2nd **Edition**
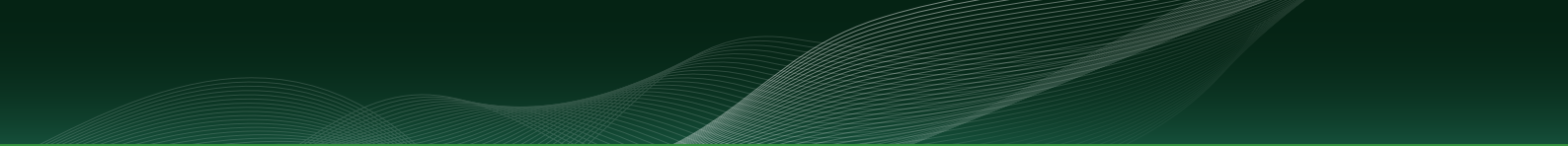
ADVANCING ON CAPACITY DEVELOPMENT FOR
NATIONAL GHG INVENTORY

Advancing on capacity development for National Inventory Systems in developing countries

An update on lessons learned in the CD-REDD project

With contributions from

Johannes Broetz, Corinna Brunschön, Ivana Dragna, Karsten Dunger, Sandro Federici, Esther Mertens, Till Neeff, Katja Oehmichen, Zoltán Somogyi

The CD-REDD Project Partners, Rome, November 2013

www.cdredd.org

Proceedings of CD-REDD

CD-REDD stands for Capacity Development for Reducing Emissions from Deforestation and Forest Degradation. The project is funded through the International Climate Initiative by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) on the basis of a decision adopted by the German Bundestag. Twelve rainforest countries were scoped in Latin America, Western, Southern, and Eastern Africa (Figure 1). CD-REDD aims to increase capacities for greenhouse gas reporting for the Land Use Change and Forestry (LUCF) and Agriculture sectors.

The range of countries covers a spectrum of technical capacity for GHG inventories, beginning with least-developed countries that had little capacity for monitoring GHG emissions and removals and ranges to countries whose technical capacities were closer to those of developed countries. This represents the full spectrum of developing countries that strive to reduce forest-related emissions and attract international mitigation funding.

The first phase of CD-REDD consisted of a series of global workshops in 2008. The success of these meetings and the strong belief in the approach of CD-REDD enabled the extension of the project into a second phase of which the proceedings are described here.

The project focused on coaching participating countries on a development path towards high-quality GHG inventory systems that would deliver transparent, accurate, consistent, comparable and complete information on GHG emissions and removals, in line with the UNFCCC reporting guidelines and the IPCC methodological guidance. With the
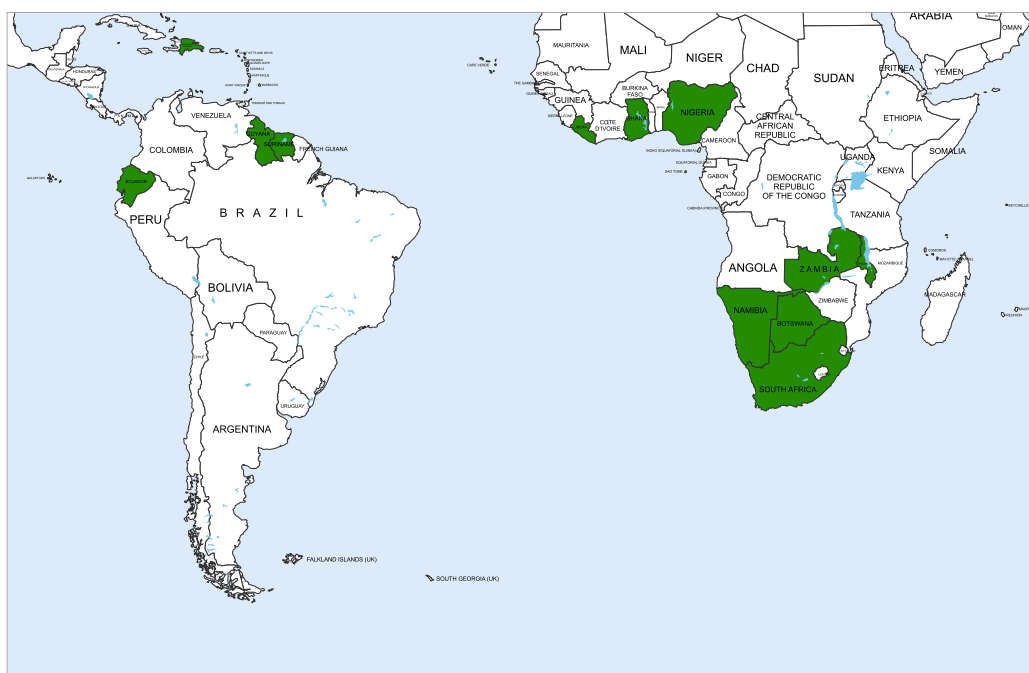
Figure 1
The 12 project countries: Botswana, Dominican Republic, Ecuador, Ghana, Guyana, Liberia, Malawi, Namibia, Nigeria, South Africa, Suriname, and Zambia.

The diagram shows circles with the following labels:

- Build a first GHG inventory then improve across the inventory cycle
- On-the-job training in-country and at workshops
- Align with UN-REDD, LECB, US-EPA and others
- Approach to CD for the national GHG inventory system
- Work with mandated GHG inventory teams
- Ensure buy-in from senior level
- Training on technical aspects and processes for the GHG inventory system
- Use a standard set of tools to choose from together with inventory teams
- Use available data, complement with international databases

objective that sustainable GHG inventories are useful for various sub-national, national and international purposes (reporting, decision making, information gathering).

To support the countries advancing on their capacity development trajectory, the project adopted a strategy (Figure 2) that focuses on building upon available data and resources to gradually building capacities on several fronts.
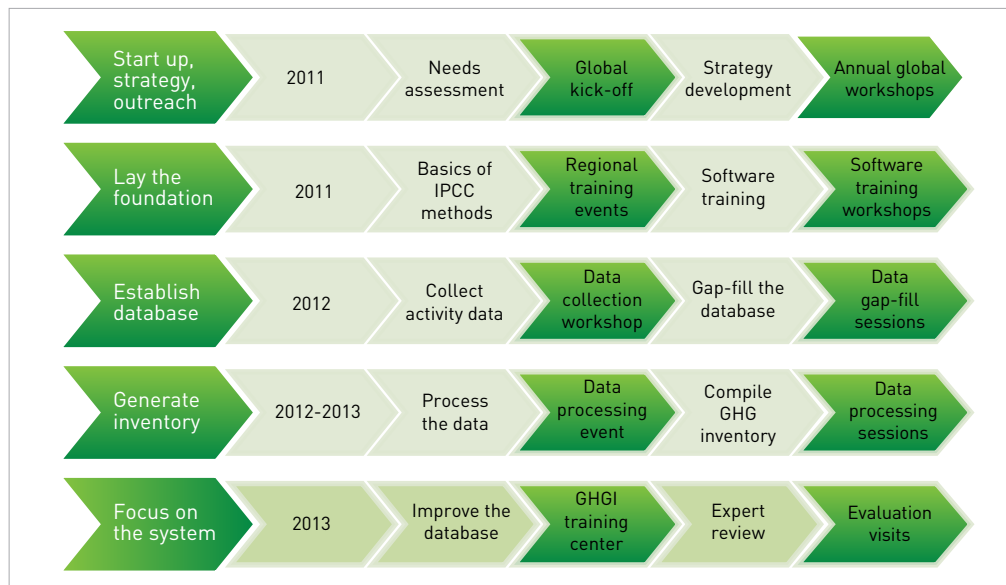
One major aspect of CD-REDD was to identify the people to form a national expert team responsible for the national GHG inventory. Ideally this team should proceed by t tworking on the GHG inventory in the future. The teams identified usually consist

of technically skilled experts from the lead institutions on climate change, forestry, agriculture, statistics and formerly existing GHG inventories.

In addition to necessary financial and institutional support, three key determinants set the environment for capacity building: the level of ambition by the countries, their teams and the set of tools to be used for the GHG inventory. During the CD-REDD Project, the pace of work was rather heterogeneous among the countries, due to country specific circumstances in terms of capacities and data availability.

Despite different targets of inventory quality in most countries a standardized set of

Start up, strategy, outreach	2011	Needs assessment	Global kick-off	Strategy development	Annual global workshops
Lay the foundation	2011	Basics of IPCC methods	Regional training events	Software training	Software training workshops
Establish database	2012	Collect activity data	Data collection workshop	Gap-fill the database	Data gap-fill sessions
Generate inventory	2012-2013	Process the data	Data processing event	Compile GHG inventory	Data processing sessions
Focus on the system	2013	Improve the database	GHGI training center	Expert review	Evaluation visits

tools has been used. The CD-REDD team developed a number of templates for the various components of GHG inventories. Also, several other templates were applied, including templates for the National Inventory System (NIS), which was originally developed within the US-EPA's National GHG Inventory Capacity Building Program[1], but widely modified and improved by the CD-REDD staff. In terms of software, some countries used the ALU GHG inventory software for GHG data calculations and others the official IPCC 2006 Inventory Software[2].

The chosen approach enabled the inventory teams to build a draft GHG inventory, which functions as a point of departure for further elaboration on the countries' process to improve their NIS. The project included a review of the developed GHG inventory through a team of international technical experts. The review provides the inventory teams with feedback on applied methodologies and data quality in the format of a review report with suggestions for possible improvements.

The project did not support collection of data; neither did it provide countries with resources for additional staff. In that regard it was different from other initiatives that work on similar issues, such as the support from the US-EPA and UN-REDD.

Much of the work during the workshops involved coaching and internal coordination oft the inventory teams. The project provided an environment where experts can learn by doing on how to compile a GHG inventory and run a sustainable NIS. To fully support the GHG inventory teams it was found useful to use a mixture of complementary measures. Global, regional, and national

---

1   www.epa.gov/climatechange/EPAactivities/international-partnerships/capacity-building.html last accessed in October 2013.
2   www.ipcc-nggip.iges.or.jp/software/index.html last accessed in October 2013.

The CD-REDD Project structure and collaborative partners

In response to calls from developing and developed countries to initiate and develop GHG inventory practices in rainforest nations, the Coalition for Rainforest Nations (CfRN) conceived of and designed the CD-REDD Project. The CD-REDD Project enjoys the support and funding of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) through its International Climate Initiative (ICI). Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH has been commissioned to implement the project jointly with the CfRN and the Thünen Institute (TI).

The project's first phase began as early as 2008 and was developed to its current form with a second phase in starting 2009. The CfRN takes the responsibility for the project activities in 7 project countries from Latin America and West Africa. The TI conducts activities with 5 countriesin Southern and Eastern Africa (See Figure 1 on page 4). Moreover CfRN is leading common activities for all project countries and on global level.

The CD-REDD team collaborates and coordinates several activities with partners working in the same environment of capacity building. A long-term collaboration was achieved in the region of the South African Development Community with a project by the Environmental Protection Agency of the United States (US-EPA). Another tight collaboration has been established with the FAO and the UN-REDD Programme. The FAO supported the CfRN-team of the CD-REDD project by providing logistical and administrative support.

meetings and workshops were organized alternately with remote support consistent with assigned tasks and explanatory tools like document templates, reads, etc. demonstrates an overview of project activities.

The context of country requirements for GHG inventory systems

The need for reliable GHG inventories under the UNFCCC

The signatory countries to the UNFCCC first introduced the concept of Measurement, Verification and Reporting (MRV) in 2007 at the thirteenth Conference of the Parties (COP13). They agreed to require "measurable, reportable and verifiable nationally appropriate mitigation commitments or actions".

The concept of MRV was also put forward at COP15 in Copenhagen where countries agreed that mitigation actions taken by Non-Annex I Parties will be subject to their domestic MRV of which the result will be reported through their national communications every two years. Also, the nationally appropriate mitigation actions (NAMAs) seeking international support will be subject to international MRV.

In 2010, at COP16 in Mexico, the Parties further decided that internationally supported mitigation actions will be verified domestically and will be subject to international MRV while domestically supported mitigation actions will be only verified in a domestic MRV. Developing countries also

agreed to enhance reporting in national communications (NC), including inventories on mitigation actions and their effects and support received. Countries further decided that REDD+ needs a national system for forest monitoring and reporting, as well as national forest reference emission levels and/or forest reference levels.

In 2011, at the COP17 in South Africa, the Parties agreed on guidelines for the preparation of biennial update reports (BUR) by Non-Annex I Parties as part of the enhanced action on mitigation by developing countries. According to the decisions the first BURs need to be submitted by December 2014 and every other year from there on. This general requirement applies to BURs of *non*-LDC (Least Development Countries) and *non*-SIDS (Small Island and Developing States). LDC and SIDS will have a higher degree of flexibility in submitting their BURs to the Secretariat of the UN Framework Convention on Climate Change (UNFCCC).

Non-Annex I Parties should provide an update of information on national circumstances and institutional arrangements relevant to the preparation of the

- national communications;
- national GHG inventories;
- mitigation actions and their effects, including associated methodologies and assumptions;
- constraints and gaps, and related financial, technical and capacity needs;

- the level of support received to enable the preparation of BUR; and
- Information on domestic MRV.

The information compiled in BURs will be subject to a process of International Consultation and Analysis (ICA) that is intended to support the reporting countries in their mitigation actions.

Following the agreement reached in Durban to develop a comprehensive set of guidelines for MRV of countries' emission reduction efforts, COP18 in Qatar decided to adopt voluntary domestic MRV guidelines by the end of 2014 to assist developing countries meet their reporting requirements domestically and internationally.

In summary, most developing countries are committed to establishing NIS that have the capability to produce GHG emission and removal estimates on an ongoing basis for BURs, NCs, feedback provided on political mitigation actions taken, and in support of national policies, academia and other stakeholders. Next to the national GHG data and their reference levels, these systems need to produce information on mitigation actions and financial and other support received. The NIS is the key instrument for the MRV of results-based mitigation funding under the NAMA and the REDD+ frameworks.

What is an Institutional Arrangements System for GHG inventories?
The National Inventory System (NIS) is a set of measures and agreements to deliver
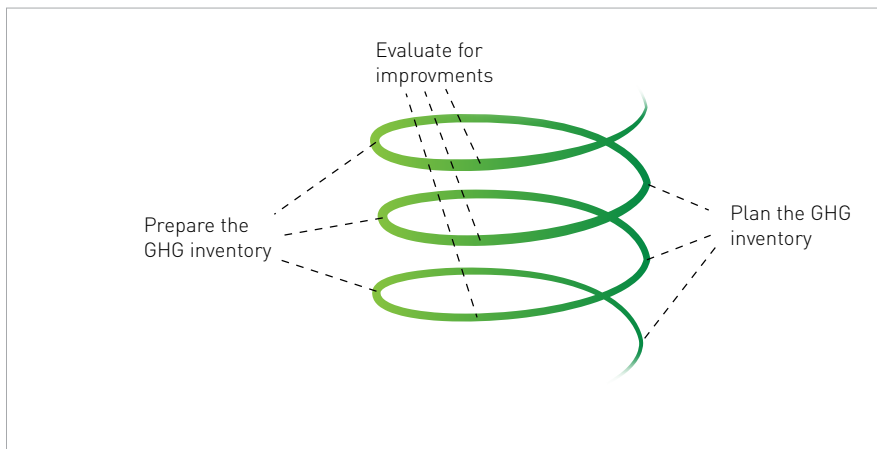
GHG information along an evolving cycle of planning, preparation, evaluation and continuous improvement (**Figure 4**). This complex system needs to ensure that the quality of output is high, continuously improves and, to fulfill this end, involves institutions and individuals that collect data and other information, process, report, and archive them.

Also key is that the NIS is managed strategically to integrate the inventories, and share information, with other policy processes such as mitigation planning that provide inputs to the process or use its outputs. The process of inventory generation should be thought of as a continuous cycle and iteration-by-iteration as an opportunity for its improvement.

General practical guidance on developing NIS is hard to come by due to diverse country-specific conditions and remains a matter that national governments need to design themselves. Some attempts have been undertaken to describe required technical specifications of GHG inventory systems but these are usually written for just one context and therefore remain incomprehensive or too general[3,4,5].

Notwithstanding, GHG inventories have a set of typical components. Along with practical requirements for inventory management, these components are defined by the IPCC methodological guidance[6] and the UNFCCC reporting requirements[7]. The components of the GHG inventory systems relate to the phase of the inventory cycle of planning, preparation, and evaluation.

The planning phase is based on the consideration of reporting requirements as well

3   GOFC-GOLD. (2010). A sourcebook of methods and proce-
    dures for monitoring and reporting anthropogenic green-
    house gas emissions and removals caused by deforestation,
    gains and losses of carbon stocks in forests remaining
    forests, and forestation (p. 209).
4   OECD. (2011). Towards Green Growth: Monitoring Progress
    (p. 144). OECD Publishing. doi:10.1787/9789264111356-en
5   UNEP. (2012). Measuring Reporting Verifying (p. 32).
6   *IPCC. (2006). 2006 IPCC Guidelines for National
    Greenhouse Gas Inventories.* Geneva, Switzerland: Inter-
    governmental Panel on Climate Change (IPCC).
7   UNFCCC. (2005). Decision 19/CMP.1. Guidelines for national
    systems under Article 5, paragraph 1, of the Kyoto Protocol.
    Bonn, Germany: United Nations Framework Convention on
    Climate Change (UNFCCC).

The components of the National Inventory System.

	PLANNING	PREPARATION	EVALUATION
INVENTORY IMPROVEMENT PLAN	Identify items to address		Include further items according to review
KEY CATEGORY ANALYSIS		Calculate the key category analysis	Use key categories for prioritizing improvement items
DATA COLLECTION AND PROCESSING	Inventorize available data, check methods	Collect data, process, generate reporting tables	Quality assurance (QA)/ quality control (QC)
DATA DOCUMENTATION AND ARCHIVING	Develop format and database	Document data and methods, archive data	QA/QC
UNCERTAINTY ANALYSIS	Design methods to reduce uncertainties in key categories	Carry out uncertainty analysis	Suggest improvements to reduce uncertainties
QA&QC / REVIEW		Ongoing quality control (QC)	Quality Assurance (QA) and external review to suggest improvements

as the necessary actions to meet these requirements. The planning phase also needs to closely consider the results of previous iterations along with the items included in the inventory improvement plan. The inventory improvement plan is a structured and prioritized list of activities to further develop procedures for estimating emissions and removals. When allocating resources, the results of the key category analysis and uncertainty estimation should be especially considered.

In preparing the GHG estimates themselves, it is essential to closely document all data sources and methodologies applied. On an ongoing basis a quality assurance and uncertainty analysis needs to be carried out. All data need to be archived.

During the final phase it is necessary to apply an effective evaluation process in order that the system can be improved in the subsequent cycles. This evaluation should not only be based on an internal effort, but alsot on a detailed process of external quality assurance that includes a review by international experts depending on the context. Cooperation between institutions in charge of the GHG inventories in

different countries could offer a solution with additional benefits (South-Stouth cooperation). A further dimension of evaluating inventory results may come in the form of feedback from the policy arena, where estimates over time are a basis for the identification of emissions trends and inputs to a mitigation analysis to underlie policy recommendations.

Building high-quality GHG inventory systems is as important as it is challenging
The NIS, in its objectives and its functions, is related to several international and national processes around climate change mitigation and sustainable development policies. In addition, much international discussion is ongoing to define the various scopes of systems for MRV of REDD+[8]. There is a need that MRV processes comply with appropriate monitoring systems to underpin green growth strategies[9], with further reporting requirements under the UNFCCC beyond the NCs and with tracking the impacts of mitigation activities[10]. The overlapping and developing policy contexts of GHG inventories make coherence hard to achieve therefore the coordination efforts of initiatives such as the project are all the more important.

There are three key requirements for running NIS in the sectors of Agriculture and Land Use Change and Forestry and tracking emissions and removals along with the countries' economic development. First, as already stated, there are reporting commitments in the context of the national communications to the UNFCCC. Second, high-quality information on the nature of the countries' economies GHG emissions and the countries' capacity to store and curve emissions should be an important input for national mitigation and development planning. Lastly, there is also a need to set up national approaches for MRV to participate in results-based climate change funding under the emerging international mechanisms such as those for NAMAs and REDD+.

Noteworthy but less esential requirements are also connected to a raising demand of academia and other national stakeholders to get reliable and country-specific estimations of GHG fluxes.

With the several contexts in which information on GHG fluxes are relevant, the NIS is a cross-cutting issue. While high-quality GHG inventories are necessary and useful on several accounts, technical and institutional issues severely constrain many countries' ability to pull together and process the necessary data inventory requirements and the processes involving GHGs, especially in the Agriculture and LUCF sectors, where processes are highly complex. Tasked by the UNFCCC, the IPCC has put together useful guidance for GHG inventories. The resulting IPCC methodological guidelines on National GHG Inventories expect a certain level of technical expertise, which in some cases

---

8   UNFCCC COP 16 (2010).
9   UNEP (2011). Towards a green economy.
10   UNFCCC COP 17 (2011).

Figure 6
Importance and challenges for National Inventory Systems.

makes it complex for compilers to correctly make use of them (Figure 6).

Inventory requirements and the processes involving GHGs, especially in the Agriculture and LUCF sectors, are highly complex. Tasked by the UNFCCC, the IPCC has put together useful guidance for GHG inventories. The resulting IPCC methodological guidelines on National GHG Inventories demand a certain level of technical expertise, which in some cases makes it complex for compilers to correctly make use of them.

Although the technical recommendations by the IPCC accommodates different levels of methodological complexity and data quality in a three-tier approach, in many developing countries basic input data for national GHG inventories are either unavailable or unreliable because appropriate data collecting and data handling procedures are not in place, and the necessary institutional setup for dealing with the above technical challenge is unavailable. Establishing such an institutional setup represents an fundamental step

in developing capacities. Moreover, there are limited resources for building the necessary technical capacities. Data providing arrangements are often missing; inventory teams are often put together ad hoc and are temporary, or are comprised of external consultants; the whole process of creating a National GHG Inventory is project rather than process based. This makes the efforts of CD-REDD at developing an appropriate and sustainable NIS in the various institutions in-country especially important – particularly in the complex field of emissions and removals in the sectors of Agriculture and LUCF.

The technical issues around the complexity of inventory requirements, data availability and reliability as well as the shortcomings of institutional set-ups put at risk the objectives and uses of national GHG inventories. First, the limited quality of the GHG inventories contained in the NC' damages the reputation of the international community's response to climate change. Second, without reliable and timely information on GHG emissions and removal trends, nation-

al policy makers lack an important input to development and mitigation planning and are forced to take sub-optimal decisions based on questionable assumptions that replace factual evidence. The argument of decisions taken based on a weak information also applies to national and international stakeholders, who are using the GHG flux data produced by the countries. Lastly, with a view towards REDD+ or NAMA arrangements, limited technical quality of GHG inventories could constrain the ability of countries to attract results-based mitigation funding.

Assessing the National Inventory Systems: the GHG inventory score card

The UNFCCC and the IPCC have defined 5 principles to guide countries in developing National Inventory Systems (NIS): they are to be set up to deliver GHG inventories that are transparent, consistent, accurate, comparable and complete[3],[11]. Beyond these, two further criteria are suggested to be considered to comprehensively assess a NIS: the institutional arrangements and the approach to inventory management.

Institutional arrangements are a precondition to generate an appropriate GHG inventory. In several countries, NCs included inventory information, but they were rather preliminary due to the lack of a NIS. However, institutional arrangements also

need to be built to allow for the continuity of activities and capacities, and continuous improvement of GHG inventories. For significant improvements to the institutional set-up, high-level political support is required. In some countries, the project could rely on an established working relationship with such high-level decision makers. Inventory management is also a strategic approach that should provide for the continuous improvement of the inventories and a connection to other uses of GHG data beyond the national communications.

Concerning the inventory criteria by the IPCC, it is important that countries strive for high-levels of transparency in their NIS. Therefore the documentation and archiving of data is an important part of the foundation of institutional set-ups for GHG inventories in the countries. Moreover, the NIS needs to be built to achieve a high level of accuracy for GHG emission and removal estimates applying the methodology of the IPCC guidelines. During the project runtime, a handful initiatives introduced projects in several countries to develop consistent land use / land cover maps, thus the necessity of a sound and accurate base of data has been understood. Depending on the use of data, the GHG inventory's completeness of emissions and removals is important. The project provided countries with experience to improve completeness of the inventory in terms of spatial disaggregation, land use classes, detail of time series, etc.

11 UNFCCC. (2005). Decision 19/CMP.1. Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol. Bonn, Germany: United Nations Framework Convention on Climate Change (UNFCCC).

The CD-REDD approach of assessing the work done was developed using similar ideas of assessing the enabling environment for NIS and the quality of established GHG inventories. Some of the ideas were influenced by the assessment carried out in other contexts, e.g., the US-EPA's Inventory Project Progress Indicator[12], work carried out between CD-REDD and the UN-REDD[13], and by Wageningen University[14] and CIFOR15.

The developed assessment method, the score card, assesses NIS according to the IPCC's five criteria of technical quality (transparent, consistent, accurate, comparable and complete) and the two additional criteria (relating to institutional and management aspects) identified by CD-REDD. For each criterion several indicators were applied (Figure 7) and the project team of GHG inventory experts assessed these indicators using a "yes/no" or "low/medium/high" scoring on whether or not or to which extent they were fulfilled. With a set of fixed indicators for each criterion, a score of 0-100% was calculated to estimate

to what extent the GHG inventory addresses the criterion at hand. The individual scores can also be combined to calculate an overall score for an NIS, which is an un-weighted average of the scores of the seven criteria.

To track the progress of work in the countries, the quality of consecutive GHG inventories has been measured with the same score card. The score for the GHG

12 US-EPA. (n.d.). The Inventory Project Progress Indicator. Washington, DC, USA: The United States Environmental Protection Agency (US-EPA).
13 Tulyasuwan, N., Henry, M., Secrieru, M., Jonckheere, I., & Federici, S. (2012). Issues and challenges for the national system for greenhouse gas inventory in the context of REDD+. *Greenhouse Gas Measurement and Management*, (November 2012), 37–41.
14 Romijn, E., Herold, M., Kooistra, L., Murdiyarso, D., & Verchot, L. (2012). Assessing capacities of non-Annex I countries for national forest monitoring in the context of REDD+. *Environmental Science & Policy*, *19-20*, 33–48.
15 Mora, B., Herold, M., Sy, V. De, Wijaya, A., Verchot, L., & Penman, J. (2012). *Capacity development in national forest monitoring* (p. 115). Bogor, Indonesia: CIFOR.

Figure 7
Overview of criteria and indicators in the GHG inventory scorecard.

Institutional arrangements
Definition of lead and support institutions
Support from academia and other institutions
Dedicated inventory budget
Role definition within inventory team

Inventory management
Definition of lead and support institutions
Support from academia and other institutions
Dedicated inventory budget
Role definition within inventory team

Transparency
Quality control
Quality assurance
Documentation of data and methodology
National inventory report

Accuracy
Separating managed and unmanaged lands
Tier levels and emission factors
Land representation
Soil and climate stratification
Uncertainty analysis

Completeness
Emission and removal categories
Land use subcategories
Livestock
Soil organic carbon
Disturbances

Consistency and Comparability
Inventory database for several time points
The use of the IPCC guidelines

inventory from the last NCs was calculated as a reference. If the NCs were not available, information was taken from other national sources. Considering the benchmarking of indicators was considered to be valuable for the countries' inventory teams. Based on this feedback on the work deon was also possible. Moreover, the score card can provide the teams with a checklist to make sure they considered important issues for an inventory which helps identify possible improvements.

It is clear that the approach needs to evolve and provides only general assessment on the progress of work in the countries from an expert's point of view. Possible improvements of the method used include reconsideration and refinement of the indicators.

Beyond such technical aspects, the system clearly has the advantage to easily and quickly provide useful information on tracking progress against targets to allow for directing future efforts.

Progress status of countries

According to the most recent estimate, countries have progressed verifiably through the support of the CD-REDD Project compared to past GHG inventories. On average the project inventories reached an average fulfillment of the criteria of 60%, which is a notable progress, compared to the inventories from last NCs (average 31% fulfillment of criteria).

Disaggregating GHG inventory progresses and the status of the inventories by countries at the end of the project shows that there is considerable diversity: Some countries start out at a fairly basic level of 10% while other countries started from a higher level (Figure 8). From that figure it can be assumed that the CD-REDD approach applied can be adapted to the specific country circumstances to reach effective results based on the capacity building measures.
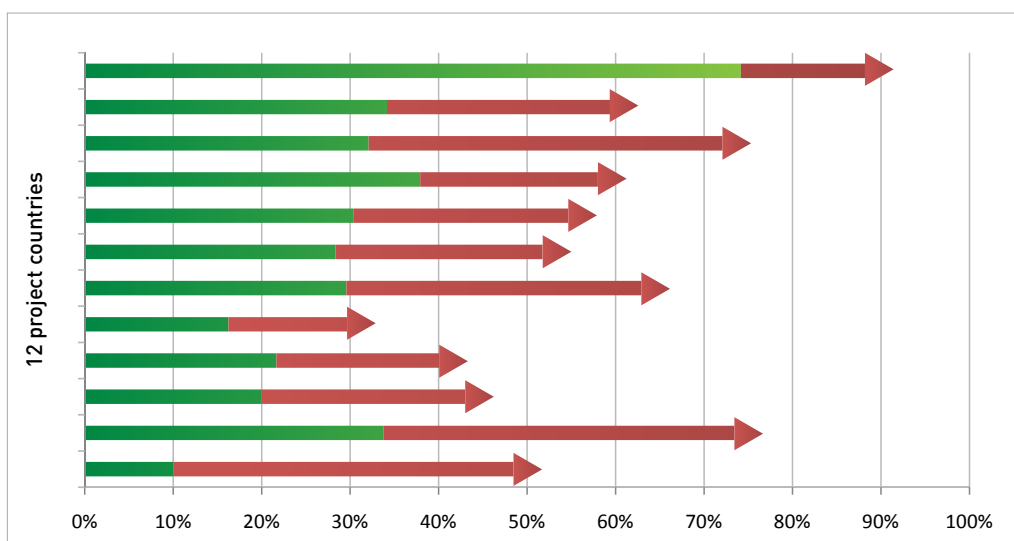
Figure 8
Improvement of 12 project countries' inventories based on reference inventories from last national communications before the project. Green color shows the inventories fulfillment of criteria before the project, whereas an arrow indicates an improvement by the end of the project.

As per the above, countries improved their inventories by around 30% between the last NC and the recent inventory prepared under CD-REDD. Even if ongoing capacity-building could deliver further significant improvement of NIS, project countries would probably still need several years before reaching higher levels of GHG inventories. Keeping in mind the phases of an inventory cycle, the time needed for the countries is depending upon the actual data collection of activity data (e.g. land representation) and emission factors (e.g. by the use of national forest/ biomass inventory). Furthermore, there are many preconditions of a high level NIS that CD-REDD's capacity building efforts cannot address, and are subject to countries' efforts to establish.

The approach applied to build capacity for NIS focuses on coaching the inventory teams and working with the data already available, providing technical advice and analytical tools, but also placing the GHG inventories high on the relevant priority lists. With such backstopping, inventory teams can increase the coverage of data and improve the quality and completeness of documentation. The

training has also led to more structured work within the inventory teams. In summary, that approach can effectively address some of the criteria needed to be fulfilled for good or high level inventories, i.e. the criteria of accuracy and inventory management (Figure 9).

Most potential for improvements remains regarding institutional arrangements for NIS. Addressing this issue the project also introduced and gives support to start the process of setting up the institutional arrangements. To have effective an NIS in place, it is necessary that the administrations complement these efforts by investing in improving the institutional dimension of GHG inventories and providing the inventory teams with an appropriate institutional framework including necessary resources.

It thus becomes apparent that further support is still needed to address the remaining issues of the current NIS in the project countries. In most of the countries spatial information on land use and land use changes are lacking, which is one of the key sets of information for conducting a GHG inventory. Often also sets of information on

Figure 9
Status of GHG inventory systems prior to the project and their improvements in 12 countries according to the GHG inventory scorecard.

16
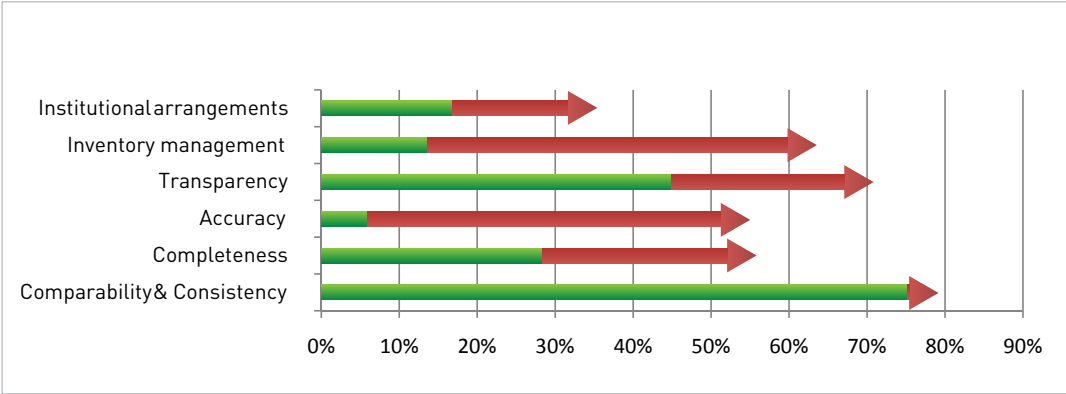
forest were not available or detailed information was missing, because no national forest/biomass inventory is established. Therefore it is important to provide countries with resources for building missing elements of their NIS, collecting missing data and building consistent databases to improve the accuracy and consistency of GHG inventories. In prioritizing efforts, countries should duly consider the results of the key category analysis of the GHG inventories to achieve most improvements in areas with the highest emissions and/or emission reduction potentials.

Lessons learned and success factors for capacity development

During the project, capacity for setting up NIS' and report on GHG inventories was successfully built. Some factors of success can be outlined. Also a strong need to secure further support of the countries was identified.

Inventory team composition
Talking to the people responsible for the GHG inventories at the technical level (including data collection) but also at the policy level in the countries is crucial to maintain sustainability in the institutions and thus within the institutional memory of the countries. Inventory teams should include data providers and compilers, who usually belong to a variety of institutions (academia and ministries in the field of agriculture, forestry, land management and statistics and institutions responsible for

the GHG inventory). This set-up allows a combination of staff knowledge, experiences of data collection, and skills to process the data (both in preprocessing spreadsheets and the tools used). This becomes especially true in environments where data are available and their delivery relies on informal requests and ad-hoc communication in various institutions.

The capacity gaps in GHG inventory teams are, among other things, connected to a general lack of resources for staff in government institutions. The members of GHG inventory teams work with modest salaries, have a high workload and have insufficient access to training and professional development. All of these factors create high turnover in GHG inventory teams, which constitute a risk factor for capacity building. On several occasions staff that had enjoyed training through the project decided to move on and leave the GHG inventory teams. In order to minimize a risk of unsustainably building capacities, the project aimed to target not only technical capacities of individuals, but also the processes within the institutions that run the GHG inventory system.

Capacity development approach and environment
Striving for and implementing a concept structured in global, regional and national meetings and workshops was considered useful and successful. Besides this general approach for effective capacity building at the policy and technical level by diversified

training measures and settings it is important to adapt to country specific needs and circumstances as far as possible.

The project facilitated global meetings to focus on strategic improvements and coordination, informing policy makers in the country about the broad picture and the necessity of a sustainable NIS. A certain level of support from the policy context was needed to successfully meet the project's goals. The goodwill and ownership at the political level drives the needed continuous support to facilitate a smooth project implementation and improvement of in-country capacities.

Regional meetings provided an environment for exchange between countries. Such meetings combined the capacity development measures at the national level with a focus on work on available data, software use and report writing with the countries' inventory teams and also delivered tangible results for the improvement of the GHG inventories.

Furthermore the concept of in-country consultation about country specific data issues and organizing meetings with the experts in the respective ministries and agencies was useful to make a wider range of expert knowledge available in the countries to overcome data shortcomings.

Cooperation

The collaboration with numerous international agencies, institutions and initiatives were a valuable contribution to the results of the project. These agencies included the US-EPA's National GHG Inventory Capacity Building Programme, the UN-REDD Programme under UNEP/UNDP/FAO, the Mitigation of Climate Change in Agriculture Programme (MICCA) under FAO, the Low Emissions Capacity Development Programme (LECB) under UNDP, the Secretariat of the UNFCCC, the Natural Resource Ecology Laboratory and Department of Ecosystem Science and Sustainability of the Colorado State University, SilvaCarbon, etc. The degree of collaboration ranged from regular communication to organizing activities together to actual development of common strategies to tackle the tasks of CD-REDD and other projects on the ground.

Conclusions

High-quality NIS in developing countries are essential for an appropriate response to climate change, comprehensive national development planning, and access to international mitigation funding. Countries not only need a NIS in place to fulfill international reporting obligations but also to ensure reliable national mitigation policy, particularly if designed to attract international results-based mitigation funding.

Currently, many developing countries are preparing to accurately account for GHG emissions and removals in all sectors (but particularly in AFOLU or Agriculture and LUCF) and their changes as results of mitigation actions. Countries would need to advance still much further before being able

to participate in a full-fledged accounting system for GHG reductions under currently discussed REDD+ financing arrangements. To create an inclusive and effective mechanism, the international community needs to recognize that most countries where REDD+ activities could be carried out are far from being able to put in place high-quality GHG monitoring systems.

Putting in place and running high-quality NIS is highly demanding and affects many levels of administration; effective capacity development therefore also needs to focus on institutional arrangements and inventory management aspects as well as on data collection. How demanding it is to run a NIS in developing countries on several accounts became clear while working with the countries' inventory teams. It is therefore unsurprising that even for developed countries much room remains for improving their NIS. The score card helped to depict the main challenges and identify the areas to work on to improve the GHG inventory systems, which includes institutional and management aspects together with issues more directly related to data collection, processing and documentation.

Capacity building by international support delivers tangible results and can significantly develop countries' capacities for creating and maintaining NIS. The advances of the project countries show that countries can significantly develop their capabilities within a short time frame if they receive continuous, country specific support and a clear guidance. It should also be noted that in-country support from the relevant political institutions dealing with climate change and data collection for an inventory in the country is an indispensable prerequisite.

To assist countries in effectively advancing on capacity development towards high-quality NIS, different kinds of support need to go hand-in-hand, such as coaching the inventory teams and providing resources for building databases and supporting to establish an appropriate institutional set-up. Efforts in countries need to be stepped up and transparent, accurate, consistent, comparable and complete GHG inventories can only be developed if countries receive support on bolstering the data they have available on land use mapping and vegetation inventories. A more 'data-focused' approach should, however, go together with continued coaching for reporting of the countries' inventory teams and building of their institutional capacities.

The design of systems for results-based mitigation funding such as REDD+ needs to recognize just how difficult it is to establish NIS and needs to allow for differentiated conditions in countries with very different levels of capacities. The breakdown of REDD+ in several phases with an increasing stringency of commitments and their monitoring and accounting against targets and a step-wise approach to fulfill MRV requirements goes a long way in this direction.
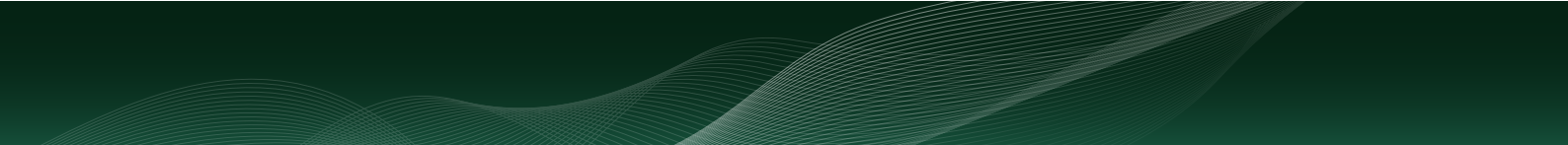
ABBREVIATIONS

AFOLU Agriculture, Forestry and Other Land Use sector in the IPCC 2006 Guidelines

BMU German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

BUR Biennial Update Report under the UNFCCC

CfRN Coalition for Rainforest Nations

CIFOR Center for International Forestry Research

COP Conference of the Parties under the UNFCCC

FAO United Nations Food and Agricultural Organisation

GHG Greenhouse Gas

GIZ Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH

NIS National Inventory System

ICA International Consultation and Analysis – verification process for BUR under the UNFCCC

ICI International Climate Initiative under the BMU

IPCC Intergovernmental Panel on Climate Change

LDC Least Developed Country

LECB Low Emissions Capacity Building programme under the UNDP

LUCF Land Use Change and Forestry Sector in the IPCC 1996 Guidelines

MICCA	Mitigation of Climate Change in Agriculture project under the FAO	**SIDS**	Small Island Development States
MRV	Measurement, Reporting and Verification	**TI**	Thünen Institute
NAMA	National Appropriate Mitigation Action	**UNDP**	United Nations Development Programme
NC	National Communication under the UNFCCC	**UNEP**	United Nations Environmental Programme
QA/QC	Quality Assurance / Quality Control	**UNFCCC**	United Nations Framework Convention on Climate Change
REDD+	Reducing Emissions from Deforestation and forest Degradation including conservation and sustainable management of forests and the enhancement of forest carbon stocks	**UN-REDD**	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
		US-EPA	United States Environmental Protection Agency

National Inventory Systems of developing countries need to produce high-quality emission estimates for the international community but also input for national mitigation and development planning. They are essential for countries to participate in results-based mitigation funding under the **REDD+** scheme. However, the quality of these systems does not yet meet the highly complex international expectations in many developing countries where the necessary capacities are currently developing.

The **CD-REDD** Project aims at providing capacity building for inventory teams in 12 project countries. The national inventory teams are coached to develop transparent, accurate, consistent, comparable and complete **GHG inventory systems** that are strategically managed and embedded in a solid institutional setup.