Report 1. Potential and challenges of DNA barcoding for the reinforcement of timber monitoring in Gabon and DRC

1. Executive summary

Stakeholder consultations were undertaken to obtain an overview of the current system of timber tracking in Gabon and DRC and identify if and how DNA barcoding may enable the strengthening of timber trade monitoring in these countries. Main research questions where: 1) what are the main control points and corresponding timber monitoring stakeholders in each country?, 2) do timber stakeholders in Gabon and DRC know about DNA barcoding? 3) do they think that this technique could strengthen the timber monitoring systems in place? and if so, 4) what would be the challenges to overcome for its successful implementation?

To address these questions, a questionnaire of 20 questions was designed and used to consult stakeholders. Moreover, a workshop was organised in Gabon so that stakeholders could provide further feedback on the utility of DNA barcoding once they would know better about it and could discuss challenges directly with project partners. Although a similar workshop was not organised in DRC, this was compensated by the fact that replies to the questionnaire were provided through interviews with project partner J. Lisingo, which enabled extended discussions on the topic with all respondents. Direct answers to the questionnaires could be obtained and analysed for 31 stakeholders in DRC and 7 in Gabon. Additional qualitative feedback was obtained from another stakeholders from Gabon. The results of an additional independent complementary study supervised by partner D. Bourobou and led by MSc student KC Essomeyo Engonga in Gabon, and of further consultations conducted by J. Lisingo in DRC were also taken into account.

The results of these activities enabled us to reply to our research questions. The main timber control points include the forest concession, roadside transport checkpoints and export points, but these are part of a very complex system of traceability, which is different in each country. In Gabon, the national system of wood traceability put in place in 2023 provides a numeric infrastructure while there is not such country-wide tool in DRC. Enabling further in-depth conversations between all types of stakeholders was perceived as essential for an accurate evaluation of the complex monitoring systems in place and to design potential improvements. This project enabled an increase of the awareness and knowledge of stakeholders around DNA-based identification of timber, which then enabled the revelation of forest concessions and customs export points as the main points of control where DNA tests could be most useful. Discussions with stakeholders also highlighted main challenges: i) the need to expand the DNA barcoding tools developed here for Meliaceae to all timber species of interest, ii) the need to strengthen species recognition in the field and the need for training in wood traceability techniques in general, and in DNA barcoding specifically if it is to be used, and iii) the need to develop quick and cost-efficient tests that can be

performed reliably at the export points.

To address these challenges, the following could be done: i) Adapting and evaluating the DNA barcodes designed for Meliaceae so that they can be used on all timber species of interest in the focus countries, focusing in priority on commercial species under high exploitative pressure, ii) Reinforcing and completing visual and DNA reference dataset for all species, iii) Ensuring all stakeholders can be trained as required by their role, notably through strengthening national and international collaborations between private and public organisations, including formation institutes, nationally and internationally, and iv) Testing the deployment of timber DNA barcoding in situ and in collaboration with the authorities of control and all relevant stakeholders. As visible throughout the feedback collected, the high level of interest among stakeholders to collaborate towards improving timber traceability systems provides a strong foundation for future projects addressing these priorities.

2. Relevant supply chain points

Building on the flowchart and review of Lowe et al. (Opportunities for Improved Traceability in the Timber Trade through Scientific Verification, 2016; https://academic.oup.com/bioscience/article/66/11/990/2754311?login=false), we distinguish eight main supply chain points where traceability checks could be implemented: Forest concession, Log yard, Sawmill, Processing workshop, Roadside transport checkpoints, Points of sale and Export points.

Conversations between project partners and with stakeholders (notably during the workshop in Gabon, see Report 3) have highlighted key sites of timber trade control corresponding to these supply chain points in Gabon and DRC, the corresponding organisms in charge of the controls, and individual stakeholders to consult.

3. Stakeholders

Stakeholders that were consulted to gain information about their knowledge on DNA barcoding and their opinion about its potential implementation for timber monitoring in their context are listed below by country. Consultations and conversations with all stakeholders were guided by a questionnaire (see section 4). Some stakeholders filled the questionnaire themselves while others responded to the same questions orally and replies were then transcribed by project partners. Finally, some stakeholders provided input when prompted on the themes covered by the questionnaire without providing direct answers to it. This last type of input was only included in our qualitative analysis.

a. Stakeholders contacted in Gabon

32 people were sent the questionnaire as part of the invitation to the workshop in December 2023. Feedback was obtained from 7 people (from BRAINFOREST, KEVA Initiative, PAFC, IRT, IRET, ENS and WAVE Gabon) as a formal reply to the questionnaire that could be included in the formal quantitative analysis below (Section 3). Two more formal replies (from TRACER-Gabon and LCQC lab) were obtained but could not be included in the quantitative analysis on time for this report so they are now considered qualitatively but may be used quantitatively in a future publication. All people mentioned below (except two, as indicated) were present at the workshop (see Report 3) and provided feedback through discussions.

Ministère des Eaux et forêts (i.e. Ministry of Water and Forests)

- Comité technique du Système National de la traçabilité du bois du Gabon (SNTBG/MENEF, i.e. technical committee of Gabon's National System of Timber Tracking): 3 people
- Direction Générale des Industries du commerce du Bois et de la Valorisation des Produits Forestiers (DGICBVPF/MENEF, i.e. General Direction of the timber trade and forest product valorisation industries): 3 people

Direction Régionale des Douanes du Gabon (i.e. regional direction of Gabon customs)

- Bureau Central de Nkok (i.e. Central direction of Nkok): 1 person
- Unité de Contrôle de Conformité (i.e. Conformity control unit): 1 person

Tracer-Gabon (independent organ of log certification)

- Coordination technique de Nkok (i.e. Technical coordination of Nkok): 2 people

Pan African Forest Certification (PAFC Gabon) - 1 person, not at the workshop but replied to the questionnaire

Non-Governmental Organisations

- Brainforest (https://brainforest-gabon.org/): 1 person
- KEVA Initiative (https://ga.linkedin.com/in/keva-initiative-0b7032183) - 1

person, not at the workshop but replied to the questionnaire

CENAREST Research institutes

- IRAF: 4 people
- IPHAMETRA: 1 person
- IRET (Institut de Recherche en Ecologie Tropicale, i.e. institute of tropical ecology research): 5 people
- IRT (Institut des Recherches Technologiques, i.e. institute of technological research): 3 people

National Herbarium : 1 person

Programme WAVE GABON (Lab): 2 people

LCQC (Chemistry and quality Lab) : 1 person

Universities and Grandes écoles :

- UIL (University of Libreville): 2 people
- ENEF (school of forestry): 1 person
- ENS (Ecole Normale Superieure of Libreville): 1 person

b. Stakeholders contacted in DRC

A total of 31 people either filled the questionnaire themselves or responded to the same questions when asked by partner J. Lisingo.

Law enforcement / Governmental bodies

- Institut Congolais pour la conservation de la nature (ICCN, DRC institute for nature conservation; https://medd.gouv.cd/iccn/) - 1 person
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, DRC Office) - 2 people
- Office Congolais de Contrôle (DRC Office of control) - 2 people
- Direction Generale de Douane et Accise (General direction of customs) - 1 person
- Coordination Provinciale De L'environnement Et Développement Durable (Provincial coordination of the environment and sustainable development) - 1 person

Scientists

- University of Kinshasa - 2 people
- Pedagogical university of Kinshasa - 1 person
- Institut Supérieur D'Etudes Agronomiques de Bengamisa (Institute of Agronomical studies of Bengamisa) - 2 people
- University of Kisangani - 1 person

Non-Governmental Organisations

- Coalition Nationale Contre l'exploitation Illégale de Bois (CNCIB; National coalition against illegal timber trade) - 1 person

- Réseau National des Observateurs Indépendants des ressources naturelles (RENOI; National network of independent observers of natural resources; https://renoi-rdc.org/) - 1 person
- Réseau Ressources Naturelles (RRN; Natural resources network; https://www.cncd.be/+-rrn-+?lang=fr) - 1 person
- Groupe de Réflexion et d'Action pour le Développement Intégral (GRADI ASBL) - 1 person
- Organisation Congolaise des ecologistes et amis de la nature (DRC organisation of ecologists and friends of nature; https://iucn.org/fr/node/35198) - 2 people
- Conseil pour la Défense Environnementale par la Légalité et la Tracabilité (CODELT; concil for the defense of the environment through legality and traceability; https://www.landcoalition.org/en/our-network/conseil-pour-la-d%C3%A9fense-environnementale-par-la-l%C3%A9galit%C3%A9-et-la-tracabilit%C3%A9/) - 1 person
- Actions pour la promotion et protection des peuples et espèces menacés (APEM; Actions for the promotion and protection of threatened people and species; https://apem-rdc.org/) - 1 person
- United Nations Force Intervention Brigade (FIB, military) - 1 person
- Tropenbos DRC (https://www.tropenbos.org/where_we_work/dr+congo) - 1 person

Timber traders and users

- Association Congolaise des Exploitants Forestiers Artisanaux (ACEFA, DRC association of artisanal loggers) - 1 person
- Association Des Menuisiers De Kisangani (Association of woodworkers of Kisangani) - 1 person
- Association Des Exploitants Artisanaux De Bois De Kisangani (Association of artisanal loggers of Kisangani) - 3 people
- Industrie Forestiere Du Congo (IFCO; logging and wood marketing company; https://ifco-cd.com/en/ifco-home-en/) - 1 person
- Compagnie Forestiere De Transformation (logging company; https://cft-drc.org/) - 1 person

c. Stakeholders contacted in other countries

We focused our survey on the two focus countries (Gabon and DRC) but a few timber tracking specialists from Belgium and the UK were also consulted.

- ENFORCE (Timber forensics centre, Royal Museum for Central Africa, Belgium): 2 people

- United Kingdom’s Office for Product Safety and Standards (OPPS): 1 person

4. Quantitative analysis of questionnaire replies

a. Questionnaire

The questionnaire included 20 main questions divided in two themes. The english version of the questionnaire was used for stakeholders in the UK and Belgium. Two French versions were used in DRC and Gabon: a version in the MS Word format, and a version formatted with a dedicated survey software (*Sphinx*). All versions are provided at the end of this report (Appendix 1).

The quantitative analysis below aims at comparing the focus countries, so the 31 replies from DRC and 7 replies from Gabon stakeholders are included in the tables and graphs summarising the responses, while the two replies from stakeholders in UK and Belgium were not included in the formal analysis but were considered separately as a complement of information.

b. Types of respondents

Type of stakeholders per focus country:

	DRC	Gabon
Scientist/Lab	6	3
Law enforcement authority	7	
Timber trader	1	
Dealer	8	
Academic (teacher)	3*	1
Other (Environmental NGOs)	9	3

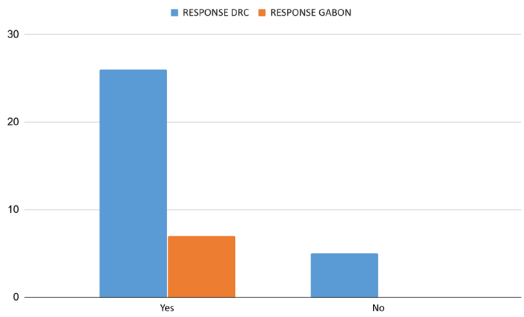
**For DRC, the academics were also scientists so there is a total of 31 (not 34) respondents*

Position of stakeholders in their organisation:

	DRC	Gabon
Administration Lead	6	2
Researcher	11	3
Analyst	2	
Representant	10	
Inspector	2	
Technical assistant		2

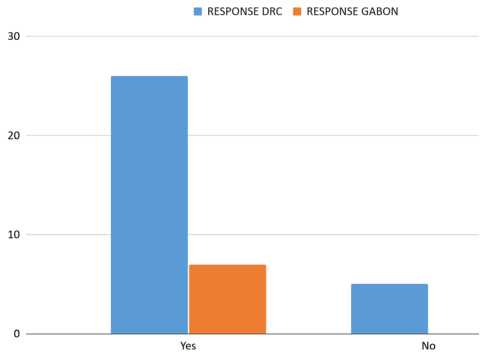
A short interpretation of questionnaire replies is provided below for the most relevant 15 questions (numbering follows the numbers used in the English questionnaire provided in Appendix 1). Further interpretation integrating qualitative feedback from the stakeholders present at the workshop in Gabon is provided in the Synthesis (Section 5).

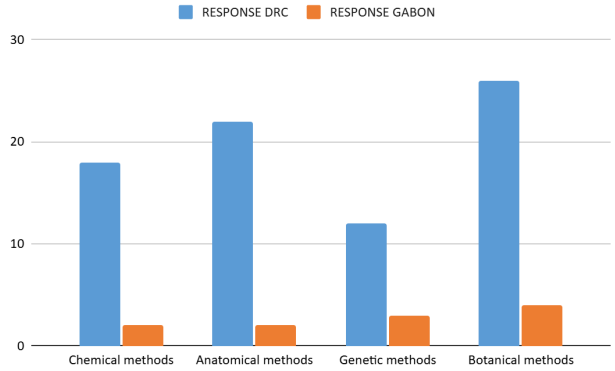
QUESTION 1.1 - *Did you know that it is possible to trace wood products, i.e. identify the species and/or geographic origin?*



Most respondents in DRC and all in Gabon were aware that tracing wood products is possible.

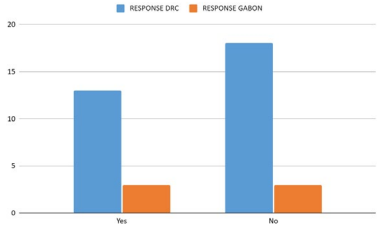
QUESTION 1.2 - *Have you heard of methods used to trace wood, i.e. to identify the species and/or geographical origin? If yes, which one(s)?*

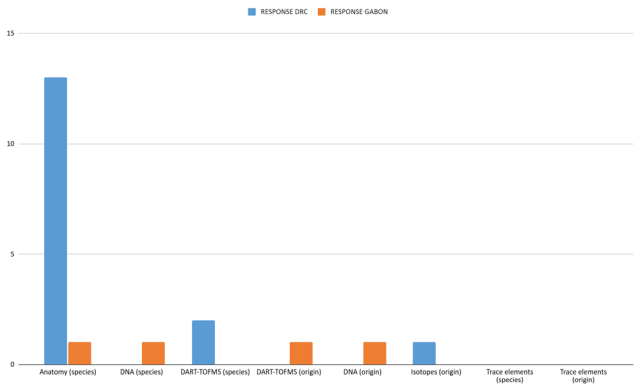




Accordingly, most respondents in DRC and all in Gabon had heard of timber tracing methods, and all types of methods (chemical, anatomical, genetic, botanical/forestry) were known from at least some of the respondents. The genetic methods were the least heard of of all methods among DRC respondents.

QUESTION 1.3 - *Have you ever used a wood traceability technique? If yes, which one(s)?*

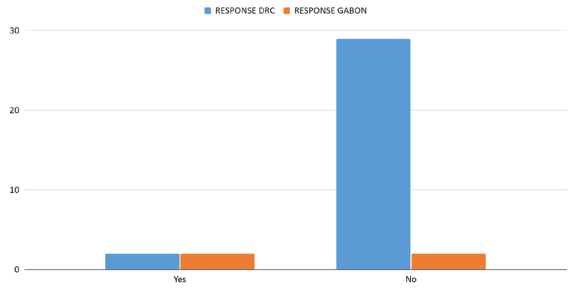




Most respondents also had already used a wood traceability technique. In DRC all respondents that had used a wood traceability technique had used anatomy (micro- or macroscopic), while a few also had experienced the use of DART-TOFMS or isotopes but none had used DNA. In Gabon, replies were spread among techniques with one respondent having used DNA for species and origin identification.

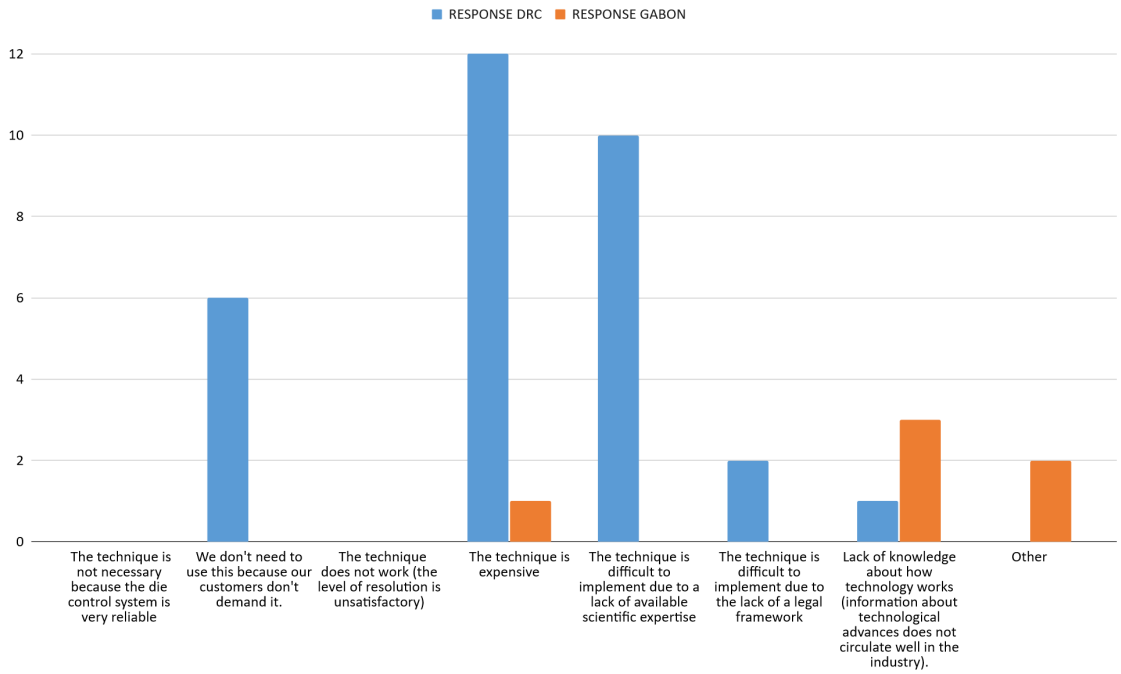
QUESTION 1.4 - *As part of your professional activity, have you ever been involved in training*

(theoretical or practical) in a wood traceability technique, and/or have you ever practised such a technique?



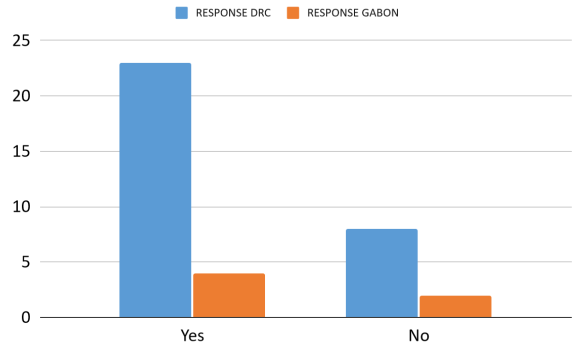
However, almost none of the respondents has been trained in using a wood traceability technique, regardless of the country.

QUESTION 1.5 - *What is the main reason why you are not currently using DNA analysis techniques to trace wood?*



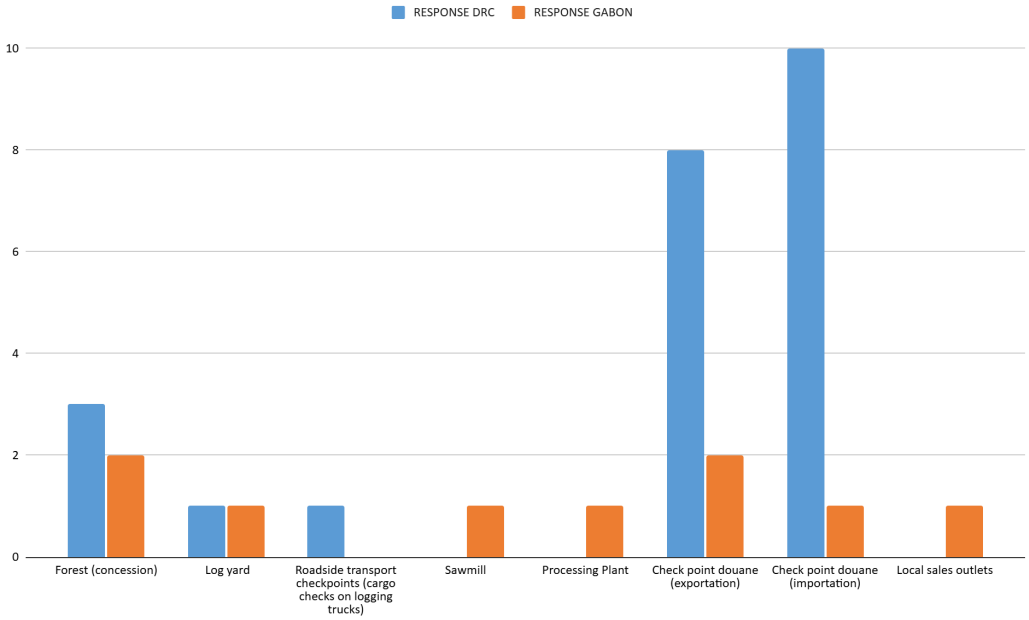
Most DRC respondents cited the high cost and the lack of scientific expertise required for implementation as the main limitation to using DNA to trace wood, while most Gabon respondents cited a general lack of knowledge about how the technique works or other reasons, namely that the technique was not necessary for certifying the origin of wood or that they never heard of it. In addition, 6 respondents from DRC considered the technique un-necessary because customers did not ask for it.

QUESTION 1.6a - *Do you think that a rapid DNA test to authenticate commercial essences would be useful for authenticating the 'customs declarations' of dubious cargoes?*



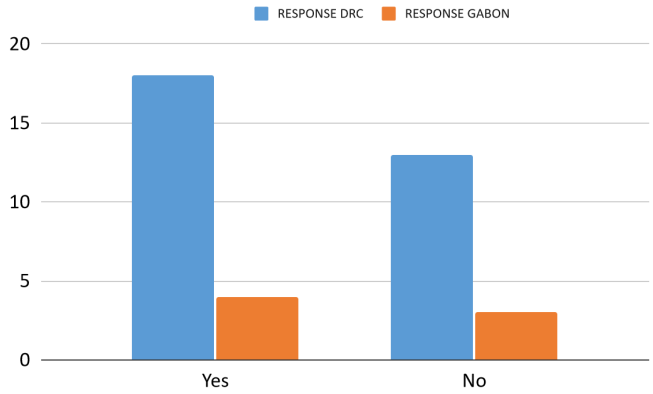
Around two-thirds of respondents in each country considered that a rapid DNA test to authenticate customs declarations would be useful.

If so, at what stage in the wood supply chain do you think it would be necessary to implement DNA techniques to achieve this objective? (multiple choices allowed)



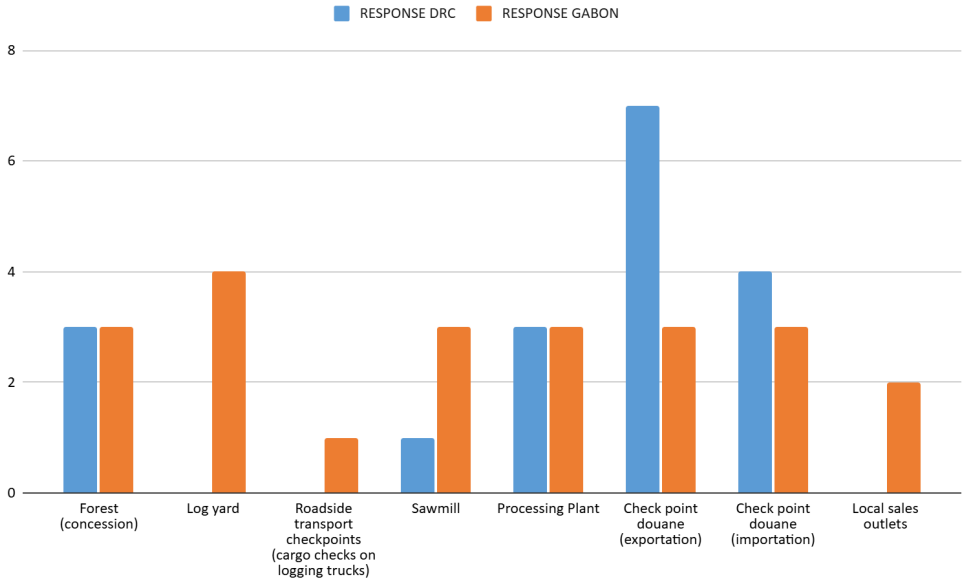
Respondents from DRC identified the custom check points (both import and export) as the main points where to implement DNA checks that can be used to certify custom declarations, while responses from Gabon stakeholders were spread across various supply chain points, with custom exporting point and forest concession slightly standing out. The latter was also the second most selected point after customs among DRC respondents.

QUESTION 1.6c - *Do you think that a rapid DNA test enabling the authentication of commercial species would be useful in securing the loyalty of certain wood consumers to achieve this objective?*



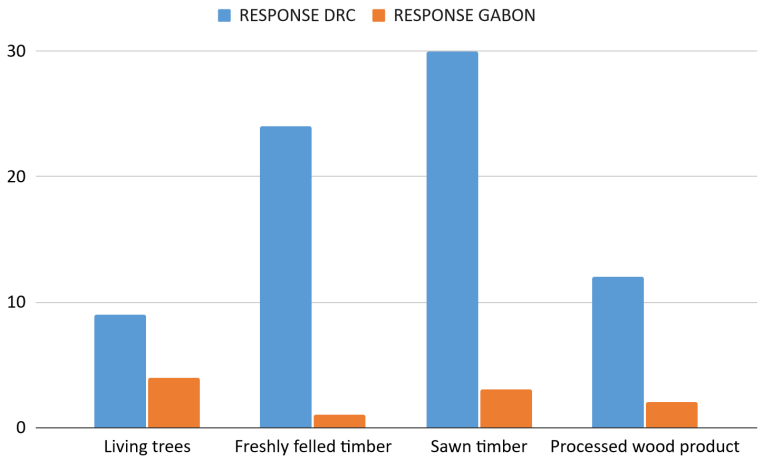
Regardless of the country, responses were almost equally shared between respondents who considered that DNA tests may be useful to secure the loyalty of wood consumers (in slight majority) and those who considered that it would not be useful.

If so, at what stage in the wood supply chain do you think it would be necessary to implement DNA techniques to achieve this objective? (multiple choices allowed)



For that purpose too, the most suitable point in the supply chain to perform DNA tests was identified to be at the custom check-points and secondarily at the concession and processing plant, while some respondents, mainly in Gabon, also selected other points.

QUESTION 1.7 *- What is the main wood product you deal with?*



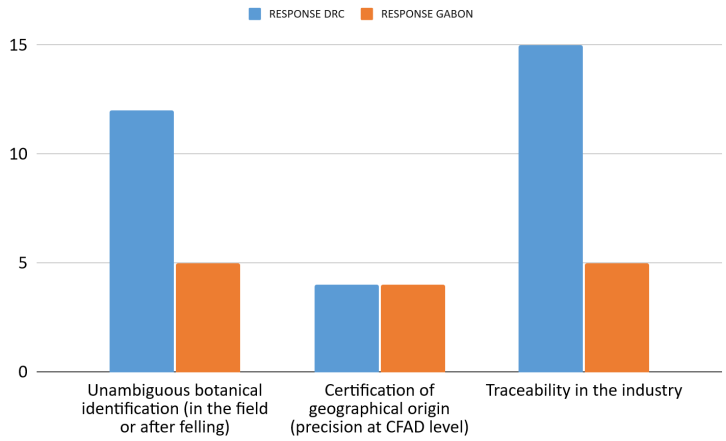
Most respondents in DRC deal primarily with freshly felled and sawn timber, while a lesser proportion deal with processed wood products and living trees. Respondents in Gabon dealt with all wood types.

QUESTION 1.8 - *For which species do you have specific needs in terms of scientific knowledge?*

Main species mentioned were:

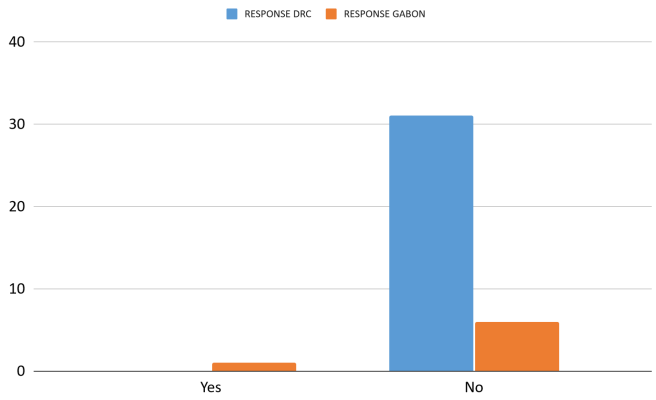
- Sapeli (*Entandrophragma cylindricum*)
- Sipo (*Entandrophragma utile*)
- Acajou / Acajou d'Afrique (*Khaya anthotheca*)
- Bubinga / Kevazingo (*Guibourtia demeusei*)
- Okoumé (*Aucoumea klaineana*)
- Andoung (*Monopetalanthus spp.*)
- Tali (*Erythrophleum suaveolens*)
- Movingui (*Distemonanthus benthamianus*)
- Bilinga (*Nauclea diderrichii*)

QUESTION 1.9 - *What is the nature of these needs?*



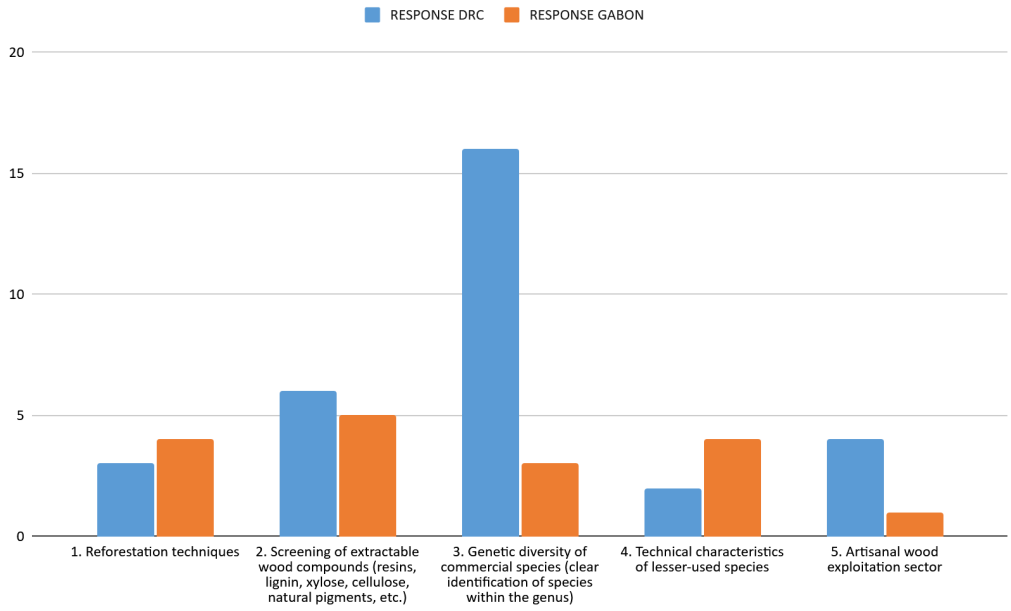
DRC respondents mentioned botanical identification and traceability in the industry as the main needs for scientific knowledge production on some timber species while the need for geographical origin certification was proportionally more cited among respondents in Gabon.

QUESTION 1.10 - *Are you aware of any laboratory(ies)/technical body(ies) in your country that can conduct genetic research on wood or provide wood DNA analysis services (identification/provenance/authentication)?*



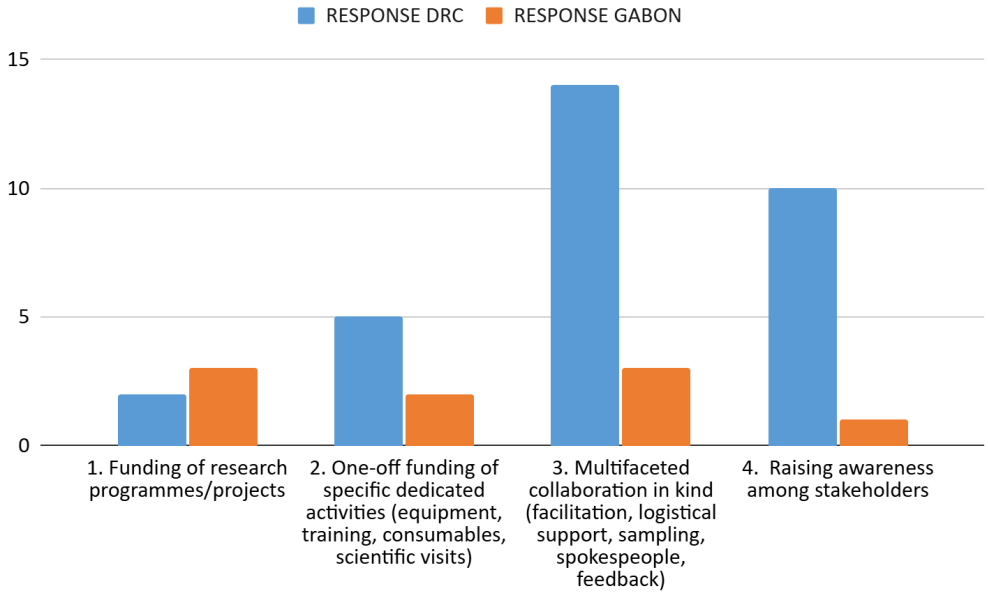
DRC respondents were unanimously unaware of labs that could perform DNA checks on wood in their country, while only one Gabon respondent was aware of such a lab in Gabon.

Question 2.6 - *What areas of research into the value-added aspects or sustainable management of the timber industry would be suited to current local or international demand for timber and timber products?* (multiple choices allowed)



More research on the genetic diversity of commercial timber species to facilitate their identification at species-level was cited as a priority for research by more than half of the respondents, both in DRC and Gabon. No other area of research was considered a priority by the majority of DRC respondents, whereas they all were by Gabon respondents except for research into the artisanal wood exploitation sector.

Question 2.7 - *At what level of involvement would you be willing to collaborate on thematic research on the subjects of your 'trade disputes' or on your prospects for adding value to wood?*



Most respondents from DRC are willing to support research into wood traceability via collaborations in king and raising awareness. Replies from Gabon respondents were more evenly spread between collaborations in kind and funding of projects or one-off activities.

c. Additional study

A second questionnaire-based study that was not originally planned was organised in parallel of the project. This was independently directed and supervised by D. Bourobou and led by Miss Keichia Chalane ESSOMEYO ENGONGA as part of her MSc diploma. Miss Essomeyo Engonga is an employee of the ministry of forests, which has supported the reinforcement of her formation on wood traceability through attendance to a MSc course and realisation of a research project on the topic. The choice of a topic including DNA appraches and of D. Bourobou as project supervisor was a direct result of the attendance of KC Essomeyo Engonga to the workshop, to which she contributed a presentation on spectrometry (Report 3). The study entitled "Diagnostic des méthodes et outils d'identification du bois et sa provenance géographique dans la chaîne de traçabilité du bois au Gabon : Implémentation des outils de la Génétique et la Chimie du bois dans les mesures correctives" focused on investigating the methods used for timber identification and provenancing in Gabon, with special focus on the implementation of genetic and chemical tools. The complete report written by KC Essomeyo Engonga (in French) is available on demand (for data protection purposes). The study involved semi-directed interviews with 17 stakeholders from the ministry of water and forests, the general direction of Gabon customs, Tracer-Gabon and Brainforest, as well as direct observations of the timber control procedures at key points of control in Gabon. Main results indicated that methods of controls currently used are only based on the availability of paper declarations and on their validation using visual and olfactive inspection but never using scientific equipment for genetic or chemical tests. Only 44% of respondents were satisfied with the methods employed and 100% would welcome further training in botany and technical support and partnerships with labs to implement scientific tests. In summary, while the study "*highlights this weakness in control procedures, it*

also points to the willingness and openness of technical bodies to implement dedicated and proven scientific methods". Main recommendations of the study were that "*the few laboratories currently equipped with molecular biology tools could be brought together in a single platform and strengthened by substantial funding to supplement the control of administrative documents for timber shipments with analyses to identify the timber and its geographical origin*" and that "*the deployment of these cutting-edge analysis methods must be preceded by the establishment of reference collections [...] with regard to genetic and chemical aspects.*" (quoted sentences are excerpts of the English abstract of the report, written by KC Essomeyo Engonga and available on demand).

d. Additional stakeholder consultation in DRC

Project partner J. Lisingo had further discussions with relevant stakeholders during the "Journée internationale de l'arbre" in DRC on 6th December 2024.

He summarised his conversations as followed (translated from French by S. Bellot):

The majority of parties agree on the use of DNA barcoding in DRC. They see this initiative as an advantage with potential to reduce illegal timber trade. However, this requires deeper research to:

- reinforce local competences,
- reinforce existing traditional systems of control,
- formalise artisanal timber exploitation.

Challenges highlighted included:

- infrastructures
- the problem of artisanal exploitation
- political will
- capacity of the forestry administration
- lab equipment
- collaboration between universities and timber stakeholders

5. Synthesis: DNA barcoding applicability and pathways towards implementation in the focus countries

Discussions between partners and qualitative and quantitative analysis of stakeholder feedback provided answers to our four research questions. Below, we summarise the results for each research question (a to d), discuss synergies with other initiatives (e) and we conclude on possible next steps (f).

a. Main control points and corresponding timber monitoring stakeholders in the focus countries

The main timber control points include the forest concession, roadside transport checkpoints and export points, while traceability also needs to be maintained throughout the supply chain, including in the log yards, sawmills, processing workshops and sale points. **Timber monitoring stakeholders** include governmental control authorities such as relevant ministries (e.g. Water and Forests ministry) and customs, but also non-governmental certification organisations (e.g. Tracer-Gabon) or watch organisations (e.g. Brainforest). Other stakeholders include timber traders and people performing inventories in the forest concessions before its exploitation. Indirectly, scientists (e.g. taxonomists) and academics (e.g. schools of forestry or agronomy) able to research or deliver training in species identification using visual clues (or potentially chemical and DNA-based methods) are also potential stakeholders, as are policy makers (e.g. CITES) and the civil society that may influence these policies before they are made, or control for their application (e.g. environmental NGOs). **This results in a very complex system of traceability in each country.** In Gabon, a lot of the timber monitoring activities have been centralised through the use of a numeric infrastructure (including an Android application, a website and a portal of geo-localisation data) for reporting and tracking timber exploitation and transport activities. The use of this system, known as the "Système National de Traçabilité du Bois du Gabon" (SNTBG), was made mandatory in 2023 by the Ministry of Water and Forests. In DRC, some numeric tools have been piloted but there is no such centralised system so far and the need to formalise and regulate local artisanal wood exploitation was highlighted by stakeholders. In both countries, inspection of the timber products and comparison with the paper (and numeric) declarations forms the basis of timber monitoring and law enforcement, and inspection is so far mainly based on visual cues. **Enabling further in-depth conversations between all types of stakeholders is essential** for an accurate evaluation of the complex monitoring systems in place and to design potential improvements.

b. DNA barcoding knowledge of timber stakeholders in Gabon and DRC

Although **many stakeholders had heard of DNA-based identification of timber** before our stakeholder consultations took place**, most of them did not appear to have a clear understanding of what DNA barcoding was** and how it could be used. Most stakeholders in the focus countries have heard of at least some timber tracing methods and many have already used botany/macroscopic anatomy to identify wood. However, very few already have hands-on or even indirect experience with the use of lab equipment for chemical or DNA-based identification since methods of controls currently use mainly botanical (visual and olfactive) inspection.

Stakeholders in DRC tended to not know of labs that could perform DNA checks on wood in their country, while awareness was a bit higher in Gabon and this was reinforced after the workshop organised in the context of this project, which brought law enforcement actors and scientists together.

c. Opinions of stakeholders on if and how DNA barcoding could strengthen the timber monitoring systems in place

Many stakeholders consider that a rapid DNA test to authenticate customs declarations would be useful, although a minority reported that DNA barcoding was not necessary for certifying timber. In addition, the possibility of **reinforcing the accuracy of forest inventories using DNA barcoding was welcomed** by stakeholders. **Forest concessions and customs export points therefore emerged as the main points of control where DNA tests could be most useful.** The aim of these tests would not be the same at both points of control. In the forest, the goal would be to verify and correct inventories before exploitation, to decrease the risk that inventory errors lead to disagreements during controls at later points. At the export points, the goal would be to increase the ability of the customs to verify the declarations when visual clues are not sufficient. **The need for tests at intermediate points remains less clear and requires further investigation.**

Requirements for implementation of DNA-based identification will share similarities and differences in the concession and at the customs. At the export point, a cost-efficient and practical test will require sample shipment to a lab where DNA extraction and sequencing of the selected DNA barcode can be performed, a robust system for tracking the tested sample throughout the testing procedure, and a user-friendly data analysis workflow enabling the delivery of an interpretable result back to the point of control, all in a reasonable amount of time, for a reasonable cost. Although the case of the in-forest test was not discussed in detail, it is likely to accommodate more time-consuming and expensive tests if they are only made periodically. Moreover the plant material available in the forest (which will include bark, sapwood and potentially leaf) may contain better quality DNA than that available at the export point. Stakeholders who replied to the questionnaire deal primarily with freshly felled and sawn timber, but some deal with processed wood products and living trees. Conversations with customs in Gabon and with partners in DRC suggest that the type of tissue available at the export point will depend on the level of transformation, type of product and country (for instance Gabon cannot export untransformed logs whereas DRC can) so even if there will be no leaf or bark tissue, there may remain sapwood in many cases, which would facilitate the tests (see Report 2).

d. Challenges to overcome for the successful implementation of timber DNA barcoding in the focus countries

A first challenge will be to ensure that DNA barcoding can be used on all timber species of interest in the focus countries. Accordingly, investigating the genetic diversity of commercial timber species to facilitate their identification at species-level was cited as a priority for research by many stakeholders in DRC and Gabon. The current study only focused on Meliaceae, therefore the DNA barcodes identified here will need to be tested for other timber species, notably in the

Fabaceae family which contains many species of high interest for stakeholders. This will require the generation of a reference dataset of the DNA barcode(s) of choice for all species to be expected in the tested samples, including relevant look-alikes and close relatives. This study has shown that such reference dataset can be created relatively easily pending an initial investment and the availability of reference sample collections that can be validated by taxonomists. The most important point to decide on will be what DNA barcodes to use. Indeed, although there are good chances that the DNA barcodes that perform well in Meliaceae also perform well to distinguish species in other plant families, this needs to be tested. Moreover, there is a risk that the primers designed to amplify these barcodes in Meliaceae would not function in other plant families due to DNA sequence divergence. **Using our findings in Meliaceae as a starting point, primer design and barcode performance comparison in the most important timber plant families will therefore be required before the final barcode selection and corresponding full reference datasets can be made.**

More generally, the need for reference datasets that can guarantee the reliability of tests based on the analysis of DNA or other features was a point of agreement among stakeholders. This is also true for macroscopic features, as references for botanical identification in the forest concession are not always available or used by sufficiently trained people. **A priority area of work identified by stakeholders in this regard is the need to strengthen species recognition in the field by integrating scientific tools and dedicated training following standardized nomenclature and using existing and new reference datasets**, notably local and international herbarium specimens, for instance via the Global Biodiversity Information Facility (GBIF), as well as updated wood sample collections. These collections can in parallel be expanded with associated genetic and chemical data that will provide the reference data required to deploy reliable and accurate DNA barcoding tests for species identification and chemical tests for sample provenancing.

A second challenge is to make sure that quick and cost-efficient tests can indeed be performed reliably at the export point(s). As described further in Report 2, the type of wood to be tested in the concession and at the export point will often contain sufficient DNA for PCR and Sanger sequencing. Moreover, we have streamlined protocols for the sequencing and analysis of a series of DNA barcodes that provide accurate species identification for Meliaceae, and there are people in both countries that can support and supervise the use of these protocols in local labs. There are at least two labs (and associated expertise) in Libreville that possess most of the necessary equipment but some adjustments (and training) would still be required to develop an efficient and reliable timber DNA barcoding platform there. In DRC, it appears that the establishment of a new lab would be necessary (see Report 2 for technical details and recommendations), which would require more funding for lab equipment and overcoming more logistical and socio-political challenges. Although this study has resolved many of the technical issues associated with timber DNA barcoding (i.e. reference dataset, choice of barcodes, DNA extraction; see Report 2), it was beyond its scope to test and deploy the new protocols in the focus countries. **The next step will therefore be to resolve practical challenges by testing DNA barcoding in situ and in collaboration with the authorities of control and the local labs**, so that their feasibility can be increased and their costs

decreased to levels enabling their routine use for the monitoring of timber cargoes.

A third challenge will be to maintain and reinforce the will of stakeholders to collaborate with each-other to develop and deploy timber DNA barcoding in the focus countries. So far, all discussions and surveys suggest that this will be possible and highlighted the high level of interest among stakeholders for improving timber traceability systems and their willingness to increase cross-disciplinary and public-private collaborations to support this goal. However, beyond the will of individuals, changes in political situations can happen which can delay or altogether prevent collaborative actions. Moreover, it is possible that when moving from theoretical to practical application of DNA barcoding, some new challenges emerge which lead to disengagement of previously interested stakeholders. **A stronger involvement (by opposition to consultation only) of key timber control stakeholders (i.e. customs, independent certification bodies, policy makers and scientists) will be essential** to prevent and remedy such situations. Finally, sustained open conversations with stakeholders submitted to the obligation of timber control (i.e. timber traders and wood workers) will be needed to alleviate any challenge that they may face due to the deployment of new DNA-based control mechanisms.

A final challenge is the need for training in wood traceability techniques in both countries, including botanical training, as highlighted by many stakeholders. Indeed, together with cost, the lack of scientific expertise was considered the main limitation to using DNA to trace wood. This can be achieved by building on and expanding existing collaborations between forestry schools, scientific institutes (herbaria and labs) and the timber trade actors, for instance through dedicated university courses in timber traceability. Ideally, such collaborations would be international to facilitate knowledge and skills exchange and ultimately inform the design of global approaches and standards.

e. Synergy with other initiatives

Our questionnaire findings align well with the United Nations Office for Drugs and Crime LEAP Programme (Law Enforcement Assistance Programme to Reduce Illicit Timber Trafficking) action points (**UNODC ILLICIT TIMBER**, **UNODC LEAP**). LEAP is a part of the UNODC's initiatives under the Container Control Programme (CCP). Its primary focus is to combat illicit timber trafficking by strengthening law enforcement capacities and improving the ability to detect and address such crimes.

Key Aspects of LEAP:

- Targeting Illicit Timber Trade: The programme addresses illegal logging and associated trade, which contribute to deforestation, biodiversity loss, and organized crime.
- Training and Capacity-Building: LEAP provides training to customs officials, border control, and law enforcement personnel to improve detection and prevention methods.
- Collaborative Efforts: The programme collaborates with governments, private sector actors, and international organizations to ensure a multi-stakeholder approach.

- Customs and Border Controls: By improving container control measures, LEAP aims to identify and intercept illegal timber shipments in international trade.

f. Conclusions

Bringing together administrative and technical players involved in wood traceability will be key to foster an inclusive and effective timber monitoring system. The use of DNA tests will be most useful at the forest concession and export points. Such tests will be most efficient as a complement or cross-validation of the existing control mechanisms, but are unlikely to fully replace them as they will be more costly and time consuming. One way by which implementation of timber DNA barcoding tests could start in Gabon and DRC is through a collaborative research and development project involving all types of stakeholders and focusing first on commercial species under high exploitative pressure. Such a programme will only be successful if enough funding can be mobilised for reference databases to be created and for the necessary technical platform of genetic analysis to be put in place. Funding acquisition and training will be facilitated by national and international collaborations, for instance through the setting up of a joint research and teaching unit and of a consortium uniting relevant research groups from the focus countries but also from countries where timber DNA barcoding is already performed. Continuous exchanges between wood traceability stakeholders will be essential if practical solutions to the above-described challenges are to be found. Such cross-disciplinary collaboration will also contribute to further raising the awareness of economic operators in the timber sector while helping to support them in implementing efficient timber monitoring practices.

Appendix 1. Questionnaire submitted to stakeholders

This appendix contains the questionnaire on wood traceability submitted to stakeholders listed in Section 3 of this Report.

Three versions of the Questionnaire are included:

1) An English version
2) A French version
3) The same French version formatted by a dedicated software

Respondents were free to choose the version they preferred.

Questionnaire for stakeholders in the Central African timber industry

Introduction

Dear participant - This questionnaire is part of a project on the traceability of timber using DNA barcoding, funded by the UK government as part of the Illegal Wildlife Trade Challenge Fund. The aim of the grant is to establish DNA barcoding for timber identification, develop a new protocol for extracting DNA from heartwood and increase expertise in DNA barcode analysis in the DRC and Gabon, in collaboration with the University of Kisangani (UNIKIS) and the Centre National de la Recherche Scientifique et Technologique (CENAREST).

The aim of this questionnaire is to assess the state of knowledge of the players in the sector about the scientific tools applied in the traceability of wood (identification and geographical origin), and to diagnose the needs in terms of scientific research, with a view to the strategic development of the sector. The aim of this questionnaire is therefore to gain a better understanding of the problems associated with illegal logging and how scientific techniques might be used to remedy them, with particular emphasis on DNA analysis of heartwood.

Please indicate your answer and multiple answers are allowed for multiple choice questions.

Questionnaire

Date:

Type of actor :

1. Scientist / forensic laboratory
2. Law enforcement authority
3. Timber trader
4. Dealer
5. Academic
6. Other (please specify):

Name of your organisation:

Your position in the organisation:

Theme 1: Wood traceability

1. **Did you know that it is possible to trace wood products, i.e. identify their species and/or geographical origin?**

    1. No
    2. Yes

    If so, how did you find out about it?

    1. Popular articles (newspapers, periodicals)
    2. Scientific articles (magazine, web)
    3. Awareness-raising workshops/meetings
    4. Media/social networks
    5. Other (please specify):

2. Have you heard of methods used to trace wood, i.e. to identify the species and/or geographical origin?

1. No
2. Yes

If yes, please specify which method(s) you have heard of:

1. Chemical methods
2. Anatomical methods
3. Genetic methods
4. Botanical/Silvicultural/Systematic methods
5. Other (specify):

3. Have you ever used a wood tracing technique?

1. No
2. Yes

If yes, please select the analysis method(s) you are aware of or have used (several answers are possible)

1. Macroscopic/microscopic anatomy of wood to determine species
2. DNA analysis to determine species
3. DART-TOFMS to determine species
4. DART-TOFMS to determine place of harvest
5. DNA analysis to determine place of harvest
6. Isotope analysis to determine harvest location
7. Trace element analysis to determine species
8. Trace element analysis to determine harvest location

4. As part of your professional activity, have you ever been involved in training (theoretical or practical) in a wood traceability technique, and/or have you ever practiced such a technique?

1. No
2. Yes

If yes, in what situation?

1. Commercial litigation
2. Professional training
3. Laboratory activities
4. Professional project
5. Other (please specify):

5. What is the main reason why you do not currently use DNA analysis techniques for wood traceability?

1. The technique is not necessary because the chain-of-custody control system is very reliable
2. The technique is not necessary because our customers have no requirements in this area
3. The technology does not work (the level of resolution is unsatisfactory)
4. The technique is expensive
5. The technique is difficult to implement due to a lack of available scientific expertise
6. The technique is difficult to implement due to the lack of a legal framework
7. Lack of knowledge about how the technique works (information about technological advances does not circulate well in the industry)
8. Other (please specify):

6a. Do you think that a rapid DNA test enabling the authentication of commercial species would be useful for authenticating "customs declarations" for dubious shipments?

1. No
2. Yes

If yes, at what stage in the timber supply chain do you think it would be necessary to implement DNA techniques to achieve this objective?

1. Forest (concessions)
2. Logyards (timber yards)
3. Roadside transport checkpoint (logging truck cargo control)
4. Sawmill
5. Processing plant
6. Customs checkpoint (export)
7. Customs checkpoint (import)
8. Local sales outlets

6b. Do you think that a rapid DNA test enabling the authentication of commercial species would be useful in expanding timber export opportunities?

1. No
2. Yes

If yes, at what stage in the timber supply chain do you think it would be necessary to implement DNA techniques?

1. Forest (concessions)
2. Logyards (timber yards)
3. Roadside transport checkpoint (logging truck cargo control)
4. Sawmill
5. Processing plant
6. Customs checkpoint (export)
7. Customs checkpoint (import)
8. Local sales outlets

6c. Do you think that a rapid DNA test enabling the authentication of commercial species would be useful in securing the loyalty of certain timber consumers?

1. No
2. Yes

If yes, at what stage in the timber supply chain do you think it would be necessary to implement DNA techniques?

1. Forest (concessions)
2. Logyards (timber yards)
3. Roadside transport checkpoint (logging truck cargo control)
4. Sawmill
5. Processing plant
6. Customs checkpoint (export)
7. Customs checkpoint (import)
8. Local sales outlets

7. What is the main wood product you deal with (several answers are possible)?

1. Live trees
2. Freshly felled timber
3. Sawn timber
4. Processed wood products

8. For which species do you have specific needs for further scientific knowledge?

9. What is the nature of these needs?

1. Unambiguous botanical identification (in the field or after felling)
2. Certification of geographical origin (precision at CFAD level)
3. Traceability in the supply chain
4. Other forms of knowledge

10. Are you aware of any laboratory(ies)/technical body(ies) in your country that can conduct genetic research on wood or provide wood DNA analysis services (identification/provenance/authentication)?

1. No
2. Yes

If yes, please name them and specify which service(s) they provide

11. If you are a laboratory, what would you need to implement DNA techniques applied to wood traceability?

12. Is there anything else you would like to add?

Topic 2: The expectations of players in the timber industry

1. Do you feel that the current regulations governing timber harvesting in your country take proper account of the essential elements of control and governance of the timber industry?

1. No
2. Yes

If not, please explain

2. If you are a player in the timber industry, what would you need to implement DNA techniques for the authentication/certification of your products intended for export?

1. A formalised national legal framework for the establishment of these techniques (Decrees, Laws, Forestry Code)
2. Support from the Ministry responsible for forestry
3. Support from scientific research/public-private partnership
4. Customer requirements (importing countries)
5. Subcontracting of analyses to a specialist laboratory

3. What are the economic issues (prospects, challenges) facing the timber industry in your host country in terms of sustainable management of timber resources and development of the industry?

1. Tree planting
2. Multi-faceted development of commercial forest species
3. Developing unused species
4. Diversification of the timber industry
5. Other (please specify):

4. What changes in "commercial disputes" could constitute applied research topics in which your company or technical body would be interested?

5. Do you have a think-tank or a research/development department for technology watch and/or the deployment of scientific tools for monitoring and studying the forestry sector in your country, your company or your sector of activity?

1. No
2. Yes

If yes, please specify (name and type of organisation):

6. What areas of research into the value-added or sustainable management aspects of the timber industry would be appropriate to current local or international demand for timber and timber products?

1. Reforestation techniques
2. Screening of extractable wood compounds (resins, lignin, xylose, cellulose, natural pigments, etc.)
3. Genetic diversity of commercial species (clear identification of species within the genus)
4. Technical characteristics of lesser-used species
5. Other (please specify):

7. At what level of involvement would you be willing to collaborate in thematic research on the subjects of your "trade disputes" or on your prospects for adding value to wood?

1. Funding of research programmes/projects
2. One-off funding of specific dedicated activities (equipment, training, consumables, scientific visits)
3. Multi-faceted collaboration in kind (facilitation, logistical support, sampling, spokespeople, feedback)
4. Other (please specify):

Thank you for completing this questionnaire.

Questionnaire pour les acteurs de la filière bois en Afrique Centrale

Introduction

Cher participant - Ce questionnaire fait partie d'un projet sur la traçabilité du bois à partir de code-barres ADN, financé par le gouvernement britannique dans le cadre de l'*Illegal Wildlife Trade Challenge Fund*. L'objectif de cette subvention est d'établir un code-barres ADN pour l'identification du bois, de développer un nouveau protocole pour extraire l'ADN du bois de cœur et d'accroître l'expertise en analyse de code-barres ADN en RDC et au Gabon, en collaboration avec l'Université de Kisangani (UNIKIS) et le Centre National de la Recherche Scientifique et Technologique (CENAREST).

Le présent questionnaire s'adresse aux acteurs de la filière bois en Afrique Centrale. Le but visé est d'évaluer l'état des connaissances des acteurs du secteur sur les outils scientifiques appliqués dans la *traçabilité* du bois (identification et provenance géographique), et de faire un diagnostic des besoins en matière de recherche scientifique, en vue d'un développement stratégique de la *filière*. L'objectif de ce questionnaire est donc de mieux comprendre les problèmes liés à l'exploitation forestière illégale et la manière dont les techniques scientifiques pourraient y remédier, en mettant l'accent sur l'analyse de l'ADN du bois de cœur.

Merci d'indiquer votre réponse et plusieurs réponses sont autorisées pour les questions à choix multiple.

Questionnaire

Date:

Type d'acteur :

1. Scientifique / laboratoire médico-légal
2. Autorité d'application de la loi
3. Négociant en bois
4. Concessionnaire
5. Enseignant
6. Autres (préciser):

Nom de votre organisation:

Votre position dans l'organisation:

Thème 1 : La traçabilité du bois

1. **Savez-vous qu'il est possible de réaliser un traçage des produits en bois, c'est-à-dire d'en identifier l'essence et/ou la provenance géographique?**
    1. Non
    2. Oui

    Si oui, par lequel de ces canaux l'avez-vous appris?
    1. Articles de vulgarisation (journaux, périodiques)
    2. Articles scientifiques (revue, web)
    3. Ateliers de sensibilisation/Réunions
    4. Médias/Réseaux sociaux
    5. Autres (préciser):

2. **Avez-vous entendu parler de méthodes utilisées pour le traçage du bois, c'est-à- dire pour l'identification de l'essence et/ou de la provenance géographique?**
    1. Oui
    2. Non

    Si oui, précisez de quelle(s) méthode(s) vous avez déjà entendu parler:
    1. Méthodes Chimiques
    2. Méthodes Anatomiques
    3. Méthodes Génétiques
    4. Méthodes Botaniques/Sylvicole/Systématiques
    5. Autres (préciser):

3. Avez-vous déjà utilisé une technique de traçage du bois ?

1. Oui
2. Non

Si oui, sélectionnez la ou les méthodes d'analyses dont vous avez eu connaissance ou que vous avez appliquées dans le cadre de votre expérience dans la filière bois (plusieurs réponses sont possibles)
1. Anatomie macroscopique/microscopique du bois pour déterminer l'espèce
2. Analyse de l'ADN pour déterminer l'espèce
3. DART-TOFMS pour déterminer l'espèce
4. DART-TOFMS pour déterminer le lieu de récolte
5. Analyse de l'ADN pour déterminer le lieu de récolte
6. Analyse isotopique pour déterminer le lieu de récolte
7. Analyse des oligo-éléments pour déterminer l'espèce
8. Analyse des oligo-éléments pour déterminer le lieu de récolte

4. Dans le cadre de votre activité professionnelle, avez-vous déjà été impliqué dans une formation (théorique ou pratique) a une technique de traçabilité du bois, et/ou avez-vous déjà pratiqué une telle technique?

1. Oui
2. Non

Si oui, dans quelle situation ?

1. Contentieux de commerce
2. Formation professionnelle
3. Activités de laboratoire
4. Projet professionnel
5. Autres (préciser):

5. Quelle est la principale raison pour laquelle vous n'utilisez pas actuellement les techniques d'analyse de l'ADN pour la traçabilité du bois?

1. La technique n'est pas nécessaire car le système de contrôle de la filière est très fiable
2. La technique n'est pas nécessaire car il n'y a pas d'exigence de nos clients sur ces aspects
3. La technique ne fonctionne pas (le niveau de résolution est peu satisfaisant)
4. La technique est onéreuse
5. la technique est difficile à implémenter par manque d'expertise scientifique disponible
6. la technique est difficile à implémenter par manque de cadre légal
7. Manque de connaissances sur le fonctionnement de la technique (l'information sur les avancées technologiques ne circule pas bien dans la filière)
8. Autres (préciser):

6a. Pensez-vous qu'un test ADN rapide permettant l'authentification des essences commerciales serait utile pour authentifier les « déclarations de douanes » des cargaisons douteuses ?

1. Oui
2. Non

Si oui, A quel stade de la chaîne d'approvisionnement du bois pensez-vous qu'il serait nécessaire de mettre en œuvre les techniques d'ADN pour atteindre cet objectif ?

1. Forêt (concessions)
2. Parc à grumes (parc a bois)
3. Check point de transport le long des routes (contrôle cargaison des grumiers)
4. Scierie
5. Usine de transformation
6. Check point douane (exportation)
7. Check point douane (importation)
8. Points de vente locaux

6b. Pensez-vous qu'un test ADN rapide permettant l'authentification des essences commerciales serait utile pour élargir les opportunités d'exportation du bois pour atteindre cet objectif ?

1. Oui
2. Non

Si oui, A quel stade de la chaîne d'approvisionnement du bois pensez-vous qu'il serait nécessaire de mettre en œuvre les techniques d'ADN ?

1. Forêt (concessions)
2. Parc à grumes (parc a bois)
3. Check point de transport le long des routes (contrôle cargaison des grumiers)
4. Scierie
5. Usine de transformation
6. Check point douane (exportation)
7. Check point douane (importation)
8. Points de vente locaux

6c. Pensez-vous qu'un test ADN rapide permettant l'authentification des essences commerciales serait utile pour fidéliser certains consommateurs du bois pour atteindre cet objectif ?

1. Oui
2. Non

Si oui, A quel stade de la chaîne d'approvisionnement du bois pensez-vous qu'il serait nécessaire de mettre en œuvre les techniques d'ADN ?

1. Forêt (concessions)
2. Parc à grumes (parc a bois)
3. Check point de transport le long des routes (contrôle cargaison des grumiers)
4. Scierie
5. Usine de transformation
6. Check point douane (exportation)
7. Check point douane (importation)
8. Points de vente locaux

7. Quel est le principal produit du bois dont vous vous occupez (plusieurs réponses sont possibles)?

1. Arbres vivants
2. Bois fraîchement abattu
3. Bois scié
4. Produit en bois transformé

8. Quelles sont les essences pour lesquelles vous rencontrez des besoins spécifiques de renforcement de connaissances scientifiques ?

9. Quelle est la nature de ces besoins ?

1. Identification botanique sans ambiguïté (sur le terrain ou après l'abattage)
2. Certification de la provenance géographique (précision à l'échelle du CFAD)
3. Traçabilité dans la filière
4. Autres formes de connaissances

10. Avez-vous connaissance d'un ou plusieurs laboratoires/organes techniques dans votre pays qui peuvent conduire des recherches génétiques sur le bois ou fournir des services d'analyse de l'ADN du bois (identification/provenance/authentification)

1. Oui
2. Non

   Si oui, citez-les et préciser quel(s) service(s) ils fournissent

11. Si vous êtes un laboratoire, de quoi auriez-vous besoin pour mettre en œuvre les techniques d'ADN appliquées à la traçabilité du bois?

12. Souhaitez-vous ajouter quelque chose ?

Thème 2: Les attentes des acteurs de la filière bois

1. Estimez-vous que la réglementation actuelle relative à la récolte du bois dans votre pays prend bien en compte les éléments essentiels de contrôle et de gouvernance de la filière bois ?

1. Oui
2. Non

Si non, Veuillez argumenter

2. Si vous êtes un acteur de la filière bois, de quoi auriez-vous besoin pour mettre en œuvre les techniques d'ADN pour l'authentification/certification de vos produits dédiés à l'exportation?

1. Cadre légal national formalisé pour l'établissement de ces techniques (Décrets, Textes de lois, Code forestier)
2. Accompagnement du Ministère en charge de la forêt
3. Accompagnement de la Recherche scientifique/partenariat public-privé
4. Exigence des clients (pays importateurs)
5. Sous-traitance des analyses dans un laboratoire spécialisé

3. Á quels enjeux économiques (perspectives, challenges) la filière bois de votre pays d'implantation doit-elle faire face pour une gestion durable de la ressource bois et un développement de la filière?

1. Plantation d'arbres
2. Valorisation multiforme des essences forestières commerciales
3. Valorisation des essences non exploitées
4. Diversification de l'industrie du bois
5. Autres (préciser):

4. Quelles modifications dans les "contentieux commerciaux" pourraient constituer des thématiques de recherche appliquée pour lesquelles votre entreprise ou organe technique manifesterait de l'intérêt?

5. Disposez-vous d'un groupe de réflexion ou d'un département de recherche/développement pour la veille technologique et/ou le déploiement des outils scientifiques de contrôle et d'études du secteur forestier dans votre pays, votre Entreprise ou votre secteur d'activité?

1. Oui
2. Non

Si oui, veuillez préciser (nom et type d'organisation):

6. Quelles thématiques de recherche sur les aspects de valorisation ou de gestion durable de la filière bois seraient adaptées à la demande locale ou internationale actuelle pour le bois et ses produits dérivés?

1. Techniques de reboisement
2. Screening des composés extractibles du bois (résines, lignine, xylose, cellulose, pigments naturels, etc.)
3. Diversité génétique des essences commerciales (identification claire des espèces dans le genre)
4. Caractéristiques techniques des espèces moins utilisées
5. Autres (préciser):

7. A quels niveaux d'implication seriez-vous disposé à collaborer à des Recherches thématiques sur les sujets de vos "contentieux de commerce" ou sur vos perspectives de valorisation du bois?

1. Financement de programmes/projets de recherches
2. Financement ponctuel d'activités spécifiques dédiées (équipements, formations, consommables, séjours scientifiques)
3. Collaboration multiforme en nature (facilitation, appui logistique, échantillonnage, porte-parole, retours d'expérience)
4. Autres (préciser):

Nous vous remercions d'avoir répondu à ce questionnaire.

Questionnaire pour les acteurs de la filière bois en Afrique Centrale

Cette enquête est une activité d'un projet qui porte **sur la traçabilité du bois en utilisant la technique de biologie moléculaire**, pour identifier l'origine du bois, développer un nouveau protocole pour extraire l'ADN du bois de cœur et accroître l'expertise en analyse de code-barres ADN en RDC et au Gabon. Ce projet est financé par le gouvernement britannique dans le cadre de "*Illegal Wildlife Trade Challenge Fund*". Les parties prenantes sont l'**Uni**versité de **Kis**angani (**UNIKIS**) et l'**I**nstitut des **R**echerches **A**gronomiques et **F**orestières (**IRAF**).

Identification de l'acteur

1. Date :

2. Type d'acteur

- ◯ Scientifique / laboratoire médico-légal
- ◯ Autorité d'application de la loi
- ◯ Négociant en bois
- ◯ Concessionnaire
- ◯ Enseignant
- ◯ Autres (préciser) :

3. Si 'Autres', précisez :

4. Nom de votre organisation :

5. Votre position dans l'organisation :

Thème 1 : La traçabilité du bois

6. Savez-vous qu'il est possible de réaliser un traçage des produits en bois, c'est-à- dire d'en identifier l'essence et/ou la provenance géographique ?

- ◯ Oui
- ◯ Non

7. Si 'oui', par lequel de ces canaux l'avez-vous appris ?

- ◯ Articles de vulgarisation (journaux, périodiques)
- ◯ Articles scientifiques (revue, web)
- ◯ Ateliers de sensibilisation/Réunions
- ◯ Médias/Réseaux sociaux
- ◯ Autres

8. Si 'Autres', précisez :

9. Avez-vous entendu parler de méthodes utilisées pour le traçage du bois, c'est-à- dire pour l'identification de l'essence et/ou de la provenance géographique ?

- ◯ Oui
- ◯ Non

10. Si 'Oui', précisez de quelle(s) méthode(s) vous avez déjà entendu parler :

- ☐ Méthodes Chimiques
- ☐ Méthodes Anatomiques
- ☐ Méthodes Génétiques
- ☐ Méthodes Botaniques/Sylvicole/Systématiques
- ☐ Autres

11. Si 'Autres', précisez :

12. Avez-vous déjà utilisé une technique de traçage du bois ?

◯ Oui ◯ Non

13. Si 'Oui', sélectionnez-la ou les méthodes d'analyses dont vous avez eu connaissance ou que vous avez appliquées dans le cadre de votre expérience dans la filière bois (plusieurs réponses sont possibles)

- ☐ Anatomie macroscopique/microscopique du bois pour déterminer l'espèce
- ☐ Analyse de l'ADN pour déterminer l'espèce
- ☐ DART-TOFMS pour déterminer l'espèce
- ☐ DART-TOFMS pour déterminer le lieu de récolte
- ☐ Analyse de l'ADN pour déterminer le lieu de récolte
- ☐ Analyse isotopique pour déterminer le lieu de récolte
- ☐ Analyse des oligo-éléments pour déterminer l'espèce
- ☐ Analyse des oligo-éléments pour déterminer le lieu de récolte

14. Dans le cadre de votre activité professionnelle, avez-vous déjà été impliqué dans une formation (théorique ou pratique) a une technique de traçabilité du bois, et/ou avez-vous déjà pratiqué une telle technique ?

◯ Oui ◯ Non

15. Si 'Oui', dans quelle situation ?

◯ Contentieux de commerce ◯ Formation professionnelle ◯ Activités de laboratoire
◯ Projet professionnel ◯ Autres

16. Si 'Autres', précisez :

17. Quelle est la principale raison pour laquelle vous n'utilisez pas actuellement les techniques d'analyse de l'ADN pour la traçabilité du bois ?

- ◯ La technique n'est pas nécessaire car le système de contrôle de la filière est très fiable
- ◯ La technique n'est pas nécessaire car il n'y a pas d'exigence de nos clients sur ces aspects
- ◯ La technique ne fonctionne pas (le niveau de résolution est peu satisfaisant)
- ◯ La technique est onéreuse
- ◯ La technique est difficile à implémenter par manque d'expertise scientifique disponible
- ◯ La technique est difficile à implémenter par manque de cadre légal
- ◯ Manque de connaissances sur le fonctionnement de la technique (l'information sur les avancées technologiques ne circule pas bien dans la filière)
- ◯ Autres

18. Si 'Autres', précisez :

19. Pensez-vous qu'un test ADN rapide permettant l'authentification des essences commerciales serait utile pour authentifier les " déclarations de douanes " des cargaisons douteuses ?

◯ Oui ◯ Non

20. Si 'Oui', à quel stade de la chaîne d'approvisionnement du bois pensez-vous qu'il serait nécessaire de mettre en œuvre les techniques d'ADN pour atteindre cet objectif ?

- ◯ Forêt (concessions)
- ◯ Check point de transport le long des routes (contrôle cargaison des grumiers)
- ◯ Usine de transformation
- ◯ Check point douane (importation)
- ◯ Parc à grumes (parc a bois)
- ◯ Scierie
- ◯ Check point douane (exportation)
- ◯ Points de vente locaux

21. Pensez-vous qu'un test ADN rapide permettant l'authentification des essences commerciales serait utile pour élargir les opportunités d'exportation du bois pour atteindre cet objectif ?

◯ Oui ◯ Non

22. Si 'Oui', à quel stade de la chaîne d'approvisionnement du bois pensez-vous qu'il serait nécessaire de mettre en œuvre les techniques d'ADN ?

- ◯ Forêt (concessions)
- ◯ Check point de transport le long des routes (contrôle cargaison des grumiers)
- ◯ Usine de transformation
- ◯ Check point douane (importation)
- ◯ Parc à grumes (parc a bois)
- ◯ Scierie
- ◯ Check point douane (exportation)
- ◯ Points de vente locaux

23. Pensez-vous qu'un test ADN rapide permettant l'authentification des essences commerciales serait utile pour fidéliser certains consommateurs du bois pour atteindre cet objectif ?

◯ Oui ◯ Non

24. Si 'Oui', à quel stade de la chaîne d'approvisionnement du bois pensez-vous qu'il serait nécessaire de mettre en œuvre les techniques d'ADN ?

- ◯ Forêt (concessions)
- ◯ Check point de transport le long des routes (contrôle cargaison des grumiers)
- ◯ Usine de transformation
- ◯ Check point douane (importation)
- ◯ Parc à grumes (parc a bois)
- ◯ Scierie
- ◯ Check point douane (exportation)
- ◯ Points de vente locaux

25. Quel est le principal produit du bois dont vous vous occupez (plusieurs réponses sont possibles) ?

☐ Arbres vivants ☐ Bois fraîchement abattu ☐ Bois scié ☐ Produit en bois transformé

26. Quelles sont les essences pour lesquelles vous rencontrez des besoins spécifiques de renforcement de connaissances scientifiques ?

27. Quelle est la nature de ces besoins ?

- ◯ Identification botanique sans ambiguïté (sur le terrain ou après l'abattage)
- ◯ Certification de la provenance géographique (précision à l'échelle du CFAD)
- ◯ Traçabilité dans la filière
- ◯ Autres formes de connaissances

28. Avez-vous connaissance d'un ou plusieurs laboratoires/organes techniques dans votre pays qui peuvent conduire des recherches génétiques sur le bois ou fournir des services d'analyse de l'ADN du bois (identification/provenance/authentification) ?

◯ Oui ◯ Non

29. Si 'Oui', citez-les et préciser quel(s) service(s) ils fournissent

30. Si vous êtes un laboratoire, de quoi auriez-vous besoin pour mettre en œuvre les techniques d'ADN appliquées à la traçabilité du bois ?

31. Souhaitez-vous ajouter quelque chose ?

Thème 2 : Les attentes des acteurs de la filière bois

32. Estimez-vous que la réglementation actuelle relative à la récolte du bois dans votre pays prenne bien en compte les éléments essentiels de contrôle et de gouvernance de la filière bois ?

◯ Oui ◯ Non

33. Si 'Non', veuillez argumenter.

34. Si vous êtes un acteur de la filière bois, de quoi auriez-vous besoin pour mettre en œuvre les techniques d'ADN pour l'authentification/certification de vos produits dédiés à l'exportation ?

- ☐ Cadre légal national formalisé pour l'établissement de ces techniques (Décrets, Textes de lois, Code forestier)
- ☐ Accompagnement du Ministère en charge de la forêt
- ☐ Accompagnement de la Recherche scientifique/partenariat public-privé
- ☐ Exigence des clients (pays importateurs)
- ☐ Sous-traitance des analyses dans un laboratoire spécialisé

35. À quels enjeux économiques (perspectives, challenges) la filière bois de votre pays d'implantation doit-elle faire face pour une gestion durable de la ressource bois et un développement de la filière ?

- ☐ Plantation d'arbres
- ☐ Valorisation multiforme des essences forestières commerciales
- ☐ Valorisation des essences non exploitées
- ☐ Diversification de l'industrie du bois
- ☐ Autres

36. Si 'Autres', précisez :

37. Quelles modifications dans les " contentieux commerciaux " pourraient constituer des thématiques de recherche appliquée pour lesquelles votre entreprise ou organe technique manifesterait de l'intérêt ?

38. Disposez-vous d'un groupe de réflexion ou d'un département de recherche/développement pour la veille technologique et/ou le déploiement des outils scientifiques de contrôle et d'études du secteur forestier dans votre pays, votre entreprise ou votre secte

◯ Oui ◯ Non

39. Si 'Oui', veuillez préciser (nom et type d'organisation).

40. Quelles thématiques de recherche sur les aspects de valorisation ou de gestion durable de la filière bois seraient adaptées à la demande locale ou internationale actuelle pour le bois et ses produits dérivés ?

- ☐ Techniques de reboisement
- ☐ Screening des composés extractibles du bois (résines, lignine, xylose, cellulose, pigments naturels, etc.)
- ☐ Diversité génétique des essences commerciales (identification claire des espèces dans le genre)
- ☐ Caractéristiques techniques des espèces moins utilisées
- ☐ Autres

41. Si 'Autres', précisez :

42. À quels niveaux d'implication seriez-vous disposé à collaborer à des Recherches thématiques sur les sujets de vos " contentieux de commerce " ou sur vos perspectives de valorisation du bois ?

- ☐ Financement de programmes/projets de recherches
- ☐ Financement ponctuel d'activités spécifiques dédiées (équipements, formations, consommables, séjours scientifiques)
- ☐ Collaboration multiforme en nature (facilitation, appui logistique, échantillonnage, porte-parole, retours d'expérience)
- ☐ Autres

43. Si 'Autres', précisez :

Merci de votre franche collaboration au renseignement de ce questionnaire