Action Plan: The MRV needs to compare scenarios to define a road map. If possible, the MRV should provide social, environmental, and economic impact indicators.

- Forestry Law (7575): The MRV needs to monitor implementation and provide indications for ecosystem services linked to payments.
- SIMOCUTE: The information of SIMOCUTE is an input into the MRV system.
- National Risk Management Policy: The MRV is expected to contribute to the calculation of losses and damages.

MRV Requirements

- **GHGi**: Expectations are high, including ecosystem services and losses and damages. Focusing on GHG emissions and sinks, including projects, is the priority.
- **AFOLU**: Reporting already covers the AFOLU sector.
- **Biennial**: Reporting every two years is sufficient, which provides time to collect information.
- **1995**: The base year for the Forest Law is 1995.
- **Projections**: Scenario analysis is essential for the National Policy for Adaptation to Climate Change and for the National Climate Change Strategy and Action Plan.
- **Minimum mapping unit**: Assumption is 1 hectare, but this needs to be confirmed.
- **Nesting**: Provincial reporting (and possibly reporting at project level) needs to be combined at national level, so the MRV system needs to have a nesting capability.
- **All management, all events**: Costa Rica has detailed agreements for mitigation in agriculture and forestry. These agreements require the monitoring of various management practices and the registration of events.
- **Approach 3**: In order to facilitate nesting of provinces and projects into national accounts, Approach 3 is necessary.
- **Tier 2 or 3**: Tier 2 is the minimum required, but the ambition is to move to a Tier 3.

Proposed Approach

Considering the budget and capacity constraints in the government, the high level of ambition, and the numerous organizations supporting the government, the most productive approach might be to use FLINTpro to deliver results immediately. In parallel, the first sprint can be used to repeat the workshop held in Mexico, but only for the partners in Costa Rica; the FLINTpro results could be used to explain how the system works and how it could be integrated into the existing structures.

Dominican Republic

Current System

The current MRV system reports forest land at Tier 2; other land uses are reported at Tier 1, using Approach 1 or 2. Enteric fermentation, manure management, burning of biomass, rice, and fertilizer use are reported at Tier 1.

The system is used for international reporting and for national policy monitoring. The first FREL is in progress. The NDCs are being reviewed. The MRV will be linked to the emissions registry, but it will also be upgraded to have the capacity to measure co-benefits from REDD+. The MRV will need to meet the Enhanced Transparency Framework of the Paris Agreement.

Challenges

Capacity and resources are key limitations to further development of the MRV. This threatens its medium- to long-term sustainability.

Defining the institutional aspects before going into technical details (responsibility for coordination, implementation of components, and so on) is required.

Find a balance between the desire to achieve the greatest possible accuracy and the ease of implementation and maintenance is a key challenge.

Uncertainty is also a key challenge.

Key Policies and Objectives

- National Development Strategy 2030: The MRV will be used to estimate emissions related to various development options and monitor progress toward the agreed goals.
- NDCs: The MRV will be used to identify the most effective mitigation options with the highest positive development impacts.
- Reference level for REDD: The MRV will be used to calculate the FREL.
- BUR: The MRV will provide info about emissions.
- REDD Implementation Program: MRV will project impact of various policies on emissions and will measure progress toward the set goals.
- National Strategy for Adaptation to Climate Change in the Agriculture Sector: The MRV will project potential emission reductions and link them to food security and low-carbon development.
- National Reforestation Plan: The MRV will project emissions reductions and the impact of reforestation on livelihoods.

MRV Requirements

- **GHGi, ecosystem services:** Focusing on the GHG inventory to develop policies and international reports can be combined with estimates for ecosystem services and changes in livelihoods.
- **AFOLU:** The MRV is expected to contribute to the development of agriculture related policies.
- **Monthly:** The National Reforestation Plan requires monthly updates.
- **1995:** The base year of the National Reforestation Plan is 1995.
- **Projections:** Scenario analyses are necessary for most policies.
- **0.5 hectare minimum mapping unit:** Valid for all policies.
- **Nesting:** It is not yet clear whether nesting of different approaches or factors will be required.
- **Management and events:** All uses and transitions between uses, fires, pests, hurricanes, storms, fertilizer use, livestock management, irrigation systems, soil conservation practices, and precipitation.
- **Approach 2:** Approach 2 is probably sufficient. If nesting is necessary, Approach 3 will have to be used.
- **Tier 2–3:** The ambition is Tier 2, but Tier 3 might be possible with the same effort.

Proposed Approach

Considering the high expectations from the MRV system as well as the capacity and resource constraints, replicating the current system on a FLINT-based system might be the best first iteration. The use of FLINTpro is the preferred option even for the medium term.

Ecuador

Current System

The current system focuses on AGB at Tier 2 for forest and at Tier 1 for all other land uses. Biomass burning, enteric fermentation, manure management, rice, and nonfixating crops are reported at Tier 1.

The preliminary MRV system is being upgraded to include additional features, some of the additional AFOLU sector categories, and even mitigation measures to develop the capacity to monitor progress on the NDCs. A new FREL is being established and the REDD+ technical annex is being revised.

The FAO and UNDP are providing support with the development of the MRV system, regarding inventory, NDC building, the collection and cleaning of data, and the development of land cover maps.

Challenges

The MRV depends on the harmonization and institutionalization of reporting cycles and data formats for statistical information used in the GHG inventory, including the interoperability of the data systems.

To improve consistency, it is essential that the same system is used for (1) greenhouse gas emissions, (2) GHG mitigation/reduction actions, and (3) expenditure and financing indicators.

The accuracy of the results of the MRV is dependent on better management of uncertainty as well as on the introduction of methods of quality control for data and processes, and also interinstitutional agreements on statistics management.

Key Policies and Objectives

- Forest resource management: The MRV is expected to track emissions and sinks from forest conservation.
- National System of Protected Areas: The MRV is required to project scenarios for the sustainable use of natural resources and the provision of environmental goods and services. The MRV needs to track biodiversity indicators and quality of life indicators.
- National Climate Change Strategy: The MRV is required to project emissions scenarios and their impacts on (crop) yields and track progress toward the established goals.
- Law of Water Resources: The MRV should project and track the available water resources.
- Gran Minga Agropecuaria: The MRV is required to project agricultural yields.
- Livestock Improvement Program: The MRV is required to project climate-smart scenarios for the highest income with the lowest emissions.

MRV Requirements

- **GHGi, biodiversity, ecosystem services, yields, water resources:** The MRV capacity will have to be built gradually, starting with GHG fluxes and experimenting with either economic or biodiversity indicators. Over time, functionality can be added.
- **AFOLU:** Several policy priorities require the MRV system to cover the main categories of the AFOLU sector, which already has important developments regarding forestry and soil use change.
- **Annual:** Most policies require annual reports.
- **1990:** Forest resource management and the National System of Protected Areas require 1995 as base year.

- **Projections:** Scenario analysis is essential for all listed policies.
- **Minimum mapping unit:** Assumption is 1 hectare, but this needs to be confirmed.
- **Nesting:** Subnational entities as well as specific projects need to be disaggregated and incorporated from the national accounts.
- **All management, all events:** As indicated above, the functionality of the MRV system will have to be built gradually. Priority management information and events can be included in the first sprints; over time, additional information can be included.
- **Approach 3:** To facilitate nesting of provinces and projects into national accounts, Approach 3 is necessary.
- **Tier 2:** It is possible to find a compromise between more functionality and accuracy. Tier 2 is the minimum required, but some less important land uses or management might be reported at Tier 1.

Proposed Approach

The proposed approach is to test the FLINT on a small area with good data so that the maximum functionality can be demonstrated in the first iteration. The next step is to carefully prioritize the policy requirements so the MRV system can be improved gradually with each sprint.

El Salvador

Current System

El Salvador has been receiving support from the German Agency for International Cooperation (GIZ) to produce its international reports. The system is reporting on AGB, BGB, DOM, and soil at Tier 1. Litter is not reported. Biomass burning, enteric fermentation and manure management are also reported at Tier 1. REDD+ activities are not yet reported. In collaboration with the World Resources Institute (WRI), efforts are made to report on biodiversity.

Advanced visualization products have been developed to report on a range of environmental indicators, including GHG emissions, water, and volume. The results can be presented in tabular form and to some extent on maps. The results are based on a range of data collected by various agencies and the system is flexible so additional indicators can be added to the system.

Challenges

Recently, the government set the target of producing the next BUR and national communication using government officials and in-house capacity. Both reports are due by the end of 2020; thus, a ministry-run MRV system needs to be in place by no later than mid-2020. Assuming sprints of about six months, this would allow three sprints to build the MRV system.

The public officials consider FLINT a potential way to combine the work now being done by outside agencies (GIZ, WRI) into a government-run MRV system.

FLINT might also reduce the hurdle to build capacity in the ministry to run their own MRV system. Interinstitutional links need to be formalized in particular with the Ministry of Agriculture. Budgets and incentives are the key challenges to build a government-run system. Capability is linked to budgets, but capacity too is a challenge.

Key Policies and Objectives

- **National Plan to Combat Climate Change:** The MRV needs to provide information about mitigation and adaptation options in the AFOLU sector using information derived from various institutions at national and subnational levels.
- **Program of Restoration of Ecosystems and Landscapes:** The MRV needs to provide targets and progress monitoring information for mitigation and adaptation in agroforestry, conservation of critical areas, and integration of green and gray infrastructure.
- **National Climate Change Plan for Forestry, Fisheries, and Aquaculture:** The MRV needs to compare policy options and provide progress information about the reconversion of management practices in the sector toward sustainable alternatives.
- **NDC update:** The MRV needs to provide realistic targets for the NDCs and provide regular progress information toward achieving these targets.
- **REDD+ Program:** The MRV needs to provide updates on the reduction of deforestation and degradation and the related reduction in emissions.

MRV Requirements

- **GHGi, water, biodiversity, ecosystem services:** The MRV needs to produce information about GHG emissions in combination with water management, biodiversity, and ecosystem services. Considering that El Salvador has developed a comprehensive environmental reporting system, additional requirements might be identified at a later stage.
- **AFOLU:** The Climate Change Plan covers the AFOLU sector and hence all land uses will have to be covered by the MRV system.
- **Annual:** Reporting on progress toward the NDCs and Climate Change Plan will require at least annual updates. However, the environmental management system is a real-time system, so more frequent updates are probably expected, for example, monthly or quarterly.
- **1980:** The calculation of the National Plan to Combat Climate Change requires a start date of 1980 for emissions estimates.
- **Projections:** The scenario analysis to determine the NDCs and Climate Change Plan requires the MRV system to have a rules-based projections capability.
- **0.5 hectare minimum mapping unit:** This is in line with the national forest definition.
- **Nesting:** Since different approaches for restoration are applied in various areas and because the data available for some areas are more detailed than for other areas, the different projects need to be nested into the national accounts.
- **Management info:** The emissions will differ based on the cause of degradation, applied restoration techniques, and agricultural practices.
- **Approach 3:** While the ambition of El Salvador is to move from Approach 1 to Approach 2, it will be necessary to increase this ambition to Approach 3 to make it possible to nest project areas with different restoration approaches into a coherent national account.
- **Tier 2 or 3:** To reach a level of accuracy necessary for results-based payments in the AFOLU sector, country-specific estimates of GHG emissions are necessary. It might be easier to jump directly to a Tier 3 system, depending on the data available.

Proposed Approach

El Salvador has international technical assistance but limited in-government capacity. Coordination between institutions is a challenge. Considering that good information is available for some parts of the country, selecting a pilot area for the national MRV system and then upscaling the system to the whole country might be the most viable option. If capacity to run such a pilot is not yet available, a FLINTpro option might be considered.

Guatemala

Current System

The current MRV system was designed within the FCPF's methodological framework. It reports AGB at Tier 2 for all land uses. Some agricultural emissions are reported at Tier 1.

The preparation of the third national communication and the first BUR and REDD+ report is ongoing. Institutional arrangements have been established for the establishment of FREL/FRL. These arrangements will be institutionalized for the regular operation of the MRV.

The system will be used to monitor REDD+ activities, NDCs, and safeguards.

Challenges

Governance structures need to be established and institutionalized to agree on a division of labor and a system of data sharing between departments at the national level as well as between national and subnational entities.

Uncertainty of the emissions estimates from the AFOLU sector has to be reduced, not only to make reported results more reliable but also to improve the capacity to plan interventions.

Capacity of public servants, and the technological tools they have available, needs to be increased to ensure reports and policy support can be provided on time and at the necessary quality. To achieve this, actions will need to be taken to reduce staff turnover.

Financial sustainability of the system needs to be guaranteed, to allow for longer term planning and investment in an institutionalized system.

Key Policies and Objectives

- National communication, BUR, FREL: The MRV will be required for GHG inventory and for projections of interventions.
- REDD+ Strategy: The MRV will have to provide scenarios analysis for available interventions and will be used to monitor progress toward results.
- NDC: MRV provides projects to establish achievable results and monitors progress.
- SDG 13 and 15: The MRV will monitor a wider range of indicators to the extent possible, including GHG emissions, forest-related indicators, biodiversity, and sustainable livelihoods.
- Forest Policy: The MRV will monitor safeguards, ecosystem services, and sustainable development indicators for affected populations.

MRV Requirements

- **GHGi, biodiversity, ecosystem services:** Focusing on the GHG inventory to support the development of pending reports is the priority. Additional indicators can be introduced when indicators around biodiversity and ecosystem services are better established.
- **Forest:** While some agricultural indicators are already reported by the MRV system, the priority is with forest-related indicators.
- **Annual:** Reporting on progress for most reports is annual.

- **2000:** The base year to start MRV calculations needs to be confirmed, so 2000 has been selected as a reasonable placeholder.
- **Projections:** Scenario analysis are necessary for REDD+ and Forest Policy.
- **Minimum mapping unit:** Needs to be confirmed.
- **Nesting:** REDD+ projects need to be nested into national accounts. Possibly, subnational accounts need to be nested in national accounts. This will be clear once governance arrangements have been established.
- **Forest management and events:** Forest management and events need to be taken into account when producing emission estimates.
- **Approach 3:** Approach 3 is necessary to nest projects into national accounts.
- **Tier 3:** To achieve the necessary accuracy, Tier 3 for all forest-related reporting is required.

Proposed Approach

Since a system has already been developed, it is probably most conducive to replicate that system on a FLINT-based platform in the first sprint. This will provide the necessary structure to facilitate discussions around governance. If emission estimates are necessary in the short term to meet international reporting requirements, FLINTpro could be used.

Honduras

Current System

Honduras has a system that reports on all pools but soil at Tier 2. The system records deforestation at Tier 2 but does not yet deal with regrowth and degradation. Conversion of forest land to other land is also reported at Tier 2. Biomass burning, enteric fermentation, and manure management are not yet reported.

Honduras is working on its third national communication and its first BUR and FREL. It has commitments for results-based payments (including FCPF and ISFL) and it has to revise its NDCs. At the national level, it reports on the National Forest Restoration Program and institutional indicators.

The current MRV system is robust. The FAO performs some key tasks.

Challenges

The existing system might not be able to keep up with increasing requirements. Automation of the calculations is essential to ensure the growing complexity does not cause human errors. The uncertainty of the system needs to be reduced to meet the requirements of agreements on results-based payments.

Honduras wants to progress toward a cycle of regular (for example, annual) reporting. This requires three types of investment. First, at an institutional level the priority is the clarification of the mandate and role of different government agencies in the production of MRV information. Second, resources need to be added and capacity needs to be built in government institutions (including taking over tasks being done by outside agencies). Third, technical aspects need to be upgraded, including change detection, biomass burning, nesting of projects, and the introduction of safeguards.

Key Policies and Objectives

- **Water, Forest and Soil Master Plan:** The plan covers the AFOLU sector and the MRV needs to provide monitoring information for forest-related activities.
- **General Law on Climate Change:** The MRV needs to produce an AFOLU GHGi.
- **National Climate Agenda:** The MRV needs to provide information about mitigation and adaptation options in the AFOLU sector.
- **NDC update:** The MRV needs to provide realistic targets for the NDCs and provide regular progress information toward achieving these targets.
- **REDD+ Program:** The MRV needs to provide updates on the reduction of deforestation and degradation and the related reduction in emissions.

MRV Requirements

- **GHGi:** The MRV needs to produce information about GHG emissions. In the future, the MRV might be used to monitor soil quality, biodiversity, or water-related indicators.
- **AFOLU:** The National Climate Agenda covers the AFOLU sector and hence all land uses will have to be covered by the MRV system.
- **Annual:** Reporting on progress toward the NDCs and National Climate Change Agenda will require at least annual updates.
- **2000:** Except for the NDCs, the estimation calculations require the year 2000 as the start date.
- **Projections:** The scenario analysis to determine the NDCs and options for the National Climate Agenda requires the MRV system to have a rules-based projections capability.
- **1 hectare minimum mapping unit:** This is in line with the national forest definition.
- **Nesting:** Projects need to be nested into the national accounts.
- **Fires, fertilizer, management info:** The emissions will differ based on the cause of degradation, applied restoration techniques, and agricultural practices. Fires will be added to forest events (in combination with degradation, deforestation, reforestation, conservation, and so on).
- **Approach 3:** While the ambition of Honduras is to move to Approach 2, it will be necessary to increase this ambition to Approach 3 to make it possible to nest project areas into a coherent national account.
- **Tier 2 or 3:** To reach a level of accuracy necessary for results-based payments in the AFOLU sector, country-specific estimates of GHG emissions are necessary. It might be easier to jump directly to a Tier 3 system, depending on the data available.

Proposed Approach

Honduras has a functioning system that needs institutionalization and upgrading. Replicating the existing system on a FLINT-based platform will create a clear structure for the division of labor between institutions. Subsequently, the approach of continuous improvement through agile sprints will upgrade the system while strengthening the institutional collaboration.

Mexico

Current System

Mexico has just completed its second BUR and its sixth national communication complete with GHG inventory. It has used its MRV system also to submit its FREL, the Emission Reduction Potential, and the allocation of emission reductions to programs and projects.

The system is reporting forests and grasslands for all pools at Tier 2. For other land uses, only AGB is reported at Tier 1. REDD+ indicators (deforestation, degradation, reforestation, regeneration, conservation, forest management) are reported at Tier 2 for AGB and BGB. DOM, litter, and soil are mainly reported at Tier 1.

Mexico receives technical and financial support from a range of partner countries. The near-term focus will be on consolidating the Forest Satellite Monitoring System (MoSaF) to obtain activity data with greater spatial and temporal resolution; generating activity data with better accuracy, using complementary approaches (National Reference Visual Interpretation Mesh); improving methodological and input materials for the Biomass and Carbon Estimation System (analytical improvements, quality controls, propagation of uncertainties, and so on); amplifying the accessibility of SNMRV information through graphical reporting platforms; developing SNMRV of mitigation actions (MRV level 2); and consolidating the model alignment and consistency of GHG accounting at multi-scale.

Challenges

The post-processing of land cover maps and change maps not only requires specialized expertise but is time-consuming and costly. Increasing capacity and developing faster, cheaper methods will be necessary. Further cost reductions can be found by reviewing the satellite-based system for forest monitoring.

Developing good interventions is dependent on the generation of good information. In this respect, a system to identify and monitor the drivers of deforestation and degradation could result in better actions and projects.

Aligning and nesting subnational and project mitigation projects and results into a national carbon accounting system will improve collaboration and increase consistency.

Improving the technical capacity to project and compare mitigation scenarios will result in better and achievable programs.

Key Policies and Objectives

Mexico was not in a position to share its policy priorities yet.

MRV Requirements

The MRV requirements below are only an indication until additional information can be provided.

- **GHGi:** Focusing on GHG inventory.
- **Forest, grasslands:** This is based on the current capabilities of the MRV system.
- **Annual:** This is a placeholder.
- **2000:** The base year to start MRV calculations needs to be confirmed, so 2000 has been selected as a reasonable placeholder.
- **Projections:** Scenario analysis are necessary for targets, programs, and activities.
- **Minimum mapping unit:** Needs to be confirmed.
- **Nesting:** Nesting has been identified as a challenge.
- **Forest, grassland management, events:** These are the focus of the existing MRV system.
- **Approach 3:** Approach 3 is necessary to nest projects into national accounts.
- **Tier 2:** Tier 2 is the reported ambition of the MRV system in two years' time. It is worth considering a jump to Tier 3, as it might be possible with the same investment.

Proposed Approach

It is hard to propose an approach with the limited information that is available. Mexico has indicated an interest in replicating the existing MRV system on a FLINT-based platform. Considering the size of the country, the complex administrative arrangements between national and subnational entities, and the challenges identified around the post-processing of land cover and change maps, it is advisable to replicate the system for a pilot area and progressively increase the geographic and function scope of the FLINT-based system.

Nicaragua

Current System

The current system is used for the development of national policies on forests and to submit the national communication to the UNFCCC. The focus is mainly on forest, as it is monitoring the state of forest resources in the country as well as identifying the trend and dynamics of deforestation and forest degradation. In addition to regular forest monitoring, the MRV system is used for fire detection and monitoring agricultural production. The team is working on the first BUR and the next FREL.

The current system is reporting AGB for all land uses and land use changes at Tier 2 and BGB at Tier 1. Other pools are not reported. Similarly, deforestation, degradation, reforestation, and regeneration are reported for AGB at Tier 2 and BGB at Tier 1. The following agricultural emissions are reported at Tier 1: enteric fermentation, manure management, agricultural soils, liming, and fertilization with urea.

Further development of the MRV system will focus on developing an early warning system for deforestation and national forest degradation; developing and validating allometric equation for the three climatic regions of Nicaragua; achieving interoperability between national monitoring systems; strengthening territorial capacities and indigenous peoples for community forest monitoring; and developing mobile applications (collectmobile).

Challenges

Monitoring of forest degradation needs a cost-effective solution.

The national emission factors for dead organic matter, litter, and soil need to be developed.

Reduction of uncertainty in the interpretation and classification of satellite images.

Resolving cloud cover on satellite images on the Caribbean coast.

Complete the National Forest Monitoring Technology Platform.

Strengthening and developing national capacity.

Key Policies and Objectives

- Protection of Mother Earth: Adaptation to Climate Change and Comprehensive Management of Disaster Risks. MRV is required to deliver REDD+ information, watershed management, biodiversity, AFOLU emissions.

- Sovereignty and food security: MRV is required for crop yield, soil health, economic contribution of forest, and ecoservices.
- Social, productive, energy, and transport infrastructure: Reduce dependence on imports including hydrocarbons. MRV is required to estimate plantation yields, wood product value, and climate impact.
- Economic growth: Policy options to combine forest conservation and climate change mitigation with sustainable economic development. MRV is necessary to compare policy scenarios.
- Integral Development of the Nicaraguan Caribbean Coast: Develop policy options for integrated economic development. MRV is necessary to compare policy scenarios.

MRV Requirements

- **GHGi, biodiversity, ecosystem services, economic impact, yields:** Focusing on GHG inventory remains the key starting point for FCPF, but additional indicators should be considered to make the MRV system more useful and thus sustainable.
- **AFOLU:** The current system already includes some agriculture indicators. The system can build on this base through incremental improvements.
- **Monthly:** Reporting on progress for most reports is monthly.
- **2000:** The base year for most policies is 2000.
- **Projections:** Scenario analysis are necessary for several policies.
- **0.5 hectare minimum mapping unit:** The minimum mapping unit for sovereignty and food security is 0.5 hectare.
- **Nesting:** Projects need to be aggregated into national monitoring updates.
- **Forest, agriculture management, and events:** Including fires, fertilizer, plantation management, natural regeneration, manure management, enteric fermentation, and so on.
- **Approach 3:** The current system already reports at Approach 3.
- **Tier 3:** Tier 3 for key pools and land uses. Others might be reported at Tier 1 or 2.

Proposed Approach

Available capacity is reasonable, but funds are scarce. The scope of the MRV is expected to be wide. It might be advisable to focus on a limited area to pilot FLINT and test a wider range of indicators. If GHG emissions information for the whole country is necessary in the short run, a FLINTpro solution might be considered.

Panama

Current System

The Panama MRV system for the AFOLU sector is reporting all land uses and all REDD+ activities. Soil and BGB were reported at Tier 1; the other pools are reported at Tier 2. Collect Earth was used to report the five REDD+ activities. Biomass burning, enteric fermentation, and manure management are reported at Tier 1. Overall, Approach 3 is used.

Panama has just submitted its third national communication. The FREL is being updated. The institutions providing activity data into the MRV system are being mapped to improve institutional arrangements and data sharing.

Several national systems are being streamlined and aligned to ensure that the reports are consistent. These systems include GHG inventories, NAMA, NDCs, and REDD+ activities.

Challenges

Inter-institutional coordination is probably the biggest challenge: There are no inter-institutional reporting protocols, low empowerment of sectors, few clear systems, and a lack of clarity of roles and responsibility.

The data series used in the MRV system have temporal and geographic gaps. This causes inconsistencies. The gaps need to be filled with alternative data or completely different data sets will have to be used. The best options for each data set need to be determined.

Data can further be improved by standardizing data collection protocols and establishing quality assurance processes as part of the standard MRV procedures.

Technical capability and capacity is a challenge for most public institutions.

Key Policies and Objectives

Panama did not share their responses from the workshop, so the information below is derived from their presentation and the national communication. The role of the MRV system is based on comparative requirements in other countries.

- **NDC update:** The MRV provides projections of policies in order to develop achievable targets. Subsequently, the MRV will monitor progress toward these targets.
- **FREL:** The MRV provides the historic emissions and sinks related to forest cover.
- **National Climate Change Strategy:** The MRV compares a number of scenarios to achieve the highest return for the climate, the environment, and sustainable development. Then the MRV monitors progress toward the set targets.
- **National REDD+ Strategy:** The MRV compares policies to set targets for forest sinks and then monitors progress toward these targets.
- **National Adaptation Plan:** The MRV compares policies to set targets for adaptation and then monitors progress toward these targets.
- **National Platform for Climate Transparency:** AFOLU MRV will be used to provide emissions and sinks from land. In addition, co-benefits like biodiversity and ecoservices might be taken into account.

MRV Requirements

- **GHGi, biodiversity, ecosystem services:** Focusing on GHG inventory is the priority, but policy scenarios need to include biodiversity and ecosystem services.
- **Forest:** While some agricultural indicators are already reported by the MRV system, the priority is with forest-related indicators.
- **Annual:** This is based on an average in other countries.
- **2000:** This base year is based on an average in other countries.
- **Projections:** Scenario analyses are necessary for the NDCs, FREL, Climate Change Strategy, REDD+ and Adaptation Policy.
- **Minimum mapping unit:** Needs to be confirmed.
- **Nesting:** Needs to be confirmed.
- **Forest management and events:** Forest management and forest-related events are the priority.
- **Approach 1:** Needs to be confirmed based on needs.
- **Tier 2:** Tier 2 is the current reported level of ambition.

Proposed Approach

It is hard to provide an appropriate approach with the limited information available. A feasible and useful approach would probably be to replicate the current calculations on a FLINT-based platform.

Paraguay

Current System

The current MRV system is used mainly for international reporting. The third national communication is due as well as are the second BUR and FREL. The reduction of uncertainty and the development of in-house capacity is a priority.

The current system reports all forest carbon pools at Tier 2 or 3. Other land uses are reported at Tier 1. Deforestation is the only REDD+ activity reported. It is reported at Tier 2 or 3. Only few other emissions from the land sector are reported.

Challenges

Definition and institutionalization of responsibilities and governance related to climate change are a challenge. In addition to the rules, capacity, capability, and funds are real challenges for the institutions supporting the AFOLU MRV with data and planning.

The arrangements beyond the government also need further definition and formalization—that is, inter-institutional coordination among public institutions, civil society, and the private sector in relation to the implementation of mitigation actions in the AFOLU sector.

Effective implementation of the Forest Monitoring System with a legal instrument (decree) would contribute to resolving the above uncertainty.

Key Policies and Objectives

- National Development Plan 2030: The MRV will be used to track restoration of degraded ecosystems and the related GHG emissions.
- National Climate Change Policy: The MRV will be used to compare emissions scenarios, coherent with the priorities of national development. The MRV will also track progress of implementation.
- National Environmental Policy: The MRV is used to monitor GHG emissions and biodiversity as a result of restoration of ecosystems. The MRV will also provide indications of impact of restoration of livelihoods and level of compensation.
- National Forest Policy: The MRV will be used to calculate emissions, yields, wood products, ecosystem services, economic potential of forests, and agroforestry or silvopastoral systems. The MRV will also provide sustainable management scenarios.
- Agrarian Statute Management: The MRV provides information on soil conservation and recovery.
- Agrarian Strategic Framework Actions: The MRV provides emissions reduction related to systems of minimum tillage, polycultures, and adoption of sustainable practices.

MRV Requirements

- **GHGi, biodiversity, livelihoods, others:** Focusing on GHG inventory to support the development of pending reports is the priority, but the National Environmental Policy requires the MRV to link emissions to biodiversity and livelihoods. The Forest Policy would require additional indicators related to yields, wood products, ecosystem services, and economic potential.
- **AFOLU:** Agrarian Strategic Framework Actions requires full AFOLU indicators. There is a strong emphasis on mixed system, for example, agroforestry or silvopastoral.
- **Annual:** Reporting cycles have not been reported. Annual reporting is an average reported by other countries.
- **2000:** The base year to start MRV calculations needs to be confirmed, so 2000 has been selected as a reasonable placeholder.
- **Projections:** Scenario analysis are for most policies.
- **Minimum mapping unit:** Needs to be confirmed.
- **Nesting:** Needs to be confirmed.
- **All management and all events:** The various policies require the full range of events and management effects on emissions and other indicators.
- **Approach 3:** Approach 3 is reported as the current approach. This might only be necessary if nesting is confirmed as a requirement.
- **Tier 1–3:** Tier 3 is the ambition for forests; Tier 1 is planned for all other land uses.

Proposed Approach

Since the political buy-in is limited, additional efforts will need to be invested to demonstrate the added value of an integration MRV system. The first iteration of a FLINT-based system could be a system based on public data that can demonstrate how policy questions can be answered.

Peru

Current System

The current MRV system reports AGB for forest land at Tier 2. All other land uses report AGB at Tier 1. Crops and grasslands also report BGB and soil carbon at Tier 1. The only REDD+ activities reported are deforestation and reforestation. Enteric fermentation, manure management, rice cultivation, agricultural soils, and burning of biomass are all reported at Tier 1.

The second BUR is being developed as well as FREL reports for FCPF, an updated NDC, an updated BAU scenario, and REDD+ reports (including degradation). This requires an MRV system that can harmonize various measuring and monitoring systems with the ability to nest projects in a national system. The system should be linked to a national registry of adaptation initiatives. The final step would be to link the system to the carbon footprint of companies and organizations.

Challenges

Institutional arrangements between the Ministry of Environment, Ministry of Agriculture, and the regional governments need to be formalized to ensure the generation of base information and reports.

Consolidate technical equipment at the national and regional levels, ensuring sufficient financial resources for

their permanence over time (sustainability). Duplication between systems could be reduced with better definition of functions.

Build capacity at all levels and transfer knowledge exchange between the national and regional levels.

Coordination among many actors, state and nonstate, directly involved in the MRV sector (for example, indigenous organizations seeking to implement community monitoring, REDD+ initiatives, research centers, and so on).

Key Policies and Objectives

- **Sustainable Agriculture Policy:** The MRV measures emissions reductions from changed agricultural and husbandry activities. The MRV also projects scenarios to identify the policies that reduce pressure on forests.
- **Policy to Control, Monitor, and Punish Illegal Forest Activities:** The MRV monitors illegal/informal activities driving deforestation and degradation. The system needs to have a link to monitoring, supervision, inspection, control, surveillance, and sanctioning systems.
- **Forest Management Policy:** The MRV monitors emissions and management at the project level or level of ownership. The MRV monitors biodiversity.

MRV Requirements

- **GHGi, biodiversity:** GHG inventory is the key capability, but links to biodiversity would be useful.
- **AFOLU:** The Sustainable Agriculture Policy requires a full AFOLU MRV system.
- **Annual:** The Sustainable Agriculture Policy requires annual reporting. If the MRV is required for early warning under the Policy to Control, Monitor, and Punish Illegal Forest Activities, then the reporting frequency will have to be higher depending on the contribution made by the MRV.
- **2000:** All policies have 2000 as the base year.
- **Projections:** Scenario analysis are necessary for all policies.
- **Minimum mapping unit:** Needs to be confirmed; it should be at least the size of the ownership of the forests. The national forest definition will probably require a finer mapping unit than ownership requirements.
- **Nesting:** REDD+ projects need to be nested into national accounts.
- **AFOLU management and events:** A range of AFOLU interventions and forest events need to be registered and calculated.
- **Approach 3:** Approach 3 is necessary to nest projects into national accounts.
- **Tier 1–3:** Tier 1 is proposed for some land uses or pools. Depending on the importance of the event, pool, or land use, Tier 3 might be required to get the necessary accuracy.

Proposed Approach

Running a FLINT-based system on a small area with good data will allow a better understanding of the MRV needs. Particularly in Peru, such a pilot would help clarify the different responsibilities of the institutions involved and provide a framework for the integration of the different contributions to the MRV system.

Uruguay

Current System

The Ministry of Agriculture is leading the MRV for the land sector in Uruguay. It reports to the Ministry of Environment, which consolidates all sectors. The MRV has been used to develop the national GHG inventory for the BUR and the national communication. The development of FREL/FRL is ongoing. The MRV is also used for intragovernment reporting.

The current MRV system only reports on AGB for forest at Tier 1 or 2 and Approach 1. Other pools and other lands are not reported. Soil is the priority pool that will be included next. The MRV reports estimation of carbon dioxide (CO₂) emissions and removals as well as methane (CH₄) and nitrous oxide (N₂O) emissions. Emissions from agriculture and livestock are more important than those from forests. Land use and land use change are mapped based on remote sensing, and national emissions factor are being developed. Automation of the estimation and reporting process is a priority.

Challenges

The development of consistent approaches to report all pools for all lands is a priority and a challenge. Soil organic carbon is particularly challenging.

Change detection in particular degradation is a challenge.

Budget constraints are limiting the speed of further development of the MRV system.

Key Policies and Objectives

- Climate-smart grassland and herd management: Project to incorporate good management practices of grasslands and livestock production in 1,000,000 hectares (10 percent of the grassland area): MRV is needed to estimate the emissions per unit of livestock, to estimate livestock productivity per unit of land, conserve natural pastures, ecosystem services, soil and biodiversity, and the amount of carbon sequestered in pastures.
- Zero Discharge Program: Use of zero discharge technologies to rivers and streams and/or application of good effluent treatment practices and/or recovery of nutrients and minimization of methane emissions in at least 40 percent of dairy establishments. The MRV will be used to estimate GHG emissions from manure management and if possible estimate the effect of discharge on water quality.
- Climate-smart agriculture: Implementation of direct sowing, with crop rotations for grain, cover crops, and rice production. The MRV will provide estimates of the potential reduction GHG and will monitor progress toward this goal.
- Forest protection: Maintain and regenerate 100 percent of the area of native forest (849,960 hectares) by 2025. Maintain 100 percent of plantation forest and 100 percent of silvopastoral lands. MRV will be used to project and monitor the reduced emissions.
- National Adaptation Plan for Climate Change in the agricultural sector: MRV could be useful to compare scenarios.
- Risk transfer instruments: Factor-based crop insurance: The MRV could be used as a basis for crop growth modeling.
- Peatland protection: The MRV will provide projects and monitoring of emissions reductions from improved peatland management.

MRV Requirements

- **GHGi, productivity, potential crop yield, biodiversity, ecosystem services:** A focus on GHG inventory for agriculture, but numerous additional indicators could be needed to inform policy development.
- **AFOLU:** Agriculture indicators are more important than forest-related indicators.
- **Biennial:** All policy require biennial updates.
- **2012:** The proposed base year is 2012.
- **Projections:** Scenario analysis would be useful but not essential.
- **0.5 hectare:** Minimum mapping unit is 0.5 hectare. This is currently being used, but it needs to be in line with the national definition of forests.
- **Nesting:** The discharge would have to be calculated by watershed before it can be aggregated at the national level. For other reports, nesting would be less important.
- **Management and events:** A range of agriculture and forest management regimes and events must be taken into account for the MRV system.
- **Approach 3:** Approach 3 is necessary to nest projects into national accounts.
- **Tier 1–3:** To achieve the necessary accuracy, careful balancing of accuracy and effort will determine at which tier each land use, management, and event can best be reported.

Proposed Approach

Considering that the current MRV system is still in its first stages of development, applying FLINT at the national level, using country-specific data to the extent it is available, is probably the best first iteration of a FLINT-based system. This will provide a clear structure and framework for further iterative development. Since Uruguay would like to invest its capacity in the development of country-specific modules for agriculture, FLINTpro might be a useful option to make fast progress.

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