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Governing knowledge transfer for deforestation monitoring: Insights from REDD+ projects in the Congo Basin region

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1 **Governing knowledge transfer for deforestation monitoring: Insights from REDD+ projects in**
2 **the Congo Basin region**

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30 **1. Introduction**

31
32 Through the Reducing Emissions from Deforestation and forest Degradation (REDD+) program,
33 the United Nations Framework Convention on Climate Change (UNFCCC) aims to address the issue
34 of climate change mitigation due to forest loss (Change, 2010). The majority of developing countries
35 engaged in REDD+ Program depend on financial and technical assistance from developed countries
36 (Cerbu et al., 2011). Monitoring, Reporting and Verification (MRV) is a set of methods for monitoring
37 REDD+ activities and outcomes. MRV activities include measuring carbon stocks and emissions of
38 carbon dioxide and other greenhouse gases, reporting these measurements to different levels
39 (global/national/local), and verifying that the predictive reductions are effective (Palmer Fry, 2011,
40 Jagger et al., 2014). It is also a priority to ensure that REDD+ is implemented with environmental and
41 social safeguards, co-benefits and strengthened governance. MRV activities can be carried out at
42 different levels, with local ground truth information being one of the main elements of the process.
43 Building a data system for the national context implies bringing together real information using
44 different local on-the-ground examples. This can help provide an accurate picture of the real carbon
45 stock situation, as well as past emissions, and guide future trends of local deforestation and carbon
46 stock dynamics.

47
48 The ‘M’ of MRV, which refers to forest monitoring or measurement, is a challenge for forest-
49 rich countries. For some researchers, the measurement is part of the monitoring (Palmer Fry, 2011,
50 Larrazábal et al., 2012). It is the first step. Measuring provides data on deforestation, which allows
51 stakeholders to follow the evolution of this deforestation (monitoring). MRV needs practical tools that

52 will help countries be autonomous in their monitoring. However, many barriers remain to MRV
53 effectiveness because technological development is still at an early stage (Sufo Kankeu et al., 2016,
54 Sufo Kankeu et al., 2019, Romijn et al., 2012, Boissière et al., 2017).

55

56 The Congo Basin countries has been highlighted as a region with insufficient monitoring
57 capacities for REDD+ purposes (Romijn et al., 2012, Romijn et al., 2015). Most of these countries
58 have produced technical reports, but most usually with external funding and technical assistance from
59 Western experts. To meet the requirements, recipient countries engaged in the REDD+ process must
60 have a thorough knowledge of their forest carbon stocks and the ability to monitor these carbon stocks
61 in space and time at the national level (Gupta et al., 2012). Methods, skills and funding needed for
62 such carbon measurements have been provided by Western aid donor agencies if targeted forests and
63 recipient actors were located in ‘weak’ or ‘fragile’ tropical countries (Karsenty and Ongolo, 2012).
64 Consequently, these tropical countries have been in a recurrent need of technical knowledge and
65 financial means to perform the process, particularly in the areas of the forest monitoring, biomass and
66 carbon stock evaluation, forest mapping and reporting systems required to claim a payment (Romijn et
67 al., 2012, Romijn et al., 2015). To complement the national/local expertise that exist in central African
68 countries, external knowledge has been brought in through projects and programs in the form of
69 external scientists and experts from universities and other private, bilateral and multi-national actor.

70

71 Apart from discussions during ad-hoc UNFCCC scientific working groups lead by western
72 scientists, such as the SBSTA¹, there are few formal platforms set up to communicate scientific
73 knowledge at the local level (Tchatchou et al., 2015, Brown and Sonwa, 2015). To fill this gap,
74 informal schemes have emerged, based on the interest of stakeholders engaged in the REDD+ process.
75 In order for such scheme to succeed, several questions need to be addressed: What are the obstacles or
76 bottlenecks that exist in transferring knowledge from the international to the national and local levels?
77 Are there any constraints on top-down knowledge transfer? In the context of Central Africa countries,
78 do stakeholders have enough of an institutional framework to acquire MRV knowledge? In this paper
79 we aim to use these subsidiary questions to examine three empirical case studies from Cameroon, the
80 DRC and Rwanda. We set out to analyze MRV knowledge production and transfer, to identify
81 obstacles and propose a key scheme for concrete transformational change of MRV knowledge transfer.
82 This paper focuses not only on knowledge transfer but also on the stakeholders, their attitudes to MRV
83 knowledge and their interactions. At the same time, we comparatively analyzed three case studies
84 (Cameroon, the DRC and Rwanda) employing a recent and highly innovative analytical framework:
85 the Research-Integration-Utilization (RIU) model (Böcher and Krott, 2016b).

85

¹ The Subsidiary Body for Scientific and Technological Advice (SBSTA) is one of two bodies permanently established by the Conference of Parties (CoP) to help provide up-to-date scientific and technological advice to the CoP.

86 Following this introduction, Section 2 is dedicated to the conceptual and theoretical framework.
87 This is followed by methods and data collection in Section 3. Our findings and analyses are presented
88 in Section 4, and discussion and implications in Section 5, while Section 6 provides some concluding
89 remarks.

90

91 **2. Conceptual and theoretical framework**

92

93 **2.1. On the exogenous, local and scientific features of knowledge**

94 Endogenous knowledge, also known as ‘local knowledge’ (LK), is contrasted in this paper
95 with exogenous knowledge, otherwise known as ‘scientific knowledge’. Local knowledge covers the
96 indigenous, traditional, innate knowledge that is associated with local rural people’s way of life. Many
97 definitions of LK co-exist in literature (Heyd, 1995, Mawere, 2010, Sonwa et al., 2009, Warburton and
98 Martin, 1999). However, the definition proposed by Warren (1991) is particularly interesting in terms
99 of this research. According to Warren (1991:1), local knowledge refers to “a knowledge that is unique
100 to a given culture and society which is passed down from generation to generation and is the basis of
101 local level decision making concerning agriculture, health, natural resources management”. According
102 to this definition, the specificity of LK is that it is a knowledge that has been historically used to
103 ensure the livelihoods and survival of indigenous and local populations including forest-dependent
104 people. Exogenous knowledge (EK), in contrast, is produced through scientific methods that have
105 been codified, tested and archived in order to be replicated and improved. Exogenous refers to
106 scientific knowledge produced by scientists and research institutions based on rigorous validated
107 methods (Warren, 1991, Agrawal, 2014). It also refers to secondary synthesized knowledge on MRV
108 produced by policy makers and development institutions through the compilation of scientific
109 knowledge. EK is often assimilated to Western knowledge as it is formally rational-based, more or
110 less available to everyone, rigorously tested, and broadly accepted as reliable.

111

112 Governance of knowledge transfer in this paper concerns how the deployment of co-
113 management processes influences knowledge production and transfer (Foss, 2007, Foss and
114 Michailova, 2009). The governance of knowledge transfer implies a clear identification of key actors
115 and their roles in the process of production, management and dissemination of knowledge within a
116 specific mechanism such as MRV in the framework of REDD+ implementation (figure 1). The
117 governance of knowledge transfer then is a formal process in which institutions are designated to
118 manage the knowledge, process or mechanism of transfer (platform, place, and means). Ultimately,
119 good governance of MRV knowledge results in the organization of transferring exogenous knowledge
120 to local or national actors so they can measure or monitor deforestation in developing countries.

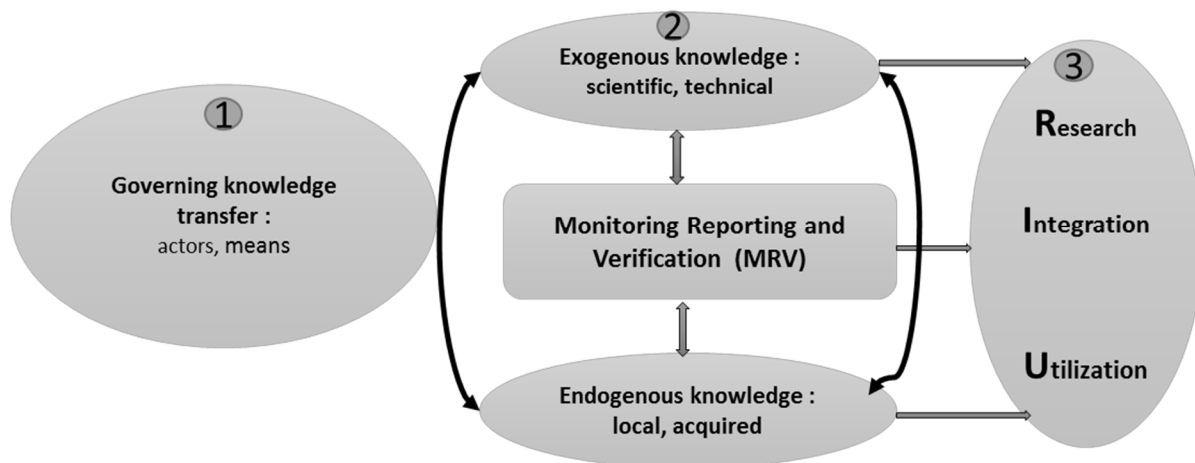
121

122 **2.2. Analyzing MRV knowledge transfer through RIU model**

123 This paper employs the Research-Integration-Utilization (RIU) model (see Figure 1)
 124 developed by Böcher and Krott (2016b) which is particularly appropriate for forest and environmental
 125 studies. The model was developed for types of scientific knowledge transfer that differ from classic
 126 knowledge transfer, which follows typical linear, functional and co-productive models (Böcher and
 127 Krott, 2014, Böcher and Krott, 2016b, Böcher and Krott, 2016a). In the context of REDD+, the notion
 128 of ‘Research’ within this model refers to scientific knowledge related to MRV. ‘Integration’ plays the
 129 role of interface between the scientific spheres and society; whereas ‘Utilization’ refers to the end-
 130 user, who is either in political or practical technical spheres.

131 RIU model has been applied to analyze multilevel issues of scientific knowledge transfer in
 132 environmental and forestry domains, especially in European (Heim and Böcher, 2016) and Asian
 133 countries (Dharmawan et al., 2016, Do Thi et al., 2017a, Nagasaka et al., 2016b). From a
 134 methodological perspective, the originality of the present paper is to test the governance of knowledge
 135 under a specific environmental technical tool called MRV.

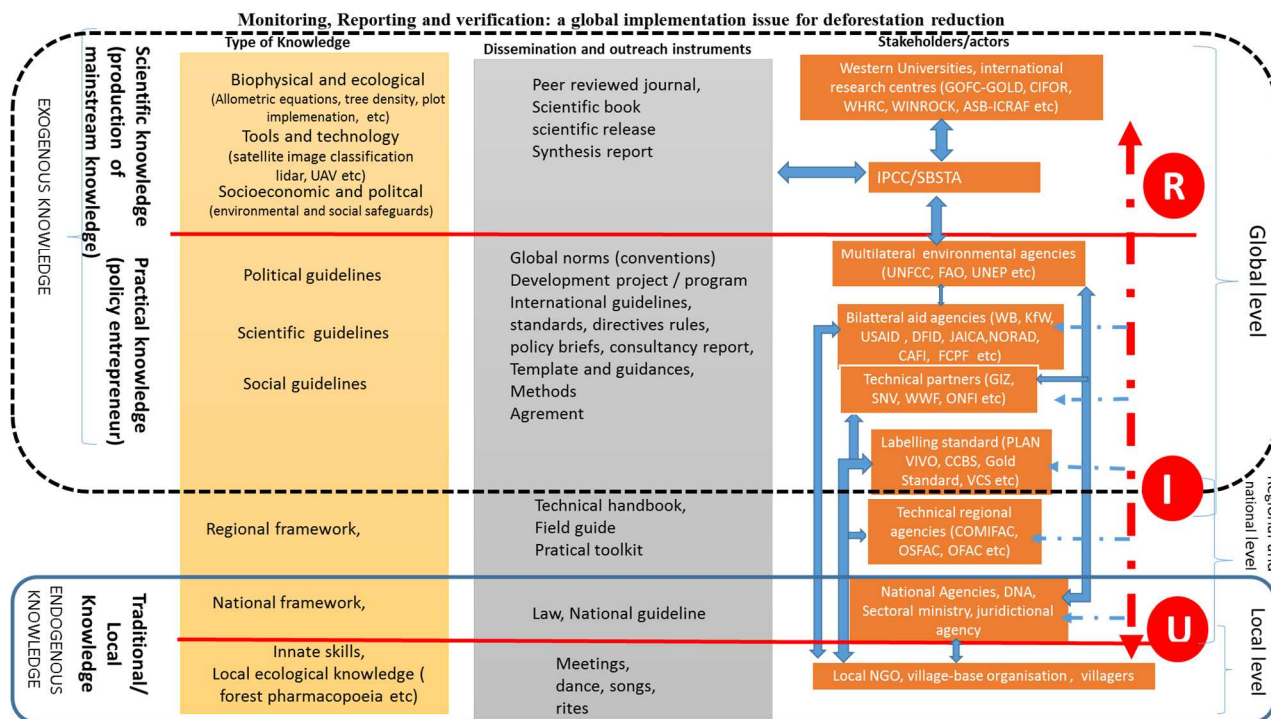
136 The conceptual framework (Figure 1) summarizes the directions taken to clarify our
 137 research question. We are interested in the governance of knowledge transfer, focusing on the actors
 138 and their means (1). This leads us to highlight the transfer of exogenous and endogenous knowledge
 139 essential for the elaboration of MRV devices (2). Data collected and described are finally analyzed
 140 with respect to the RIU model (3).



141
 142 Figure 1: Conceptual framework of a knowledge transfer system (adapted from the RIU model)
 143

144 MRV knowledge transfer represents a complex framework of global knowledge transfer, from
 145 the scientific arena to the local-level end user, passing through the political and institutional arena. The
 146 framework in which we intend to consider knowledge transfer consists of a crosscutting edge in which
 147 there are three variables: i) the typology of the knowledge produced, outreach instrument and
 148 stakeholders; ii) the knowledge domain with the exogenous and endogenous knowledge; iii) multiple
 149 scales covering global, regional, national and local levels. As shown in Figure 2, the scientific

150 knowledge can be divided into three sectors for the purpose of MRV: biophysical and ecological; tools
 151 and methods; and socioeconomic and political. The knowledge is disseminated through scientific
 152 papers in peer-reviewed journals. As these journals mostly target a scientific readership, the
 153 information they convey can easily be overlooked by political and practical stakeholders. Three main
 154 elements are considered: stakeholders, dissemination instruments, and type of knowledge (Figure 2).



155
 156 Figure 2: Framework design of scientific knowledge and actors according to the RIU model
 157

158 Endogenous knowledge produced at the local level, or learned through experience during
 159 contacts with external development partners is also relevant to MRV. Presence of environmental,
 160 social and development partners, whether through bilateral or multilateral partnerships, can make a
 161 difference at the local level during MRV activities. Depending on local contacts, relationship between
 162 the local people and the forest, and presence of development organizations, skills developed by local
 163 communities can help with the monitoring of both forest and the environment. As such, the
 164 constructed and innate knowledge that can serve the MRV encounters scientific knowledge. These
 165 different knowledges will then need to mix to create new strong and effective knowledge. The
 166 knowledge conjunction created by the meeting and friction between different knowledge types has
 167 received little attention from scholars. The three case studies detailed below, based on pilot projects in
 168 Cameroon, the DRC and Rwanda, will constitute our empirical research cases.

169
 170 **3. Methods: data collection and case study contexts**

171 **3.1 Data collection**
 172

173 The collection of scientific data on MRV was initially conducted through intensive desk-
174 based research. Materials were found in peer-reviewed journals, scientific books or releases and other
175 scientific documents. Another set of materials was found in guidelines, reference works, and practical
176 toolkits developed by multilateral or bilateral funding agencies or labelling standard experts. The basic
177 Boolean operators ‘AND, OR, NOT or AND NOT’ were used to include and exclude documents not
178 in line with the overall theme of this paper. The selection was made based on any knowledge or data
179 that referred to REDD+ MRV or that could help build the MRV process. This literature search was
180 based on key word research using mainly Google Scholar and occasionally Google. We based our
181 method on interviews with key informants at international, national and local levels. Information was
182 collected during meetings involving one, two or many of the following actor categories: REDD+
183 experts, scientists, policy entrepreneurs, donors and technical partners. Data collection on the case
184 studies was completed in person by the first author of this paper from May to August 2014 across the
185 three field sites; a couple of update processes were made after this period of field work.

186 Additionally, based also on our experience in these study areas, we formulated hypotheses
187 and analyzed results from the field. The substantial experience of the first author as a ‘scientific
188 expert’ with institutions; at both local and international levels, was useful for identifying the correct
189 roles of many of the organizations involved in REDD+ processes and their influence on the production
190 and dissemination of knowledge within climate management. We used RIU model to characterize
191 stakeholders and their role, to analyze possible barriers to knowledge transfer within the REDD+
192 mechanism in the Congo Basin.

193

194 **3.2. Case study contexts**

195 Spanning approximately 175 million hectares (De Wasseige et al., 2013), forest in the
196 Congo Basin plays a very important ecological, social and economic role for global biodiversity and
197 climate change mitigation (Mayaux et al., 2013). The three forest landscapes in Cameroon, the DRC
198 and Rwanda (Figure 3), analysed in this article are located in distinct political and forest governance
199 contexts that affect MRV knowledge transfer differently, particularly in terms of use or misuse of local
200 knowledge.

201 During implementation of this research from 2014 (data collection) to 2018 (data analysis),
202 Cameroon was more or less considered to be an emerging country with a relatively stable political
203 system. The country had a medium degree of forest law enforcement. During the same period the
204 DRC, a post-conflict country, had a decentralized state organization system and was impacted by
205 extreme poverty and collapsed forest regulation. Conversely, Rwanda, although also a post-conflict
206 country, was a strongly centralized and authoritarian state with strong forest law enforcement. At the
207 time of this research, Rwanda was considered to be one of Africa’s most prosperous tropical countries.

208 These three countries have high forest coverage with 30% of Rwanda, 46% of Cameroon and
209 59% of DRC covered by forest (Megevand et al., 2013, Rwanda, 2013). The three countries have

210 developed relatively advanced institutions and governance frameworks for deforestation monitoring
211 and reporting. Equally, they all embraced the REDD+ mechanism simultaneously, each struggling to
212 prepare the institutional, technical and financial framework required for REDD+ implementation.
213 Cameroon is a specific case, as far as the REDD+ process and national institutions are concerned
214 (Tsayem Demaze et al., 2015). As such, the Cameroon case study is more receptive and aware of
215 technical monitoring than other countries. In contrast, the DRC and Rwanda cases are more complex
216 due to both the administrative organization of these countries and to the sociological level of the local
217 people. As shown in Table 1, the DRC case is inappropriate for effective MRV knowledge transfer
218 due to the formal over decentralization, weak state representation and local illiteracy. The absence of
219 forest, high centralization of the state, and medium levels of literacy among local people in the
220 northwest of Rwanda are some of the difficulties that have defeated efforts in this country.

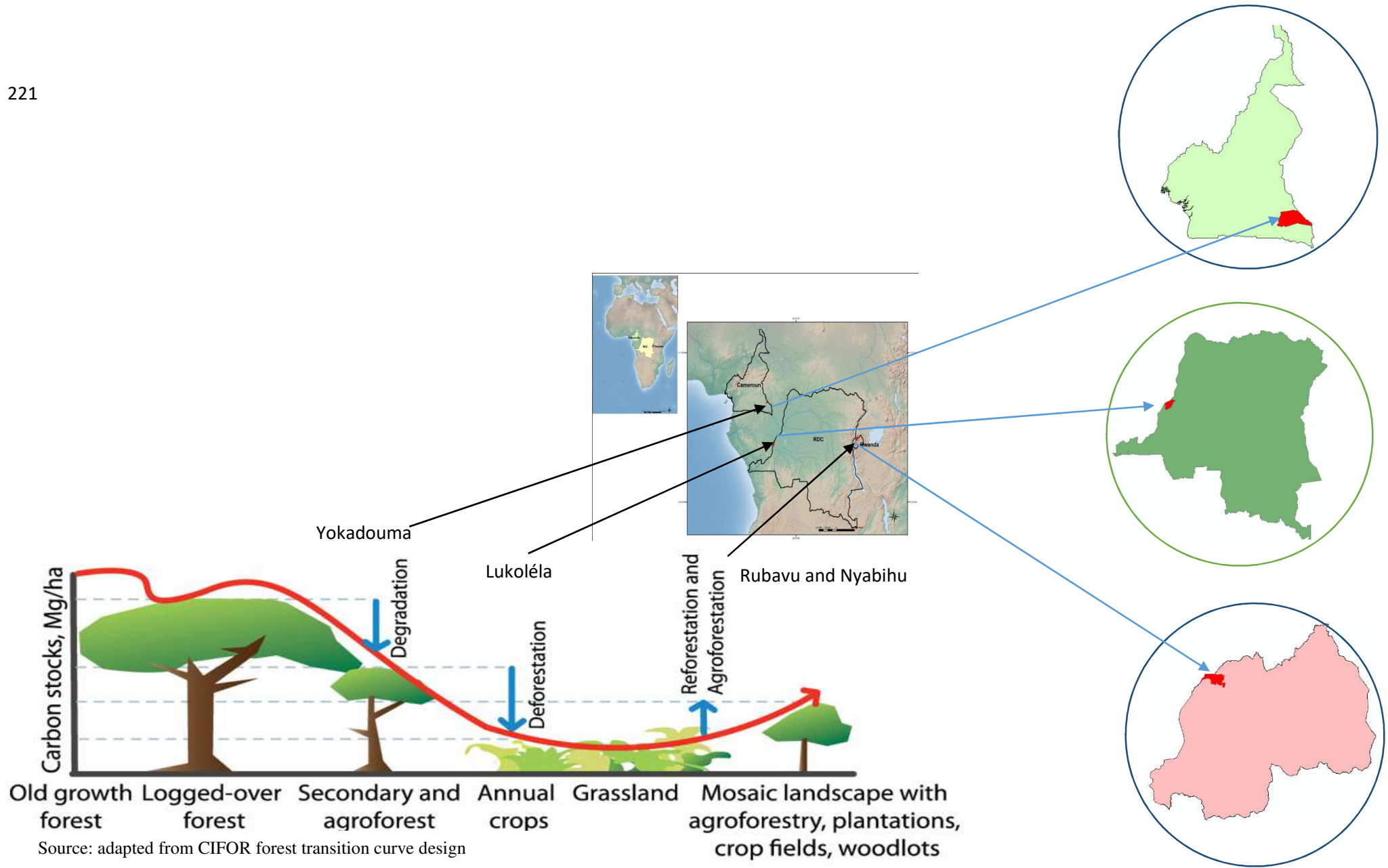


Figure 3: Location of the three pilot sites in the Congo Basin region

222 **Table 1:** brief description of the forest governance and socioeconomic context of study sites.
 223

Domain	Yokadouma Cameroon (TNS LS)	Lukolela DRC (Lac Télé-Lac Tumba LS)	Nyabihu and Rubavu Rwanda (Virunga LS)
Forest governance and institution	<ul style="list-style-type: none"> • Robust law enforcement and implementation • Strong local institutions • Project in two community forests 	<ul style="list-style-type: none"> • Weak law enforcement • Weak local institutions and failure of government follow-up • Project in remote decentralized district 	<ul style="list-style-type: none"> • Robust law enforcement • Good local institution activities • Project in well-organized communities
Deforestation and degradation	<ul style="list-style-type: none"> • Degradation due to logging and agriculture activities 	<ul style="list-style-type: none"> • High deforestation due to ‘slash and burn’ agriculture, and forest logging 	<ul style="list-style-type: none"> • Reforestation and agroforestry (bamboo and eucalyptus plantations)
Socioeconomic and political context	<ul style="list-style-type: none"> • Stable country but with security issue in the east and north part and also secessionist claims • Strong local experience and traditional knowledge of natural resource management 	<ul style="list-style-type: none"> • Weak state at local level a post-conflict status (rural poverty) • Poor experience on forest monitoring but good local knowledge 	<ul style="list-style-type: none"> • Decentralized next to centralized state in a post social crisis context (risk of conflict from Goma in the DRC) • Poor local experience on forests but good reporting skills

224 LS: Landscape, TNS: Sangha Trinational, a landscape that cover protected forest between Central African Republic, Cameroon and Congo-
 225 Brazzaville.
 226
 227
 228

229 **4. RESULTS**

230 **4.1. Actors and MRV knowledge transfer: from fragmentation to complexity**

231 **4.1.1 Mapping a constellation of actors of knowledge governance in the DRC**

232
 233
 234 In the north-west of the DRC, years of civil war and the weakness among local institutions
 235 have created socio-political disorder that encourages uncontrolled deforestation. Forest governance has
 236 been highly impacted by years of extreme poverty and poor governance. While many actors recognize
 237 that efforts have been made at the national level to push the REDD+ process forward, independent
 238 observers highlight that a large part of the technical work remains to be done. For example,
 239 international NGO expert are very skeptical about the progress of the REDD+ process due to the
 240 compartmentalization of actors. Following Schusser et al. (2016) works on the notion of ‘actor’ in
 241 comparative research, we broke down the governance structure of REDD+ institutions in the DRC into
 242 national and international technical partners, civil society organizations, national institutions,
 243 development actors or donors, and research institutions (Table 2).

244 With regards to institutional organization, the national strategy stipulates that the DRC
 245 should have a multisector anchorage. The process was led initially by the National REDD+
 246 Coordination (CN-REDD) attached to the Directorate of Sustainable Development. Subsequently, the
 247 National REDD+ Fund (FONAREDD) led the process in the Multi-Partner Trust Fund Office (MPTF)
 248 under the leadership of the UNDP. The main role of FONAREDD is to ensure inter-sectoral
 249 coordination, resource mobilization, and the monitoring of the fiduciary implementation of projects.

250 This inter-ministerial committee, brings together representatives of national stakeholders, and is
251 responsible for strategic coordination and decisions. Within the DRC's state bureaucracy system, the
252 Ministry of Environment, Nature Conservation and Tourism (MECNT) is liable for forest
253 management. Other ministries involved are the Ministry of Agriculture, Fisheries and Livestock
254 (MINAGRI), the Ministry of Scientific and Technological Research (MINREST), the Ministry of
255 Energy and Water Resources (MERH), the Ministry of Communication and Media, and the Ministry
256 of Higher Education and Universities. Civil society organization are coordinated by the REDD
257 Climate Working Group (GTCR).

258 Civil society organizations contribute to the governance of knowledge and the REDD+
259 MRV system in the DRC. The Forest Peoples Programme (FPP), a non-state organisation engaged
260 with the CN-REDD and MECNT to implement the Free, Prior and Informed Consent (FPIC) of local
261 people on the agreement in REDD+ in the DRC, is part of these civil society organizations. Donors or
262 development actors were represented by the likes of UNDP, NORAD, AfDB, the World Bank and
263 FAO. Technical and research partners influencing the MRV system in the domestic sphere were
264 mainly represented by the Catholic University of Louvain (UCL) – a Belgium academic institution,
265 International research Institute for Applied Systems Analysis (IIASA), the Japan International
266 Corporation Agency (JICA), the World Resource Institute (WRI), Woods Hole Research Centre
267 (WHRC) and the Center for International Forestry Research (CIFOR). The technical organisation, like
268 World Wide Fund for Nature (WWF), Wild Conservation Society (WCS), and African Model Forest
269 Network (RAFM), have been involved for years in the technical training of actors (Table 2).

270 According to REDD+ national strategy and discussions with experts, there is no formal
271 structure for MRV knowledge transfer. In the absence of a state bureaucratic management structure for
272 REDD+ MRV issues in the DRC, private actors and research institutions have stepped into the void.
273 Little information on MRV were flowed from the National REDD+ leading institution FONAREDD
274 to the district level. At the project level in Lukolela, the forest district officer was the main local actor,
275 but had no real power to influence the REDD+ MRV system. From a socio-political perspective, the
276 local situation is not bright, civil war and political instability have occurred since independence was
277 declared in the early 1960s.

278

279 **4.1.2. Actors governing MRV knowledge transfer in Cameroon**

280 The southern part of Cameroon is a forested area subject to selective forest exploitation.
281 Forestland tenure in this region is organized into two categories: permanent forest and non-permanent
282 forest. The first category is divided into Forest Management Units (FMU), forest reserves, protected
283 areas, communal forests and hunting zones. Non-permanent forest consists up of community forests
284 and sales standing wood volume. Organization of forestland into these categories has slowed down
285 uncontrolled deforestation particularly in the permanent forest domain (Chia and Sufo Kankeu, 2015).

286 Until 2017, the overall process of REDD+ was formally supervised by a steering committee
287 under the prime minister; this was handled technically by the Ministry of Environment, Nature
288 Protection and Sustainable Development (MINEPDED), and supported by a technical secretary of
289 REDD+ for the management of MRV issues. The Ministry of Forests and Wildlife (MINFOF) co-
290 chaired MRV activities with MINEPDED.

291 Other multi-scale and multi-sector actors were also involved in MRV and knowledge
292 transfer activities, including the focal points of the United Nations Framework Convention on Climate
293 Change (UNFCCC), the National Observatory on Climate Change (ONACC) and the National
294 Coordinator of REDD+ who all played an important role. Alongside the technical ministries, the
295 Ministry of Scientific Research and Innovation (MINRESI), the Ministry of Higher Education
296 (MINESUP), and the Ministry of Territorial Administration and Decentralisation (MINATD) were all
297 involved in the production and circulation of knowledge. Civil Society organisations (REFACOF,
298 ROS4C), international conservation NGOs (IUCN, WWF), technical financial partners (GIZ, FAO,
299 US Forest Service, UNDP) and development partners (AfDB, World Bank), all contributed through
300 their partnerships with MINFOF and MINEPDED.

301

302 **4.1.3. Actors governing MRV knowledge in Rwanda**

303 Rwanda suffered a tragic civil war and genocide that obstructed the development of social
304 and educational structures, particularly from the early 1990s to end of the 2000s. As seen in many sub-
305 Saharan countries including the DRC and Cameroon, a lack of efficient energy sources for cooking
306 has led to massive deforestation of forestlands since the 1990s. However, post-genocide environmental
307 education initiatives and law enforcement measures in the forest domain have led to high reforestation,
308 with the popularization of the ‘family forest’². State bodies are strong and well-structured with
309 efficient local representation, including those bodies in charge of the forest, environmental and
310 education sectors: the Ministry of Environment and Natural Resources (MINIRENA), the Ministry of
311 Local Government (MINALOC) and the Ministry of Education (MINEDUC). These state bodies are
312 the main handlers of knowledge, transferring from international institutions to local actors. Among
313 those stakeholders actively engaged in Rwanda’s climate change activities, many are involved directly
314 or indirectly in knowledge transfer, including the Ministry of Lands and Forestry, through the Rwanda
315 Water and Forestry Authority (RWFA), and the MINIRENA, through the Rwanda Environment
316 Management Authority (REMA). The Rwanda Development Board (RDB), which manages national
317 park forestland, the Rwanda Agricultural Board (RAB) and the Rwanda Natural Resources Authority
318 (RNRA) coordinated knowledge-transfer activities. The National Industrial Research and

² According to Rwanda’s forest law, ‘family forest’ refers to a private forest owned by one family; this is present in almost all family plots.

319 Development Agency (NIRDA) stands out as a research institution involved in biodiversity
 320 assessment training, closely related with MRV activities.

321 Local actors include District Forestry and Natural Resources Officer and Forestry Extension
 322 Officers. According to the national Forest Investment Plan (FIP), the roles of actors is formally
 323 clarified from state to the district level. A number of institutions are involved in decentralized action,
 324 from national to local level. This action is supervised by many centralized technical institutions (RDB,
 325 REMA, RAB and RNRA) that are strongly legitimated by the state, and offer the advantage of having
 326 built up a sustainable scheme. In the Nyabiyu and Rubavu areas of west Rwanda, the situation differs
 327 with regards decentralization and actors. At village level, the lowest administrative unit, all actors are
 328 involved in reforestation. In villages like Rurengheri, Rukoma, and Kanyove for example, forest
 329 plantation has been increasing so fast that each family has their own eucalyptus plot. Outside of local
 330 and national NGOs, however, few organizations exist at village level, thus weakening the flow of
 331 knowledge.

332

333 4.1.2. Institutional issue and knowledge governance

334 Analysis of the actors involved in knowledge transfer in the three case studies shows
 335 different stages of responsibility in MRV knowledge governance (Table 2). Of all categories, technical
 336 institutions are the most involved.

337

338 Table 2: Mapping of key institutions involved in MRV knowledge transfer in Cameroon, the DRC and
 339 Rwanda

340

Government institution		DRC	Cameroon	Rwanda
	Ministries	MECNT, MINAGRI, MINREST, MERH,	MINEPDED, MINFOF, MINRESI, MINESUP, MINATD;	MINIRENA, MINALOC MINEDUC,
Technical institution	FONAREDD, CN-REDD, GTCR	STREDD+*, ONACC,	RDB, REMA, RAB, RNRA,	
Technical partners	GIZ*, WCS, WWF, RAFM, VCS*, CCBS*, COMIFAC*, WRI, JICA PREREDD*, UNDP*, PACEBco*, IUCN*, VCS*, CCBS*	GIZ, FAO, US forest service UNDP, IUCN*, COMIFAC, PREREDD, WWF*, PACEBco, IUCN, VCS, Plan vivo*	WCS, BTC*, NUFFIC* COMIFAC, PACEBco, UN-REDD+, IUCN	
Research organization	Universities, IIASA, WHRC, CIFOR*, UCL	IIASA, Universities, CIFOR*, ICRAF*, CIRAD*	Universities, NIRDA, ICRAF, CIFOR	
Donors	UNDP*, FCPF*, NORAD*, AfDB*, World Bank, FAO*, UN-REDD+, CEEAC*	FCPF, NORAD*, AfDB, World Bank, FAO, UNDP, PACEBco, CEEAC	USAID, AfDB, World Bank, UN-REDD+, Australian Aid, PACEBco, CEEAC	
Civil society organizations	OIP*, FPP,	REDD+ and climate change platform, RFC*, REFACOF*, ROS4C*	ARECO-Rwanda Nziza* ,	

341 *AfDB: African Development Bank; ARECO-Rwanda Nziza: Association Rwandaise des Ecologistes; BTC: Belgian Development Agency;
 342 CCBS: Climate, Community and Biodiversity Standard; CEEAC: Economic Community of Central African States; CIFOR: Center for

343 International Forestry Research; CIRAD: French Agricultural Research Centre for International Development; COMIFAC: The Central
 344 African Forest Commission; ECCAS: The Economic Community of Central African States; FAO: Food and Agriculture Organization;
 345 FCPF: Forest Carbon Partnership Facility; GIZ: German International Cooperation Agency; ICRAF: World Agroforestry; JICA: Japan
 346 International Corporation Agency; NORAD: Norwegian Agency for Development Cooperation; NUFFIC: Netherlands Organization for the
 347 Internationalization of Education; ONACC: National Observatory on Climate Change in Cameroon; PACEBco: The Congo Basin
 348 Ecosystems Conservation Support Program; PREREDD: Projet Régional REDD+; REFACOF: African Women's Network for Community
 349 Forest Management; RFC: Community Forestry Network; ROS4C: Cameroonian Civil Society Organizations Network on Climate Change;
 350 STREDD+: National REDD + Strategy of Cameroon; UNDP: United Nations Development Program; UNREDD: United Nations REDD
 351 Program; VCS: Voluntary carbon standard; WRI: World Resource Institute.

352 MRV knowledge transfer in the Congo Basin region is often handled by foreign actors
 353 recruited by development organizations, technical and financial partners and research organizations.
 354 National partners often act as support entities for MRV initiatives coming from abroad, while local
 355 actors are usually those most aware of any knowledge transfer issues due to the related effects on their
 356 livelihoods. We observed that local-level forest monitoring knowledge were more useful for a
 357 domestic implementation of REDD+ MRV activities than imported expertise. For this reason, research
 358 organizations and international actors occasionally work directly with local-level actors circumventing
 359 national actors and institutions. Projects from abroad come with significant technical knowledge to be
 360 absorbed. Relationships between researchers and local communities are frequent due to the need to
 361 validate research results or implement development or research projects. These relationship strengthen
 362 the capacities of those rural people who will be involved in projects thus building an important pool of
 363 local experts.

364 4.2. Scrutinizing MRV knowledge transfer through the RIU model

365 Both the production and dissemination of MRV knowledge remain complex in the Congo
 366 Basin due to fragmentation of the multiple actors interacting through erratic formal platforms. The
 367 model aids in identifying and analyzing bottlenecks that can slow the process within a REDD+ context
 368 in Congo Basin context (Table 3).

369 Table 3. An assessment of MRV knowledge transfer in the Congo Basin based on the RIU model.

RIU Model activities	Criteria	Fulfilment of criteria*	Description of MRV activities
Research	Assess current scientific information	++	MRV is one of the most important aspects to be assessed through the REDD+ process
	Complies with procedures of sound practice	++	Methods provided in the research are accurate, practice and credible
	Cooperates with scientific project and institution	++	Much of the research is based on scientific projects and research institutions
	Provides independent meaningfulness of scientific findings	++	Finding have been provided based on allometric equation, plot implementation, remote sensing and carbon stock modeling. however databases do not meet

			high scientific standards
Integration	Oriented toward public goals and demand	+	The main goal is evaluation of GHG and forest carbon stock.
	Relevant to political processes	++	All data produced on MRV are in reaction to challenges in the field
	Relevant to internal, external, 'wise' and learning allies	+	All allies (stakeholders) should be able to access the results of research, regardless of whether support is provided or not
	Target group oriented information provided in the right medium	--	Scientific results in scientific journals and books are not accessible to all;
Utilization	Participates in scientific discourse	++	Contributes to scientific discussion; discussions around MRV issues have been very productive over the last decade.
	Contributes to democracy	--	Politics has not really changed with REDD+ implementation (if some aspects of governance have improved, there is no clear link between these improvements and the REDD+ process).
	Contributes to rule of law	+	New legal institutions, texts and decrees have been created from the MRV implementation process (e.g. national institutions, like STREDD+ and ONACC in Cameroon, and FONAREDD in the DRC, have been created to lead the MRV process).
	Contributes to good governance	+	The REDD+ scheme has largely contributed to the good governance of natural resources and changed the behaviors of civil servant
	Provides appropriate solutions to problems	++	MRV scientific publications provide solutions to policy and local MRV issues, but need to be accessible

370 *Score: fulfillment of the criteria from strong to weak: ++, +, -, --;

371 As presented in the table, the MRV knowledge has a strong research background, a weak MRV
372 knowledge integration and a mitigated direct utilization

373 **4.2.1 MRV knowledge: strong research focus for poor dissemination**

374
375 The in-depth analysis behind Table 3 has shown that the scientific knowledge produced by
376 scientists, accessed through peer-reviewed papers and scientific releases, is not always useful for
377 actors in the Congo Basin, as utilization of this scientific knowledge is often not possible for REDD+
378 actors who are not from academic spheres, due to the limited accessibility and publication language
379 (English) of peer-reviewed papers, particularly when the majority of Congo Basin countries are
380 French speaking. There is a need to select and customize scientific knowledge to be adapted to those
381 actors who are not from academic spheres. Following the principles of the RIU model, press releases,
382 toolboxes, guidelines, policy briefs and technical handbooks could all be used as the main
383 dissemination tools for efficient MRV knowledge transfer in the Congo Basin. Likewise, international
384 scientific organizations like IPCC, SBSTA, IUFRO, CIFOR, FAO and GOFC-GOLD, GFOI³, which

³ GFOI : Global Forest Observations Initiative ; GOFC-GOLD : Global Observation for Forest Cover and Land Dynamics

385 have been identified as the main producers of MRV knowledge, should adopt specific measures for
386 appropriate dissemination of scientific knowledge to the general public.

387 **4.2.2. Weak MRV knowledge integration**

388 The huge amount of data on MRV produced since the launch of REDD+ at the end of the
389 2000s contrasts with the lack of ‘accessible’ scientific knowledge available for policy makers and
390 local actors. Likewise, not all stakeholders – ‘allies’ in RIU model terminology – are always involved
391 in the production of MRV knowledge, nor in the integration process of its transfer. In the case of
392 Cameroon, for example, the central organization in the REDD+ process, STREDD+, struggled to
393 transform technical and scientific documents into accessible formats for local and forest-dependent
394 people. Ultimately, little has been done to facilitate effective ownership of MRV knowledge through
395 the REDD+ process in the Congo Basin. In the project site of Yokadouma in Cameroon, it was
396 challenging to find anyone who was informed about the issue of climate change, let alone the REDD+
397 process.

398 **4.2.3. Mitigated direct utilization**

399 Low integration of knowledge alters the utilization of knowledge. Usually, the targets of
400 scientific knowledge are academic and research actors, rarely policy makers and local population. In
401 other words, results and explicit or implicit recommendations in scientific papers do not reach the
402 appropriate audience who can change society, particularly in the context of social and political
403 uncertainties, as seen in Congo Basin countries. In this region, policy actors in state bodies are still
404 requesting knowledge and technology transfer within REDD+ arenas to curb domestic forestland
405 conversion. Creation of national institutions to handle the REDD+ process, as seen in Cameroon and
406 the DRC, give hope for the effective transfer and utilization of MRV knowledge. In Cameroon and the
407 DRC, the launch of national-level REDD+ strategy documents indicates that improving the circulation
408 of MRV knowledge would be a good starting point toward ownership of the REDD+ process in the
409 countries.

410 **4.3 Barriers around MRV knowledge transfer in the Congo Basin**

411 Looking at the principles of the RIU model, strong internal integrators of knowledge are still lacking
412 for rigorous monitoring of deforestation and forest degradation in the DRC, Cameroon and Rwanda.
413 The case of Maï Ndombé in the DRC is an interesting example. Maï Ndombé has been a project with
414 many interventions and funding flows for a range of REDD+ activities, including for MRV knowledge
415 production and transfer. While such interventions and financial resources have led to the improvement
416 of MRV tools and methods, there are still bottlenecks relating to the management and coordination of
417 this project.

418 Country profiles also influence the transfer of MRV knowledge from the national to local level. As an
419 example, the political and social context of the DRC is less favorable for efficient MRV knowledge
420 production and transfer than Cameroon or Rwanda. Civil war, a rocky decentralization process and
421 extreme poverty have tended to reduce the capacity of state bodies in the DRC, in terms of the co-
422 production and ownership of scientific knowledge needed for robust implementation of REDD+ in the
423 country. There is continuous external technical assistance, without which key sectoral ministries
424 involved in REDD+ would have not been able to produce and use MRV knowledge. In contrast, due to
425 the political stability and relative institutional strength in Cameroon and Rwanda, these two countries
426 seemed to be almost ready to carry out REDD+ processes at a domestic level.

427 Among the three countries analyzed in this paper, the DRC is a prime example of advanced
428 decentralization. From district to provincial and national level, decentralization has become a barrier
429 for knowledge transfer. Poverty is exacerbated by decentralization, demonstrated by the fact that rural
430 people are very far from central command. In a country as large as the DRC, it is fairly difficult to
431 ensure knowledge transfer from the national to the provincial level in the absence of an institutional
432 framework for that purpose. Forest management has therefore been impacted by this socioeconomic
433 and political instability. The Cameroonian and Rwandan cases are very similar in so far as governance
434 and decentralization is concerned, although the Rwandan decentralization is stricter than that of
435 Cameroon. The Rwandan Governance Board (RGB) has been engaged in decentralization since the
436 early 2000s without significant change; this has involved vertical decentralization, where the central
437 government remains the principal element and local people are agents. This political will for
438 decentralization has helped to transfer forest management responsibilities to local people, and this
439 transfer has been transformed into knowledge.

440 **5. Discussion**

441 In this paper, we have outlined the governance of MRV knowledge and examined the distinction
442 between exogenous and endogenous knowledge in the Congo Basin context. MRV knowledge
443 governance in the three case studies (the DRC, Rwanda and Cameroon) is influenced by the different
444 contexts of these countries. We have shown that these three countries have significant differences in
445 terms of their political and forest governance; this predisposes them to a management system for the
446 transfer of specific scientific knowledge. Actors involved in knowledge transfer do not follow any
447 formal frameworks, instead adapting their practices depending on the specific country context,
448 including political contexts at the domestic level.

449

450 **5.1 Exogenous knowledge vs endogenous Knowledge?**

451 Traditional/endogenous knowledge and management practices have recently been
452 embraced, particularly in relation to helping local communities and forest-dependent people to adapt

453 to climate change; this has included adjusting agricultural calendars, improving crop selection, and
454 management of forest and woodland species. This is in stark contrast with how endogenous
455 knowledge has been neglected and ignored since colonization in former Western colonies like those in
456 the Congo Basin region, where indigenous people were not supposed to produce useful knowledge
457 (Coquery-Vidrovitch 2017). With the emergence of REDD+, it is well known that local populations
458 can substantially contribute to the measuring and monitoring of forest biomass and carbon stocks, if
459 the key scientific elements required are transferred to them (Danielsen et al., 2013).

460 **5.2 The RIU model**

461 This paper demonstrates how the RIU model can be applied to MRV knowledge transfer
462 analysis. The focus on MRV knowledge transfer in this article was motivated by the importance of the
463 issue within the REDD+ process in forest-rich countries like those in the Congo Basin. Scholars have
464 mainly been interested in knowledge transfer in REDD+ as a whole (Tchatchou et al., 2015, Oreskes,
465 2004, Houghton et al., 2001) rather than specifically knowledge transfer of MRV systems. Several
466 previous studies employing the RIU model have shown successful implementation of scientific
467 knowledge transfer at global, national and project-based levels (Do Thi et al., 2017a, Do Thi et al.,
468 2017b, Nagasaka et al., 2016a, Böcher and Krott, 2014). Conservation practitioners and local forest
469 management committees were actively engaged in implementing policy, as this is in accordance with
470 their respective interests. Actors then acted in their own interest, influencing local or national
471 stakeholders on how to use natural resources. Actors can selectively adopt specific environmental
472 idioms that can serve their own interests. Evidence provided by Pasgaard (2015) is in line with our
473 present finding on the knowledge transfer and interest of actors.

474 In contrast to these previous studies, the present paper has shown a complex pattern of
475 MRV knowledge transfer that cannot be understood through the RIU model alone, but that requires the
476 integration of transversal ‘policy entrepreneurs’ who play the role of integrator at all levels of
477 exchange. There is, then, a kind of “politicization of science” and “scientization of politics”, already
478 shown by Maasen and Weingart (2005) who confirmed the power relationships of actors at the
479 international level. There is a need not only for “wise allies”, as stated Böcher and Krott (2014), but
480 also an integrator, named by Pielke Jr (2007) as an “honest broker”. The assessment of knowledge
481 transfer through the lens of the RIU model shows compliance with the research aspects of MRV; there
482 is regard for research procedures, but also high availability of scientific data related to the concept of
483 MRV. However, there is a low level of stakeholder integration in each country’s knowledge transfer
484 platform, even where there is strong political will.

485 **5.3. Governance of MRV knowledge transfer in Congo Basin**

486 The diversity and differences among actors still pose significant problems for knowledge
487 transfer, due to conflicts and coordination difficulties, which have been reported at every stage.
488 Regarding conflicts of interest, the categorization of actors has shown that those engaged in MRV

489 knowledge production and dissemination have different interests. Political actors who use knowledge
490 only to serve their own interests have different orientations. As noted by Alemagi et al. (2014),
491 Minang et al. (2014), stakeholder coordination and collaboration remain the core barriers. This
492 observation is in line with what has been demonstrated in this paper. At present, decisions are not yet
493 followed by funding and concrete actions, and MRV schemes remain nascent, lacking true connection
494 between different scales. Decentralization seems to be a good solution for knowledge transfer in states
495 where efforts are made to unite actors with the same objective. MRV knowledge transfer goes beyond
496 the separate interests, as it includes political, donor, scientific and practical strategies. At this stage, we
497 propose that collaboration between scientific and local actors is encouraged and intensified, both to
498 enhance the integration and co-production of knowledge, and also to foster its utilization. It is difficult
499 to highlight commonalities between the diverse categories of actors working in climate and the
500 environment, mainly due to the countries' different governance systems, and the place that
501 environment and climate issues occupy in the countries' official agendas. The classification of these
502 actors in this paper is similar to Alemagi et al. (2014) but different to that seen in Schusser et al.
503 (2016) and Somorin et al. (2014). The lack of coordination between actors at all levels shows poor
504 integration and a failure of MRV knowledge transfer. A low level of scientific knowledge utilization
505 has been observed in the studied countries, due to weak stakeholder capacities but also due to a lack of
506 financial and intellectual resources. As a result, there is little integration and use of MRV-related
507 knowledge in the three case study countries.

508

509 **6. Conclusion**

510 In this paper, we set out to analyze MRV knowledge transfer; identify main stakeholders and analyze
511 obstacles for concrete transformational change regarding knowledge transfer. The conventional
512 knowledge channel, from international high-level panel to local-level community, can be broken down
513 into three steps in the context of REDD+. The production of knowledge is completed by scientists
514 with scientific methods to assess a problem and propose solutions. Stakeholders need to adopt the
515 innovation and apply the solution or technique to solve their MRV problem. This shows that MRV
516 knowledge transfer fits with the RIU model, but with some limitations. The first limitation is that the
517 RIU model is inadequate for covering the whole field of MRV. The second is that stakeholders were
518 collaborative at the international level of knowledge transfer, acting in their own interests, while at the
519 local level, knowledge transfer between scientists and local people is a real opportunity to synergize
520 the knowledge of these parties and emerge with more practical co-produced knowledge. Integration
521 and utilization are the weak spots of knowledge transfer as there has been very little integration and
522 marginal use of MRV-related scientific knowledge at the local level. A formal process, in which MRV
523 knowledge is transferred and followed up on, is also lacking. The Cameroonian case study is the most
524 efficient in terms of MRV knowledge transfer, and the most willing to enhance MRV knowledge
525 transfer, in contrast to the DRC, where highly decentralized districts do not have capacity to be

526 involved. As a whole, this study has shown that interactions between actors are more complicated than
527 anticipated. While the three case studies examined here are dissimilar in terms of bottlenecks, they all
528 face technical issues in terms of MRV implementation. As for removing these barriers, we propose an
529 inclusive synergistic approach, in which all stakeholders can reverse the present trend and contribute
530 to successful MRV implementation. This would involve a formal multi-scale platform being
531 established for interested and involved stakeholders, as well as the integration of co-produced
532 knowledge.

533

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545

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547

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