SalvaTerra

Report of the training on forest-related GHGs inventory
Comments on the setting of the National Forest Monitoring System (NFMS)

June 2019

IFAD

Integrated Carbon Sequestration Project

Summary

Acronyms

AD	Activity Data
AFOLU	Agriculture, Forestry, and Other Land Use
AGB	Above Ground Biomass
API	Application Programming Interface
BCEF	Biomass Conversion and Expansion Factor
BGB	Below Ground Biomass
BIRDP	Butana Integrated Rural Development Project
BUR	Biennial Update Report
C	Carbon
CF	Carbon Fraction
CO_2	Carbon Dioxide
COP	Conference of the Parties to the UNFCCC
CV	Coefficient of Variation
DBH	Diameter at Breast Height
DMU	Data Management Unit
EF	Emission Factor
FAO	Food and Agriculture Organization (United Nations)
FCPF	Forest Carbon Partnership Facility (World Bank)

FRA	Forest Resources Assessment
FR(E)L	Forest Reference (Emission) Level
GEF	Global environment Fund
GFOI	Global Forest Observation Initiative
GHG	Greenhouse Gas
GIS	Geographic Information System
GOFC-GOLD	Global Observation of Forest Cover - Global Observation of Land Dynamics
GPG	Good Practice Guidance
HCENR	Higher Council for Environment and Natural Resources
ICA	International Consultation and Analysis
ICSPS	Integrated Carbon Sequestration Project in Sudan
IFAD	International Fund for Agriculture Development
IFFN	International Forest Fire News
IPCC	Intergovernmental Panel of experts on Climate Change
JRC	Joint Research Centre (European Commission)
KP	Kyoto Protocol
LANDSAT	Land Satellite (US satellite series)
LoA	Letter of Agreement
LULUCF	Land Use, Land Use Change, and Forestry
MRV	Measuring, Reporting and Verification
NC	National Communication
NCCD	National Coordinating Committee for Desertification
NFI	National Forest Inventory
NFMS	National Forest Monitoring System
NGGI	National GHG Inventory
QA/QC	Quality Assessment / Quality Control
R	Root-to-Shoot ratio
REDD+	Reducing Emissions from Deforestation and forest Degradation; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
RMU	REDD+ Sudan Management Unit
RSSA	Remote Sensing and Seismology Authority
SBSTA	Subsidiary Body for Scientific and Technological Advice to the UNFCCC
SLMS	Satellite Land Monitoring System
SU	Sample Unit
TAC	Technical multi-sector Advisory Committee (to REDD+ Sudan)
TWG	Technical Working Group
UNFCCC	United Nations Framework Convention on Climate Change
VHR	Very High Resolution

List of figures

Introduction

Late 2018, the Integrated Carbon Sequestration Project in Sudan (ICSPS), financed by the International Fund for Agriculture Development (IFAD) and the Global environment Fund (GEF), requested a support to (i) organise and facilitate a 2-day training on forest-related Greenhouse Gases (GHG), and (ii) design a roadmap for the Measuring, Reporting and Verification (MRV) of REDD+ activities (Reducing Emissions from Deforestation and forest Degradation; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries).

The objectives for the first item were described in specific terms of references (ICSPS, 2018)[1], while the objectives of the second item were discussed over the phone at mid-December 2018 with the Project Management Unit of the ICSPS.

Considering the existence of a comprehensive action plan for the development of the MRV of REDD+, supported by the FAO (FAO, 2016)[2] (FAO, 2018)[3], as well as relevant elements produced through this technical assistance, such as a study on "*Institutional arrangement and gap analysis for the MRV of REDD+*" (Roberts and Osman, 2017)[4], it was logically agreed in the course of the in-country mission that the consultant should rather analyse the progress made so far in implementing the existing action plan.

The 2-day training was organised on the 2nd and 3rd of April 2019 in Khartoum and the consultant worked on the second item from the 4th to the 11th of April 2019. It is important noting that Khartoum saw significant protests as of Friday, the 5th of April 2019, which limited opportunities for meeting with local actors, as many institutions were closed and movements in town were not recommended.

However, the consultant was able to meet with some local actors (see List in **Annex 1**) and to collect additional documents in Khartoum (see Bibliography in **Annex 2**). After the field mission, he also communicated with various REDD+ experts: Jenny Wong from the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC); Giacomo Grassi, researcher at the Joint Research Centre (JRC) of the European Commission; Sandro Federici, Advisor to the Coalition of Rainforest Nation (CRfN).

The present report therefore includes a report on the training on forest-related GHG inventory (**Part 1**); an analysis of the progress made so far to set up the National Forest Monitoring System (NFMS): defining the related institutional arrangements (**Part 2.1**); elaborating multi-date maps of Land Use, Land Use Change, and Forestry (LULUCF) (**Part 2.2**); carrying out a National Forest Inventory (NFI) (**Part 2.3**); reporting GHGs emissions/removals from the LULUCF sector (**Part 2.4**).

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[1] ICSPS, 2018. *Consultancy on Conducting Training in Carbon Inventory, GHG Accounting and MRV*. Khartoum – ICSPS, November 2018. 5p

[2] FAO, 2016. *Agreement between the Republic of the Sudan and the Food and Agriculture Organization of the United Nations (FAO) for the provision of technical assistance for the implementation of support for the design of the MRV system in the framework of REDD+ readiness in the Sudan (UTF/SUD/079/SUD)*. Roma – FAO, August 2016. 63p

[3] FAO, 2018. *Amendment number 1 to the Agreement between the Republic of the Sudan and the Food and Agriculture Organization of the United Nations (FAO) for the provision of technical assistance for the implementation of support for the design of the MRV system in the framework of REDD+ readiness in the Sudan (UTF/SUD/079/SUD)*. Roma – FAO, January 2018. 35p

[4] Roberts, G., & Osman, M., 2017, *Support for the design of the MRV system in the framework of REDD+ Readiness in the Sudan - Institutional arrangement and gap analysis*. Khartoum – FNC / REDD+ Sudan, July 2017. 45p

1. Report of the training on forest-related GHGs inventory

1.1. Attendance, agenda and content

The 2-day training took place at the Corinthian Hotel, in Khartoum, the 2nd and 3rd of April 2019. It was attended by 20 participants (see list of attendance in **Annex 3**), 7 men and 13 women, mostly from the FNC: 4 for the ICSPS, 2 for the REDD+ Sudan, 4 attending the climate negotiations as part to the Sudanese Delegation, 4 in charge of the NFI, 2 in charge of the national GHGs inventory, 3 from other Departments/Units of the FNC. There were also 2 participants external to the FNC: 1 from the Faculty of Forestry of the University of Khartoum and 1 from the Butana Integrated Rural Development Project (BIRDP), an IFAD-funded project.

After an introduction by the ICSPS Coordinator, participants presented themselves and expressed their expectations regarding the training. Then, the consultant presented the objectives and agenda of the training.

After that, 7 presentations were made by the consultant, basis for exchanges and questions/answers, and focusing on the following (NB: all the presentations are compiled in a separate training manual, also submitted to the ICSPS):

#1 CONTEXT – United Nations Framework Convention on Climate Change (UNFCCC) context and requirements, and introduction to the Intergovernmental Panel of experts on Climate Change (IPCC) 2003 Good Practice Guidance (GPG) and 2006 Guidelines;

#**2 MONITORING OF LAND USE CHANGE** - Monitoring Activity Data (AD) for forest-related Land Use Change (LUC);

#3 MONITORING OF DEGRADATION - Monitoring Activity Data (AD) for forests remaining forests;

#4 ESTIMATING EMISSION FACTORS - Estimating Emission Factors (EFs) for Land Use, Land Use Change, and Forestry (LULUCF) activities;

#5 ESTIMATING GHG - UNFCCC context & requirements, and IPCC recommendations;

#**6 ESTIMATING UNCERTAINTIES** - Identifying and minimizing uncertainties (lack of precision and/or accuracy);

#7 REPORTING OF GHG - Reporting LULUCF performance using IPCC 2003 GPG and IPCC 2006 Guidelines.

1.2. Level of understanding of the participants

At day 1 and 2, before lunch break and before the closing of the day, participants have been invited to fill multiple choice quizzes, to assess their level of understanding. The quizzes are presented in **Annex 4** and here below are the results:

		Mean	Q1	Q2	Q3	Q4	Q6	Q7
1	Ahmed Hassan Rehab		8	4	9	9	6	7
2	Taghreed Ali Elsiddiq		7	6	5	5	7	3
3	Fathi Ismail Omer		7	7	9	8	6	8
4	Salah Yousif Mohamed		6	9	7	8	5	6
5	Mashair Ahmed Eltigani		10	8	8	10	8	6
6	Sawsan Abdalla Ali		9	8	7	7	5	7
7	Salah Ahmed Elmahyaa		8	8	5	5	6	3
8	Israa Salah Ahmed		7	6	7	8	8	8
9	Manal Awad Khairy		9	10	8	8	5	8
10	Massaud Mohamed		9	7	5	6		6
11	Khalda Abass Hassan		9	6	5	7	6	7
12	Bakri Mahmoud Hineit		7	5	6	6	6	7
13	Marwah Ali Aldaw		6	5	4	6	4	5
14	Mohamed Ahmed Omer		6	6	8	7	5	7
15	Suhair Mohamed Musa		7	8	7	8	3	2
16	Saffa Ahmed Berima		9	8	6	8	9	7
17	Nagla Mahgoub Mohamadin		7	6	7	8	8	9
18	Samia Bakhiet Mando		9	9	7	8	7	7
19	Sumia Omer Abdon		9	6	6	9	8	7
20	Adil Ahmed Siliman		6	8	7	5	6	6
21	Hanady Ibrahim		9	8	9	9	8	9
	Mean	**7,0**	**7,8**	**7,0**	**6,8**	**7,4**	**6,3**	**6,4**
	Max	**8,7**	**10**	**10**	**9**	**10**	**9**	**9**
	Min	**5,0**	**6**	**4**	**4**	**5**	**3**	**2**
	CV (=Standard Dev. / Mean)	**14%**	**17%**	**22%**	**21%**	**19%**	**25%**	**29%**

Figure 1 - Results to the training quizzes (author, 2019)

The main conclusions that can be drawn are the following:

- Overall, the results are good: the overall mean for all participants is 87/10. This means that most of the knowledge from presentations and exchanges has been integrated.
- The results are homogeneous between participants: the minimum mean per participant is 5/10 and the maximum is 8.7/10, and the coefficient of variation (CV = ratio of the standard deviation to the mean, expressed in %) is very low and equal to 14%. This means that no participant was left "on the side of the road" during the training.
- The results are homogeneous across topics: the minimum mean per topic is 6.3/10 and the maximum is 7.8/10, and the coefficients of variation are moderate, ranging from 17% to 30%. This means that, *a priori*, all the topics treated have been well understood.

1.3. Level of satisfaction of the participants

Before closing the training, the participants were invited to anonymously express their opinion on the interest of the topics addressed during the training and to classify them on a scale of 5 to 1 as follows: 5 = Indispensable; 4 = Very useful; 3 = Moderately useful; 2 = Not very useful; 1 = Not useful. The opinions are generally very good, as shown below:

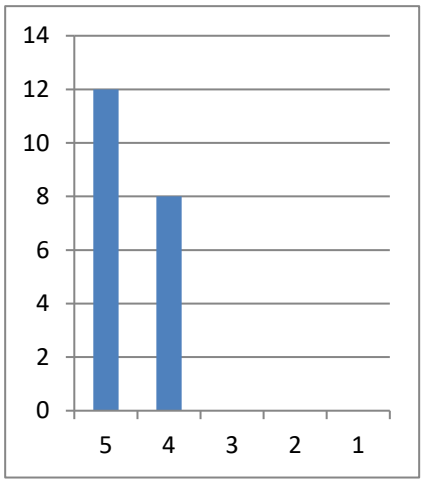

Figure 2 - Satisfaction reg. Ppt1 – Context (mean = 4.6)

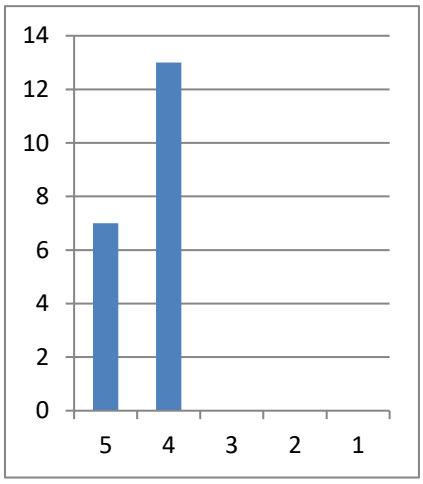

Figure 3 - Satisfaction reg. Ppt2 – Monitoring land use change (mean = 4.4)

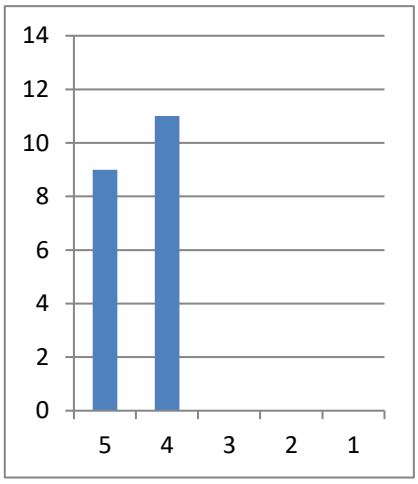

Figure 4 - Satisfaction reg. Ppt3 – Monitoring degradation (mean = 4.5)

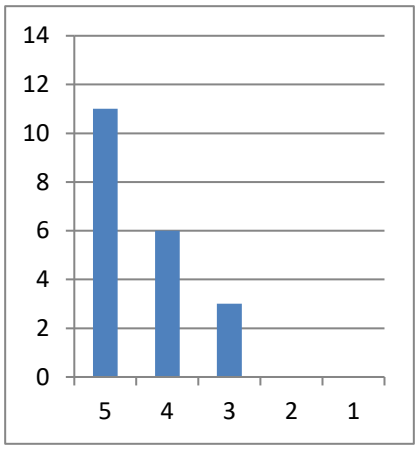

Figure 5 - Satisfaction reg. Ppt4 – Estimating EFs (mean = 4.4)

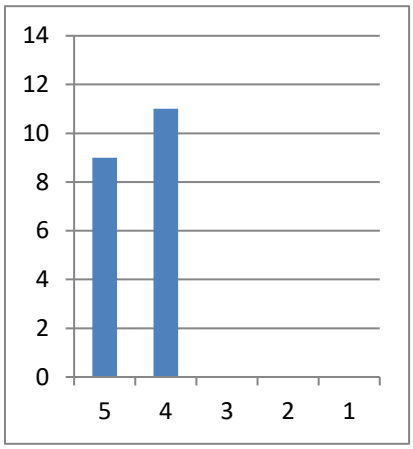

Figure 6 - Satisfaction reg. Ppt5 – Estimating GHGs (mean = 4.5)

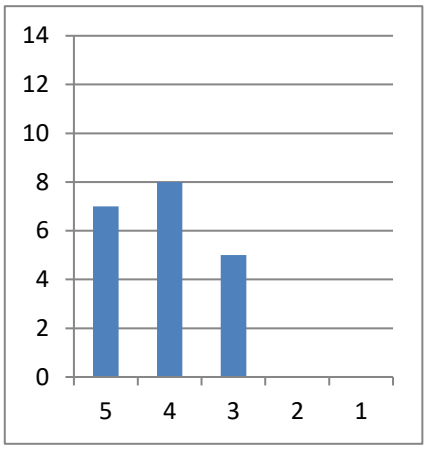

Figure 7 - Satisfaction reg. Ppt6 – Estimating uncertainties (mean = 4.1)

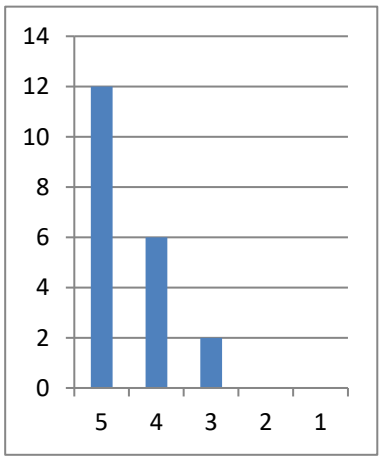

Figure 8 - Satisfaction reg. Ppt7 – Reporting GHGs (mean = 4.5)

In general, the satisfaction rates by topic vary between 4.1 and 4.6 (very useful to indispensable), which means all the topics addressed during the training were appropriate.

In addition to the technical content of the training, participants were also invited to rate the organisation and the facilitation of the training, ranking their response as follows: 5 = Excellent; 4 = Very adapted; 3 = Moderately adapted; 2 = Poorly adapted; 1 = Not adapted.

The results are hereafter. Overall, the participants found that the organization of the training was very adapted, apart from the duration and pace of the training, respectively considered too short and too fast for some participants.

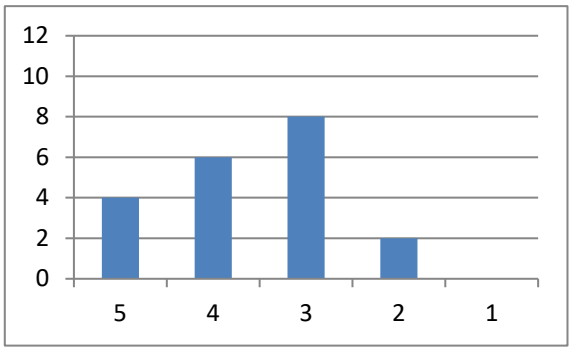

Figure 9 - Satisfaction reg. duration and pace of the training (mean = 3.6)

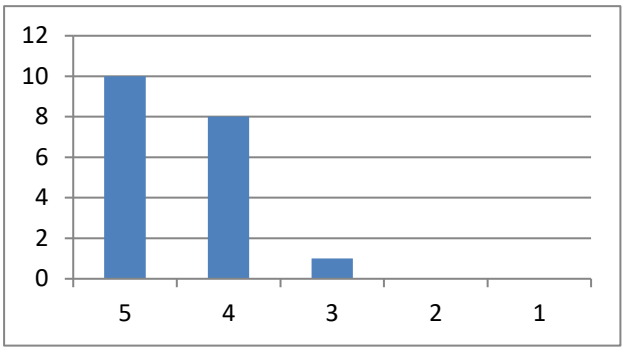

Figure 10 - Satisfaction reg. clarity of the presentations (mean = 4.5)

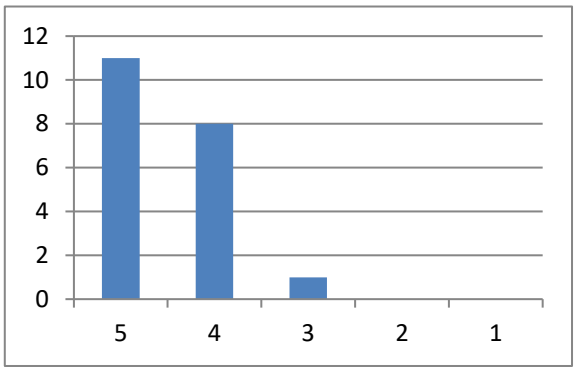

Figure 11 - Satisfaction reg. logistics - place of venue and meals (mean = 4.5)

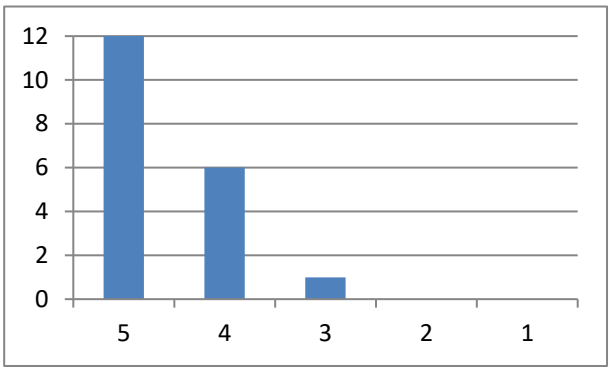

Figure 12 - Satisfaction reg. the facilitation (mean = 4.6)

2. Comments on the setting of the NFMS

The preparation of a comprehensive action plan for the setting of a NFMS started in October 2014. This plan was finally validated in August 2016 and the FAO committed to bring technical assistance for its implementation (FAO, 2016)[5].

This plan was latter refined in 2018 (FAO, 2018)[6]: upgrading of existing activities; addition of new activities (elaboration of Forest (Emission) Reference Level (FR(E)L); fires monitoring; desertification monitoring; GHG inventory); extension of the duration (till 2020); increase of the total budget (to 3,3 MUS$).

In what follows, we describe the progress made so far in implementing 4 of the 5 Outputs (the Output 4 – Development of FR(E)L) was not assessed, as it goes beyond the scope of the NFMS and the present assignment) and make some comments regarding the implementation.

Unfortunately, information and data are scattered, and the fact that security conditions have worsened since the 5th of April 2019 did not help to organise meetings and locate the relevant information/data.

In particular, the consultant could not meet with the REDD+ Technical Assistant, Mr. Lichtenberger, as well as with the fire specialist at Khartoum University, Mr. El Gamri.

Despite requests to the FNC and the FAO, nor was it possible to collect relevant documents such as the progress reports of the FAO project (apart from a hard copy of the last one, August 2018 / February 2019: FAO, 2019a[7]), the signed Letters of Agreement (LoA) with the Karthoum and Kordofan Universities (verification of some Sample Units (Sus) in the frame of the NFI), the draft LoA with the Remote Sensing and Seismology Authority (RSSA) (involvement in the LULUCF mapping).

2.1. Fine-tuning the institutional arrangements

➔ *Progress so far*

Here below is a summary of activities planned and/or achieved so far under *Output 1 - Institutional arrangements and data management systems to support the national MRV system are in place and fully operational.*

Activity	Description and progress as of March 2019 (according to FAO, 2016; FAO, 2018; FAO, 2019a)
1.1. Support to MRV Tech. WG (TWG)	This MRV TWG is supposed to receive the technical support of the FAO, so as to be deeply involved in the decisions regarding the NFMS action plan. During the mission, it proved difficult to identify roles/responsibilities of this MRV TWG in the decision-making process regarding the NFMS.

[5] FAO, 2016. *Agreement between the Republic of the Sudan and the Food and Agriculture Organization of the United Nations (FAO) for the provision of technical assistance for the implementation of support for the design of the MRV system in the framework of REDD+ readiness in the Sudan (UTF/SUD/079/SUD)*. Roma – FAO, August 2016. 63p

[6] FAO, 2018. *Amendment number 1 to the Agreement between the Republic of the Sudan and the Food and Agriculture Organization of the United Nations (FAO) for the provision of technical assistance for the implementation of support for the design of the MRV system in the framework of REDD+ readiness in the Sudan (UTF/SUD/079/SUD).* Roma – FAO, January 2018. 35p

[7] FAO, 2019a. *Support for the design of the MRV system in the framework of REDD+ Readiness in the Sudan (UTF/SUD/079/SUD): Progress Report n°4 – 1 August 2018 – 28 February 2019.* Roma – FAO, March 2019. 15p

1.2. Assessment of MRV gaps, arrangements, roles and responsibilities	The first assessment of the MRV gaps and institutional arrangement is available (Roberts & Osman, 2017). To further deepen and verify the feasibility of the recommendations, a consultation process is planned at national level and all potential implementation institutions (at national and subnational level) are supposed to be invited to further discuss about the right way to manage the NFMS system in Sudan and their involvement. This consultation process is expected to highlight the potential modification of the mandate of some institutions and the project is expected to support the formalization of these mandates in order to institutionalize the MRV process. Once the mandate of the institutions clearly identified, the Government is supposed to develop the legal text for the institutionalisation of their mandate in the framework of REDD+ and MRV. The creation of a Data Management Unit (DMU), in charge of the implementation of the NFMS is planned within FNC, as well as capacity building of its members (see activity 1.5.).
1.3. Data management needs are assessed and equipment are procured	FAO experts, with the support of a national information technology / database expert visited FNC premises and assessed existing equipment used for field data collection/computing, and developed a procurement plan (purchase, installation and servicing over the project's period). Most of the equipment have already been purchased (Salah, 2018)[8].
1.4. Design & implementation of a NFMS/MRV action plan	The timeline for the implementation of the NFMS/MRV action has been updated, taking into consideration the delays in implementing the NFI, the LULUCF mapping, and the GHG inventory. An awareness meeting is planned with the institutions involved on the NFMS issues (identified through the activity 1.2) to discuss the roles/responsibilities of each institutions.
1.5. Strengthening of NFMS/Data Management Unit (DMU)	The creation of a NFMS/DMU is planned, as explained earlier (see activity 1.2). It is supposed to receive operational and technical support from FAO (centralization of all trainings provided from FAO: in NFI, in remote-sensing, in GHG inventory and in web portal development and update). The creation of an office space is planned for this DMU, which will be in charge of the management of all data for the implementation of NFMS and MRV system. This unit will also be responsible of the update of the REDD+ web geoportal. FAO intended to intensify MRV-works/trainings at State level, but decision by FNC of the selection of the focus States is still pending (institutional set-up of federal Government relation to the States which remains unclear). An international MRV expert was supposed to be hired for coordinating MRV activities, insuring the consistency of overall technical support from FAO, strengthening the DMU capacity. It was not possible due to continued volatile security situation in the country.

Figure 13 - Summary of Output 1 – Institutional arrangements / NFMS (FAO, 2016; FAO, 2018; FAO, 2019a)

[8] Salah, Y., M. 2018. *The General Directorate for Forests Sustainable Development / The Technical Administration. Report on Forests equipment under the Project UTF/SUD/079/SUD*. Khartoum - FNC, April 2018. 2p

➔ *Comments*

The institutional arrangements described in (Roberts & Osman, 2017) are diverse and not easy to understand. The first diagram below is extracted from the mid-term progress report to the Forest Carbon Partnership Facility - FCPF (Republic of Sudan, 2017)[9], the two others were prepared by (Roberts & Osman, 2017).

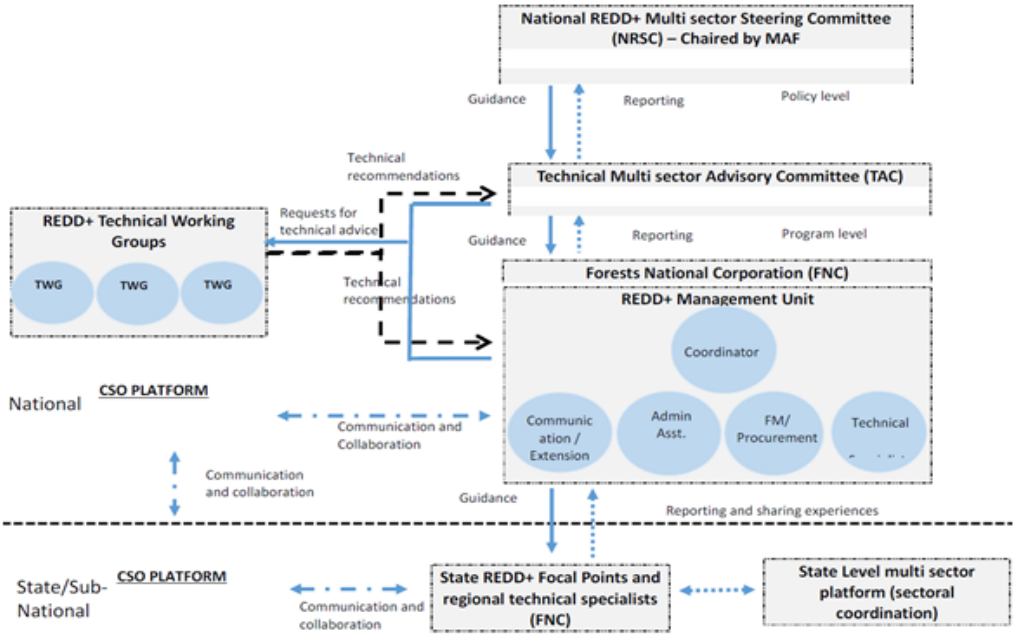

Figure 14 - Institutional arrangements for the REDD+ process, including MRV (RoS, 2017)

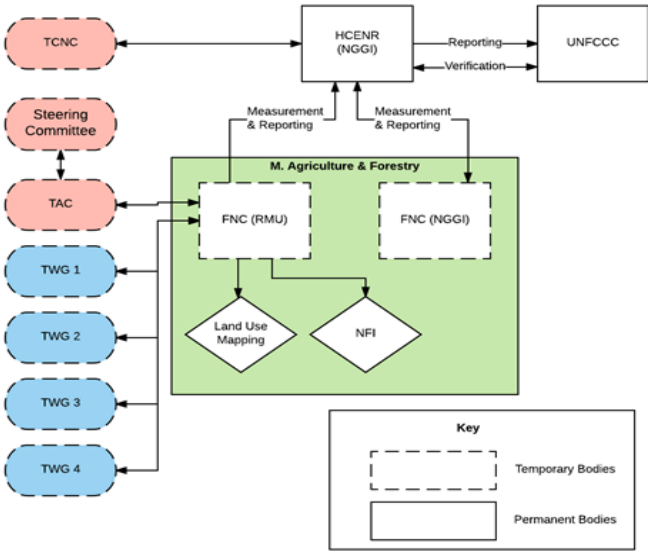

Figure 15 - Institutional arrangements for the NFMS/MRV (Roberts & Osman, 2017)

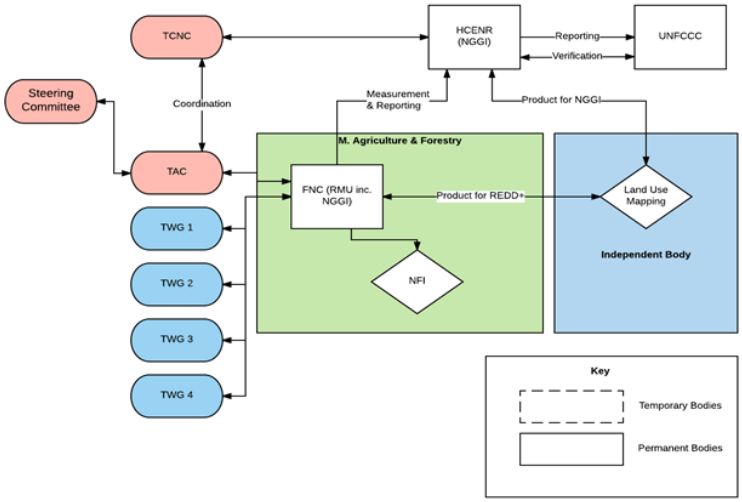

Figure 16 - Alternative institutional arrangements for the NFMS/MRV (Roberts & Osman, 2017)

Consequently, even the Sudanese experts directly involved in the NFMS/MRV process are getting lost, such as Yousif Mohamed Salah, National Coordinator of the FAO project, writing in his comments to (Roberts & Osman, 2017): "*While* [figure on the left below]

[9] Republic of Sudan. *Mid-Term Progress Report to the FCPF*. Khartoum – Republic of Sudan, February 2017. 74p

explained REDD+ structure (FNC-REDD+ Management Unit, NSC, TAC, in addition to NGGI) as temporary bodies, in [figure on the right above] *the RMU is going to be a permanent body at FNC including the NGGI. The Land Use Mapping LUM of the SLMS is going to be detached from the NFI and will be a separate independent body. The question is: Where is the under development/establishment NFM/MRV systems?*" (Salah, 2017)[10].

Despite of the complexity of the existing arrangements and the fact that the study was aimed at "*identifying possible objectives and policy requirements of the REDD+ MRV and NFMS, the roles/responsibilities of key institutions relevant to REDD+ MRV […] and proposed coordination mechanisms amongst those institutions*", the report makes "*only minor recommendations on changes to the current institutional arrangements for developing the MRV system*" (ROBERTS & OSMAN, 2017).

This being said, the report quotes some relevant observations:

- *"It appears to be some disconnect between the activities of the RMU and the broader FNC work. This is exemplified by FNC staff working on the NGGI being separate from the REDD+ team, as well as some issues with coordination between the RMU and teams implementing REDD+ activities within FNC […] for example, the ICSPS";*
- *"It is recommended that tasks are either carried out by an individual consultant, or where multiple consultants are used to create a product, that this is managed under a single project with clear requirements of coordination between all parties. The generation of duplicate pieces of work is inefficient, and is likely to create confusion";*
- *"There are processes running in parallel for the National Communication (NC) and the REDD+ program, with overlapping responsibilities. For example, separate land use maps are being discussed for the NGGI and REDD+, and developing Emission Factors (EFs)for forestry activities";*
- *"The current institutional arrangements do not recognize the fact that the MRV system is an on-going body of work that is never 'done', and as such there is a need for permanent institutional arrangements for the implementation of the REDD+ MRV";*
- *"It is unlikely that the RMU will be able to deliver on the REDD+ system with the existing staff. There is no clear position within the RMU responsible for coordinating the individual aspects of the MRV or NFMS, or on the process of receiving, reviewing, using and archiving datasets. It is recommended that additional resources be allocated to the RMU to support the process, and capacity training be provided to the existing/new staff […] It is recommended that consideration be given to having the FNC staff allocated for the NGGI move to the RMU to ensure consistency between the two systems".*

The same kind of observations were made during the present assignment: there are various groups/entities working on NFMS/MRV issues (RMU under the FNC, NFI team under the FNC, NC/GHG team – including for the LULUCF sector – led by the Higher Council for Environment and Natural Resources (HCENR), etc.) and it is difficult, in practice, to understand who does what. The share of roles/responsibilities and flows of information/data among these groups/entities is not very clear.

It also seem that the national experts are either not well-informed of the on-going activities and that the FAO staff directly supervises certain key-activities, such as the design and

[10] Salah, Y., M. 2017. *Comments to the institutional arrangements report*. Khartoum – FNC, October 2010. 4p

data treatment for the NFI (data collection being carried out by staff from the FNC (main survey) or the Univ. of Khartoum and Kordofan (control)) and the LULUCF mapping.

Finally, the consultant had limited technical exchanges on NFMS/MRV with a handful of people: Yousif Mohamed Salah (FNC staff. National Coordinator of the FAO project), Alyas Ahmed Daak (University staff. Appointed to the FAO project as remote-sensing specialist. Currently manipulating the IPCC 2006 software[11]), Dr Rehab Ahmed Alhassan (HCENR staff. Coordinator of the GHG inventory for the 3rd NC), Mrs Saffaa Ahmed Birema / Mrs Khalda Abbas Hassan El Gizouri / Mrs Rana Mohamed El Tayeb (FNC staff. In charge of feeding FNC data of word harvest into the IPCC 2006 software).

In this context, it would be really necessary to simplify / rationalise the current institutional arrangements:

- Asses the usefulness of the (many) groups/entities, permanent and non-permanent, created in the frame of REDD+, and clarify their roles/responsibilities. If need be, merge them or, even, eliminate them;
- Institutionalise the roles/responsibilities of the remaining groups/entities and the flows of information/data to be strengthened or created, after adequate consultations, to avoid any misunderstanding (e.g. between FNC and RSSA regarding LULUCF mapping);
- Identify key-resource persons in the remaining groups/entities able to do the job, including through the provision of adequate capacity-building;
- Avoid substitution of national experts by international experts, or – if no alternative because of the complexity of the issues at stake, i.e. data treatment and quality assessment/quality control (QA/QC) for LULUCF mapping – include minimum on-the-job training to get a chance to create a minimum local know-how, on which to build in the future.

2.2. Elaborating multi-date LULUCF maps

➔ *Progress so far*

Here below is a summary of activities planned and/or achieved so far under *Output 2 - Capacities to regularly assess forest & land cover change are strengthened to produce activity data for REDD+.*

It has to be noted that a draft report (FAO, 2019b)[12] gives the latest updates on the progress made so far regarding the LULUCF mapping. "*Some preliminary results are presented but should be taken with great caution because the work is ongoing*" (pers. Com. M. Piazza – FAO, May 2019).

Activity	Description and progress as of March 2019 (according to FAO, 2016; FAO, 2018; FAO, 2019a; FAO, 2019b)
2.1. Define & agree on forest definition for REDD+	The discussion on the forest definition has been carried out in March 2017. A preliminary draft of the definition has been the result of this consultative work. FAO expects the institutionalization of the forest definition through a ministerial decree, not published so far.

[11] Cf. www.ipcc-nggip.iges.or.jp/software/

[12] FAO, 2019b. *Support to National Forest Resources Assessment of Sudan. Ministry of Forestry/FAO. Project: TCP/…. - Preliminary results of the Forest Change detection for selected States*. Roma - FAO, February 2019, 12p

	According to discussions held with FNC staff, the Directorate of Sustainable Forest Management of the FNC is in charge of following-up the endorsement, either by the Minister or by the National Assembly. But the proposed forest definition (thresholds: minimum mapping unit of 0.42 ha = 1 *Feddan*; minimum tree crown cover of 10%; minimum height of trees of 2m) is different from the current one (used for the Forest Resources Assessment - FRA) and raises concern, which explain why the process is blocked.
2.2. Assessing existing LULUCF maps	This activity focused on the assessment of Africover 2000 and 2010 land cover/use maps (see activity 2.3 below for explanations about Africover. 25 man-days of work, sub-contracted by the FAO in 2018 to Anwar SidAhmed from RSSA). Available data on fire monitoring have also been assessed in order to include them into the Satellite Land Monitoring System (SLSM).
2.3. Development of an updated forest and land cover map	According to (FAO, 2019b), the following activities were performed (NB: summarized and simplified presentation below): First, the Africover 2010 map (based on Landsat images + SPOT, IRS and ASTER images. Overall accuracy is probably more than 80%), basis for the 2012 Land Cover Atlas of Sudan (FAO, FNC & RSSA, 2012)[13], was used to produce a forest/non forest map and a forest mask for 2010, that was latter used as ancillary data. Then, a forest change map 2010-2017 was estimated using direct change detection instead of a post-classification change detection, which tends to produce less accurate estimates. Landsat 8 images for 2010 and 2017 were used, and the data collection / correction / composition were implemented within Google Earth Engine Application Programming Interface (API). Training data were collected for each class of change and no-change, using very high resolution (VHR) images (Google Earth, Bing Maps), and the visual assessment was performed using the Collect Earth Interface. The procurement process of these VHR images took longer than expected due to economic sanctions against Sudan. Finally, classification was done with two algorithms, CART and RandomForest. The same methodology was used at State level, in 3 selected States (El Gadarif, Sinnar, and Blue Nile), with an intensification of training samples, in order to get a representative sample size for each class and more accurate data (the idea being to build 3 regional FR(E)L on this basis). As far as we understand the draft report (FAO, 2019b), an accuracy assessment of the change map 2010-2017 is still to be carried out at national level, but has been carried out for the 3 pilot States.
2.4. Develop a SLMS methodology and operational procedures, and create a consistent time series of forest	The development of an SLMS is the consolidation of the activity 2.3. The FAO expects a production chain to be further explained through a specific training and to become operational once in the hand of the technical team. This activity partly includes the finalization of the adjusted areas estimates on forest change, based on the mapping efforts. It also includes the development of a fire monitoring mapping, using the global data and processes. […] In the 2018 addendum to the TA project (FAO, 2018), the FAO expected the activities 2.3 and 2.4 to be led by FAO, in collaboration with FNC experts

[13] FAO, FNC & RSSA, 2012. *Land Cover Atlas of Sudan*. Roma – FAO, 2012. 56p

cover and assess change	and other relevant experts (especially from RSSA). FAO also planned to have an international consultant based in Khartoum for the overall coordination of the SLMS work and for the RMU/DMU empowerment. It was not done so far and might not be done in the short-term, knowing the current situation.
2.5. Produce LULUCF maps and final report	The activity data produced will be used for the development of the FR(E)L. In line with the activities 2.3 and 2.4, the FAO expects a final report on the forest map and change assessment to be consolidated for dissemination of the final statistics.
2.6. Development of NFMS geoportal	The FAO expects the NFMS geoportal to compile all the available mapping for the REDD+ process and to be used to list the REDD+ activities in Sudan. The fire monitoring system, using global data and land-use data (through available and checked land use assessment) may also be included within the geoportal.
2.7. Set-up of fire/desertification monitoring	The fire situation in Sudan has been described, but requires further data rich description. National experts have to be updated in available technologies and algorithms necessary for the improvement of this system. A strong coordination with the Range and Pasture Departments and the National Coordinating Committee for Desertification (NCCD) is foreseen with regard to the fire/desertification monitoring (FAO, 2019a). The activities linked to fire/desertification monitoring have been launched recently and most remains to be done. Progress so far is presented under Part 2.3. Carrying out a NFI, as these are cross-cutting issues (linked to estimation of activity data and also estimation of emission factors).
2.8 Capacity building on fire/desertification monitoring	It includes activities to strengthen the technical capacity of national institutions including General Directorate of Combating Desertification and Erosion, State Meteorological Authority: capacity development of the national experts for the update, maintenance and operationalization of the fire/desertification monitoring system and building/implementing a processing chain to build map and reports on active fire and burnt areas. It has started very recently.
2.9 Validation and diffusion of data in NFMS geoportal	This activity consists on following up the existing desk-based land use assessment, through ground-truthing but also with satellite imagery. Local community consultations will be conducted during the ground-truthing exercise in 3 pilot States.
2.10 Fire management S & AP	The FAO expects a fire management strategy and action plan to be consolidated, after a survey of relevant strategy and policies and taking into consideration the "*Sudan National Action Programme– A Framework for Combating Desertification in Sudan*".

Figure 17 - Summary of Output 2 – LULUCF mapping / NFMS (FAO, 2016; FAO, 2018; FAO, 2019a; FAO, 2019b)

➔ *Comments*

Activities under this Output 2 are on-going and results are preliminary. Therefore, it is delicate to comment these activities. One can simply make preliminary and general remarks about three aspects: (i) Involvement of Sudanese experts/institutions, (ii) Forest definition, (iii) Accuracy and completeness of land use change detection estimates.

Involvement of Sudanese experts/institutions:

In the initial TA project document (FAO, 2016), activities under this Output 2 were supposed to be implemented in a participatory manner: "*It will be led by FAO staff in close*

collaboration with FNC's remote-sensing experts, as well as other relevant remote-sensing experts. The work will be undertaken in a "learning-by-doing" set-up, whereby national experts will be trained and supervised to yield concrete products" (FAO, 2016).

This was in fact the approach taken by the FAO when supporting the FNC and RSSA to elaborate the 2012 Land Cover Atlas of Sudan: two international technical assistants were assigned to this study and one of them, Mrs Daniela MARTINI, spent 6 months in Khartoum to facilitate on-the-job training of Sudanese experts (pers. com. Anwar SidAhmed – RSSA, April 2019).

In practice, from our observations during the field mission, very few Sudanese experts are able to present the main steps, achievements and challenges under Output 2. Even Alyas Ahmed Daak (hired by the FAO as a national remote-sensing expert) or Yousif Mohamed Salah, National Coordinator of the FAO project, had limited information. The only Sudanese expert having partial information about Output 2 was Mrs Anwar SidAhmed, from the RSSA, as she was directly tasked by the FAO (i) to assess the Africover 2010 data and (ii) to carry out the visual interpretation of training points, using Google Earth.

Indeed, the last progress report of the TA project (FAO, 2019a) points out the fact that collaboration with FNC was difficult ("*the limited capacities of the GIS and remote-sensing unit of FNC have been hindering the progress of activity data development*") and that the collaboration with the RSSA is not yet formalised ("*FAO initiated several discussions with the RSSA to investigate potential collaboration with the entity to produce activity data and an updated land cover map […] A LoA is supposed to be signed*". NB: Mrs Anwar SidAhmed was hired by the FAO under her own name).

Obviously, the current political situation in Sudan explains why it is difficult to have an international expert based in Khartoum, and thus facilitate on-the-job training with diverse Sudanese experts. It is to be hoped that the political situation improves and allows such collaboration on a day-to-day basis with the local institutions.

<u>Forest definition:</u>

"*Forest definition should be clarified. REDD+ definition is more comprehensive, since it includes also a shrub-component […] additional source of information to know where losses (and possible degradation) occur over areas dominated by shrub. However, statistics cannot be disaggregated by vegetation types if REDD+ definition is used, and comparability with other historical data could be challenging*" (FAO, 2019b).

Given the fact that the forest definition in the frame of REDD+ is not yet officially endorsed, the forest mask for 2010 was created by merging 2010 Africover classes into (i) FRA-compliant definitions ("forest" and "tree plantation") and (ii) REDD+-compliant definitions ("shrub" and "shrub plantations") (FAO, 2019b).

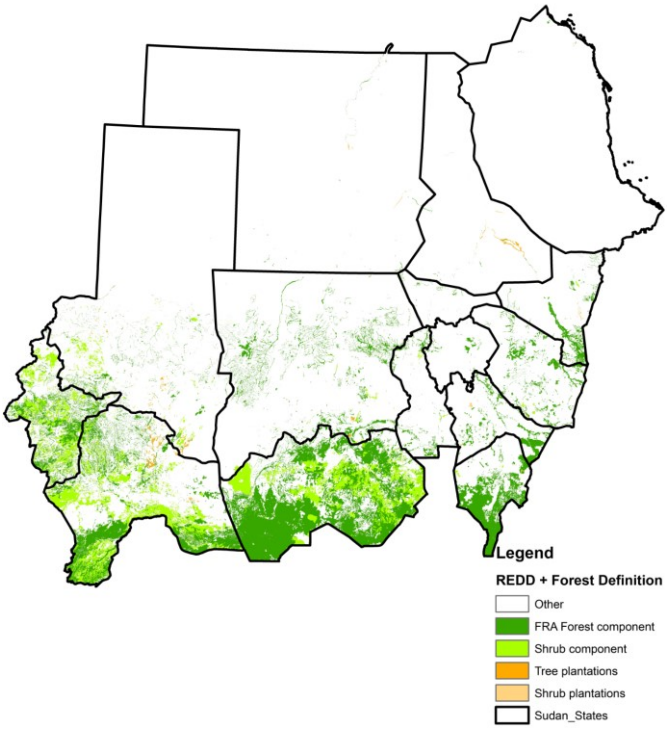

Figure 18 - Forest cover map for 2010, based on merging of Africover 2010 classes (FAO, 2019b)

Furthermore, it would be useful to investigate how to introduce sub-definitions of forest, as it is currently the case for the reporting of GHG in the UNFCCC software (see Part 2.4 below): forests in high rainfall areas; forests in low rainfall areas and clay soils; forests in low rainfall areas and sandy soils. As far as we could understand, these sub-definitions were derived from the 2012 Land Cover Atlas of Sudan and have been used for reporting GHG emissions/removals for the 2 first National Communications.

Completeness and accuracy of land use change detection estimates:

Forest changes 2010-2017 were estimated at national level and these estimates were further refined at State level, for 3 pilot States, as shown below:

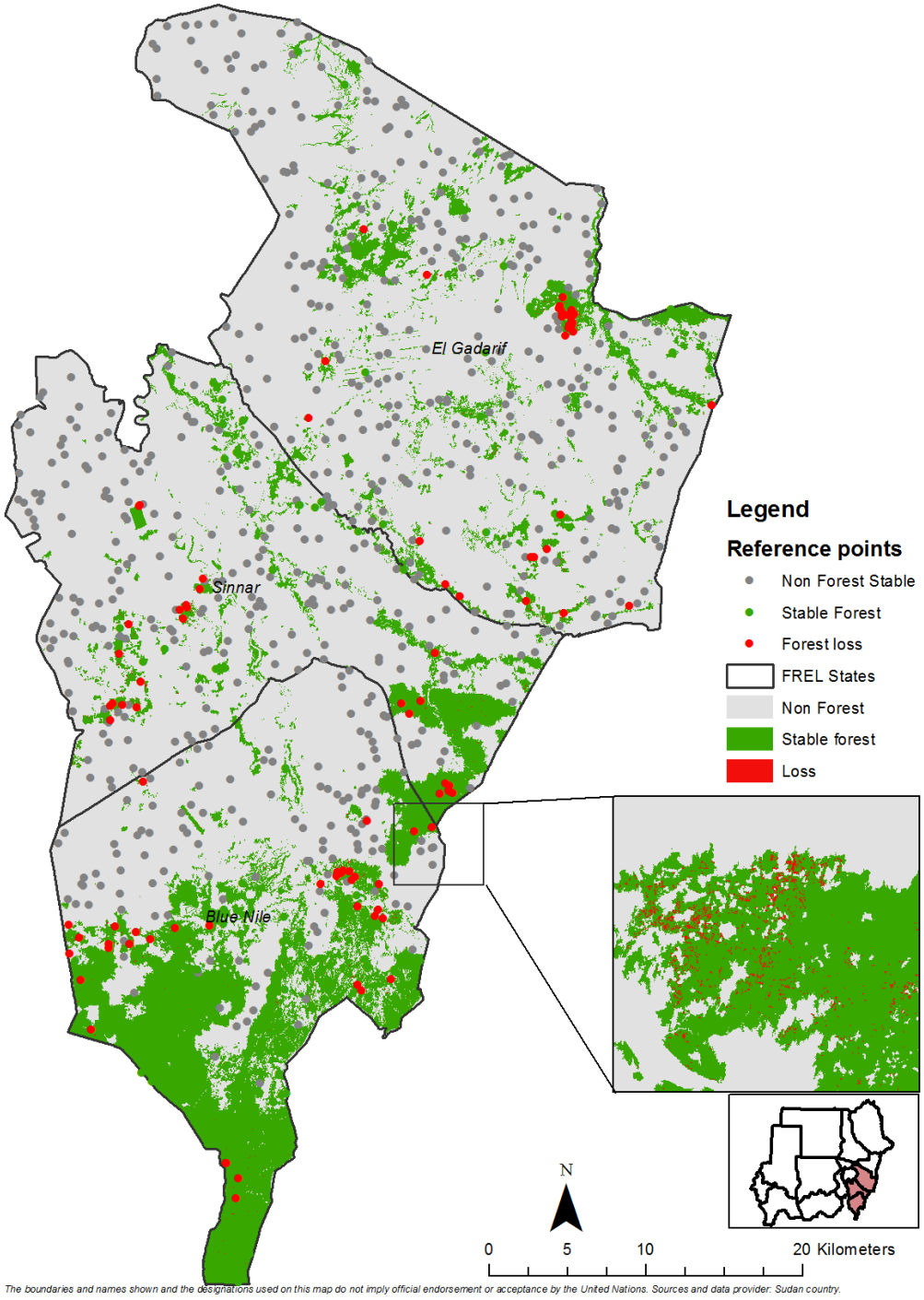

Figure 19 - Forest change 2010-2017 for the 3 pilot States (FAO, 2019b)

Therefore, 3 classes are monitored: stable forest / stable non-forest / forest loss. It is worth noting the monitoring follows Approach 3 (every patch of forest loss is quantified and spatialized). However, for now, there is no further detail about the sub-classes (forest types under the forest class; land use conversion, from forest to cropland or grassland or settlements under the forest loss class) and it would be helpful to upgrade the LULUCF mapping over time, to capture such information.

Another matter of concern is the actual level of accuracy of the LULUCF mapping, for the 3 selected States (as far as we understand, these accuracy assessment was not carried out at national level). Here below is the confusion matrix (FAO, 2019b):

		Reference data			
		Stable Forest	**Forest loss**	**Stable Non Forest**	**Total samples in map class**
Map data	**Forest stable**	61	6	42	**109**
	Forest loss	32	7	34	**73**
	Non forest stable	63	8	481	**552**
Total ref. samples per class		**156**	**21**	**557**	**734**

Figure 20 - Confusion matrix of forest loss and stable class maps in 3 pilot States (FAO, 2019b)

The level of accuracy seems perfectible. For example (FAO, 2019b):

- For Stable Forest: "*61 plots are in "agreement" with the reference data, but 48 were over-detected, in particular 6 sample plots were actually Forest Loss and 42 were Stable Non Forest*";
- For Forest Loss: "*there are 14 reference points classified as Forest Loss which the map omitted while only 7 are in agreements. Bearing in mind that loss class refers to a rare event and that generally cover less than 1% of the total forest area, the reference points of loss should be further validated (by multiple interpreters)*".

Efforts must be continued to refine the LULUCF mapping and to increase the level of accuracy. But, in any case, the preliminary estimates recently produced through the TA project, lead to a great improvement over the current situation, where the deforestation is very roughly estimated by expert saying at 174 415 ha/year. This figure is considered constant for the last 15 years and is reported in the last FRA national reports, such as the 2015 FRA national report (RoS, 2015)[14], but its origin is unclear.

2.3. Carrying out a NFI

➔ *Progress so far*

Here below is a summary of activities planned and/or achieved so far under *Output 3* - A *NFI is carried out to improve carbon and forest information, and capacities are built to update it regularly.*

[14] Republic of Sudan, 2014. *Global Forest Resources Assessment 2015 – National Report for Sudan*. Roma – FAO, 2014. 107p

Activity	Description and progress as of March 2019 (according to FAO, 2016; FAO, 2018; FAO, 2019a)
3.1. Elaboration of NFI manual	This activity has been achieved with the elaboration of a NFI manual (FNC & FAO, 2017)[15], detailing all the procedures and tools: sampling design, selection of plot shape/size, field forms, biomass calculations, etc. The data collection is based on cluster sampling (Sample Units – SUs, including various sub-sampling units). The proposed methodology was already used in Uganda, Ethiopia, Tanzania, etc. (more than 20 countries worldwide).
3.2. Assessment and analysis of available data, data entry, digitization and report	In the initial TA project document, it was planned to analyse the existing data/literature: analysis of past methodologies, datasets, stratification / classification systems, forest definition, existing wood density and allometric equation databases, etc. Unfortunately, there was a significant loss of data from the last NFI (1995-1998) due to inadequate safeguards. The only piece of information that could be gathered during the mission is a draft summary of this NFI (FNC, 1998)[16], transmitted by Yousif Mohamed Salah. In addition to that, relevant data at local level are scarce and/or inadequate: (i) forest management plans in reserved forest are designed by FNC, but there is no specific guideline for forest inventories, (ii) FNC statistics are often kept at State level. Data sent to Khartoum are considered not reliable (pers. com. Yousif Mohamed Salah – FNC, April 2019). In the initial TA project document, it was also planned to compile carbon stock data - testing the use of proxy data to assess forest degradation emission factors (e.g. small-scale farming, logging and timber records, fuel wood and charcoal production and consumption statistics, intensity and location of grazing areas). To our knowledge, these data compilation has not been done.
3.3. Training and equipment / tools for data collection.	FNC staffs were trained on the latest tools and methodologies for NFI (field equipment usage, sampling design, and data collection techniques, etc.): 8 teams x 4 field staffs/team = 32 field staffs + 4 supervisors. 2 training sessions organised (in Damazin / Blue Nile State in April 2017, in Fasher / North Darfur States – refreshment 6 months latter)
3.4. Strengthening of technical capacity and supervision missions	FAO experts, with the support of a national forest inventory expert visited FNC premises and assessed existing equipment used for field data collection and computing, and developed a procurement plan. The budget was used to acquire equipment (field measurement equipment, camping gear, outfits for field crew, etc.), ensure installation and provide servicing over the project's period.
3.5. Data collection and measurement activities (incl. establishing permanent sampling plots)	Out of a total of 705 SUs, 532 could be covered (151 in 2017, 381 in 2018). 135 were inaccessible, the majority due to security concerns. At the time of writing the last progress report, the remaining 38 SUs (Kordofan and Darfur States) were supposed to be covered in the coming months. At a FNC/FAO meeting held on January 31, 2019, it was also decided to densify the data collection in the southern part of the country (moving from a 40 km x 40 km grid to a 40 km x 20 km grid, thus adding 262 SUs). The FNC

[15] FNC & FAO, 2017. *National Forest Monitoring for REDD+ in Sudan. Manual for integrated field data collection*. Roma – FAO, May 2017. 134p

[16] FNC, 1998. *No title [draft summary of the 1995-1998 NFI]*. FNC – Khartoum, 1998. 98p

	was supposed to provide advance payments to start the field work by early March 2019, but it was not done at the time of writing the last progress report.
3.6.Data cleansing, entering, development data analysis methodology & analysis	In the initial TA project document, it was planned to enter, analyse and combine field data from the NFI with existing data to produce relevant forest information/analysis, including EFs for key land classes. This activity thus covers field data entry, data cleansing, development of the data analysis methodology, analysis of new NFI, as well as historical data (needed for understanding change over time of the Sudan's forest resources and essential to determining EFs for key land classes). This activity is behind schedule, for various reasons: • Only 1 out of 8 crews used the Open Foris application on the tablets (no access to Google Earth images due to economic sanctions against Sudan, poor access to electricity, little daily supervision) and most of the data was collected using paper forms; • Additional staffs were hired to enter data, but the quality of the work was poor and required two cycles of data cleansing. The second one is still on-going (pers. com. M. Piazza - FAO, May 2019); • The Universities of Khartoum and Kordofan were tasked with the QA/QC, but they also delayed: 56% of controlled SUs covered, as at March 2019. 16 out of 35 for Univ. of Khartoum and 24 out of 35 for Univ. of Kordofan. FAO prefers continuing the future collaboration with the Univ. of Kordofan only. From the preliminary results of the QA/QC, no significant deviations appear between the results of the NFI and the QA/QC, which is good news. Unfortunately, due to this delay in collecting and cleansing the field data, the FAO could not initiate the analysis of the results (situation as at May 2019).
3.7. Dissemination of NFI results	The FAO expects it will serve to guide government on how to share its NFI data through a consultancy that will produce a data sharing policy. Results will be presented in two national events and a report will be disseminated.

Figure 21 - Summary of Output 3 – NFI / NFMS (FAO, 2016; FAO, 2018; FAO, 2019a)

➔ *Comments*

The gathering of ad hoc forest inventory data for Sudan is greatly needed, for many purposes, including for the reporting of GHG emissions/removals from the LULUCF sector to the UNFCCC.

As at now, this reporting is very basic and estimates are probably subject to considerable incompleteness, uncertainties, and inaccuracies: 3 forest types are distinguished by ecological zones (low rainfall, high rainfall / clay soil, high rainfall / sandy soil), and default tier 1 Biomass Conversion and Expansion Factor (BCEF) and Root-to-Shoot ratio (R) are used for each one.

Using available references from international literature, it would already be possible to move from Tier 1 to Tier 2 regarding certain estimates. The website www.globallometree.org lists ecosystem- or stand-specific allometric equations, Root-to-Shoot ratios, etc. For instance, for the tropical shrubland (classification made following FAO Global Ecological Zone) of Sudan, there is a country-specific allometric equation, which seems robust (58 trees sampled; correlation coefficient $R^2 = 0.95$): V = 0.000406 x

$CD^2 \times H$[17]. Once the NFI data treated, it will be possible to triangulate these data with the existing ones and to create/refine/update country-specific values.

This being said, in the absence of preliminary results from the NFI, it is delicate to add more specific comments than those mentioned above. However, general comments can be made about three aspects: (i) Involvement of Sudanese experts/institutions, (ii) Monitoring of firewood/charcoal production/consumption, (iii) Monitoring of forest fires.

Involvement of Sudanese experts/institutions

In the study on institutional arrangements for NFMS/MRC, it was mentioned that "*there was comment on the process used to design the NFI, in that there could have been further consultation on the design*" (Roberts & Osman, 2017).

From the observations made during the mission, it indeed appears that the NFI methodology is not well understood by the Sudanese experts expected to take part in the work, as most of it – apart from the data collection (either first capture by FNC field staffs or second capture by the QA/QC field staffs) and data entry - is directly supervised by FAO experts: methodology design, methodology fine-tuning (such as the intensification of sampling in the Southern part of Sudan), data cleansing, data treatment.

Obviously, it would be good to strengthen the collaboration between FAO, FNC, Univ. of Kordofan, etc., in a participatory manner, and this could be greatly facilitated by having an international technical assistant based permanently in Khartoum…But this seems difficult in a near future, knowing the current political situation.

Monitoring of firewood/charcoal production/consumption

A study on drivers of deforestation was carried out in 2018. The draft report (Hassan and Tag Consultants, 2018)[18] is still under revision by the FNC and, thus, not yet validated. However, it is interesting to note that the unsustainable harvest of firewood and production of charcoal on the one hand, bush fires on the other hand, are considered as major drivers of forest degradation and deforestation.

Therefore, the estimation of AD and EFs associated with these 2 drivers are of major importance.

Regarding firewood/charcoal, the following issues should be addressed:

- AD: How to monitor areas affected by fuelwood collection?
- EFs: What is the ratio of fuelwood related to deforestation processes such as commercial agriculture expansion, with definitive conversion to cropland VS degradation processes such as selective harvesting of fuelwood and/or itinerant agriculture?

[17] Cf. http://globallometree.org/data/allometric-equations/47450/ (visited on the 6th of May, 2019). Sourced from : Glen, W.M. 2001. *Les arbres hors forêt : le cas du Soudan.* In: Bellefontaine, R., Petit, S., Pain-Orcet, M., Deleporte, P. and Bertault, J.G. (eds.). *Les arbres hors forêt, vers une meilleure prise en compte*. Roma – FAO, pp193-198

[18] Hassan and Tag Consultants, 2018. *Republic of Sudan REDD+ Programme - In-depth analysis of Drivers of Deforestation & Forest/Range Degradation*. Khartoum – NFC, January 2018. 134p

As "*the NFI methodology includes collecting information about fuelwood practices, however not in a quantitative way*" (pers. com. M. PIAZZA – FAO, May 2019), the 2012 WISDOM study for Sudan (Drigo & Osman, 2012)[19] would be of help and allow using proxies for estimating GHG emissions due to fuelwood collection: projecting the last 2008 population census data up to now by States / Localities / Administrative units, and considering different buffers for local auto-consumption and economic profitability thresholds for commercial consumption.

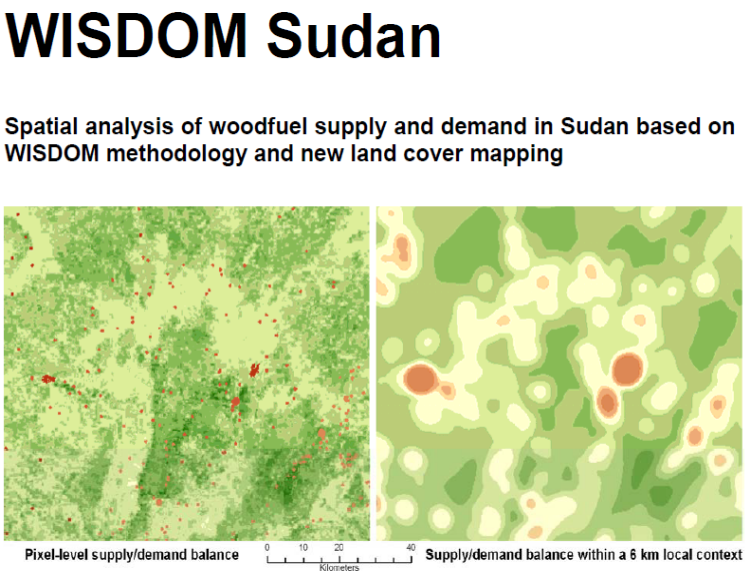

Figure 22 - Front page of the 2012 WISDOM Study for Sudan (Drigo & Osman, 2012)

In the WISDOM report, it is said the complete set of data (shapefiles and statistics) was left to the FNC. Unfortunately, we have seen no sign of this during the mission and the national Project coordinator for the FAO project, Yousif Mohamed Salah, does not have such data. May be it would be worth that the FAO staffs engaged in the TA project ask directly to R. Drigo whether he has kept the complete set of data?

Monitoring of bush fires

As for the firewood/charcoal, there are challenges in estimating AD (surface and location of forest fires) and EFs (types of forest or shrubland affected and number of bush fires affecting the same piece of land in a given period – roughly presented: the greater the number of bush fires, the lesser the EF to be considered).

Unfortunately, is was not possible to meet with the Dr El Gamri, bush fire specialist at the Faculty of Forestry and Range Science of the University of Sudan for Science and Technology. However, it was possible to exchange after the mission by email with Peter Moore, bush fire specialist at the FAO. According to him:

- Sudan has had some studies and interventions in the past. In particular, there is a field based report published in 1995 (no reference) and an overall summary published in 2001 (IFFN, 2001)[20] with focus on the area of the GTZ project at Jebel Marra which has been the most studied area;
- There have been analyses using remote sensing, mainly MODIS. According to Dr El Gamri, estimates are too high, as shown below (extraction of the Global Fire Emissions Database - GEFD). The average of area burnt by year is estimated at 7 Mha, over the period 2000-2018, which indeed seems very high.

[19] Drigo, R. & Osman, M. *Sudan Institutional Capacity Programme: Food Security Information for Action (SIFSIA) - FAO OSRO/SUD/620/MUL - WISDOM Sudan: Spatial analysis of woodfuel supply and demand in Sudan based on WISDOM methodology and new land cover mapping*. Roma – FAO, March 2012. 102p

[20] IFFN, 2001. *Fire Situation in Sudan - IFFN No. 25*. Roma – FAO, July 2001, pp115-117

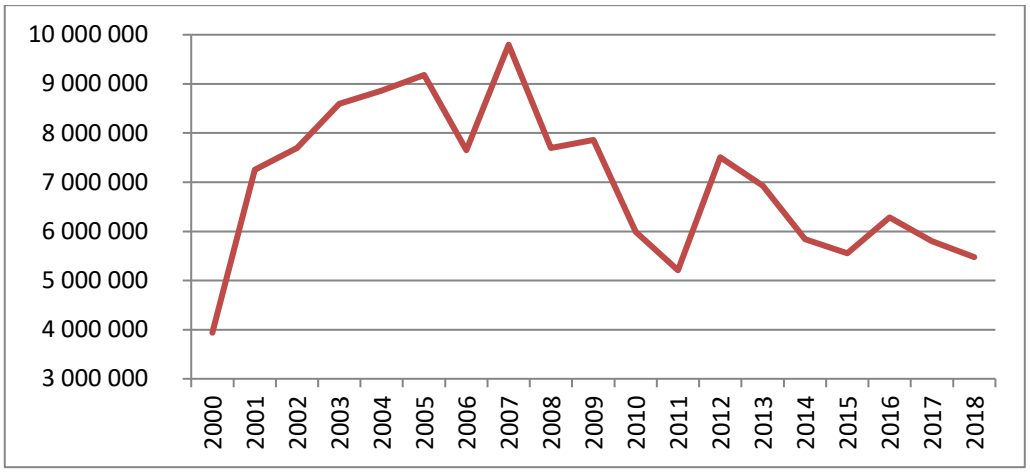

Figure 23 – Estimates of area affected by bush fires in Sudan from 2000 to 2018 (GFED, 2019)

- In terms of data to be used for the GHG inventory, there are limited at the moment: (i) AD: limited to this sort of independent data. Systematic mapping of fires and burned area is not routine, (ii) EFs: as far as P. Moore knows, there has been no specific work on the components of the IPCC formula for calculating GHG emissions from fires (Area burnt, Available Fuel, Combustion Factor, Emission Factor, and Fuel Load).
- Since the addendum to the TA project document has been signed (FAO, 2018), work has started on this issue. A FAO field mission was organised in October 2018, followed by workshops organised by FAO, FNC and RSSA in 5 States. The next steps are to be:
  - Review and analysis of available satellite data on forest fires (including Landsat and Sentinel data);
  - Collate historical records of fires: agencies, past reviews, reports, existing fire plans and strategies, articles in the press and peer reviewed journals, and other sources;
  - Collection of information and interpretation about fires from local people, experienced agency staff, and others;
  - Prepare a fire history and analysis of fire in Sudan based on these data and materials.

It is a good news work has started on the issue of bush fires and it is hoped that ad hoc data will be soon available to estimate the associated AD and EFs, as the GHG emissions due to bush fires are currently partially reported by the HCENR through the 2006 IPCC software (see Part 2.4). In addition, the origins/assumptions made regarding input data are not described, and it is likely estimates are uncomplete and/or uncertain and/or inaccurate, whereas bush fires can be considered as a key-category.

2.4. Reporting LULUCF GHGs emissions/removals

➔ *Progress so far*

Here below is a summary of activities planned and/or achieved so far under *Output 5* - A *GHG inventory and reporting process is developed for the land-use sector.*

Activity	Description and progress as of March 2019 (according to FAO, 2018; FAO, 2019a; discussion with Dr Rehab, GHG inventory coordinator)
5.1 Capacity	In the addendum to the TA project document, the following was planned:

assessment on land-use related GHG inventories and workplan development	"*Past GHG inventories for the land-use sector will be reviewed as included in any official reporting to the UNFCCC. Available data and required data will be assessed. A technical and functional capacity assessment will be carried out to understand most urgent needs for capacity development. A work plan will be developed along the lines of a submissions schedule to the UNFCCC*." So far, a scoping mission has been recently carried out (November 2018), led by Esther Mertens from the FAO Roma. The main conclusion of the scoping mission was that "*gaps identified for AFOLU sector are mainly related to issues with the use of the IPCC software that is not satisfactory adapted to national circumstances and difficult to do categorization of subsectors (higher tier approaches)"* (FAO, 2019a). Other specific observations were also made (*ibid*): data on harvest (fuelwood and roundwood) available by States, while needed by agro-ecological zones in the software; data on firewood expressed in bags or staked, not m^3; no data on land use changes.
5.2 Strengthen the GHG inventory process	In the addendum to the TA project document, the following was planned: "*Institutional arrangements for the GHG inventory will be mapped. Recommendations will be formulated for strengthening the GHG inventory process and for addressing technical capacity gaps*". So far, based on the few elements compiled in (FAO, 2019a) and based on the discussions held with Dr Rehab, GHG inventory coordinator, most remains to be done: • 3 trainings on GHG reporting (including a specific one on LULUCF GHG reporting) have been recently organised with support from the Global Support Programme of UNDP/UNEP; • The FAO promised to work on "*general and standardized template for GHG reporting according to the national circumstances of Sudan*", but at the time of our mission, the GHG inventory team was still using the IPCC software and was planning to submit its GHG inventory for the 3rd National Communication (NC) and 1st Biannual Update Report (BUR) (reports merged in one single report) • The FAO expected to insure a QA/QC of the existing data and calculations done for the 3rd NC and 1st BUR, but this was apparently not done (at the time of the mission, in April 2019) and the HCENR was looking for finalising the GHG inventory as soon as possible.
5.3 Strengthen the GHG inventory team	In the addendum to the TA project document, the following was planned: "*The GHG inventory team for the land-use sector comprises experts at the Monitoring and Reporting Unit, dedicated to the context of REDD+, and at the FNC. The technical capacity of the cross-institutional GHG inventory team for land-use will be strengthened*". As highlighted in Part 2.1, the institutional arrangements for the NFMS are not very clear, including for the GHG inventory pillar. Indeed, FNC staff involved in the LULUCF GHG inventory team have a poor knowledge of the work carried out under the 2 other pillars (LULUCF mapping to estimate AD, NFI to estimate EFs) as well as cross-cutting issues (monitoring of bush fires, estimation of firewood/charcoal/sawnwood production by the FNC, etc.). Therefore, the challenge for strengthening the GHG inventory team is not only to build their capacities in terms of GHG reporting tools and methodologies,

	but also to liaise them with other experts/entities working on the other pillars of the NFMS and clarify the flows of information/data to set up.

Figure 24 - Summary of Output 5 – GHG inventory / NFMS (FAO, 2016; FAO, 2018; FAO, 2019a; Dr Rehab, 2019)

➔ *Comments*

Conflicting timelines and objectives

As said earlier, the LULUCF GHG reporting team has recently started putting figures in the 2006 IPCC software. The team is aware of the gap between what is currently done and what is planned in terms of NFMS under the REDD+ process (and supported through the TA of the FAO), but they also want to finalise asap the GHG inventory to be included in the 3rd NC and 1st BUR (documents merged).

Actually, there are conflicting timelines and objectives for the 2 processes, as already noted by (Roberts and Osman, 2017):

- 3rd NC / 1st BUR to be submitted as soon as possible, for which the LULUCF GHG inventory team is compiling existing data (of dubious quality, whether it is about AD or EFs) and applying Approach 1 and Tier 1 methods;
- REDD+ FR(E)L to be prepared for 3 pilot States by end of 2019 (and may be latter on at national level? It is not yet clear from the documents analysed and discussions held), for which new data are expected, in terms of AD and EFs (LULUCF mapping, IFN, specific work on bush fires), and finally GHG estimates. The REDD+ Sudan team is looking for using Approach 3 and Tier 1, 2, 3 Methods (depending on the LULUCF activities).

Compilation of AD and EFs to estimate LULUCF GHG emissions/removals

After the mission in Khartoum, discussions were held about this issue with various REDD+ experts: Jenny Wong (Secretariat of the UNFCCC), Giacomo Grassi (JRC), Sandro Federici (CRfN). Here below is a summary of these discussions.

The 2006 IPCC software is not compatible with Approach 3 and Tier 3 methods. It can manage Approach 2, however it does not build land representations; data from a consistent land representation (usually built with excel) need to be input in the software. Anyway, Approach 3 is quite sophisticated and rarely used. Most of Approach 3 declared representations are either partially Approach 3 (i.e. just for some categories) or simply Approach 2 (it is indeed spatially-explicit, although it does not allow tracking land units across the entire time series, as Approach 3 does).

This being said, a possible option to build land representations that can later generate input (in terms of AD) for the 2006 IPCC software is to use Open Foris Collect Earth[21]. It is a web-based tool with no cost that allows building sample-based spatially-explicit complete and consistent land representations, at either Approach 2 or Approach 3.

Current quality level of the LULUCF GHG inventory

First, the LULUCF GHG inventory is incomplete: land use changes and the related GHG emissions are not reported, notably for deforestation (see figure 25 below); emissions from bush fires are reported, but the underlying assumptions in terms of areas burnt, specific EFs, etc. are not presented and the estimates are dubious (see figure 26 below).

[21] Cf. http://www.openforis.org/tools/collect-earth.html

Categories	Activity Data		Net carbon stock change and CO2 emissions									Net CO2 emissions
			Biomass				Dead organic matter			Soils		
	Total Area (ha)	Thereof: Area of	Increase	Decrease	Carbon	Net carbon	Carbon	Carbon	Net carbon	Net carbon	Carbon	(Gg CO2)
3.B - Land	89 858 898,89	-	42 542,00	50 270,63	-	(7 728,64)	-	-	-	-	-	28 338,33
3.B.1 - Forest land	19 209 938,20	-	42 542,00	50 270,63	-	(7 728,64)	-	-	-	-	-	28 338,33
3.B.1.a - Forest land Remaining Forest land	19 209 938,20	-	42 542,00	50 270,63		(7 728,64)			-		-	28 338,33
3.B.1.b - Land Converted to Forest land	0	0	0	0	0	0	0	0	0	0	0	0
3.B.1.b.i - Cropland converted to Forest Land	0	0	0	0		0	0		0	0	0	0
3.B.1.b.ii - Grassland converted to Forest Land	0	0	0	0		0	0		0	0	0	0
3.B.1.b.iii - Wetlands converted to Forest Land	0	0	0	0		0	0		0	0	0	0
3.B.1.b.iv - Settlements converted to Forest Land	0	0	0	0		0	0		0	0	0	0
3.B.1.b.v - Other Land converted to Forest Land	0	0	0	0		0	0		0	0	0	0
3.B.2 - Cropland	21818629,69	0	0	0	0	0	0	0	0	0	0	0
3.B.2.a - Cropland Remaining Cropland	21818629,69	0	0	0		0			0	0	0	0
3.B.2.b - Land Converted to Cropland	0	0	0	0	0	0	0	0	0	0	0	0
3.B.2.b.i - Forest Land converted to Cropland	0	0	0	0		0	0		0	0	0	0
3.B.2.b.ii - Grassland converted to Cropland	0	0	0	0		0	0		0	0	0	0
3.B.2.b.iii - Wetlands converted to Cropland	0	0	0	0		0	0		0	0	0	0
3.B.2.b.iv - Settlements converted to Cropland	0	0	0	0		0	0		0	0	0	0
3.B.2.b.v - Other Land converted to Cropland	0	0	0	0		0	0		0	0	0	0
3.B.3 - Grassland	48100000	0	0	0	0	0	0	0	0	0	0	0
3.B.3.a - Grassland Remaining Grassland	48100000	0				0			0	0	0	0
3.B.3.b - Land Converted to Grassland	0	0	0	0	0	0	0	0	0	0	0	0
3.B.3.b.i - Forest Land converted to Grassland	0	0	0	0		0	0		0	0	0	0
3.B.3.b.ii - Cropland converted to Grassland	0	0	0	0		0	0		0	0	0	0
3.B.3.b.iii - Wetlands converted to Grassland	0	0	0	0		0	0		0	0	0	0
3.B.3.b.iv - Settlements converted to Grassland	0	0	0	0		0	0		0	0	0	0
3.B.3.b.v - Other Land converted to Grassland	0	0	0	0		0	0		0	0	0	0

Figure 25 - Extraction of Sudan 2015 GHG inventory - Table 3.2 Background Table 3.B (HCENR, 2019)

Categories	Activity Data			Emissions							Information item: Carbon	
	Description (2)	Unit	Value	CO2 (3)	CH4 (4)	CH4	N2O	CO (4)	CO (4)	NOx	Biomass	DOM
3.C - Aggregate sources and non-CO2 emissions sources on land				-	78,32	23,53	7,58	-	-	-	58,74	17,65
3.C.1 - Emissions from biomass burning				-	78,32	23,53	7,58	-	-	-	58,74	17,65
3.C.1.a - Biomass burning in forest lands				-	76,36	-	6,97	-	-	-	57,27	-
Area burned				-	76,36	-	6,97	-	-	-	57,27	-
Controlled Burning				-	-	-	-	-	-	-	-	-
Wildfires	Area burned	ha	670 866,20	-	76,36	-	6,97	-	-	-	57,27	-
Amount burned				-	-	-	-	-	-	-	-	-
Controlled Burning				-	-	-	-	-	-	-	-	-
Wildfires				-	-	-	-	-	-	-	-	-
3.C.1.b - Biomass burning in croplands				-	-	23,53	0,61	-	-	-	-	17,65
Area burned				-	-	-	-	-	-	-	-	-
Biomass Burning in Cropland Remaining Cropland				-	-	23,53	0,61	-	-	-	-	17,65
Controlled Burning	Area burned	ha	2 179 094,00	-	-	23,53	0,61	-	-	-	-	17,65
Wildfires				-	-	-	-	-	-	-	-	-

Figure 26 - Extraction of Sudan 2015 GHG inventory - Table 3.4 Background Table 3.C (HCENR, 2019)

Second, EFs are all IPCC default ones. The LULUCF GHG inventory team declared having specific C fraction for some tree species, but these data are not used in the 2006 IPCC software.

Third, the GHG inventory team intends to report GHG emissions for biomass burning under the energy chapter of the inventory, while it is already accounted for under the LULUCF chapter (as GHG emissions from forest land remaining forest land, as described below), which would then leads to a double counting.

Forth, the only estimates done are related to GHG emissions from forest land remaining forest land (GHG removals thanks to annual net increment are not estimated, due to a lack of data), using the equation 2.12 of the IPCC 2006 guidelines: L = H x BCEF x (1+R) x CF, where L = Loss, H = Harvest, BCEF = Biomass Conversion and Expansion Factor, R = Root-to-Shoot Ratio, CF = Carbon Fraction. In addition to the fact BCEF, R and CF are IPCC default values. Several observations can be made about the entry data gathered to estimate the harvest:

- Data on harvest (fuelwood and roundwood) are available by States, while needed by agro-ecological zones in the software (5 agro-ecological zones defined: forests in high rainfall areas; forests in low rainfall areas and clay soils; forests in low rainfall areas and sandy soils). The LULUCF GHG inventory team makes a rough assumption, considering a simple relation between States and agro-ecological zone (i.e. low rain fall in sand = West Kordofan / North Kordofan / Norh Darfour / West Darfour);
- Dubious quality of data compiled at States level. A priori, most of the harvest is not recorded and, therefore, it leads to a huge underestimate of the associated carbon loss;
- There are various problems of conversion:
    - Sawnwood: There are many types (*merg, rasas, korki, gazas, falakab, dagag, shaaba*) and for the same name, different measures depending on the State (e.g. *merg* can correspond to a wood lumber of – NB: all units expressed in cm - 50 x 22,5 x 22,5 or 50 x 26 x 26 or 50 x 30 x 30). Another source of confusion is that data are sometimes expressed in cm/m or in feet. The volumes are commercial ones and need to be converted to total volume of roodwood (which is not the case presently). Last but not the least, all estimates are based on the same basic formula: Volume = D_{BH} x H x Form Factor, where D_{BH} = Diameter at breast height (or length x width), H = High, and Form Factor is considered constant and equal to 0.5;
    - Firewood: data sent by the State level offices of the FNC are assumed to be in m^3 by the LULUCF GHG reporting team. But, discussing with the team, it appears most deconcentrated services report data expressed in terms of “staked wood”. Yet, it is generally considered a ratio well below 1 to convert a piece of 1 m x 1 m x 1 m of “stacked wood” to m^3…In addition, the ratio is most of the time locally specific, as it depends on the average diameter and average lengths of the logs/branches sold as firewood;
    - Charcoal: the LULUCF GHG reporting team considers a ratio of 3 bags of charcoal for 1 m^3 of wood, but cannot indicate the source of such assumption, which is critical considering the great amount of charcoal produced in the country and the fact charcoal is the major destination of the harvest.

Annex 1 – List of persons met during the in-country mission

Name	Institution	Phone	Email
(Dr) Adil Osman Idris	IFAD Sudan	018 377 14 74	idrisadil2000@yahoo.com
(Dr) Ahmed Hassan Rehab (Mrs)	HCENR		rehabkhatmi@hotmail.com
(Dr) Ahmed Siddig	Khartoum Univ.	091 294 02 22	ahmed_nyala@yahoo.com
(Dr) Anwar SidAhmed (Mrs)	RSSA		nanosid25@yahoo.com
Bakri Mhmoud Hinet Idris	ICSPS	091 017 89 78	bhineit7@gmail.com
Burae Balla Elhussien	REDD+ Sudan	091 228 74 97	bballa@reddsudan.org
Elyass Daak	Khartoum Univ.		elyassdaak@hotmail.com
Hagir Mahagoub Elnasri (Mrs)	Khartoum Univ.	011 788 33 76	hagir.mahagoub@yahoo.com
Hanady Ibrahim	FNC		hanadyabdelgabbar@yahoo.com
Khalda Abass Hassan (Mrs)	FNC		hassan_khalda@yahoo.com
Mohamednour Abdehafiz Elzubair	REDD+ Sudan	090 454 75 42	mohamednourhafiz29@gmail.com
Rana Mohammed	Petroleum Fac.		rana.mohammed.1992@gmail.com
Saffa Ahmed Berima	FNC		safaaberaima2007@gmail.com
Salah Yousif Mohamed Ahmed	FNC	012 976 12 60	salahbadawi8@gmail.com
Sayeda Ali Ahmed Khalil (Mrs)	REDD+ Sudan	011 258 69 19	sayeda_khalil@yahoo.com
Sirage M. Sharif	REDD+ Sudan	091 266 04 01	siraj.shareef@gmail.com

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Annex 3 – List of attendance to the training

Name	Organization	e-mail	Gender
Bakri Mahmoud Hineit	ICSPS	bhineit7@gmail.com	Male
Burae Balla Elhussain	FNC (REDD+ Sudan)	buraeballa@gmail.com	Male
Sumia Omer Abdon	FNC (Sudan delg. COP)	Somayaabdoun190@gmail.com	Female
Sawsan Abdalla Ali	FNC (Sudan delg. COP)	Alisawsan35@yahoo.com	Female
Nagla Mahgoub Mohamadin	FNC (Sudan delg. COP)	naglaajebory@gmail.com	Female
Salah Ahmed Elmahyaa	FNC (NFI)	elmahiyo@gmail.com	Male
Salah Yousif Mohamed	FNC (NFI &FRA)	salahbadwi@gmail.com	Male
Samia Bakhiet Mando	FNC (NFI)	samiafnccorp@yahoo.com	Female
Manal Awad Khairy	Khartoum University	nadakheiry@hotmail.com	Female
Taghreed Ali Elsiddiq	ICSPS	taghreedsiddiq@gmail.com	Female
Mohamed Ahmed Omer	BIRDP*	Madom2008@gmail.com	Male
Fathi Ismail Omer	ICSPS	fathitota@gmail.com	Male
Adil Ahmed Siliman	FNC (REDD+ Sudan)	adilforest@yahoo.com	Male
Mashair Ahmed Eltigani	ICSPS	Mashair_tigania@hotmail.com	Female
Suhair Mohamed Musa	FNC	Suhairyousif7979@gmail.com	Female
Marwah Ali Aldaw	FNC	Maewahaldaw4@gmail.com	Female
Khalda Abass Hassan	FNC (GHGs group)	Hassan_khalda@yahoo.com	Female
Israa Salah Ahmed	ICSPS (trainee)	Israataha158@gmail.com	Female
Saffa Ahmed Berima	FNC (GHGs group)	Safaaberaima2007@gmail.com	Female
Hanady Ibrahim	FNC (Technical admin)	hanadyabdelgabbar@yahoo.com	Female
Massaud Mohamed	FNC (Sudan delg. COP)	mmassaud@yahoo.com	Male

** Butana Integrated Rural Development Project (BIRDP)*

Annex 4 – Quizzes submitted to the training participants

P1 – CONTEXT

1. Climate change is due to:
□ Accumulation of GHG in the atmosphere, blocking infra-red rays
□ Hole in the ozone layer, letting pass more solar rays
□ Coal plants pollution and forest fires, heating the atmosphere

2. GHG emissions from the AFOLU sector directly account for:
□ 14% of global GHG emissions
□ 34% of global GHG emissions
□ 24% of global GHG emissions

3. Aboveground biomass stocks are higher:
□ In boreal forests (Russian Federation, Canada, etc.)
□ In tropical dry forests
□ In tropical humid forests

4. The REDD+ mechanism has been under negotiation since:
□ COP15 in Copenhagen (2009)
□ COP19 in Warsaw (2013)
□ COP11 in Montreal (2005)

5. Countries commitments under the Paris Agreement (2015) are presented in:
□ Monitoring, Verification, and Reporting (MRV) plans
□ National Inventory Reports (NIRs)
□ Nationally Determined Contributions (NDCs)

6. In phase 3 of REDD+, a country may claim result-based payments by comparing its performance against:
□ A National Strategy or Action Plan
□ A National FR(E)L
□ A National REDD+ Roadmap

7. The 5 IPCC reporting principles are:
□ Comparability, consistency, precision, accuracy, robustness
□ Consistency, comparability, transparency, accuracy, completeness
□ Precision, certainty, adaptability, accuracy, completeness

8. What are the thresholds to be defined for setting a country-specific forest definition under the UNFCCC?
□ Minimum and maximum for: area / crown cover / tree height
□ Minimum for: area / crown cover / tree height
□ Minimum for: area / diameter / tree height

9. In Approach 2 for estimating Activity Data:
□ Nature and location of deforestation are known
□ Nature and location are known
□ Nature of deforestation is known; its location is unknown

10. In Tier 3 for estimating Emission Factor:
□ IPCC default values can be used
□ Country-specific data can be used, even in the absence of a recent updating
□ Country-specific data, subject to regular updating, can be used,

SURNAME:	Name:

P2 – MONITORING OF LUC

1. What are the 2 main mapping approaches to estimate AD?
□ Sampling vs wall-to-wall
□ Optical remote-sensing vs radar remote-sensing
□ Remote-sensing and ground-based analysis vs pure remote-sensing analysis

2. In general, what are the types of satellite images used to monitor LUC at large scale (nationwide), in the context of UNFCCC?
□ Coarse resolution (e.g., SPOT vegetation)
□ Medium resolution (e.g., LANDSAT)
□ Fine resolution (e.g., RapidEye)

3. A stratified sampling means:
□ Sample plots are randomly selected for the whole area
□ The whole area is divided into strata and the number of sample plots depends on the heterogeneity in each strata
□ Sample plots are distributed at regular interval (e.g., every 10 km)

4. What are the 3 main pre-processing steps for satellite data?
□ Pre-sampling, stratification, sampling,
□ Multitemporal analysis, visual interpretation, sampling
□ Geometric corrections, cloud and cloud shadow masking, radiometric corrections

5. What does "radiometric corrections" means:
□ Ensuring images in a time series overlay properly by registering every image thanks to ground control points
□ Identifying a water body or dark object and calibrating the spectral values of other objects based on its spectral value
□ Suppressing cloud and haze thanks to automated methods

6. Identifying deforestation & afforestation on satellite images is:
□ Nearly the same
□ Different: it is more difficult to see land use change in case of afforestation (gradual change vs brutal change)
□ Different: it is easier to see land use change in case of afforestation (light green for young leaves)

7. What does image segmentation mean?
□ Grouping pixels that are spectrally similar and spatially adjacent
□ Grouping objects that are spectrally similar and spatially adjacent

8. Visual interpretation of satellite images:
□ Is not needed for automated classification methods
□ Is needed after running an automated classification methods (verification on reference plots)
□ Is needed before / after running an automated classif. methods

9. For accuracy assessment, a good reference datasets should be:
□ Made of higher quality data, captured around the same year
□ Made of higher quality data, whatever the date of capture
□ Made of similar quality data, captured around the same year

10. What are the major limitations to the use of satellite images in tropical countries?
□ No limitation
□ Cloud cover and presence of snow
□ Cloud cover and scarcity of historical data

SURNAME:	Name:

P3 – MONITORING OF DEGRADATION

1. Broadly speaking, what does forest degradation mean?
□ Natural or anthropogenic intervention that leads to change in forest cover, structure, composition and function
□ Same as above, but limited to anthropogenic intervention
□ Conversion of forest land to another land use category

2. What is the main factor of forest degradation in Africa?
□ Fuelwood collection and charcoal production
□ Timber logging
□ Livestock grazing

3. In general, detectability of forest degradation using medium resolution satellite images is:
□ Easy and feasible at large scale
□ Complex and not always feasible at large scale
□ Impossible

4. What are the 2 main approaches to monitor forest degradation?
□ Optical remote sensing analysis and radar remote sensing analysis
□ Forest inventories and household surveys
□ Field observations and remote sensing analysis

5. Degradation due to selective logging can be quantified based on:
□ 2 factors: Wood Density (D), Diameter at Breast Height (DHB)
□ 3 factors: Extracted Log Emissions (ELE), Logging Damage Factor (LDF), and Wood Density (D)
□ 3 factors: Extracted Log Emissions (ELE), Logging Damage Factor (LDF), and Logging Infrastructure Factor (LIF)

6. The FAO method for the spatial analysis of woodfuel supply and demand is called:
□ WINDOW
□ WIDOW
□ WISDOM

7. What does endmember mean?
□ A spectrally pure material, with a specific/stable reflectance
□ A pixel with the lowest reflectance in a given image
□ A pixel entirely covered by intact forest

8. Forest degradation can be suspected if the Normalized Differencing Fraction Index (NDFI) is between:
□ -1 and 0
□ 0 and +1
□ 0.70 and 0.85

9. "intact forests" are:
□ Not fragmented by infrastructures or any human intervention, and have a canopy cover reaching 100%
□ Not fragmented by infrastructures or any human intervention, and have a canopy cover between 10% and 100%

10. Software to map degradation are:
□ Only specialised software (CLASlite, ImgTools, etc.)
□ Commercial software (ENVI, ERDAS, etc.) or specialised software (CLASlite, ImgTools, etc.)
□ Not yet in use

SURNAME:	Name:

P4 – ESTIMATION OF EFs

1. What are the 5 forest carbon pools?
□ Tree, branches, soil, shrubs, deadwood
□ Above-ground biomass, below-ground biomass, shrubs, litter, soil
□ Above-ground biomass, below-ground biomass, litter, deadwood, soil

2. Tier 1 default values for EFs are generally characterised by:
□ Low cost and low uncertainty
□ High cost and low uncertainty
□ Low cost and high uncertainty

3. Roughly summarised, the stock-difference approach consists in:
□ Comparing forest C stocks in key pools, before and after land use change
□ Summing annual C losses (harvest, mortality, etc.) and gains (forest growth) between 2 dates

4. What are the mains reasons for stratifying?
□ Reducing number of samples for a given level of accuracy / precision; putting efforts on strata with higher heterogeneity
□ Increasing number of samples for a given level of accuracy / precision; spreading efforts all over the strata

5. Having an error of 12% with a 95% probability threshold means:
□ There is 88% chance that the result will be within a range of +/- 5% around the real value
□ There is 95% chance that the result will be within a range of +/- 12% around the real value

6. Regarding the standard deviation on measurements of biomass:
□ The higher the standard deviation, the higher the heterogeneity of the forest in terms of biomass, the more sample plots is needed.
□ The higher the standard deviation, the higher the homogeneity of the forest in terms of biomass, the less sample plots is needed

7. In terms of C pools to monitor, it is good practice:
□ To monitor C pools representing 5% or more of total C stock.
□ To monitor C pools representing 10% or more of total C stock.
□ To monitor all C pools, whatever the cost and complexity.

8. What is the most commonly measured criteria in forest C inventories:
□ Basal area
□ Diameter at Breast Height (DHB)
□ Tree height

9. Belowground biomass (BGB) is generally estimated:
□ Based on direct measurements of roots (length, diameter, etc.)
□ Thanks to shoot-to-root ratios, linking AGB to BGB

10. C change in the soil depends on:
□ Land use system, soil management regime, and organic matter input
□ Soil management regime, humidity, and deadwood decay
□ Land use system and organic matter input

SURNAME:	Name:

P6 – ESTIMATING UNCERTAINTIES

1. What would be a correct definition of uncertainty?
□ Lack of knowledge of the true value of a parameter, leading to overestimation or underestimation
□ Absence of knowledge of the true value of a parameter
□ Lack of knowledge of the true value of a parameter, leading to a systematic overestimation

2. What would be a correct definition of precision?
□ Agreement among repeated estimates
□ Agreement between estimates and the true value

3. What would be a correct definition of accuracy?
□ Agreement among repeated estimates
□ Agreement between estimates and the true value

4. A lack of precision can be the consequence of:
□ Systematic errors
□ Random errors
□ Systematic or random errors

5. An error of commission means:
□ Including an area in a category to which it does not truly belong, i.e., area overestimation
□ Excluding an area from a category to which it does truly belong, i.e., area underestimation

6. Compared to the accuracy assessment of land cover map, the accuracy assessment of land cover change map is generally:
□ Easier
□ More complex
□ Of similar complexity

7. What are the key components to address uncertainties in area change estimates?
□ Sampling design, response/reference design, analysis design
□ Radiometric processing, MMU, ground truth data
□ Geometric processing, visual interpretation, post-processing

8. What are the main factors for random errors in estimating EFs?
□ sampling error and allometric model
□ Instrumental precision and allometric model
□ Instrumental precision, sampling error, and allometric model

9. In the context of systematic errors in estimating EFs, what does "lack of completeness" mean?
□ Sampling plots not well distributed among forest strata
□ Significant C pools not monitored
□ Errors made by the field staff when compiling measures.

10. Combining uncertainty using the tier 1 uncertainty level assessment is:
□ Always feasible
□ Feasible under specific conditions
□ Better than combining uncertainty using the tier 2 uncertainty level (Monte-Carlo simulation), which is too complex

P7 – REPORTING OF GHG

1. In the context of the UNFCCC, "Accounting" means:
□ Getting GHG reporting data checked by a certified accountant
□ Using GHG reporting data to claim for result-based payment (in the case of Non-Annex 1) or to assess a Party's performance as compared to its binding commitment (in the case of Annex 1)
□ Providing information in National Communications.

2. Developed Countries (DCs) are expected to:
□ Regularly submit National Communications (NCs) and Biennial Update Reports (BURs). All DCs are concerned.
□ Regularly submit NCs. All DCs are concerned.
□ Regularly submit NCs and BURs. Least DCs and Small Island Developing States (SIDS) may submit at their discretion.

3. Sudan has already submitted:
□ 2 NCs (in 2003 and 2013) and a BUR (in 2018)
□ 1 NC (in 2013) and a BUR (in 2018)
□ 2 NCs (in 2003 and 2013)

4. To receive result-based payment under REDD+, a DC should:
□ Provide information on GHG reduced emissions / increased removals, as compared to its FR(E)L, in an Annex to its BUR
□ Provide information on GHG reduced emissions / increased removals in its NC
□ Send its forest inventory to the UNFCCC

5. Completeness implies:
□ Providing estimates for all the significant categories, gases, and pools, and explaining any gaps if they exist
□ Providing estimates for all the significant categories, gases, and pools, and inventing data to fill in the gaps when needed
□ Submitting estimates which are not systematically either over or under the true value.

6. A GHG inventory is made of:
□ Common Reporting Format (CRF) tables and a National Communication (NC)
□ A NC and a National Inventory Report (NIR)
□ A NIR and CRF tables

7. Notation keys are used in CRF tables for:
□ Ranking the level of accuracy of the estimates
□ Differentiating the land use categories
□ Explaining why certain cells are not filled in.

8. Retropolation means:
□ Archiving data from previous GHG inventories
□ Recalculating past estimates, by propagating backward any updated assumptions
□ Assessing the trend uncertainties

9. At a global scale, soil carbon emissions caused by deforestation are:
□ Marginal
□ Significant
□ Low

10. In a GHG inventory (GHGI), "key category" means:
□ Sources/sinks of emissions/removals that contribute substantially to the GHGI or are key sources of uncertainty in the overall trend
□ Key economic sector
□ Sources/sinks of emissions/removals that need to be monitored using tier 1 methodologies

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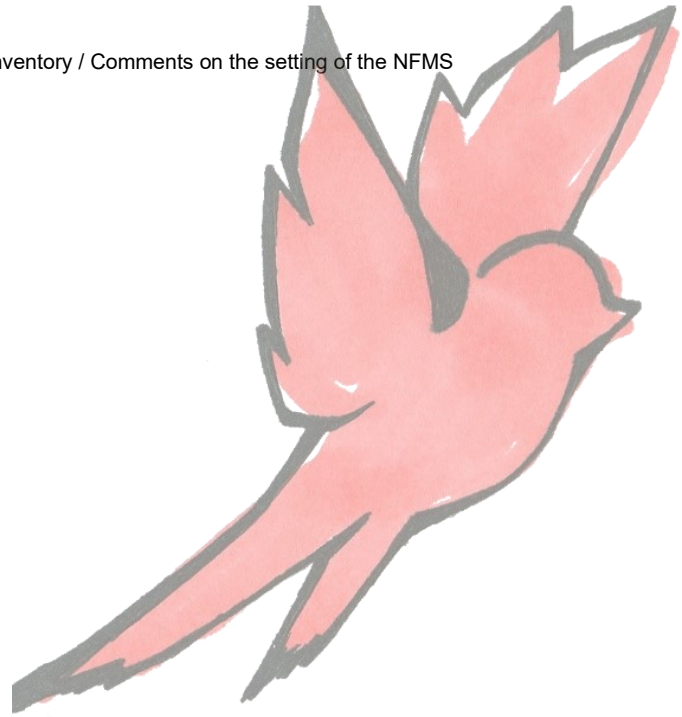
SURNAME:	**Name:**



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SAS SalvaTerra
6 rue de Panama
75018 Paris I France
Tel: +33 (0)6 66 49 95 31
Email: info@salvaterra.fr
Web: www.salvaterra.fr
Video: www.salvaterra.fr/fr/video