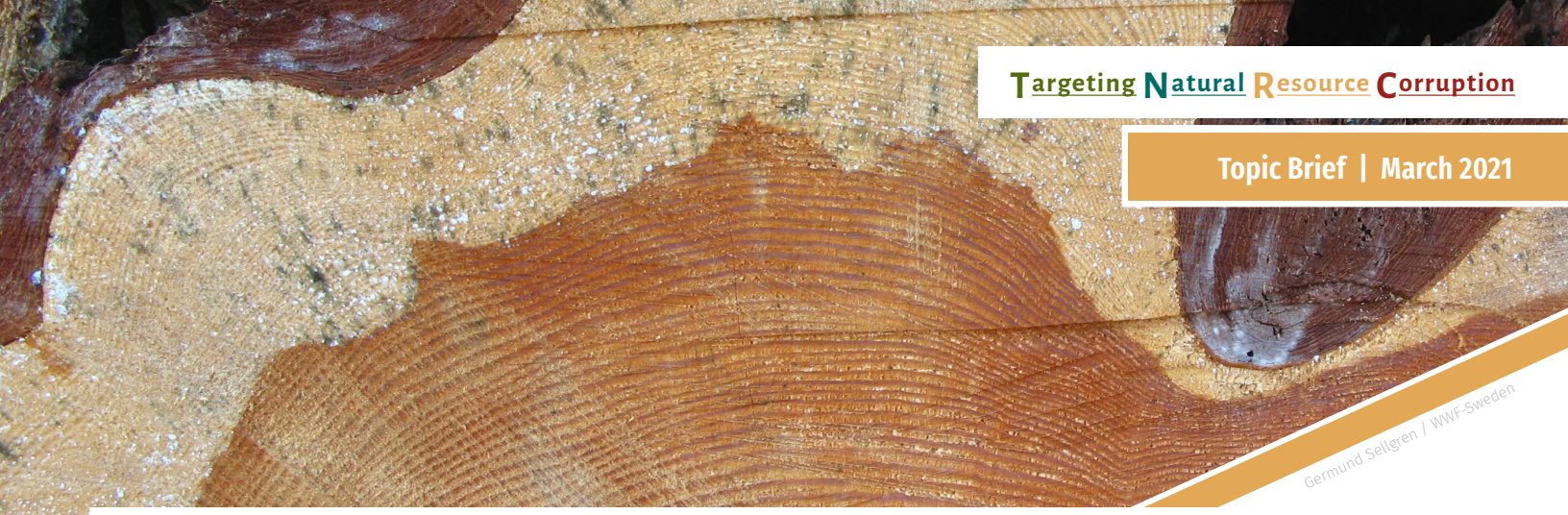

Targeting Natural Resource Corruption

Topic Brief | March 2021

Using Wood Forensic Science to Deter Corruption and Illegality in the Timber Trade

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Key takeaways

- Illegal logging and the associated illegal timber trade are major global threats to forest conservation and management and are closely linked to corruption, both in the forest and in the supply chain to market.
- Wood forensic science[1] can help law enforcement combat illegality in the forestry sector, and it could also deter associated corruption, by using scientific testing methods to verify the species and/or geographic origin of wood products, thereby detecting fraud, strengthening the rule of law, and curbing supply of illegal wood products.
- Wood forensic science encompasses an emerging set of tools, the use of which needs to be scaled up, and their effectiveness in combatting crime and corruption will be contingent on enabling institutional, political and social conditions.
- Wood forensic science has yet to reach its full potential but is improving rapidly; properly supported and used in combination with other approaches, it can make a significant contribution towards combatting crime and corruption in the forestry sector.

Challenges: Illegal logging and associated corruption

Illegal logging is a scourge of truly global proportions. It accounts for a majority of timber harvest in many producer countries, particularly but not exclusively in the tropics (INTERPOL 2019). The international trade in illegal, primary wood products is estimated to account for about 15 percent of the total (IUFRO 2016),[2] making it the world's third largest transnational crime after counterfeiting and drugs (Global Financial Integrity 2017).

Illegal logging is a major factor in forest degradation and deforestation in the geographies where it is prevalent; it threatens not just individual species but entire ecosystems, and also contributes to climate change. The damage caused by the illegal timber trade is economic as well as environmental. It harms the forest products industry globally by depressing international timber prices, thereby undercutting the financial viability of legal, managed forestry and the profitability of law-abiding companies (Seneca Creek Associates & Wood Resources International 2004). It deprives governments of billions of dollars in revenue through the loss of fees, taxes and duties, diverting monies that could be used for the common good into the pockets of criminals and corrupt officials. Most

[1] In this paper, the term "wood forensic science" encompasses both wood identification technologies and the use of test results to aid in law enforcement.

[2] Estimates vary widely by product type (roundwood vs. lumber vs. plywood; softwood vs. hardwood), as well as the methodology used by source studies.

seriously of all, it threatens the livelihoods of more than a billion forest-dependent peoples (WWF 2011).

Corruption and crime in the forestry sector are closely interrelated. Much of the world's remaining primary forests containing high-value timber are found in countries with weak governance, where corruption is systemic and forest crime is rampant. While not all cases of illegal timber harvest or trade involve corruption, the linkage between them is well established.

A 13-country survey conducted by INTERPOL between 2009 and 2014 identified an average of 250 cases of forestry-sector-related corruption, per country per year (INTERPOL 2016). Illegality and corruption can occur at all stages in the timber supply chain, from granting concessions and issuing logging permits, to harvest, transport, processing, export and import.

Corruption can take a variety of forms, including bribery, fraud, abuse of office, extortion, and nepotism. It can occur at all levels of governance, from forestry technicians who falsify inventories of timber species and volumes to cover for illegal logging, to checkpoint or customs officials who look the other way as illegal wood is transported, to government ministers with authority over granting forest concessions and other key aspects of a nation's forest industry (INTERPOL 2016). Additionally, corruption in the forestry sector facilitates other crimes; INTERPOL found that networks for illegal movement of timber, established by bribing officials, have been exploited by criminals to transport and export other illicit goods, such as weapons and drugs (INTERPOL 2016).

One reason that the illegal wood trade and the corruption that facilitates it have flourished is that, by laundering illegal wood in supply chains in ways that make it difficult to distinguish from legal wood, criminals and corrupt actors have generally evaded scrutiny. Wood forensic science has the potential to reveal illicit activities that are otherwise easily disguised, bringing a new level of transparency and accountability to the international timber trade.

Laws to combat the illegal timber trade and challenges to their enforcement

Forest crime has been the subject of growing national and international concern and action. At the international level, the most prominent measure to combat the illegal international trade in plants and animals is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which has been implemented by Parties since 1975. CITES regulates the trade in some widely commercially traded listed species, for example rosewoods *Dalbergia spp.*, including some rare and endangered tree species such as Red sanders *Pterocarpus santalinus*. Species are continually being listed under CITES as Parties determine that regulation is required to protect wild populations. CITES bans the trade in endangered species or requires permits to demonstrate sustainability and for legal trade.

Additionally and significantly, several major consumer nations – including the United States through amendments to the Lacey Act, the countries of the EU through the European Union Timber Regulation (EUTR), South Korea's Act on Sustainable Use of Timber, and Australia's Illegal Logging Prohibition Act – have adopted laws that prohibit and penalize the importation of illegally harvested or traded wood products. These laws are intended not only to curb the global illegal wood trade but also to encourage the development and enforcement of laws regulating timber harvest and trade in producer countries (see Figure 1).

Banning illegal timber is one thing, however, and enforcing a ban is quite another. One of the key challenges to cracking down on forest crime and associated corruption is that illegal wood is difficult to detect because its true taxonomy or origin can be readily misrepresented. The laws cited above generally require importers to determine and declare

Figure 1: International measures against illegal logging (download the full spreadsheet)

USA: Farm Bill; Food, Conservation and Energy Act of 2008; Lacey Act

Unlawful to import, export, sell, acquire, or purchase fish, wildlife or plants that are taken, possessed, transported, or sold: 1) in violation of U.S. or Indian law, or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law.

A ban on the trade in any plant harvested, possessed, transported, or sold in violation of the law that "protects" [not defined] plants or regulates "taking" payment of fees or taxes, or places limitations on exportation or transshipment. It is illegal to falsify or submit falsified documents, accounts or records of any plant covered by the Act. Operators have to conduct due care to check that the product is legal. Not all plant products are covered, but the exceptions are limited.

Anti-Corruption Requirements: No direct mention about corruption. Prosecution of infractions involves presenting evidence that individual or corporation should have known that the plant was illegally taken, possessed, transported or sold. This can include the court consideration to determine if any aspects of the law was infringed due to corrupt practices.

The broad products coverage related to plants means any aspect of the supply chain where corruption can occur can be applied if evidence can be found. However, if the corruption occurs in an overseas country, cooperation with the authorities there would be needed to obtain the necessary evidence. However, as shown in the 1MDB Malaysian corruption case against the previous Prime Minister, anti-money laundering laws can be applied, even though corruption charges may not be feasible.

AUSTRALIA: Australian Illegal Logging Prohibition

Australian importers must not import illegally logged timber or timber products into Australia and Australian processors must not process illegally logged raw logs. Importers of regulated timber products must provide declarations, at the time of import, to the Customs Minister about the due diligence that they have undertaken. Provides declaration requirements and covers a broad range of timber products.

Anti-Corruption Requirements: The legislation does not mention about corruption. However, it is assumed that corruption should form part of the risk assessment and mitigation efforts of the importers. But the government agency is not obligated to assess the declaration and evidence of compliance with the laws of the country of harvest on the basis of corruption.

SOUTH KOREA: Act on the Sustainable Use of Timbers

The Act requires timber producers to endeavour to import, distribute, produce and sell legally harvested timber or timber products. The key obligation for operators is to submit an import declaration including evidence that the timber or timber products imported are legal. Harvest related legislations in country of harvest would be sufficient to prove legality. KFS verify the imports of products against the legality documentation provided in the declaration, and Korean customs clears the imports. Some timber products are covered, which can be extended.

Anti-Corruption Requirements: Corruption is not directly mentioned in the Act but Article 14-3 (3) of the Enforcement Rule addresses the risk of corruption. It states that the Korea Forest Service may request the country that issued legality documentation to verify the accuracy and authenticity of the documents submitted by the importer as part of the import declaration. In addition, the Korea Forest Service is currently revising an article of the Act to prevent inspectors from being involved in corruption.

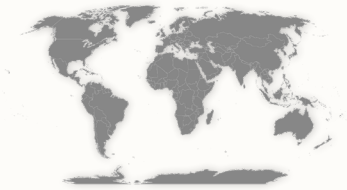
EUROPEAN UNION: EU Timber Regulation

EU operators and traders must not place illegally harvested timber and timber products on the EU market for the first time. This covers a broad range of timber products, and applies to timber which has been harvested in contravention of the applicable legislation in the country of harvest. EU operators must exercise due diligence when placing timber products on the EU market. Due diligence system is a framework of procedures designed to minimise the risk of placing illegally harvested timber or timber products on the EU market.

Anti-Corruption Requirements: The EUTR does not mention corruption, but the 2016 Guidance Document for the EUTR specifies that operators must consider the risk of corruption when evaluating documentation as part of their due diligence measures. Mitigation measures must be in place when the risk is high, for example low Corruption Perceptions Index score.

Figure 1: International measures against illegal logging (cont.)

GLOBAL *(parties only)*: Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)



Obligatory for all signatories and parties to CITES. Each Party must establish a CITES Management Authority to issue CITES permits and certificates and conducts the day to day implementation of the Convention at the national level; and a Scientific authority to function as a technical body ensuring trade is conducted at sustainable levels and does not adversely affect the survival of any species in the wild.

Effective implementation requires the support of national law enforcement agencies such as Customs, Police, Courts, Port Authorities, Forestry, Fisheries and Wildlife, etc.

CITES only governs species listed under its three Appendices, determined according to their level of threat of extinction. For Appendix I and II-listed species, the most important condition is that international trade must not be detrimental to their survival in the wild. Regulation is based on a system of permits and certificates which can only be issued if certain conditions are met. These must be presented when specimens leave or enter a country.

Anti-Corruption Requirements: Resolution Conf 17.6: Prohibiting, preventing, detecting and countering corruption, which facilitates activities conducted in violation of the Convention

NATIONAL: Forestry; Transportation; Processing/ Industrial; Trade; Taxation; Customs; Conservation (including CITES); Environment; Social; Land Code; National Parks and Protected Areas; Agriculture; among others

The primary legislation is the land code which designate the category of forests and its uses. The main legislation that governs production forests is the Forestry Legislation. Other legislations are relevant to the land use and management of timber that comes out of the forests.

Legality in the forestry sector requires enforcement and private sector to identify where the logs come from, the boundary of the productive forests, owner, access, harvest rights and transport out of the forests to the mill or export. Conservation, and taxes requires knowledge of species names and values.

Traceability is an important factor that links provenance to the royalties taxes paid for logs harvested. This is to prevent illegality, fraud, corrupt practices from undermining the systems of checks and balances in the forestry sector.

Anti-Corruption Requirements: General national anti-corruption legislation applies. Anti-corruption agency also has jurisdiction over the forestry sector. The Forestry Department and other agencies may have their internal anti-corruption guidelines and units to monitor against corrupt practices. Systemic corruption affects the entire government structure. And countries with low Corruption Perception Index (CPI) may be prone to such systemic problems.

Ad-hoc corrupt practices can occur at the local site level and within units of the Forestry Department as well as other agencies as the authority of approval rests in many different units and individuals within the department.

the species and origin[3] of the wood products they procure, and then to conduct due diligence to assess and mitigate the risk of illegality. Given that certain countries and species are considered high risk, such due diligence will be based in part on the information contained in import declarations. This information, however, is typically drawn from documents that can be easily falsified (Outhwaite 2020); and when wood is illegal, the motivation for fraud is obvious.

Filing import declarations containing false information on species and/or provenance may or may not be deliberate. In some cases, both the exporting and the importing company have known that the wood they were trading was illegal and falsified declarations to cover up their criminal activity. For example, Lumber Liquidators was charged under the US Lacey Act for importing wood flooring into the US made from illegal timber from vulnerable forests in the Russian Far East, sold by Chinese manufacturers, who were themselves directly involved in illegal logging. Additionally, the company was charged for fraudulently declaring Mongolian Oak (*Quercus mongolica*), a CITES listed species, as Welsh Oak (*Quercus petraea*) (US Dept. of Justice 2016).

Cases in which companies toward the end of the supply chain are aware of illicit activity may be exceptional, however. Illegal wood is more often laundered with legal wood near the start of the supply chain (e.g., logs at a sawmill), after which the material can be passed through subsequent steps in manufacturing and distribution using the documents associated with the legal logs. Along the way, further mixing of illegal and legal material may occur such that the former is even harder to isolate and identify. When this happens, law-abiding exporters who manufacture value-added wood products such as furniture may use illegal raw materials unknowingly and provide incorrect information for their customers' import declarations inadvertently.

Wherever in the supply chain the true identity or provenance of illegal wood is disguised, each time the fraud goes undetected the result is the same: the criminals and corrupt officials involved profit with impunity. In the absence of a deterrent, such law-breaking is likely to continue. Fortunately, a new generation of science-based tools is emerging that can help reveal fraudulent declarations of species and origin.

The power and promise of wood forensic science

One of the most promising approaches to curbing the illegal wood trade and associated corruption to emerge in recent years is wood forensic science, which encompasses a suite of wood identification technologies that are tamper-resistant and grow more viable by the day. These are being advanced by a global network intent on cracking down on forest crime that includes governments, non-governmental organizations (NGOs), and due diligence service providers (see, for example, the Global Timber Tracking Network).

Under the right conditions, testing methods can identify both the species and/or the origin of a wood product (see Figure 2). In and of itself, this usually will not determine if wood is legal or illegal, but it can provide a basis for exposing illegal acts in many instances, including:

- identifying species and origins that may be falsely declared to avoid CITES controls, other trade restrictions, and/or taxes;
- identifying species and origins that may be falsely declared to avoid harvest limits or other forest management restrictions;
- identifying wood that originates in protected areas or outside of approved forest management units.

In these and other cases, and when combined with

[3] The US Lacey Act requires the declaration of the full scientific name (genus and species), while similar legislation in other jurisdictions require only trade names, common names, or genus where the full scientific name is not known. Legislation in the United States and Canada require only that the country of origin be declared for traded timber, whereas legislation in the European Union requires the region and concession of harvest "where applicable," and Australia requires region and harvesting unit information in all cases. (Lowe et al 2016)

Figure 2: Timber testing technologies (download the full spreadsheet)

TIMBER TESTING TECHNOLOGIES

DNA PROFILING *$90–170 per sample*

The method by which an organism is genotyped across a range of genetic loci (markers) to develop their individual genetic "fingerprint".

Anti-Corruption Role: Where species is mis-identified, fraud, document falsification of species, CITES abuse and misidentification, other nationally protected plant species, due to corruption based on species names.

Use: Provenance: yes | **Species:** yes | **Supply Chain Stage:** any | **Traceability:** yes

AUTOMATED MACHINE VISION *$2200-2700 (Xyloscope)*

Captures images of the wood anatomy under specific conditions and uses signal processing approaches to extract information from the image. The resulting data are used to establish a classification scheme. The system relies on the input of high quality reference images of the taxa to be classified and is then able to assign unknown images to these reference groups. For example, the XyloScope captures high-fidelity macroscopic images of wood and then uses statistical processing software run from a laptop computer for identification.

Anti-Corruption Role: Where species is mis-identified, fraud, document falsification of species, CITES abuse and misidentification, other nationally protected plant species, due to corruption based on species names; at a particular supply chain stage.

Use: Provenance: species with restricted ranges | **Species:** yes | **Supply Chain Stage:** any | **Traceability:** combined with other technology

MASS SPECTROMETRY *$50 to $100 per sample*

Characterizes phytochemicals present in the heartwood, often termed extractives and exudates, or metabolites. Extractives can be measured through mass spectrometry to generate a chemical profile or fingerprint. Statistical analyses of these profiles can be optimized to cluster together taxonomically related individuals.

Anti-Corruption Role: Where species is mis-identified, fraud, document falsification of species, CITES abuse and misidentification, other nationally protected plant species, due to corruption based on species names.

Use: Provenance: only when directly comparing wood and stump measurements | **Species:** yes | **Supply Chain Stage:** any | **Traceability:** yes

NEAR INFRARED SPECTROSCOPY (NIRS)

Measures the absorption spectra of materials when exposed to near infrared electromagnetic energy. Can be applied to solid timber, as well as particles such as pulp, and when used on solid timber it returns information derived from both the chemical and physical structure of the wood.

Anti-Corruption Role: Where species is mis-identified, fraud, document falsification of species, CITES abuse and misidentification, other nationally protected plant species, due to corruption based on species names.

Use: Provenance: only when directly comparing wood and stump measurements | **Species:** yes | **Supply Chain Stage:** any | **Traceability:** yes

DNA BARCODING *$225 – 675 per sample*

Built on the premise that particular gene regions show sufficient genetic variation to enable members of one species to be reliably distinguished from members of another species. A subset of using genetic variability is to capture the spatial genetic structure using molecular markers to create a genographic map of that species and their utility for verifying the origins of timber.

Anti-Corruption Role: Where species is mis-identified, fraud, document falsification of species, CITES abuse and misidentification, other nationally protected plant species, due to corruption based on species names.

Use: Provenance: possible to phylogeographic level within species | **Species:** yes | **Supply Chain Stage:** any | **Traceability:** yes

MACROSCOPIC WOOD ANATOMY *$90–170 per sample*

Examination of the shape, size, arrangement and contents of the various cell and tissue types found in wood, using characteristic differences in wood grain, pores and color. Test samples can be evaluated either by the unaided eye or with a hand lens (macroscopic analysis) or with the aid of a microscope (microscopic analysis).

Anti-Corruption Role: Where species is mis-identified, fraud, document falsification of species, CITES abuse and misidentification, other nationally protected plant species, due to corruption based on species names.

Use: Provenance: species with restricted ranges | **Species:** definitive to genus, some to species | **Supply Chain Stage:** any | **Traceability:** combined with other technology

Figure 2: Timber testing technologies (cont.)

RADIO CARBON DATING

The element carbon occurs in the environment as a radioactive isotope. Measuring the decay rate can help to determine calendar ages of trees.

Anti-Corruption Role: Limited use. Can be used to estimate time of harvest for legality verification using time stamp of license validity.

Use: Provenance: no | **Species:** no | **Supply Chain Stage:** logging site | **Traceability:** no

STABLE ISOTOPE *$450– 850 per sample*

Compares the ratios of common elements within wood samples to verify the harvest origin. Isotopic analysis involves measuring natural variations in the ratio of these isotopes. The ratios of the various stable isotopes fluctuate in nature and are often correlated with various climatological, biological and geological variables.

Anti-Corruption Role: Where provenance information may be abused due to corruption based on location; at a particular supply chain stage.

Use: Provenance: combined with other technology | **Species:** no | **Supply Chain Stage:** any | **Traceability:** yes

NANOTECHNOLOGY

Uses optical markers at the nanoparticles level to mark timber at various processing points. The markers can be embedded in a clear or colour spray and applied to live trees or cut logs and other timber products. A hand held detector can help to detect the presence of the nanoparticles.

Anti-Corruption Role: Where species is mis-identified, fraud, document falsification of species, CITES abuse and misidentification, other nationally protected plant species, due to corruption based on species names.

Use: Provenance: when marker is applied at the harvest site | **Species:** when marker is applied at the harvest site | **Supply Chain Stage:** any | **Traceability:** yes

DENDROCHRONOLOGY

Study of tree growth based on analysis of the periodic, often annual growth increments (tree rings) formed in most temperate and some tropical tree species.

Anti-Corruption Role: Where provenance information may be abused due to corruption based on location; at a particular supply chain stage, only for logs.

Use: Provenance: combined with other technology | **Species:** no | **Supply Chain Stage:** logging site | **Traceability:** limited use

other evidence, the use of wood forensic science can support investigations and enforcement actions (Lowe et al., 2016).

While the authors were unable to identify examples of wood forensic science being used as an anti-corruption tool *per se*, there are numerous cases where it has been used as part of investigations into or enforcement actions against the illegal wood trade. For example:

- The Environmental Investigation Agency (EIA) gathered much of the evidence that led to the above-referenced enforcement action against Lumber Liquidators. As part of their investigation, EIA obtained samples from a batch of oak flooring that investigators observed being prepared for export by a Chinese supplier. Eight of these samples were sent to a laboratory for testing using stable isotope analysis, and the results indicated that seven of the eight samples came from trees in the Russian Far East, belying claims that it originated from low-risk countries in western Europe (EIA 2016).
- In 2016, the governments of Peru and the US confirmed that large quantities of illegal wood from the Peruvian Amazon had been imported into the US over a period of several years (EIA 2018). In 2017, US government agents acting under the Lacey Act reached an agreement with one of the importing companies that led to the destruction of inventories of illegal wood. This action was based on a report that inspections carried out in the areas where the timber was allegedly harvested indicated that the imported wood could not be of the species authorized for harvest – a finding that was subsequently corroborated in testing by the US Forest Service's Forest Products Laboratory (US Dept. of Justice 2017).

Insofar as forest crime and corruption are linked, it follows logically that, particularly when used in combination with other mechanisms, wood forensic science could strengthen efforts to curb corruption in the forestry sector. In placing a check on misrepresentations of species or origin, wood forensic science can place pressure on exporters and

importers to ensure that the information provided in import declarations is correct, as required by law or other controls such as ecolabel, timber legality and certification schemes. This pressure, in turn, can extend up the supply chain, encouraging actors at all levels to avoid wood from unknown and possibly illegal sources – even if it is less expensive than wood from known, legal sources. If the market for illegal wood tightens as a result, there could be less reason to bribe officials to obtain it or to facilitate its flow.

Wood forensic science could also deter some forms of corruption by increasing the likelihood of exposure. For example, customs officials overseeing the export of wood products may find through testing that a product is not of the species or origin indicated in accompanying documents. This then begs the question as to why, where and how the problem occurred upstream, and may point to responsible authorities who failed to do their jobs. If investigations ensue and result in the exposure and sanctioning of corrupt behavior, then the deterrent effect could be significant.

A tool is only useful if used

The preceding paragraph contains a series of significant "ifs." Wood forensic science can only be an anti-corruption tool in the hands of actors who are not themselves engaged in corrupt behavior, and who will not eschew it out of fear of being caught. In countries where corruption in the forestry sector is endemic, the willingness of individuals in either the public or private sector to use wood forensic science to expose fraud is likely to be eroded if the authorities responsible for enforcing the law fail to act on test results.

Where political will and institutional capacity for such action exist, along with conditions that reduce opportunities and incentives for corrupt actions that could short-circuit testing regimes, testing can be usefully employed:

- by officials in producer countries to check declarations of species/origin at the log yard, at log transport checkpoints, at mills, and/or at customs prior to export to strengthen law enforcement;
- by officials in consumer countries to check declarations of species/origin as required under their national legislation to combat illegal importation of wood products;
- by companies concerned that the corrupt practices of others will damage their reputations and business interests;
- by civil society watchdogs, including NGOs in both the anti-corruption and conservation/natural resource management fields, as well as journalists and researchers.

All this is contingent on the ability to fund testing and the availability and capacity of the necessary facilities, whether they be government laboratories, universities or in the private sector. Many developing countries that wish to use wood forensic science will require external financial and technical assistance.

Testing can also be highly useful for commercial enterprises and market-based certification schemes. The selection of a given wood to trade in, as well as its price, depend to a large extent on the unique performance characteristics and properties of the species in question. Businesses that are particular about the species used in their products can use wood identification technologies to ensure that there is no substitution, and exercise due care in the process.[4] Also, voluntary forest and legality certification schemes[5] can, and in some cases do, use wood identification technologies to reinforce their effectiveness or mitigate the risk of damage to

[4] To take a real-world example, there is a large US wood flooring distributor that imports large quantities of European Oak, a trade name that comprises about a dozen species whose range stretches from western Europe to the Russian Far East. The company only accepts the subset of species that occur in western Europe, both because they are low risk for illegality and because they have the right properties for accepting stains. The company is using isotopic testing to ensure that their policy is followed.

[5] E.g., Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC), NEPCon's LegalSource program, SGS's Timber Traceability & Legality program, etc.

One important lesson in anti-corruption is that there is no one-size-fits-all solution, and a single approach is rarely sufficient. The application of wood identification technologies can enhance and be enhanced by:

- Strong enforcement of current log traceability systems which have been instituted by national forestry legislation in many producer countries.
- Increased use and continuous improvements of:
  - commercial timber traceability systems such as Sourcemap, String3, Xylene, and Global Traceability/Radix Tree
  - traceability technologies such as barcodes, Radio-Frequency Identification, Stardust
  - chain of custody forest certification systems, e.g., Forest Stewardship Council and Programme for the Endorsement of Forest Certification
- Forest monitoring systems and tools such as Global Forest Watch, drones, and the KEDR system
- Transparency tools like the Open Timber Portal
- Cooperative law enforcement and anti-corruption efforts that are coordinated between producer and consumer countries.

It will take a combination of all of these approaches – and more – to end illegal logging, halt the trade in illegal wood, and root out the corruption that enables forest crime.

their credibility if it is discovered that their labels are being used on illegal products, as well as to control corruption in their auditing systems.

Enabling conditions

The effectiveness of wood forensics in combatting crime and corruption hinges on the institutional, political and social context. Given that enabling conditions do not currently exist in many countries that produce or transship high-risk wood, those who make and implement public policy in importing countries where commitments to ban illegal wood and fight corruption are relatively strong are probably best positioned to drive wood testing technologies toward their full potential. For example:

- Customs agencies in countries that have criminalized the illegal wood trade are increasingly conducting random testing of imported products at customs. In 2019, Forest Trends surveyed government agencies responsible for the enforcement of timber regulations about their current and future plans for using wood forensic science. They found that 12 of the 21 countries surveyed were using testing to check the accuracy of import declarations (Forest Trends 2019). Also, legislation banning illegal wood could be strengthened by encouraging or requiring importers to use wood identification testing and to report negative test results to the proper authorities as part of their due diligence systems.
- Authorities in consumer countries can share test results with their counterparts in exporting countries and use their influence to maximize the chances of their being put to use. For example, the use of testing to enforce laws and deter corrupt activity could be integral to the Forest Law Enforcement, Governance and Trade (FLEGT) licensing system, which is accepted as proof of legality under the EUTR. It could be a required part of national timber legality assurance systems (TLAS) for producer countries engaged in Voluntary Partnership Agreements (VPAs) under FLEGT and a condition for the granting of licenses. Joint implementation committees responsible for monitoring the TLAS for the continuation of licenses could require evidence that test results are being used effectively, whether the testing is done in or out of country.

A practical constraint on the use of wood forensic science to combat illegality and corruption in the forestry sector is reference data, or rather, the lack thereof (Wiedenhoff et al., 2019). All wood testing methods, whether for the identification of species or

origin, require previously gathered data against which test results can be compared.[6] While a substantial body of reference data exists currently, it must be expanded significantly before wood forensic science can reach its potential. There are extensive international efforts underway to accomplish this and also to build an independent institutional infrastructure to house and share the data,[7] but these efforts would benefit from increased support by governments and other donors. For example, funding for certain REDD+ projects could underwrite the costs of, and be conditioned on, the collection of reference data.

Going Forward

Boosted by legislation in consumer countries, momentum behind the development and application of wood forensic science is building; reference data sets are becoming more abundant for commercial species and origins at risk of illegal logging; and wood testing is increasingly being used to enforce legislation aimed at curbing the illegal wood trade. While it is not a cure-all, wood forensic science will play a growing role in combatting forest crime and associated corruption, but the speed and scale at which this will occur depends largely on the above-referenced enabling conditions.

Recommendations

Practitioners, private sector actors and policymakers interested in taking advantage of, and contributing to, the utility of wood forensic science as an anti-corruption tool can:

- Promote its increased use by companies in due diligence systems[8] and by governments in law enforcement and timber legality assurance systems.
- Work toward the development or strengthening of enabling conditions necessary for their effective use in the countries in which they operate. A relatively easy step in this direction would be to identify and network the institutions and individuals that have expertise in wood identification technologies within a given country. Practical guidance for addressing governance issues has been developed through the TNRC project, and these overviews on natural resource management institutions, law enforcement, and thinking and working politically are good places to start.
- Ensure sufficient funding is available to gather reference data.

Learn more

- Nature Magazine, "Tree Sleuths are using DNA Tests and Machine Vision to Crack Timber Crimes"
- World Wildlife Fund, "Can Forensics Save Forests?"
- Smithsonian Magazine, "How Forest Forensics Could Prevent the Theft of Ancient Trees"

[6] It is worth noting, however, that wood forensics can still serve as a deterrent to illegality and corruption in the absence of reference data provided that criminals and corrupt officials are not aware that it is currently lacking.

[7] The World Forest ID is a global consortium of organizations committed to building the world's largest geo-referenced wood sample collection and an associated collection will be available to all. Members of the WFID consortium include the US Forest Service, AgroIsoLab, Royal Botanic Gardens, Kew, FSC, and World Resources Institute. To date, the WFID Consortium has collected over 700 geo-referenced wood samples from 6 countries. Samples are shipped to Kew Gardens under internationally agreed export and import arrangements where they are analyzed and added to the reference collection. Through 2021, the WFID Consortium plans to double the number of samples, focusing sample gathering on species and locations important to international timber trade.

[8] There is a great deal of guidance available on due diligence systems, e.g.: the European Timber Trade Federation's "ETTF System for Due Diligence;" the European Commission's "Guidance Document for the EU Timber Regulation;" TFT's "Guide to Legality:" World Resource Institute's "Sourcing Legally Produced Wood"

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About Targeting Natural Resource Corruption

The Targeting Natural Resource Corruption (TNRC) project is working to improve biodiversity outcomes by helping practitioners to address the threats posed by corruption to wildlife, fisheries and forests. TNRC harnesses existing knowledge, generates new evidence, and supports innovative policy and practice for more effective anti-corruption programming. Learn more at tnrcproject.org.

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