International Tropical Timber Organization
ITTO
Project Proposal

Title	Implementing a DNA timber tracking system in Indonesia
Serial Number	TFL – PD 037/13 Rev.2 (M)
Committee	
Submitted By	University of Adelaide, Australia
Original Language	English

Summary
Illegal logging and associated trade are the cause of many economic and ecological problems both in timber producer and timber consumer countries. The key problem to be addressed by this project is the weak capacity in forest law enforcement. DNA marker methods use characters inherent in the timber (i.e. impossible to falsify) and guarantee a method, which is cost effective and statistically robust, for controlling the origin of wood and wood products. We propose to develop a two-year project on species identification and timber tracking system using DNA methods for important Indonesian timber tree species, the red meranti group; and light red Meranti. For two of these species we will sample leaf, cambium and wood samples from across their distribution area. We will develop gene markers that differentiate genetically between trees of different locations and also work for processed timber. The samples will be screened for DNA markers and provide a genetic reference data base to control the region of origin. Using DNA-fingerprints a tree by tree approach to control the chain of custody will also be applied for light red meranti in cooperation with timber companies in Indonesia. As measures of capacity building and technology transfer, staff from the Indonesian partners will be trained to apply DNA-techniques to perform simple DNA tests to check origin. The University of Adelaide in Australia is the executive agency and will work closely with CFBTI in FORDA and other institutes from Indonesia, Germany and USA.

Executing Agency	University of Adelaide North Terrace Adelaide, SA5005, Australia	
Duration	24 months	
Approximate Starting Date	01.01.2014	
Proposed budget and other funding sources	**Source**	**Contribution (in US$)**
	ITTO	518.833
	UoA	30,930
	Total	549,763

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PROJECT BRIEF

EXISTING SITUATION AND PROBLEMS

Illegal logging and associated trade are the cause of many economic and ecological problems both in timber producer and timber consumer countries. Although many legislative instruments (forest laws in Indonesia, Australian Illegal Logging Prohibition Act 2012, EU FLEGT initiative, EU Timber Regulation, US Lacey Act etc.) have been established to combat illegal logging and trade of illegally sourced timber, practical control mechanisms to identify the origin of wood and wood products are still lacking. The test used currently to identify species and control their international trade (such as CITES), and existing timber tracking systems (using mostly paper-based documentation) have met their limits for many tropical tree species. A new technique that labels timber with secure bar-code tags uploaded automatically into Helveta's CI World online system is being tested in some places. But all of the techniques use externally applied markers that can be manipulated along the chain of custody and don't eliminate the possibility of laundering timber from illegal sources.

DNA fingerprinting techniques use characters inherent in the timber (i.e. impossible to falsify) and guarantee a high spatial resolution method, which is cost effective and statistically robust, for controlling the origin of wood and wood products. DNA barcoding methods can also distinguish closely related or similar species unambiguously.

DEVELOPMENT AND SPECIFIC OBJECTIVES

The proposed project is in conformity with TFLET objectives, in particular with the following TFLET specific objectives:

i) Strengthen forest law compliance and governance through improved national policy and legal frameworks.

ii) Improve transparency and effective management of supply chains and increased domestic and international trade in legally produced tropical timber.

The proposed project also complies with the ITTA Objectives laid out in Article 1 of the 2006 International Timber Trade Agreement (ITTA) and will contribute to the advancement of the Agreement of the following objectives:

i) Strengthening the capacity of members to improve forest law enforcement and governance, and address illegal logging and related trade in tropical timber.

ii) Promoting improved understanding of the structural conditions in international markets, including long-term trends in consumption and production, factors affecting market access, consumer preferences and prices, and conditions leading to prices which reflect the costs of sustainable forest management.

iii) Contributing to sustainable development and poverty alleviation.
Tropical rain forests play such an important role in the Indonesian economic development and the global ecosystem. At the current rate of deforestation, the sustainability of these resources is under serious threat. The proposed project will contribute to the sustainability of tropical rain forest through curbing illegal logging as well as to poverty alleviation by recognizing the right of the local community to use the resources in accordance with their customary laws.

The project will develop a cost-effective, non-paper based timber tracking system that is integrated into Indonesian certification standards by 2016 by:

- Developing and implementing species identification and timber tracking system with DNA fingerprints for two commercial timber tree species
    - 50 tree species have been identified by DNA barcode
    - Genetic reference data to control the country of origin for two important timber species have been established
    - Building the capacity of Indonesia partners to use DNA markers for timber tracking and species identification
    - Demonstration of control of chain of custody with one tree species and that stakeholders have been involved

BENEFICIARIES, OUTCOMES AND OUTPUTS THAT WILL LEAD TO OUTCOMES

The project will result in better enforcement of forest laws and regulations through chain of custody and tracking and tracing systems and improved verification and monitoring procedures. Key players in delivering and enforcing the Indonesian policies relating to timber trade will have access to these new technologies including: Government agencies in Indonesia, NGOs and timber traders. At the end of the project Indonesia should be able to continue with the species and origin control by themselves.

HOW THE PROJECT WILL BE IMPLEMENTED, HOW IT WILL INFLUENCE STAKEHOLDER PARTICIPATION

Pilots studies conducted on various tropical species have demonstrated the robustness and the credibility of the new DNA methods on small scale. We propose therefore to develop a two year regional project on species identification and timber tracking system with DNA fingerprints in Indonesia. The project will focus primarily on the following two red meranti species chosen from the genus *Shorea*, a highly valuable group of timber trees from the Dipterocarpaceae family; red meranti (e.g. *Shorea amplexicaulis*) and light red meranti (e.g. *Shorea parvifolia*).

For these species, we will sample over their distribution area in Indonesia and sample leaves or cambium and wood samples from up to 10 trees in each of up to 40 locations per species. For the two species we will develop gene markers that show a high genetic differentiation among trees of different locations and work also for processed timber. Then the samples will be screened for DNA fingerprints and provide in this way a genetic reference data base to control the country of origin.

Using DNA-fingerprints a tree-by-tree approach will be taken to check the chain of custody for 100 individuals of one of the red meranti species (replicated for forest and saw mill samples, i.e. 200 samples) in cooperation with timber companies.

Moreover for 50 important meranti timber species (from the family Dipterocarpacea, and the genus Shorea), we will develop tools to identify the species using DNA barcoding.

Due to the diversity of the meranti group (see Table 1) and sampling practicalities, a final selection of species for genetic mapping, DNA fingerprinting and DNA barcoding will be made by the project partners at the first meeting of the project (although the species are unlikely to change from the ones indicated here).

The statistical power and practical performance of the different assignment approaches (species identity, country of origin and chain of custody of individual trees) will be checked by blind tests (50 samples from unknown origin).

The application of DNA markers to assign species and origin on processed timber assumes that the quality of extracted DNA is sufficient. To keep the risk of insufficient DNA quality as low as possible we will (a) put particular emphasis to further develop the DNA extraction protocols, and (b) work with DNA-markers that show genetic variation for short DNA fragments because these DNA markers are less sensitive to degraded DNA.

Assigning the geographic origin of timber assumes that a significant spatial pattern of genetic variation exists in natural populations. To ensure this we will (a) develop a high number of DNA-markers for each of the two species using the new generation DNA sequencing approach and (b) make a combined application of DNA-markers to assign the country of origin.

The sampling of plant material for the two timber species to develop the reference data bases is labor intensive and complicated work. It needs well trained and coordinated teams. In addition, we have three different labs working on different components of the genetic work. Hence we need to make sure that the quality and precision of the scored data is comparable between the different labs. Training in and exchange of methods for sampling and genetic analysis is an important component of the project.

The forest authorities and logging companies in Indonesia will require convincing that the new tools offer a sufficient advantage, at minimal costs, and so are worthy of adoption. It is well known that the involvement of end-users in research results in a much higher rate of adoption of the research, and so

we will make every effort to involve end-users in the design, analysis and implementation of the project. We expect that the results of the blind tests will help persuade stakeholders of the power of the enforcement tools.

To aid capacity building and technology transfer, we will train staff from the Indonesian partners to apply DNA-techniques to identify the tree species and to perform simple DNA tests to check the origin. This capacity building and the plan to integrate the genetic reference data bases into the international coordination office for origin assignment at Bioversity International in Malaysia will help sustain the project's results after its completion. Moreover by the integration of private labs into the project we hope to open a pathway for commercial application of the assignment after the project ends.

PARTNERS

The University of Adelaide is the executive agency and coordinator of the project. The other partners in the project are; The Centre for Forest Biotechnology and Tree Improvement (CFBTI) in the Forest Research and Development Agency (FORDA), Indonesia, The Institute of Forest Genetics at the Thünen Institute in Germany and the World Resources Institute in the USA. This project has been developed jointly between the University of Adelaide and CFBTI in FORDA , through a face to face meeting earlier this year, and then a number of phone calls and numerous email exchanges.

To ensure that the project is sustained beyond its completion, key players in the delivery and enforcement of Indonesian policies relating to timber trade will have access to these new technologies including: Government agencies in Indonesia, NGOs and timber traders. At the end of the project Indonesia should be able to continue with the species and origin control by themselves.

ASSUMPTIONS AND RISKS AND MITIGATION

The sampling of the plant material for the two meranti timber species to develop the reference data bases for origin assignment is labor intensive and complicated work. It needs a good coordination between different teams and we need to get access to remote places. The sampling teams need to be well trained We will follow a two step sampling approach with a first genetic screening of 2/3 of all samples followed by a first data analysis and the remaining 1/3 sampling according to the first results and identified high priority sampling regions. The sampling will be coordinated by Dr Anto Rimbawanto from CFBTI in FORDA, who has significant experience with sampling in Indonesia over many years.

The application of DNA markers to assign species and origin of processed timber assumes that the quality of extracted DNA is sufficient. To minimize the risk of insufficient DNA quality,we will (a) put particular emphasis to further develop the DNA extraction protocols, and (b) work with DNA-markers that show genetic variation for short DNA fragments because these DNA markers are less sensitive to degraded DNA.

Assigning the geographic origin of timber assumes that the underlying spatial genetic pattern of DNA-markers in the natural distribution area of the tree species is high strong enough. To be sure of that we will (a) develop a high number of DNA-markers for each of the two species using the new generation DNA sequencing approach and (b) make a combined application of DNA-markers to assign the region of origin.

The forest authorities and logging companies might stay skeptical about the developed reinforcement tools. We will try to involve them as much as possible in the project. Good results of the blind tests should convince them on the power of the enforcement tools.

The total budget of the project includes two satellite projects covering a complementary part of the ITTO work program. For this part proposals have been submitted by the University of Adelaide and the TI at the Australian Research Council (Discovery Project requested additional budget = 656,000 US$). There is a risk that this proposal is not successful. In that case the extra sampling planned for the two target species would not be completed but this will not endanger the planned output from the project.

BUDGET SUMMARY

ITTO	**$504.344**
% PERSONNEL	**49%**
% CAPITAL	**0%**
OTHERS	**$30,930**

ACRONYMS AND ABBREVIATIONS

Abbreviation	Full description
BMELV	German Federal Ministry for Food, Agriculture and Consumer Protection
CBD	Convention on Biological Diversity
CFBTI	Centre for Forest Biotechnology and Tree Improvement
CIFOR	Center for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoC	Chain of Custody
DNA	Deoxyribonucleic acid is a nucleic acid
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FLEGT	European Commission Action Plan on Forest Law Enforcement, Governance and Trade
FORDA	Forestry Research and Development Agency Indonesia
FSC	Forest Stewardship Council
ITTA	International Tropical Timber Agreement
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organizations
MoF	Ministry of Forestry Indonesia
PEFC	Programme for the Endorsement of Forest Certification
SCS	Scientific Certification Systems
SGS	Société Générale de Surveillance
SNP	Single Nucleotide Polymorphism
SVLK	Sistem Verifikasi Legalitas Kayu/Timber Legality Verification System (Indonesia)
TFLET	ITTO Thematic Programme on Forest Law Enforcement, Governance and Trade
TFT	The Forest Trust
TI	Thünen Institute – German Federal Research Institute for Rural Areas, Forestry and Fisheries
TI-FG	Thünen Institute – Institute of Forest Genetics
TPD	Thematic Programme Document
UA	University of Adelaide
WRI	World Resources Institute
WWF	World Wide Fund For Nature

MAP OF PROJECT AREA

Map 1. LOCATION OF SELECTED AREAS FOR GENETIC MATERIALS COLLECTION

Map 2. LOCATION OF CENTER FOR FOREST BIOTECHNOLOGY AND TREE IMPROVEMENT RESEARCH

PART 1. PROJECT CONTEXT

1.1 Origin

Illegal logging contributes to deforestation and by extension global warming, causes loss of biodiversity and undermines the rule of law. Illegal logging takes place when timber is harvested, transported, bought or sold in violation of national laws. These illegal activities undermine responsible forest management, encourage corruption and tax evasion and reduce the income.

Responding to the widespread illegal logging in Indonesia's forests, the Indonesian Ministry of Forestry has set out combating illegal logging as one of the top five priorities of the Ministry of Forestry national strategy. In addition to calling on consumer countries to ban the entry of illegal wood from Indonesia, the Ministry of Forestry has also intensified law enforcement to curb illegal logging. In the international forum, the development of specific initiatives targeting the problem of illegal timber, such as the EU Action Plan on Forest Law Enforcement, Governance & Trade (FLEGT), and government procurement policies in consumer countries, are a consequence of this need.

This proposal is an outcome of a workshop held in Kuala Lumpur, Malaysia between 24-26th April 2012 on 'Identification of Timber Species and Origins', organised by the Global Timber Tracking Network, at which the project partners met and began planning the project. The partners recognized the need to introduce DNA tracking system for some of major dipterocarps species of Indonesia. Implementation of such tracking method would not only help Indonesia to clamp down on illegal logging but equally important, would also enhance the efforts to conserve the diminishing resources of the species.

Forestry Research and Development Agency (FORDA) of Indonesia has a well equipped DNA laboratory suitable for developing DNA tracking systems. Having a lab capable of implementing this technique would be very useful should Indonesia decide to introduce DNA tracking system into the SVLK scheme.

The project builds on partnerships already established by a number of successful on-going projects; for example: between the University of Adelaide and Thunen Institute (ITTO and Australian Research Council projects); between the World Resources Institute, Thunen Institute, and University of Adelaide (US government funded projects); and between the University of Adelaide and the Thunen Institute, who are also partners on a recently submitted Australian Research Council Discovery grant.

1.2 Relevance

1.2.1 Conformity with ITTO's objectives and priorities

ITTO is concerned with improving market conditions and transparency to support and promote the international flow of tropical timber from sustainably managed and legally harvested sources. Under the Thematic Programme of Forestry Law Enforcement, Governance and Trade (TFLET), ITTO is pursuing to help producer member countries such as Indonesia to clamp down on illegal logging and illegal trading of timber.

For instance, one of the areas of intervention under TFLET strategy is to support trade in legally produced timber and effective management of supply chains. The activity under this intervention that is relevance to the project is implementation of timber tracking systems.

The proposed project is in conformity with TFELT objectives, in particular with the following TFLET specific objectives:

i) Strengthen forest law compliance and governance through improved national policy and legal frameworks.

   The Indonesian legal frameworks of timber legality require the compliance to legal certificate which must be accompanied by transportation permits (SKSHH) and certificate of origin (SKAU). Unfortunately, this system is prone to manipulation; legal documents can also be obtained on the black market.

   In contrast, DNA is contained within the wood and cannot be tampered with. The use of certificate of origin based on the DNA profile will improve the legal framework.

ii) Improve transparency and effective management of supply chains and increased domestic and international trade in legally produced tropical timber.

   The use of DNA markers to trace the origin of timber will contribute to improving transparency because it is robust and cannot be tampered with.

The proposed project also complies with the ITTA Objectives laid out in Article 1 of the 2006 International Timber Trade Agreement (ITTA) and will contribute to the advancement of the Agreement of the following objectives:

i) Strengthening the capacity of members to improve forest law enforcement and governance, and address illegal logging and related trade in tropical timber.

   Illegal logging is certainly not unique to Indonesia, even in western world illegal logging is also taking place. However, because of the importance of tropical biodiversity and the severity of impact to the country's economy, minimizing the practice by implementing policy and system to prevent illegal logging is of high priority.

ii) Promoting improved understanding of the structural conditions in international markets, including long-term trends in consumption and production, factors affecting market access, consumer preferences and prices, and conditions leading to prices which reflect the costs of sustainable forest management.

   The practice of illegal logging is a result of a combination of factors. Sustainable forest management of tropical forest, i.e. elimination of illegal logging can be achieved if all the factors are addressed and resolved. Therefore, the cost of achieving it by way of introducing DNA timber tracking system needs to be accounted in the cost of sustainable forest management.

iii) Contributing to sustainable development and poverty alleviation.

   Tropical rain forests play such an important role in the Indonesian economic development and the global ecosystem. At the current rate of deforestation, the sustainability of these resources is under serious threat. The proposed project will contribute to the sustainability of tropical rain forest through curbing illegal logging as well as to poverty alleviation by recognizing the right of the local community to use the resources in accordance with their customary laws.

The proposed project complies with ITTO Action Plan 2013-2018, particularly under the Strategic Priority 1 "Promote good governance and enabling policy frameworks for strengthening SFM and

related trade and enhancing SFM financing and investment". ITTO is concerned with improving market conditions and transparency to support and promote the international flow of tropical timber from sustainably managed and legally harvested sources. Under Expected Outcome 4, ITTO is expected to see reduction in illegal logging. Members are expected to improve forest law enforcement and governance and address illegal activities in the forest sector.

1.2.2 Relevance to the submitting country's policies

This project is well aligned with Australia's objectives regarding illegal logging. It will support Australia's illegal logging policy by providing capacity building for Indonesia to implement DNA tracking to complement existing timber legality verification systems. The activitiy will provide a mechanism to strengthen the ability to trade in legally sourced and sustainable timber, thus indirectly assisting timber traders and importers to respond to the provisions of Australia's Illegal Logging Prohibition Act.

Combating illegal logging remains Indonesia's top priority in the national forestry development strategy. Recognizing the economic, environment and social impacts of illegal logging to the country, Ministry of Forestry has intensified law enforcement. In addition, regulation on verification on the legality of timber has also been introduced.

Central to most efforts to tackle illegal logging and associated trade is the need to distinguish between illegal and legal timber at different stages of the supply chain, both to aid enforcement and cut off markets for stolen wood. Systems and technologies that can help achieve this goal will be central to successful implementation of both voluntary company-based solutions and mandatory government controls.
DNA technology has the potential to be used to trace the origin of timber to clarify a potential illegal origin. The Ministry of Forestry has welcomed the idea to adopt advance technology such as DNA methods to ensure the legality of all timber exported from and marketed in Indonesia. In addition to the existing verification of legal documents, the use of DNA markers, which cannot be tampered with will further strengthen the robustness of the chain of custody of Indonesia's timber.

The project will directly support the verification of legally sourced timber products from Indonesian sources that are now required by recent Australian legislation, the European Union's FLEGT Action Plan, and the US Lacey Act. Recently, the EU implemented further legislation concerning due diligence of operators placing timber on the EU internal market.

While the EU FLEGT Action Plan provides measures to support developing countries to achieve improved forest governance, it also provides for Voluntary Partnership Agreements between timber-producing developing countries and the EU. The latter requires partner countries to implement a timber licensing scheme and EU border control agencies to allow imports from these countries only if they are accompanied by FLEGT licenses. According to the EU, the tracking systems should be reliable, cost efficient and forgery proof, something that can only be achieved if physical controls at critical points are intensified. This is where robust methods to verify the origin of timber such as DNA of timber would complement existing methods and help demonstrate the exact origin of wood.

In Indonesia, the legality system being implemented as part of the EU FLEGT Voluntary Partnership Agreement is the SVLK and is a major initiative of the Ministry of Forestry.

Finally the project will help improve monitoring and control of CITES listed species. Forest policies are dealing with the monitoring and control of these species and most of them have only had limited success so far. Better traceability methods (such as the ones to be developed by the fingerprinting project) are expected to improve the monitoring and identification of CITES species by customs authorities.

1.3 Target Area

1.3.1 Geographic location

Indonesia is an archipelago in South East Asia comprising approximately 17,500 islands, with a total land area of 1,904,569 km^2, making it the fifteenth largest country in the world by land area: Latitude 5.00^o S & Longitude 120.00^o W. It has 34 provinces with over 242 million people[1], and is the world's fourth most populous country, and is expected to grow by a further 50 million people in the next 20 years. Indonesia has long been in a strategic location due to its intersection with major trading routes of the Indian Ocean to Pacific Ocean.

The study will take place in two major geographical areas, the laboratory works will be carried out at the Laboratory of Molecular Genetics of the Centre for Forest Biotechnology and Tree Improvement in Yogyakarta. Genetic materials for the study will be collected from Kalimantan where the species occurs naturally. The project team will collect samples from across Kalimantan to target all species. The exact locations for collecting samples will be determined when the project is up and running.

1.3.2 Social, cultural, economic and environmental aspects

Indonesia: one of the most mega-diverse countries in the world

The rainforests of Indonesia's have some of the highest levels of biological diversity in the world. Indonesia contains the world's third largest area of rainforest after the Amazon and Africa's Congo Basin. Whilst Indonesia is 1 percent of the Earth's land area, it's rainforests contain 10 percent of the world's known plant species, 12 percent of mammal species and 17 percent of all known bird species. And there is still much to be discovered. The Indonesian Ministry of the Environment estimates that more than half of Indonesia's species are still unrecorded.

The rapid loss of Indonesia's biologically wealthy rainforests is a major risk to the survival of many Indonesian species. So while Indonesia has more species of mammal than any other nation, 515 species, it also has the highest number of threatened mammals at 135 species. The loss of habitats and potential loss of species causes economic as well as environmental damage, with Indonesian biodiversity responsible for over 11% of its GDP[2].

Impacts of illegal forestry on biodiversity in Indonesia

Indonesia's forests are being lost at significant rates, Between 1990 and 2005, approximately 108,110 square miles of Indonesian forest disappeared, 77% of which were virgin forest (see map at Figure 1 for a visual of this loss in Borneo).

Illegal logging is a major contributor to the loss of Indonesia's forests. A 2007 United Nations Environment Program report estimated that 73-88% of timber logged in Indonesia is illegally sourced. More recent estimates place the figure at a lower rate of 40-55%, which while still troubling, represents a major achievement by an Indonesian government who have shown a commitment to reduce the levels of illegal timber harvesting. It estimated that the loss of revenue to the Indonesian government from illegal logging is an estimated $2 billion per year due to corruption, uncollected taxes, unacknowledged subsidies, and general poor management of resources.

Increased demand for forests products has brought some financial benefits for poor people living near to forests. But there is also evidence to show that usually, poor communities who are completely dependent on forests lose out to powerful interests, logging companies and migrant workers who reap most of the benefits.

Globally, nearly 500 million people, 200 million of whom are indigenous peoples, depend on forests for their livelihoods (Chao, 2012). Initial processing of wood often occurs in remote and sparsely populated areas with limited job opportunities, social support systems, access to education, and infrastructure. These remote areas are sometimes beyond the control of government authorities. This provides significant opportunities for illegal traders to avoid giving any adherence to local laws relating to fair pay, employment benefits, job training, health and safety, and sharing of benefits with local

[1] http://data.worldbank.org/country/indonesia
[2] Indonesian Biodiversity Research Center

communities.

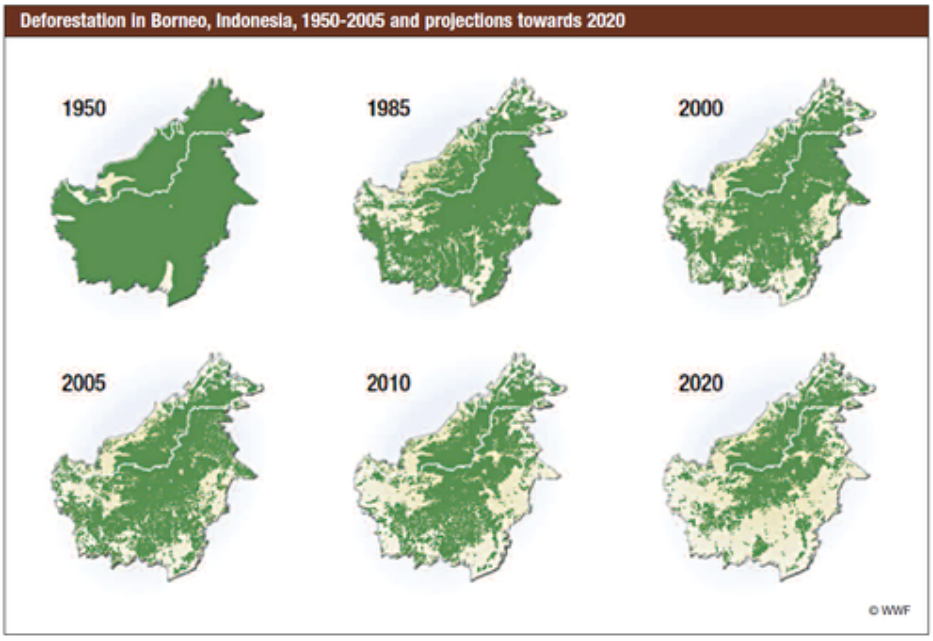


Fig. 1. Deforestation in Borneo and projections towards 2020 Source: World Wildlife Fund

In Indonesia, land tenure can be customary or statutory: the former is defined and adhered to by local communities land ownership and management as well as the right to access and use resources. Both customary and statutory land tenure can be ignored by illegal traders This can lead to violent clashes which have threatened livelihoods and human rights. Even in cases where land tenure is recognized, there can be distributional inequities regarding gender and ethnicity within the community.

Indonesia is the largest producer of tropical timber
Indonesia, is the largest ITTO producer country (Fig 1), producing about 34 million m^3 of sawn and veneer logs a year since 2007 as a result of rising GDP and growing domestic demand from the construction industry.

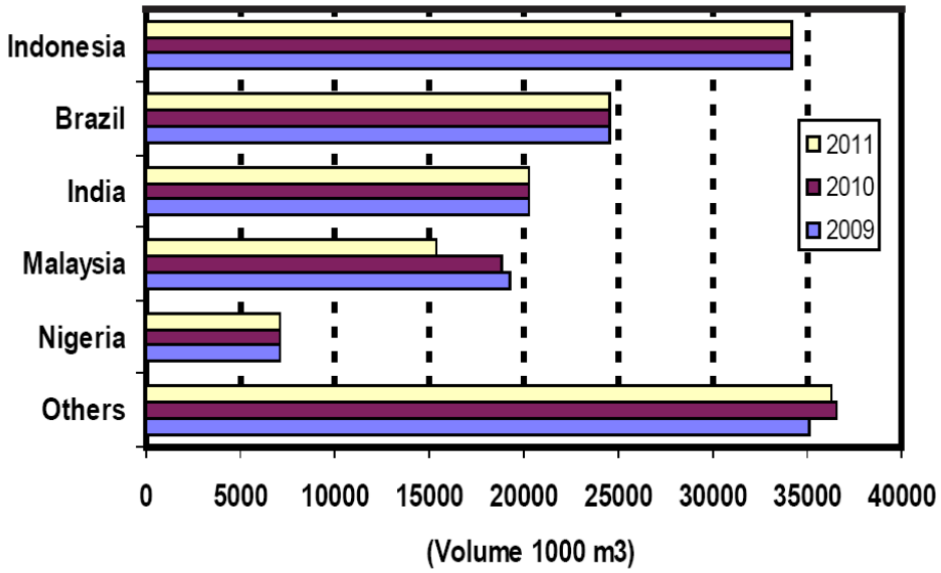


Fig. 2. Major Tropic Wood Producers

The majority of timber exported from the region (51.6% of annual traded value of US$ 208 M- trade figures for Malaysia, 2009, where trade names are accurately recorded and the most similar comparable forest composition to Indonesia, Table 1) comes from the meranti group, particularly the red meranti group.

Table 1. Trade and species name and value of important SE Asian meranti timber species

Timber trade name	Species	Trade value (ITTO trade data US$ Million)
Red meranti	*Shorea amplexicaulis, Shorea splendida, Shorea stenoptera*	71
Dark/light red meranti	*Shorea acuminate, Shorea beccariana* *Shorea hemsleyana, Shorea platycarpa* *Shorea palembanica, Shorea macrantha*	-
Light red meranti	*Shorea parvifolia ssp. parvifolia* *Shorea parvifolia ssp. velutinata* *Shorea ovalis ssp. sarawakensis* *Shorea ovalis ssp. sericea* *Shorea almon, Shorea dasyphylla* *Shorea lepidota, Shorea leprosula* *Shorea quadrinervis, Shorea rubra* *Shorea scrabrida, Shorea smithiana* *Shorea teysmanniana*	34
Dark red meranti	*Shorea platyclados, Shorea pauciflora* *Shorea ovate, Shorea flaviflora* *Shorea curtisii, Shorea coriacea* *Shorea argentifolia, Shorea singkawang* *Shorea slootenii*	1

Yellow meranti	*Shorea faguetiana, Shorea acuminatissima* *Shorea balanocarpoides, Shorea gibbosa* *Shorea longisperma, Shorea maxima* *Shorea multiflora, Shorea richetia* *Shorea xanthophylla*	-
White meranti	*Shorea gratissima, Shorea agami* *Shorea assamica, Shorea bracteolate* *Shorea henryana, Shorea ochracea* *Shorea resinosa, Shorea roxburghii*	-
Other meranti	*Shorea pubistyla, Shorea rugosa* *Shorea uliginosa*	2

Indonesia's natural forests face pressure from conversion to agriculture (particularly oil palm plantations) and forest plantations (for the pulp and paper industries), as well as from rising domestic demand for wood products from the growing housing construction sector. Indonesia's industrial roundwood production has become increasingly constrained, with the wood processing sector experiencing significant overcapacity and continuing reports of relatively high rates of illegal roundwood consumption.

However, some progress in combating illegal logging has been made at the national level. A two-year moratorium of new forest-clearing concessions was announced in 2010 under the climate-change partnership between the Government of Indonesia and the Government of Norway aimed at reducing GHG emissions from Indonesian forests. A compulsory certification scheme for concession holders also imposes a certain degree of oversight on forest operations[3]. Indonesia has made a commitment to improve the quality of their industry data. Indonesia is also a signatory to the FLEGT Voluntary Partnership Agreement (VPA) process.

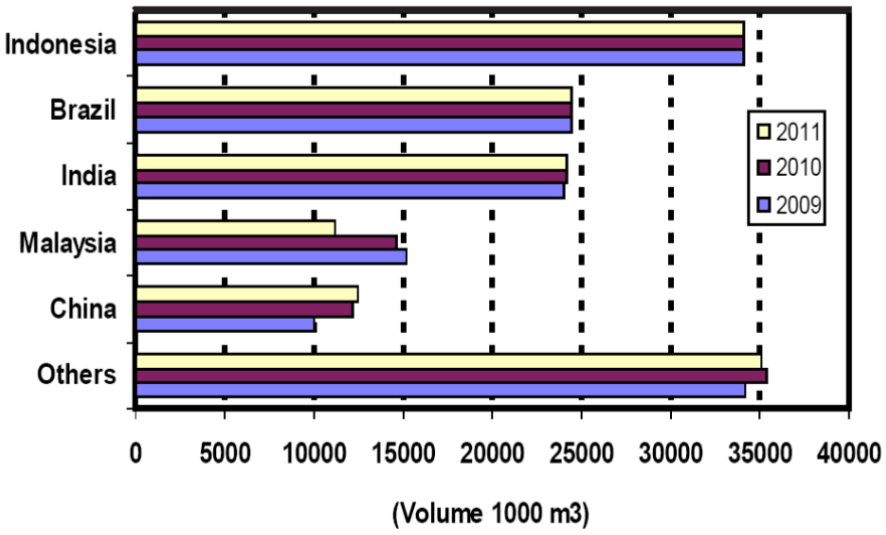


Fig. 3. Major Tropical Wood Consumers

Figure 3 shows tropical log consumption for 2009-2011, which was very similar to production trends in the top four countries. Indonesia is also the world's largest consumer of tropical logs.

[3] INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO) 2011b: Status of Tropical Forest Management 2011. ITTO Technical Series #38. International Tropical Timber Organization, Yokohama

Indonesian economy[4]

Growth in GDP for Indonesia over the past decade has averaged 5.5%, making it one of the strongest emerging economies. The Indonesian economy is the world's sixteenth largest by nominal GDP ($928 billion) and fifteenth largest by purchasing power parity[5]. The GNI per inhabitant is $3,495, placing it 109th in the world also making it one of the poorest rapidly developing economies.

The people of Indonesia are highly dependent on the agricultural sector for their livelihoods. Half of Indonesia's people live in rural areas and half of all Indonesian households are primarily dependent upon agriculture – the cultivation of rice and other foods, estate crops (such as rubber, coconut, palm oil and coffee), livestock and poultry and fishing. Only 37% of the work-force are estimated to be employees with the remainder self-employed and unpaid. 12.5% of people are classified as living in poverty[6] and two-thirds are classified as undernourished.

Contribution of forestry to Indonesian economy

Forests cover 94 million ha, or 52% of the total area of the country. The forestry sector has moved from localised selective felling to large-scale plantation development. The forest-based manufacturing industry has diversified from small manufactures to large-scale plywood production and most recently pulp and paper production.

- Combined, the sectors contribute approximately US$ 21 billion to Indonesia's GDP, or roughly 3.5 per cent of the national economy;
- Wood products and pulp and paper manufacturing represent around 8.3 per cent of manufacturing value-added;
- The sectors employ a combined total of 3.76 million people; around 4 per cent of the working population and roughly 1.5 per cent of the total population;
- If employment multipliers are taken into account, this figure is likely to be closer to or exceed 4 million people;
- If dependents are taken into account, this equates to more than 15 million people dependent upon the sector.

Forestry (harvesting and silviculture) contributes roughly US$ 5.1 billion (approximately 1 per cent) to Indonesia's GDP. The contribution of forestry harvesting to employment is particularly significant. While estimates of employment within the formal forestry sector are around 241,000 according to recent estimates, informal sector employment is much higher. Plantation forestry alone is responsible for approximately 713,000 permanent jobs, and approximately 450,000 short-term jobs annually during plantation establishment.

Wood and wood manufacturing contributed US$ 9 billion (around 1.4 per cent) to Indonesia's GDP in 2009. Its share of manufacturing value added was around 2.3 per cent in the same year. Pulp and paper manufacturing and its associated industrial forest plantations combined directly employ around 1.51 million people and contribute around 1.8 per cent of GDP. The pulp and paper industry contribute approximately 1.2 per cent of GDP, and approximately 6 per cent of manufacturing value-added. Wood products and pulp and paper represent 6 per cent of total exports in 2010 and around 9 per cent of non-mineral exports.

Table 2: Forest related indicators in Indonesia

Criteria		Indonesia
Land area (1 000 ha)		190,457
Forest	1 000 ha	94,432
	% of land area	52
Primary forest	1 000 ha	47,236
	% of forest area	50%
Ownership pattern	Public ownership	91
	Private ownership	9
	Other	0

[4] The Economic Contribution of Indonesia's Forest Industries (2011) ITS Global
[5] International Monetary Fund estimate 2013
[6] http://data.worldbank.org/country/indonesia

Holder of management rights of public forests	Public administration	43
	Business entities and Institutions	57
	Communities	n.s.
	Other	n.s.
Permanent forest estate	1 000 ha	77,067
	% of forest area	82
Forest within protected areas	1 000 ha	37,811
	% of forest area	40
Forest with management plan	1 000 ha	0
	% of forest area	0
Industrial roundwood (1 000 m³ over bark)	1990	25485
	2000	17792
	2005	14428
Production volume (m³) **	Logs	35992
	Sawn wood	4169
	Veneer	287
	Plywood	4150
Forest revenue	% of country GDP	3.5
Industrial logging contribution to GDP	% of production	1

GDP: Gross domestic products; Sources: FAO, Global Forest Resources Assessment 2010;
** ITTO, 2009. *Annual review and assessment of the World timber situation 2011*

1.4 Expected outcomes at project completion

We expect three main outcomes of the project:

Better enforcement of forest laws and regulations through chain of custody and tracking and tracing systems and improved verification and monitoring procedures.

The genetic reference database established by this project will enable governmental authorities in timber producer and timber consumer countries to control the declared region of origin for *Shorea* species. The project database will be integrated into the open access database at the coordination office of Bioversity International in Malaysia. Thus also NGOs (WWF, EIA, etc.) and timber traders could use it via accredited genetic labs to check the declared country of origin for timber at any step in the chain of custody. The pilot studies for the DNA based tree by tree check of the chain of custody will stimulate the transfer of the technologies from public research Institutes to the private sector.

Better enforcement of forest laws and regulations through chain of custody and tracking and tracing systems and improved verification and monitoring procedures. Within the project the tools for species identification of 50 meranti tree species (in the genus *Shorea*, family Dipterocarpacea) will be developed. Again governmental authorities responsible for CITES, NGOs and the private sector will make use of these tools to check the species identification. Moreover the new Australian and EU timber regulations and the US Lacey Act ask for a declaration on the botanical species. Thus improving tools for species identification will directly support authorities in timber producer and timber consumer countries responsible for the control of those declarations.

Enhanced capacity of small and medium-sized enterprises in harvesting, processing and handling timber from legal and sustainably managed sources. Two people from Indonesia will be trained in high level genetic labs in Australia. And at least one training workshop will be done during the planned ITTO project. Thus at the end of the project the timber producer countries should be able to continue with the species and origin control by themselves.

PART 2. PROJECT RATIONALE AND OBJECTIVES

2.1 Rationale

2.1.1 Institutional set-up and organizational issues

Four partners will work together to implement the project. Two from producer and two from consumer countries. Two of the consumer country partners are universities and research institutes experienced in DNA fingerprinting techniques. They have conducted a number of joint research projects on various topics (many related to timber tracking) and there is a good level of cooperation and trust between them. Their scientific performance is demonstrated by many publications in high-ranking international journals (e.g. see Annex 2).

The University of Adelaide will be the executive agency and coordinator of the project. For over 15 years, the group of Professor Andrew Lowe, Director of the Australian Centre for Evolutionary Biology and Biodiversity, has been researching the topic of DNA fingerprinting for timber tracking and DNA barcoding of trees.

CFBTI in FORDA is a key provider of forest research in Indonesia and has a major stake in the development of DNA tracking technologies for chain of custody compliance. As a part of the Ministry of Forestry, CFBTI in FORDA is in an ideal position to influence the policy agenda in Indonesia. The involvement of CFBTI in FORDA in particular and the Ministry of Forestry more generally will be at a strategic level on the Steering Committee and at an operational level as a key delivery agent for the project. Crucially, CFBTI in FORDA will also ensure the ongoing sustainability of the outcomes from this project by acting as the champion and delivery agent of DNA testing inside the Indonesian government.

The Institute of Forest Genetics in the Thunen Institute also has extensive experience in forest genetics and DNA analysis, and several projects are jointly being progressed with the University of Adelaide. The institute also has good experience in the implementation of the EUTR legislation with European partners.

The Centre is experienced in DNA analysis of tree species and has well equipped DNA laboratory suitable for undertaking the DNA barcoding and fingerprinting work proposed in the project. The Centre has initiated its own DNA tracking system research of indigenous tree species.

The World Resources Institute is also experienced in the legislative requirements of the US Lacey Act and EU FLEGT Voluntary Partnership Agreement, and currently has a supply chain project in Indonesia examining the feasibility of integrating DNA into current certification processes to satisfy consumer country legislation.

2.1.2 Stakeholder analysis

Stakeholder group	Characteristics	Problems, needs, interests	Potentials	Involvement in the project
Primary stakeholders				
DG of Management of Forest Utilization	Responsible for the management and utilization of production forest	Recognize the potential but concern over the cost	Provide information of logging areas	Assistance in data and sample gathering
Provincial Forestry Service	Directly involved in utilization of the dipterocarps	Insufficient capacity and capability to control illegal logging	Assistance to access field site	Ground support for sample collection

Stakeholder group	Characteristics	Problems, needs, interests	Potentials	Involvement in the project
Forest concessionaires	Derive revenues from timber logging	Face competition from illegally logged timber; concern about practical field application of the system; concern over what will happen to the current timber tracking methods; concern over the cost and who will pay for that	Have good knowledge of timber resources	Primary project beneficiaries, will assist for sampling
Timber trade federations and private companies	Derive revenue from timber and timber products trade	'Wait and see' proof that the system works and to know how it will be linked with current regulations; concern by the cost	Experienced in the wood and wood-based products market	Primary beneficiaries, can supply samples for blind test
FLEGT + CITES control authorities in timber producer and timber consumer countries	Are responsible for the legality control of timber exports and imports	Need reliable tools to control species and origin; may have wrong expectations on the costs; need to know which method is suitable for which control	Can specify the control needs	beneficiaries
Secondary stakeholders				
NGO's and development agencies	Actively involved in the sustainable management of natural resources	Want to develop small verification kits usable directly in the field	Experienced in working with various stakeholders from developing and developed countries	Can help during sampling, training and capacity building; will organize the blind test; can multiply the funding and lead in the extension of the system
Indonesian forest administrations	Make, implement or control forest management plans	Need training for sampling and implementation of the system	Experienced in existing timber tracking systems; knowledge of Indonesian forests; can mobilize staff for assistance	Can assist for sampling; can provide authorization and assistance to sample in protected forests and concessions

Stakeholder group	Characteristics	Problems, needs, interests	Potentials	Involvement in the project
Indonesian government	Make and implement forest laws	Needs to have non-falsifiable control methods guaranteeing the origin of wood and wood products	Desire to stop illegal logging; have the authority and influence to implement new timber tracking system	Primary project beneficiaries; Can incorporate the system into forest laws
Certification organisations	Attest the origin of wood raw material and its status and/or qualifications; have systems designed to measure forest management practices against standards and to demonstrate compliance with those standards	Support implementation of robust timber legality system (SVLK); low percentage of Indonesian forest certified; specific ecological, social and economic performance indicators can be manipulated along the chain of custody; needs to have indicators that cannot be manipulated	Experienced in working with stakeholders the timber industry	Primary project beneficiary; can use DNA fingerprinting techniques to increase certification standards
CFBTI in FORDA	Responsible for R&D to support policy development	Improved research outputs and outcomes to support MoF policy	Policy support to conduct advance research	Guidance in project implementation
Tertiary stakeholders				
Indonesian regional organizations	Primary authority for decision-making and coordination of sub-regional actions and initiatives pertaining to the conservation and sustainable management of forests	Project cover some of their strategic priorities: knowledge of the resource, management of ecosystems; sustainable exploitation of forest resources, monitoring, strengthening of capacities, training; research development	Authority and influence in the region	Desire to be member of the steering committee and to coordinate training and education activities

Stakeholder group	Characteristics	Problems, needs, interests	Potentials	Involvement in the project
Western countries governments	Make and implement forest laws	Have laws and regulations prohibiting the placing on the market of illegally sourced timber; Since March 2013, the EU-timber-trade-regulation obliges operators to prove the origin of wood and wood products imported to the internal EU-market; needs non-falsifiable methods to control the origin of wood and wood products	Great desire to stop illegal logging; have already appropriate laws and the means to enforce them	Supporting the project financially; will apply the system to track timber
International organizations: (Bioversity International)	Carry out global research to seek solutions for sustainable agriculture, nutrition and conservation; host the newly established international facility "Identification of Timber Species and Origins"	Want to use the international database as a tool to promote the up-scaling of DNA fingerprinting techniques; needs supports from all institutions working in the field	Competence in coordinating research, setting standards and establishing network	**Can** host the project reference database
Western countries universities and research institutes	Have education and research missions	Lack means to finance new timber tracking research	Competence in research; studies and training	Will collaborate in implementing project activities; might look for additional funding
Commercial partners	Provide service on origin checking for public authorities, NGOs and forest companies	Needs to get better access to the market	Important pathway of technology transfer and durable application of the project's results	Will do part of the genetic screening for the reference data bases and will participate in blind tests

Stakeholder group	Characteristics	Problems, needs, interests	Potentials	Involvement in the project
Indonesian universities and research institutes	Have education, training and research-development mandates	Lack: means to finance research; DNA fingerprints laboratory in many institutes; Needs: training of trainers, education of young scientists; Interests: host reference laboratory or have small equipment necessary to perform timber tracking works	Competence in research; experienced in teaching and training in Indonesia	Will assist in sampling; desire to organize training and education activities; desire to include know-how and knowledge generated by the project into curricula of existing degree and non-degree programmes

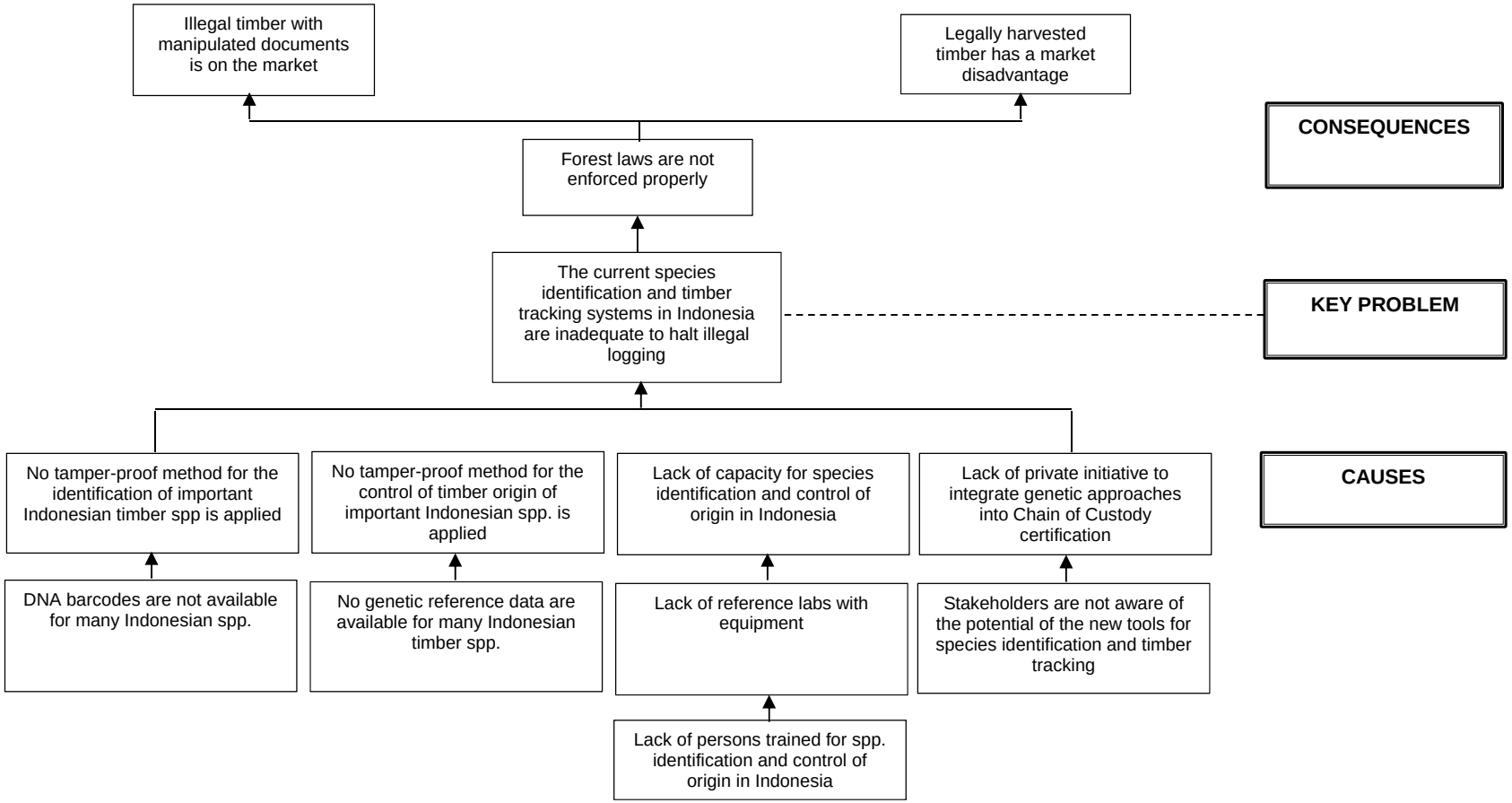
2.1.3 Problem analysis

The key problem that we want to address with the project is the inefficient tree species identification and control of timber origin in Indonesia. The consequences are that existing forest laws and regulations against illegal logging are not enforced properly. As long as this is the case illegal timber with manipulated documents claiming legality will remain on the market. And because the costs for illegal timber are significantly lower there will also remain a market disadvantage for legally harvested timber.

What are the causes of the missing application of tamper proof methods?

For more than 100 years, wood anatomical approaches have been used for the identification of tree species. However, for many important Indonesian timber species, particularly from the family Dipterocarpacea (e.g. the meranti group) wood anatomy hasn't been successful at discrimination down to species level. The modern alternative is the DNA barcoding. This new approach searches for genetic differences among species and develops gene markers that screen these differences. But for many species worldwide, we still need to develop the DNA barcodes. Genetic fingerprinting is also a very reliable approach to control the origin of timber. Unfortunately, for the important Indonesian timber species a reference database with the spatial distribution of DNA fingerprints across the range of a species has not yet been developed.

There are two reasons for the lack of application of genetic approaches in Indonesia: a) there are no reference labs with trained persons and sufficient equipment, and (b) lack of initiatives of various stakeholders group (private sector, government, NGOs, development agencies etc.) in this area, caused by a low level of knowledge of the potential of the new genetic tools.

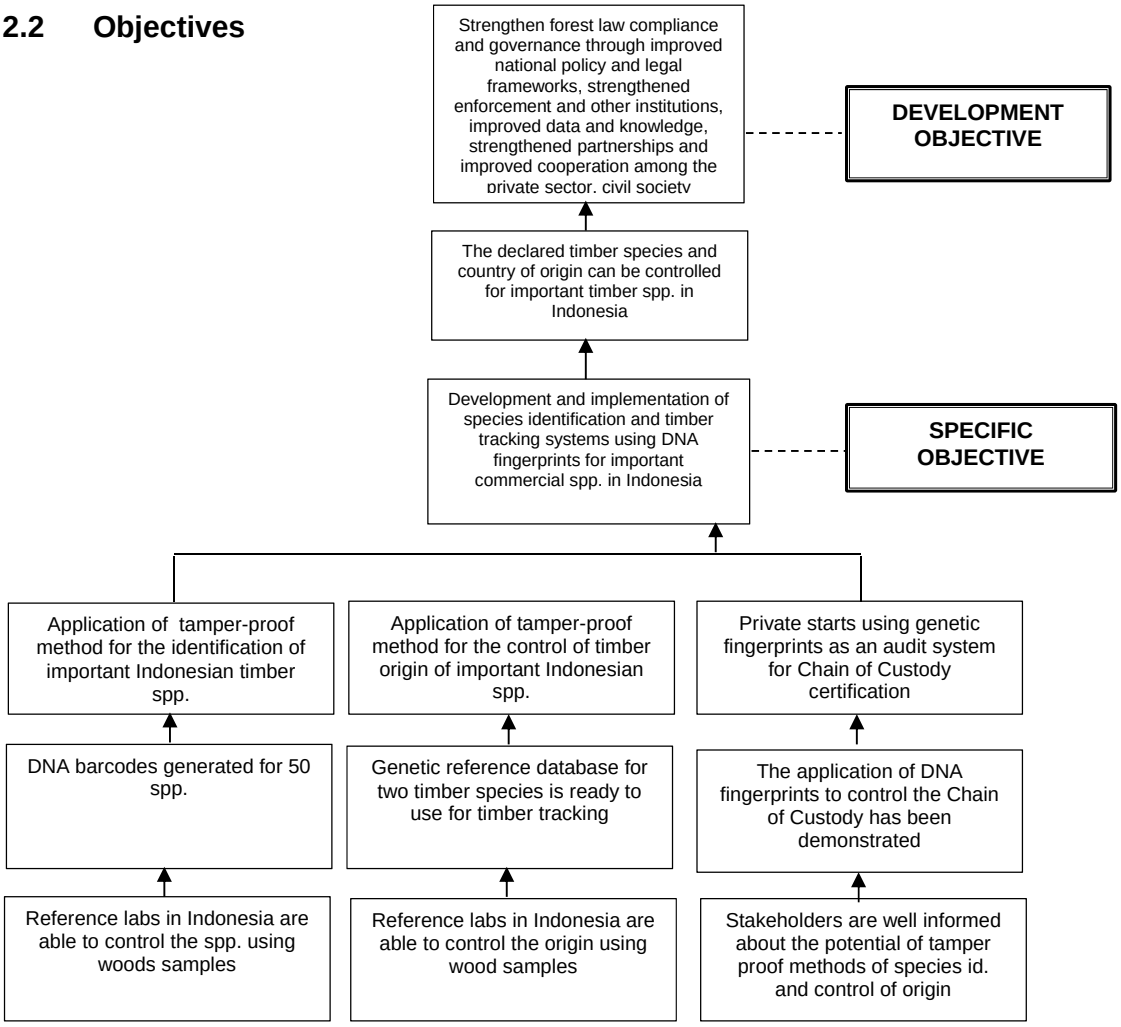

Illegal timber with manipulated documents is on the market
Legally harvested timber has a market disadvantage
CONSEQUENCES
Forest laws are not enforced properly
The current species identification and timber tracking systems in Indonesia are inadequate to halt illegal logging
KEY PROBLEM
No tamper-proof method for the identification of important Indonesian timber spp is applied
No tamper-proof method for the control of timber origin of important Indonesian spp. is applied
Lack of capacity for species identification and control of origin in Indonesia
Lack of private initiative to integrate genetic approaches into Chain of Custody certification
CAUSES
DNA barcodes are not available for many Indonesian spp.
No genetic reference data are available for many Indonesian timber spp.
Lack of reference labs with equipment
Stakeholders are not aware of the potential of the new tools for species identification and timber tracking
Lack of persons trained for spp. identification and control of origin in Indonesia

2.1.4 Logical framework matrix

STRATEGY OF INTERVENTION	INDICATORS	MEASURABLE INDICATORS	KEY ASSUMPTIONS
Development Objective: Contribute to the strengthening of forest law compliance and governance through improved national policy and legal frameworks, strengthened enforcement and other institutions, improved data and knowledge, strengthened partnerships and improved cooperation among the private sector, civil society organizations and other stakeholders	Impact indicators: • Cost-effective and non-paper based timber tracking systems developed and implemented in Indonesia. • By 2016, certification standards have recognised DNA as additional audits	• Report on the implementation of the systems, certification of verification of legality, chain of custody certification reports • Compendium of tracking and tracing technologies and evidence on dissemination • Statistics of public control agencies • Certifications standards • Workloads at the reference laboratories • Requests to the central data base at Bioversity International	Sustainability assumptions: • DNA timber tracking system introduced into countries policies and practices • Commitments from timber importing countries to use the system
Specific Objective: Development and implementation of species identification and timber tracking system with DNA fingerprints for two commercial timber tree species	• By 2014, a species identification based DNA barcode is available for 50 Indonesian timber species • By 2015, a DNA fingerprints timber tracking system is ready for use for two timber species • By 2015, partners are doing independently timber tracking with DNA fingerprints in Indonesia	• Project reports and publications • Online databases • Established timber tracking systems	Development, hypothesis, linking specific objective to development objective: • Strong commitments from timber producing countries governments to participate to the project • Strong support from partners and stakeholders
Output 1: 50 tree species have been identified by DNA barcode	Output Indicators: • By the end of the project, the DNA barcode sequences of 50 timber species is completed	• Barcode sequence database	Implementation assumptions linking outputs to the specific objective: • Presence of variation in DNA barcode sequence

STRATEGY OF INTERVENTION	INDICATORS	MEASURABLE INDICATORS	KEY ASSUMPTIONS
Output 2: Genetic reference data to control the country of origin for two important timber species have been established	Output Indicators: • By the end of the 2nd year, sampling of wood probes, cambium or leaves is completed • By the end of the project, a spatial genetic reference database of 2 important timber species is available online	• Report of field sampling • Genetic reference database	Implementation assumptions linking outputs to the specific objective: • Strong commitments from timber producing countries partners and stakeholders to support sampling • Presence of DNA sequence variation in the genome of each species showing clear spatial genetic pattern
Output 3: Capacity building of Indonesia partners to use DNA markers for timber tracking and species identification	Output Indicators: • By the end of the project, up to 30 forestry officials of mid and top management have received sufficient information of the potential of DNA markers for timber tracking. • By the end of the project, enabling condition for implementation of timber tracking using DNA markers identified. • By the end of the project, recommendations on policy formulation for implementation are available	• Training reports • Policies developed by the Ministry of Forestry	Implementation assumptions linking outputs to the specific objective: • Commitment from Indonesian partners to have staff members trained • Commitment of partners staff members to do the training
Output 4: Demonstration of control of chain of custody have been done with one tree species and stakeholders have been involved	Output Indicators: • By the end of the 2nd year, timber of individual trees can be traced back with DNA-fingerprints to their exact position of origin along the chain of custody	• Genetic reference database • Project reports and publications	Implementation assumptions linking outputs to the specific objective: • Presence of SNP markers in the genome of each species showing sufficient variation and a fine scale spatial genetic pattern • Protocols on DNA extraction of processed timber are sufficient developed

2.2 Objectives



2.2.1 Development objective and impact indicators

To improve transparency and effective management of supply chains and increased domestic and international trade in legally produced tropical timber

=>See section 2.1.4 “Logical framework matrix”

2.2.2 Specific objective and outcome indicators

Development and implementation of species identification and timber tracking system with DNA methods for two commercial timber tree species in Indonesia

=>See section 2.1.4 “Logical framework matrix”

PART 3. DESCRIPTION OF PROJECT INTERVENTIONS

3.1 Outputs and activities

3.1.1 Outputs

Output 1: 50 tree species from the meranti group have been identified by DNA barcoding

Output 2: Genetic reference data to control the country of origin for two important timber species have been created

Output 3: Indonesian personal trained for timber species identification and control of origin

Output 4: Demonstration of control of chain of custody with one meranti species and stakeholders have been involved

3.1.2 Activities

For Output 1:
1. CFBTI in FORDA to sample wood probes and cambium or leaves from 100 individual trees
2. CFBTI in FORDA and University of Adelaide to develop DNA barcodes for 50 tree species
3. CFBTI in FORDA undertake blind testing of 50 samples from unknown origin based on barcoding analysis

For Output 2:
1. CFBTI in FORDA to sample cambium or leaves from up to 800 individual trees belonging to 2 species (up to 40 locations and 10 samples per location for genetics)
2. University of Adelaide to optimise DNA extraction protocols for wood
3. University of Adelaide to develop genetic markers (chloroplast and nuclear microsatellites, SNPs) for red meranti
4. University of Adelaide to develop genetic markers (chloroplast and nuclear microsatellites, SNPs) for light red meranti
5. CFBTI in FORDA and University of Adelaide to undertake DNA fingerprinting of up to 400 red meranti trees
6. CFBTI in FORDA and University of Adelaide to undertake DNA fingerprinting of up to 400 light red meranti trees
7. CFBTI in FORDA undertake blind testing of 50 samples from unknown origin belonging to 2 species based on DNA fingerprinting

For Output 3:
1. Training in Australia and Indonesia of Indonesian scientists in marker development, barcoding and DNA fingerprinting
2. In-house training by University of Adelaide scientist in Indonesian lab
3. Development of communication strategy by CFBTI in FORDA and University of Adelaide to ensure that policy makers and general public are well informed
4. CFBTI in FORDA and University of Adelaide to organize national workshop on timber tracking using DNA markers
5. World Resources Institute works with CFBTI in FORDA to identify the required conditions in Indonesia for the implementation of DNA markers in timber tracking
6. CFBTI in FORDA and World Resources Institute to evaluate existing log tracking systems
7. CFBTI in FORDA works with stakeholders to identify suitable conditions for implementation of log tracking using DNA markers

For Output 4:
1. CFBTI in FORDA to sample cambium or leaves and wood probes of 100 meranti trees
2. CFBTI in FORDA and University of Adelaide to develop DNA fingerprinting for 100 meranti trees
3. CFBTI in FORDA and University of Adelaide to train local staff from enforcement and scientific testing agencies in Indonesia in the use of genetic markers for enforcement of Indonesian timber laws

4. CFBTI in FORDA to organise meetings with stakeholders to make them aware of the power and application of genetic markers for enforcement of Indonesian timber laws

For project co-ordination:
1. University of Adelaide to provide executive agency coordination
2. University of Adelaide to coordinate a kick-off meeting
3. Steering committee formed by the University of Adelaide
4. Steering committee and partners meetings schedule developed by the University of Adelaide

3.2 Implementation approaches and methods

The approach of implementing the laboratory work of this project will be divided into a series of activities. Collection of genetic materials for genetic analysis will be one of the top priorities. At the same time techniques for DNA extraction from woody materials has to be developed. The laboratory work essentially consists of DNA extraction and purification, Polymerase Chain Reaction (PCR) reaction, electrophoresis and data scoring, analysis and interpretation. DNA markers to be examined for the chloroplast DNA are SNP and microsatellite/SSR. The steps are summarized in the following:

Development of DNA extraction protocols: The first challenge for using genetic markers in timber identification is to successfully isolate DNA from dry wood. For most genetic study, generally DNA is isolated from leaves or seeds of a species. However, since wood is the target of examination, the existing method for DNA extraction that is common for leaf material cannot be applied. Wood contains compounds that inhibit PCR technique. Furthermore, the timber products that reach the market may consist of only heartwood, which is not a good source of DNA since it contains dead cells. However, extraction of DNA from wood has been successful and reported.

Milestones:
- Preliminary works on DNA extraction has been carried out and showed promising results.
- Testing a range of different wood samples to test the robustness of the protocols.

Development of chloroplast DNA primers: Chloroplast DNA is maternally inherited and dispersed through both pollen and seeds. The consequence of this is the chloroplast DNA variation is often highly geographically structured, suitable to identify geographic origin. The DNA is found in many copies and thus the probability of PCR amplification success is likely to be high. Primers will be developed as universal primers for non-coding region of chloroplast DNA via the Polymerase Chain Reaction (PCR).

Milestones:
- Indonesian researcher has experience in developing primers for chloroplast DNA of other species. The approach to primers development is universal.
- Developing SNP and SSR primers for chloroplast DNA
- Construction of genetic database: Genetic database would be the baseline for identification of timber origin. DNA profile of wood sample would be interrogated against the database. The first level of verification would be to check the geographic origin of the wood sample.

Milestones:
- Collection of sample materials from the whole range of populations and successful isolation of DNA.
- Differentiation of geographic populations using DNA markers developed by the project

3.3 Work plan (updated)

		Year 2014												Year 2014											
Outputs and Activities	**Responsible Partner**	**Schedule (in months)**												**Schedule (in months)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
For Output 1:																									
1. **CFBTI** to sample wood probes and cambium or leaves from 100 individual trees	**CFBTI**																								
2. **CFBTI** and University of Adelaide to develop DNA barcodes for 50 tree species	UOA																								
3. **CFBTI** undertake blind testing of 50 samples from unknown origin based on	**CFBTI**																								

barcoding analysis																									
For Output 2:																									
1. CFBTI to sample cambium or leaves from up to 800 individual trees belonging to 2 species (up to 40 locations and 10 samples per location for genetics)	**CFBTI**																								
2. University of Adelaide to optimise DNA extraction protocols for wood	UOA																								
3. University of Adelaide to develop genetic markers (chloroplast and nuclear microsatellites, SNPs) for red meranti	UOA																								

4. University of Adelaide to develop genetic markers (chloroplast and nuclear microsatellites, SNPs) for light red meranti	UOA				[redacted]																		
5. **CFBTI** and University of Adelaide to undertake DNA fingerprinting of up to 400 red meranti trees	UOA												[redacted]										
6. **CFBTI** and University of Adelaide to undertake DNA fingerprinting of up to 400 light red meranti trees	UOA												[redacted]										
7. **CFBTI** undertake blind testing of 50 samples from	**CFBTI**																			[redacted]			

unknown origin belonging to 2 species based on DNA fingerprinting																								
For Output 3: Indonesian timber producer countries equipped and their personal trained for timber species identification and control of origin																								
1. Training in Australia and Indonesia of Indonesian scientists in marker development, barcoding and DNA fingerprinting	CFBTI																							
2. In-house training by University of Adelaide	CFBTI																							

scientist in Indonesian lab																			
3. Development of communication strategy by CFBTI and University of Adelaide to ensure that policy makers and general public are well informed	CFBTI																		
4. CFBTI and University of Adelaide to organize national workshop on timber tracking using DNA markers	CFBTI																		
5. World Resources Institute works with CFBTI to identify the required conditions in Indonesia	CFBTI																		

for the implementation of DNA markers in timber tracking																									
6. CFBTI and World Resources Institute to evaluate existing log tracking systems	CFBTI																								
7. CFBTI works with stakeholders to identify suitable conditions for implementation of log tracking using DNA markers	CFBTI																								
For Output 4:																									
1. CFBTI to sample cambium or leaves and wood probes of 100 meranti trees	CFBTI																								
2. CFBTI and	UOA																								

University of Adelaide to develop DNA fingerprinting for 100 meranti trees													
3. CFBTI and University of Adelaide to local staff from enforcement and scientific testing agencies in Indonesia in the use of genetic markers for enforcement of Indonesian timber laws	CFBTI												
4. CFBTI to organise meetings with stakeholders to make them aware of the power and application of genetic markers for	CFBTI												

enforcement of Indonesian timber laws																										
For project co-ordination:																										
1. University of Adelaide to provide executive agency coordination	UOA																									
2. University of Adelaide to coordinate a kick-off meeting	UOA																									
3. Steering committee formed by the University of Adelaide	UOA																									
4. Steering committee and partners meetings schedule developed by the University of Adelaide	UOA																									

3.4 Budget

3.4.1 Master budget schedule

			Quantity					ITTO		Executing agency
		Budget Component	Year 1	Year 2	Units	Unit Cost $US	Total Cost	Year 1	Year 2	
For Output 1:										
1.1. CFBTI in FORDA to sample wood probes and cambium or leaves from 100 individual trees										
	Scientist	15	4	0	Months salary	2250	9000	9000	0	
	Field Coordinator	14	0.5	0	Months salary	500	250	250	0	
	Facilitating access to logging concessions	21	1	0	Subcontract	7500	7500	7500	0	
	Local transport	33	3	0	trips x participants	1000	3000	3000	0	
	Consumables	54	30	0		250	7500	7500	0	
	Daily subsistence	31	20	0	per person	100	2000	2000	0	
1.2. CFBTI in FORDA and University of Adelaide to develop DNA barcodes for 50 tree species										
	Scientist	15	2.5	0.5	Months salary	2250	6750	5625	1125	
	Technical Project Coordinator	11	1.5	0.5	Months salary	8085	16170	12127.5	4042.5	
	Technician	13	2	0	Months salary	1667	3334	3334	0	

	Consumables	54	20	15		250	8750	5000	3750	
	Executing Agent Management Costs	71	0.1	0.1	Months salary	15465	3093			3093
1.3. CFBTI in FORDA undertake blind testing of 50 samples from unknown origin based on barcoding analysis										
	Scientist	15	0	0.5	Months salary	2250	1125	0	1125	
	Field Coordinator	14	0	0.5	Months salary	500	250	0	250	
	Technician	13	0	2	Months salary	1667	3334	0	3334	
	Local transport	33	0	2	trips x participants	1000	2000	0	2000	
	Consumables	54	10	10		250	5000	2500	2500	
	Daily subsistence	31	0	10	per person	100	1000	0	1000	
For Output 2:										
2.1. CFBTI in FORDA to sample cambium or leaves from up to 800 individual trees belonging to 2 species (up to 40 locations and 10 samples per location for genetics)										
	Scientist	15	2	1	Months salary	2250	6750	4500	2250	
	Project Secretariat	12	2.5	0	Months salary	1000	2500	2500	0	
	Field Coordinator	14	0.5	0.5	Months salary	500	500	250	250	
	Local transport	33	2	3	trips x participants	1000	5000	2000	3000	
	Consumables	54	20	30		250	12500	5000	7500	
	Daily subsistence	31	20	30	per	100	5000	2000	3000	

					person					
2.2. University of Adelaide to optimise DNA extraction protocols for wood										
	Technical Project Coordinator	11	3	2	Months salary	8085	40425	24255	16170	
	Consumables	54	10	10		250	5000	2500	2500	
	Executing Agent Management Costs	71	0.1	0.1	Months salary	15465	3093			3093
2.3. University of Adelaide to develop genetic markers (chloroplast and nuclear microsatellites, SNPs) for red meranti										
	Technical Project Coordinator	11	2	0	Months salary	8085	16170	16170	0	
	Technician	13	1	0	Months salary	1667	1667	1667	0	
	Consumables	54	10	10	per person	250	5000	2500	2500	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
2.4. University of Adelaide to develop genetic markers (chloroplast and nuclear microsatellites, SNPs) for light red meranti										
	Technical Project Coordinator	11	2	0	Months salary	8085	16170	16170	0	
	Technician	13	1	0	Months salary	1667	1667	1667	0	
	Consumables	54	15	0		250	3750	3750	0	
	Executing Agent Management Costs	71	0.1	0	Months salary	15465	1546.5			1546.5
2.5. CFBTI in FORDA and University of Adelaide to undertake DNA fingerprinting of up to 400 red meranti trees										
	Technical Project Coordinator	11	0	2	Months salary	8085	16170	0	16170	

	Technician	13	0	2	Months salary	1667	3334	0	3334	
	Consumables	54	0	40		250	10000	0	10000	
	Scientist	15	0	1	Months salary	2250	2250	0	2250	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
2.6. CFBTI in FORDA and University of Adelaide to undertake DNA fingerprinting of up to 400 light red meranti trees										
	Technical Project Coordinator	11	0	2	Months salary	8085	16170	0	16170	
	Technician	13	0	1	Months salary	1667	1667	0	1667	
	Consumables	54	0	40		250	10000	0	10000	
	Scientist	15	0	1	Months salary	2250	2250	0	2250	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
2.7. CFBTI in FORDA undertake blind testing of 50 samples from unknown origin belonging to 2 species based on DNA fingerprinting										
	Scientist	15	0	0.5	Months salary	2250	1125	0	1125	
	Field Coordinator	14	0	1	Months salary	500	500	0	500	
	Technician	13	0	1	Months salary	1667	1667	0	1667	
	Local transport	33	0	2	trips x participants	1000	2000	0	2000	
	Consumables	54		25		250	6250	0	6250	
	Daily subsistence	31	0	20	per	100	2000	0	2000	

					person					
For Output 3: Indonesian timber producer countries equipped and their personal trained for timber species identification and control of origin										
3.1. Training in Australia and Indonesia of Indonesian scientists in marker development, barcoding and DNA fingerprinting										
	Project Secretariat	12	0	0.5	Months salary	1000	500	0	500	
	Technical Project Coordinator	11	0	0.5	Months salary	8085	4042.5	0	4042.5	
	Consumables	54	0	20		250	5000	0	5000	
	International travel	32	0	2	Flight	2166	4332	0	4332	
	Scientist	15	0	0	Months salary	2250	0	0	0	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
3.2. In-house training by University of Adelaide scientist in Indonesian lab										
	Project Secretariat	12	0	0.5	Months salary	1000	500	0	500	
	Technical Project Coordinator	11	0	0.5	Months salary	8085	4042.5	0	4042.5	
	International travel	32	0	1	Flight	2166	2166	0	2166	
	Consumables	54	0	20		250	5000	0	5000	
	Scientist	15	0	1	Months salary	2250	2250	0	2250	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
3.3. Development of communication strategy by CFBTI in FORDA and University of Adelaide to ensure that policy makers and general public are well informed										

	Project Secretariat	12	1	1	Months salary	1000	2000	1000	1000	
	Technical Project Coordinator	11	0	0.5	Months salary	8085	4042.5	0	4042.5	
	Consumables	54	0	0		250	0	0	0	
	Scientist	15	0	0.5	Months salary	2250	1125	0	1125	
3.4. CFBTI in FORDA and University of Adelaide to organize national workshop on timber tracking using DNA markers										
	Project Secretariat	12	1	1	Months salary	1000	2000	1000	1000	
	Technical Project Coordinator	11	0	0.25	Months salary	8085	2021.3	0	2021.3	
	Consumables	54	0	0		250	0	0	0	
	Workshop facilitator	23	0	1	subcontract	2500	2500	0	2500	
	Rent Conference facilities and catering	53		1	Room hire	800	800		800	
	Scientist	15	0	0.5	Months salary	2250	1125	0	1125	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
3.5. World Resources Institute works with CFBTI in FORDA to identify the required conditions in Indonesia for the implementation of DNA markers in timber tracking										
	Project Secretariat	12	1	3	Months salary	1000	4000	1000	3000	
	Technical Project Coordinator	11	0	0.25	Months salary	8085	2021.3	0	2021.3	
	International travel	32	0	1	Flight	2166	2166	0	2166	

	Consumables	54	0	0		250	0	0	0	
	Scientist	15	0	0.5	Months salary	2250	1125	0	1125	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
3.6. CFBTI in FORDA and World Resources Institute to evaluate existing log tracking systems										
	Project Secretariat	12	3	3	Months salary	1000	6000	3000	3000	
	Consumables	54	0	0		250	0	0	0	
	Scientist	15	2	0.5	Months salary	2250	5625	4500	1125	
3.7. CFBTI in FORDA works with stakeholders to identify suitable conditions for implementation of log tracking using DNA markers										
	Project Secretariat	12	3	3	Months salary	1000	6000	3000	3000	
	Office supplies and consumables	52	1	1		1000	2000	1000	1000	
	Scientist	15	0	0.5	Months salary	2250	1125	0	1125	
	Local transport	33	0	2	trips x participants	1000	2000	0	2000	
	Rent Conference facilities and catering	53		1	Room hire	800	800		800	
	Consumables	54	0	0		250	0	0	0	
	Daily subsistence	31	0	8	per person	100	800	0	800	

For Output 4:										
4.1. CFBTI in FORDA to sample cambium or leaves and wood probes of 100 meranti trees										
	Scientist	15	1	0	Months salary	2250	2250	2250	0	
	Field Coordinator	14	1	0	Months salary	500	500	500	0	
	Facilitating access to logging concessions	21	0	1	Subcontract	7500	7500	0	7500	
	International travel	32	0	1	Flight	2166	2166	0	2166	
	Local transport	33	3	0	trips x participants	1000	3000	3000	0	
	Consumables	54	10	0		250	2500	2500	0	
	Daily subsistence	31	20	30		100	5000	2000	3000	
4.2. CFBTI in FORDA and University of Adelaide to develop DNA fingerprinting for 100 meranti trees										
	Technical Project Coordinator	11	0	0.25	Months salary	8085	2021.3	0	2021.3	
	Technician	13	0	2	Months salary	1667	3334	0	3334	
	International travel	32	0	1	Flight	2166	2166	0	2166	
	Consumables	54	0	10		250	2500	0	2500	
	Scientist	15	0	2	Months salary	2250	4500	0	4500	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
4.3. CFBTI in FORDA and University of Adelaide to local staff from enforcement and scientific testing agencies in Indonesia in the use of genetic markers for enforcement of Indonesian timber laws										

	Technical Project Coordinator	11	0	0	Months salary	8085	0	0	0	
	Publishing	22	0	1	subcontract	1500	1500	0	1500	
	International travel	32	0	1	Flight	2166	2166	0	2166	
	Consumables	54	0	20		250	5000	0	5000	
	Scientist	15	0	1.5	Months salary	2250	3375	0	3375	
	Executing Agent Management Costs	71	0	0.1	Months salary	15465	1546.5			1546.5
4.4. CFBTI in FORDA to organise meetings with stakeholders to make them aware of the power and application of genetic markers for enforcement of Indonesian timber laws										
	Technical Project Coordinator	11	0	0.25	Months salary	8085	2021.3	0	2021.3	
	Scientist	15	0	0.5	Months salary	2250	1125	0	1125	
	Local transport	33	0	5	trips x participants	1000	5000	0	5000	
	Publishing	22	0	1	subcontract	1500	1500	0	1500	
	Workshop facilitator	23	0	1	subcontract	2500	2500	0	2500	
	Rent Conference facilities and catering	53		3	Room hire	800	2400		2400	
	Consumables	54	0	0		250	0	0	0	
	Daily subsistence	31	0	5		100	500	0	500	

For project co-ordination:										
1. University of Adelaide to provide executive agency coordination										
		Budget Component	Year 1	Year 2	Units	Unit Cost $US	Total Cost	Year 1	Year 2	
	Executing Agent Management Costs	71	0.2	0	Months salary	15465	3093			3093
	Project Audits	62	1	1	1 x annual 1 x final	2000	4000	2000	2000	
2. University of Adelaide to coordinate a kick-off meeting										
	Executing Agent Management Costs	71	0.1	0	Months salary	15465	1546.5			1546.5
	Technical Project Coordinator	11	0.5	0	Months salary	8085	4042.5	4042.5	0	
	Project Secretariat	12	0.25		Months salary	1000	250	250	0	
	Scientist	15	0.5	0	Months salary	2250	1125	1125	0	
	International travel	32	0	3	Flight	2166	6498	0	6498	
3. Steering committee formed by the University of Adelaide										
	Executing Agent Management Costs	71	0.1	0	Months salary	15465	1546.5			1546.5
	Project Secretariat	12	0.25		Months salary	1000	250	250	0	
4. Steering committee and partners meetings schedule developed by the University of Adelaide										
	Executing Agent Management Costs	71	0.1	0.1	Months salary	15465	3093			3093
								175183	257061	30930

3.4.2 Consolidated budget by component (Revised)

Column1	Outputs and Activities	Year 1	Year 2	Input	Unit Costs	TOTAL	Year 1	Year 2
	(featuring Input and Unit Costs)							
	Budget Components							
10	**Project Personnel**							
	11 Technical Project Coordinator (Australia)	9.00	9.00	18.00	8,085.00	145,530.00	72,765.00	72,765.00
	12 Project Secretariat (Indonesia)	12.00	12.00	24.00	1,000.00	24,000.00	12,000.00	12,000.00
	15 Scientist (Indonesia)	12.00	12.00	24.00	2,250.00	54,000.00	27,000.00	27,000.00
	13 Technician (Germany)	4.00	8.00	12.00	1,667.00	20,004.00	6,668.00	13,336.00
	14. Field Coordinator	2.00	2.00	4.00	500.00	2,000.00	1,000.00	1,000.00
	19 Component Total			**78.00**	**13,002.00**	**245,534.00**	**119,433.00**	**126,101.00**
20	**Sub Contracts**							
	21 Facilitating access to logging concessions			2.00	7,500.00	15,000.00	7,500.00	7,500.00
	22 Publishing			2.00	1,500.00	3,000.00		3,000.00
	23 Workshop facilitator			2.00	2,500.00	5,000.00		5,000.00
	19 Component Total			**6.00**	**11,500.00**	**23,000.00**	**7,500.00**	**15,500.00**
30	**Travel**							
	31 Daily subsistence allowance	60.00	103.00	223.00	100.00	16,300.00	6,000.00	10,300.00
	32 International travel		10.00	10.00	2,166.00	21,660.00		21,660.00
	33 Local transport costs	8.00	14.00	22.00	1,000.00	22,000.00	8,000.00	14,000.00
	39 Component total			**255.00**	**3,266.00**	**59,960.00**	**14,000.00**	**45,960.00**
40	**Capital Items**							
	49 Component Total							
50	**Consumable Items**							
	52 Office supplies and consumables for Secretariat in Indonesia			2.00	1,000.00	2,000.00	1,000.00	1,000.00

	53 Rent Conference facilities and catering			5.00	800.00	4,000.00	2,400.00	1,600.00
	54 Consumables lab work	125.00	250.00	375.00	250.00	93,750.00	31,250.00	62,500.00
	55 PCR Machine							
	59 Component Total			**380.00**	**1,050.00**	**99,750.00**	**34,650.00**	**65,100.00**
60	**Miscellaneous**							
	61. Sundry							
	62. Auditing	**1**	**1**	**2**	**2,000.00**	**4,000.00**	**2,000.00**	**2,000.00**
	63. Contingencies							
	69. Component Total			**2**	**2,000.00**	**4,000.00**	**2,000.00**	**2,000.00**
70	**National Management Costs**							
	71. Executing Agent Management Costs	0.80	1.20	2.00	15,465.00	30,930.00	12,372.00	18,558.00
	72. Focus Point Monitoring							
	79. Component Total			**2.00**	**15,465.00**	**30,930.00**	**12,372.00**	**18,558.00**
	SUB-TOTAL					**463,174.00**	**189,955.00**	**273,219.00**
80	**Project Monitoring and Administration**							
	81. ITTO Monitoring and Review	**1.00**	**1.00**	**2.00**	**8,000.00**	**16,000.00**	**8,000.00**	**8,000.00**
	82. ITTO midterm, final and ex-post Evaluation Costs					15,000.00	8,000.00	7,000.00
	83. ITTO Programme Support Costs (12% of ITTO costs)					**55,589.28**	23,229.96	32,359.32
	84. Donor Monitoring Costs							
	89. Component Total					**86,589.28**	**39,229.96**	**47,359.32**
90	**Refund of Pre-Project Costs (pre-project budget)**							
100	**GRAND TOTAL**					**549,763.28**		
	ITTO Total					**518.833.28**		

Sub-contracts:
A consultant will be required to assist in gaining access to logging concessions.
An external publisher will be used for publishing promotional materials
A professional workshop facilitator will be engaged for running workshops with key stakeholders.

Project personnel:
The largest part of the total budget (48%) is reserved for Project Personnel. This includes a significant amount for creating genetic reference data. Key appointments for this project will include a full-time Technical Project Coordinator based in Australia, a full-time scientist and project secretariat as well as a part time field coordinator based in Indonesia and a part time technician in Germany.

Travel:
International local traveling is planned for: training (10 international flights), for stakeholder meetings, the kick-off meeting, planning meetings and project coordination. There will be a significant amount of internal travel to collect samples and meet with stakeholders. Part of the travel budget is also reserved for per diems of the persons travelling to workshops and also for collecting samples.

Consumables:
Most of the consumables will be required for lab work in Europe, Indonesia and Australia. The additional costs of purchasing laboratory chemicals in Indonesia has been accounted for.

National Management Costs:
Professor Andrew Lowe will be involved for 2 months on this project, funded by the University of Adelaide.

3.4.3 ITTO budget by component

Yearly Project Budget by Source - ITTO

Annual Disbursements	Total	Year 1	Year 2
10. Project Personnel	$ 245,534.00	$ 119,433.00	$ 126,101.00
20. Sub contracts	$ 23,000.00	$ 7,500.00	$ 15,500.00
30. Duty travel	$ 59,960.00	$ 14,000.00	$ 45,960.00
40. Capital items	$ -	$ -	$ -
50. Consumable items	$ 99,750.00	$ 34,650.00	$ 65,100.00
60. Miscellaneous	$ 4,000.00	$ 2,000.00	$ 2,000.00
70. Executing Agency Management Costs			
Subtotal 1	**$ 432,244.00**	$ 177,583.00	$ 254,661.00
80. ITTO Monitoring and Evaluation Costs	$ 16,000.00		
82. ITTO midterm, final and ex-post Evaluation Costs	$ 15,000.00		
Subtotal 2	**$ 463,244.00**		
83 .Program Support Costs (12% of total budget)	$ 55,589.28		
84. Donor Monitoring Costs	0		
90. Refund of Pre-Project Costs	0		
ITTO TOTAL	**$ 518,833.28**		

3.4.4 Executing agency budget by component

Yearly Project Budget by Source - E. Agency / Host Government

Annual Disbursements	Total	Year 1	Year 2
10. Project Personnel	$ -	$ -	$ -
20. Sub contracts	$ -	$ -	$ -
30. Duty travel	$ -	$ -	$ -
40. Capital items	$ -	$ -	$ -
50. Consumable items	$ -	$ -	$ -
60. Miscellaneous	$ -	$ -	$ -
70. Executing Agency Management Costs	$ 30,930.00	$ 15,465.00	$ 15,465.00
EXECUTING AGENCY TOTAL	**$ 30,930.00**	**$ 15,465.00**	**$ 15,465.00**

Note: The Project Coordinator Prof Andrew Lowe has applied for $650,000 from the Australian Research Council (ARC). If approved in October 2013, the project would:

- Increase the number of sampling that can be achieved for the meranti timber species listed in this ITTO project.
- Add additional Meranti species to the sampling program, but at a coarser scale than proposed for this ITTO project.
- These two outcomes will complement the outcomes of the ITTO project, and increase the statistical probability of making the assignment of Meranti timber to a particular concession.
- The Project Coordinator has a 75% rate of approvals for projects submitted to this funding Organisation.

3.4.5 Other sources budget by component

Yearly Project Budget by Source

Annual Disbursements	**Total**	**Year 1**	**Year 2**
10. Project Personnel	$ -	$ -	$ -
20. Sub contracts	$ -	$ -	$ -
30. Duty travel	$ -	$ -	$ -
40. Capital itemms	$ -	$ -	$ -
50. Consumable items	$ -	$ -	$ -
60. Miscellaneous	$ -	$ -	$ -
70. Executing Agency Management Costs	$ -	$ -	$ -
EXECUTING AGENCY TOTAL	**$ -**	**$ -**	**$ -**

Note: The Project "Supply Chain Issues in Indonesia" funded by the World Resource Institute ($200,000) will be an important co-contributing project to this work. The University of Adelaide are collaborators with the World Resource Institute on other projects such as the application of DNA to supply tracking in the US and far East Russia.

3.5 Assumptions, risks, sustainability

3.5.1 Assumptions and risks

The sampling of the plant material for the two meranti timber species to develop the reference data bases for origin assignment is labor intensive and complicated work. It needs a good coordination between different teams and we need to get access to remote places. The sampling teams need to be well trained. We will follow a two-step sampling approach with a first genetic screening of 2/3 of all samples followed by a first data analysis and the remaining 1/3 sampling according to the first results and identified high priority sampling regions. The sampling will be coordinated by Anto Rimbawanto from CFBTI in FORDA, who has significant experience with sampling in Indonesia over many years.

The application of DNA markers to assign species and origin of processed timber assumes that the quality of extracted DNA is sufficient. To keep the risk of insufficient DNA quality as low as possible we will (a) put particular emphasis to further develop the DNA extraction protocols, and (b) work with DNA-markers that show genetic variation for short DNA fragments because these DNA markers are less sensitive to degraded DNA.

Assigning the geographic origin of timber assumes that the underlying spatial genetic pattern of DNA-markers in the natural distribution area of the tree species is high strong enough. To be sure on that we will (a) develop a high number of DNA-markers for each of the two species using the new generation DNA sequencing approach and (b) make a combined application of DNA-markers to assign the region of origin.

The forest authorities and logging companies might stay skeptical about the developed reinforcement tools. We will try to involve them as much as possible in the project. Good results of the blind tests should convince them on the power of the enforcement tools.

The total budget of the project includes two satellite projects covering a complementary part of the ITTO work program. For this part proposals have been submitted by the University of Adelaide and the TI at the Australian Research Council (Discovery Project requested additional budget = 656,000 US$). There is a risk that this proposal is not successful. In that case the extra sampling planned for the two target species would not be completed but this will not endanger the planned output from the project.

Key Assumptions

- The local partner CFBTI/FORDA will play a key role in the project delivery and governance and will continue to promote the use of DNA-based compliance within Indonesia
- DNA timber tracking system introduced into countries policies and practices
- Commitments from timber importing countries to use the system
- Strong commitments from timber producing countries governments to participate to the project
- Strong support from partners and stakeholders
- Presence of variation in DNA barcode sequence
- Strong commitments from timber producing countries partners and stakeholders to support sampling
- Presence of DNA sequence variation in the genome of each species showing clear spatial genetic pattern
- Commitment from Indonesian partners to have staff members trained
- Commitment of partners staff members to do the training
- Presence of SNP markers in the genome of each species showing sufficient variation and a fine scale spatial genetic pattern
- Protocols on DNA extraction of processed timber are sufficient developed

Risks or issues will be investigated further should the project proceed (This table added)

Assumption	Likelihood the assumption will not be met	Mitigation Strategy
DNA timber tracking system introduced into countries policies and practices	Possible	Involvement of MoF through CFBTI in FORDA in the delivery of project. Include decisions makers from Indonesia agencies on Steering Committee for project.
Commitments from timber importing countries to use the system	Possible	Include decisions makers from timber importing countries on Steering Committee for project. Inclusion of World Resources Institute in the project delivery.
Strong commitments from Indonesian government to participate to the project	Unlikely	Involvement of MoF through CFBTI in FORDA in the delivery of project. Include decisions makers from Indonesia agencies on Steering Committee for project.
Strong support from partners and stakeholders	Unlikely	Involvement of MoF through CFBTI in FORDA in the delivery of project. Include decisions makers from Indonesia agencies on Steering Committee for project.
Presence of variation in DNA barcode sequence	Rare	Negotiate with Steering Committee to assess an alternative timber species if there is insufficient variation in DNA barcode sequence
Strong commitments from Indonesian partners and stakeholders to support sampling	Possible	Involvement of MoF through CFBTI in FORDA in the delivery of project. Include decisions makers from Indonesia agencies on Steering Committee for project.
Presence of DNA sequence variation in the genome of each species showing clear spatial genetic pattern	Rare	Negotiate with Steering Committee to assess an alternative timber species if spatial pattern not present.
Commitment from Indonesian partners to have staff members trained	Unlikely	Include decisions makers from Indonesia agencies on Steering Committee for project.
Commitment of partners staff members to do the training	Unlikely	Include decisions makers from Indonesia agencies on Steering Committee for project.
Presence of SNP markers in the genome of each species showing sufficient variation and a fine scale spatial genetic pattern	Likely	Negotiate with Steering Committee to assess an alternative timber species if spatial pattern not present
Protocols on DNA extraction of processed timber are sufficiently developed	Unlikely	University of Adelaide and the Thunen Institute agree to put additional resources into the research to optimise the DNA extraction protocols.

3.5.2 Sustainability

Sustainability on political level

The main outcome of the project will be an enforcement of laws and regulations on international timber trade and CITES protection. For this purpose genetic tools will be developed and reference

data bases to check the country of origin will be created. Moreover starting in 2013 the new EU timber trade regulation will be applied, and in Australia the new regulation will start in 2014. For timber imported to the USA the US Lacey Act will be applied. Thus there is an elementary interest of both the timber producer and the timber consumer countries to maintain and further develop the tools that have been developed within this project.

Sustainability on institutional level

The genetic reference data bases to control the country of origin of timber needs to be developed only once for each tree species. Thus this data keep valid also decades after the project ends because the underlying spatial genetic and spatial isotopic pattern does not change within decades. All project data will be integrated into the open access and centralized data base at Bioversity International. Because this database is 'open access', it guarantees that the data will be maintained and available for a long time. Bioversity International (http://www.bioversityinternational.org) is one of the centres of the Consultative Group on International Agricultural Research (CGIAR).

Local personnel will be trained in data collection, DNA analysis and interpretation and inclusion of this information in chain of custody assessment protocols. CFBTI in FORDA are a key partner in the delivery of the project, and they agree to champion the use of this technology in Indonesia for chain of custody assessment and assurance of Indonesia timber. The organization already undertake timber log tracking work for other species such as Merbau. CFBTI in FORDA will lead these particular components and will participate in all aspects of the project governance and delivery. They will ensure the ongoing sustainability of the outcomes from this project by acting as the champion and delivery agent of DNA testing inside the Indonesian government after the project has been completed.

Financial sustainability

The responsible timber companies operating in Indonesia should have an elementary interest to proof the legal origin of their timber. This will be a market advantage to their competitors and it is known by the success of the FSC logo that consumers in Europe, USA and Australia are sensitive to this topic. Within the project particular efforts are undertaken to stimulate the private sector initiatives to establish DNA audit systems on the market. For this reason private companies and government agencies operating in Indonesia are directly involved in or linked to the project.

PART 4. IMPLEMENTATION ARRANGEMENTS

4.1 Organization structure and stakeholder involvement mechanisms

4.1.1 Executing agency and partners

The University of Adelaide in Australia will be the executive agency and the director of the Australian Centre for Evolutionary Biology and Biodiversity, Prof Andrew Lowe, will be the coordinator of the project. The University of Adelaide provides scientific leadership in the development of DNA extraction and analysis tools from standing trees, logs and processed timber. Prof Andrew Lowe has led major collaborative research programs, and has played a leading role in organisations such as the Global Timber Tracking Network

Three other collaborative agencies will support the University of Adelaide. The work of the Institute of Forest Genetics at the Thünen Institute (TI) in Germany, will be coordinated through Dr Bernd Degen. They have been long time collaborators with the University of Adelaide on molecular tracking techniques for timber, and will undertake the DNA extraction, for which they have high level skills in. The work of the CFBTI in FORDA will be coordinated through Dr Anto Rimbawanto. CFBTI in FORDA is a key provider of forest research in Indonesia and has a major stake in the development of DNA tracking technologies for chain of custody compliance. As a part of the Ministry of Forestry, CFBTI in FORDA is in an ideal position to influence the policy agenda in Indonesia. The complimentary project by the World Resources Institute on supply chain issues in Indonesia will be connected to this project by Adam Grant.

Table 3: Project partners and their abbreviations

N°	Partners name	Code	Country
1	University of Adelaide	UA	Australia
2	Centre for Forest Biotechnology and Tree Improvement in Forest Research and Development Agency	CFBTI in FORDA	Indonesia
3	Thunen Institute (TI) - Forest Genetics	TI	Germany
4	World Resources Institute	WRI	USA

Revised table

	UoA	CFBTI	vTI	WRI
Output 1: 50 tree species from the meranti group have been identified by DNA barcoding				
1.1. CFBTI to sample wood probes and cambium or leaves from 100 individual trees				
1.2. CFBTI and University of Adelaide to develop DNA barcodes for 50 tree species				
1.3. CFBTI undertake blind testing of 50 samples from unknown origin based on barcoding analysis				
Output 2: Genetic reference data to control the country of origin for two important timber species have been created				
2.1. CFBTI to sample cambium or leaves from up to 800 individual trees belonging to 2 species (up to 40 locations and 10 samples per location for genetics)				
2.2. University of Adelaide to optimise DNA extraction protocols for wood				
2.3. University of Adelaide to develop genetic markers (chloroplast and nuclear microsatellites, SNPs) for red meranti				
2.4. University of Adelaide to develop genetic markers (chloroplast and nuclear microsatellites, SNPs) for light red meranti				
2.5. CFBTI and University of Adelaide to undertake DNA fingerprinting of up to 400 red meranti trees				
2.6. CFBTI and University of Adelaide to undertake DNA fingerprinting of up to 400 light red meranti trees				
2.7. CFBTI undertake blind testing of 50 samples from unknown origin belonging to 2 species based on DNA fingerprinting				
Output 3: Indonesian partner personal trained for timber species identification and control of origin				
3.1. Training in Australia and Indonesia of Indonesian scientists in marker development, barcoding and DNA fingerprinting				
3.2. In-house training by University of Adelaide scientist in Indonesian lab				
3.3. Development of communication strategy by CFBTI and University of Adelaide to ensure that policy makers and general public are well informed				
3.4. CFBTI and University of Adelaide to organize national workshop on timber tracking				
3.5. World Resources Institute works with CFBTI to identify the required conditions in Indonesia				
3.6. CFBTI and World Resources Institute to evaluate existing log tracking systems				
3.7. CFBTI works with stakeholders to identify suitable conditions for implementation of log tracking using DNA markers				
Output 4: Demonstration of control of chain of custody with one meranti species and stakeholders have been involved				
4.1. CFBTI to sample cambium or leaves and wood probes of 100 meranti trees				
4.2. CFBTI and University of Adelaide to develop DNA fingerprinting for 100 meranti trees				
4.3. CFBTI and University of Adelaide to local staff from enforcement and scientific testing agencies in Indonesia				

in the use of genetic markers for enforcement of Indonesian timber laws				
4.4. CFBTI to organise meetings with stakeholders to make them aware of the power and application of genetic markers for enforcement of Indonesian timber laws				
For project co-ordination				
1. University of Adelaide to provide executive agency coordination				
2. University of Adelaide to coordinate a kick-off meeting				
3. Steering committee formed by the University of Adelaide				
4. Steering committee and partners meetings schedule developed by the University of Adelaide				

Fig. 4: Organizational allocation of tasks of the ITTO project

4.1.2. Project management team

The project management team consists of the project coordinator from the University of Adelaide, Prof Andrew Lowe, and a postdoctoral research scientist who will be appointed at the University and will take care of the day-to-day project management. A project accountant at the University will support the project for the contractual and financial aspects.

4.1.3. Project steering committee

The executing agency will establish a project steering committee with the primary role to oversee project implementation, approve expenditures within the budget, review the activities that have been carried out, and to review and propose changes in budgets and activities. The project steering committee will monitor the overall strategic management of the project and ensure that it proceeds in a timely, efficient and effective manner in accordance with its logical framework matrix and work plan.

The Project Steering Committee (PSC) consists of ITTO representative, policy makers appointed by the Minister of Forestry (MOF) the Government of Indonesia and would include the DG of Forest Production Development, Provincial Forest Services and FORDA, and the Project Executing Team. Director General of FORDA will be the Chairman of PSC.

The steering committee will have meetings in month 6, 18 and 24 of the project.

4.1.4. Stakeholder involvement mechanisms

Key stakeholders from the timber sector will be involved in the project.
A stakeholder meeting (workshop) designed exclusively for participants not involved in the project is planned for the end of the project, and will be held in Indonesia to guarantee the participation of anyone interested. It is important to mention (a) that such a workshop is not for stakeholders from the research sector, (b) that the language will be kept simple and easy to understand by everyone, and (c) that the discussion will focus mostly on the practical application/use of the projects results and how the tamper-proof methods can be integrated into the existing timber tracking systems. Stakeholders will also be kept informed via newsletters and an up to date project homepage.

Stakeholders such as forest concessionaires and forest administrations will also be directly involved in the sampling phase of the project activities: their field staff will be trained and will help for sampling.

NGOs, international and development agencies working directly in Indonesia will supply timber samples for the blind tests. Thus their participation will demonstrate to the wider audience the utility of the new methods.

The broad involvement of many stakeholders other than the research sector will keep them informed about and involved in the project implementation and will provide a platform for them to provide input into the project. Such steps are necessary to draw conclusions at the end of the project for the future practical application of the tamper-proof methods for timber tracking.

4.2 Reporting, review, monitoring and evaluation

The project inception report is planned at project month 3. Progress reports and technical reports will be prepared once a year. The ITTO monitoring visits to the executing agency will be combined with the meetings of the steering committee (thus at month 6 and 18). The project management team will have meetings (by teleconference) to monitor the progress of the project every 3 months. An internal participatory evaluation involving stakeholders will be conducted once a year. One representative of the collaborating agencies responsible for each of the main project outputs will participate in that. As all ITTO project we will enter the project progress into the ITTO online monitoring system.

All reports will follow the ITTO Manual on Project Monitoring, Review, Reporting and Evaluation and they will include the following aspects:

- Baseline survey/study
- Identification of key indicators
- Schedules and monitoring timetables and responsibility for monitoring
- Formats and protocols for data collection and analysis
- Ways of obtaining feedback on project implementation from stakeholders
- Staff and skills required to implement the monitoring and evaluation system, including training needs.

4.3 Dissemination and mainstreaming of project learning

4.3.1 Dissemination of project results

The project results will be distributed to all relevant stakeholders, i.e. representatives from timber trade companies and federations (timber trade federations, certification enterprises e.g. FSC, PEFC, MTCC, LEI, SVLK, auditing enterprises e.g. SGS, SCS, Control Union, Bureau Veritas, MTC, NGOs (e.g. WWF, Greenpeace) but also representatives from responsible authorities (e.g. forest, customs, trade, implementation of CITES) in FLEGT-partner countries, the EU, other G8 countries, other major timber trading countries (e.g. China, Vietnam) and other interested countries as well as relevant international organizations (e.g. Bioversity International, ITTO, IUFRO, CIFOR, CITES, CBD).

It is planned to present the concept and results of the project at thematically suitable international conferences or workshops possibly taking place during the project period (e.g. Conferences and workshop in addressing FLEGT, CITES or the US Lacey Act).

Besides scientific publications, results will be published also in a practice oriented manner to reach a large audience. A electronic leaflet summarizing the project results will be posted online and distributed through relevant internet pages dealing with timber and logging issues such as www.illegal-logging.info, http://www.itto.or.jp/live/index.jsp, http://www.cbd.int/tech-transfer/info-database.shtml, http://www.cites.org/forum/forum.php).

At least two scientific publications are envisaged from the project. Papers will be submitted to journals such as Forest Ecology and Management.

4.3.2 Mainstreaming project learning

The presented regional project has a very clear link to national and international politics related to the Australian legislation, FLEGT and the US Lacy act and all national laws and regulations aiming to reduce illegal logging. This project will strengthen the changes in policy and legislation, lead to the integration of the tamper-proof methods into the current timber tracking systems and to a better enforcement of forest laws in each country. The scientific coordinator “Tree species identification and Geographic origin” at Bioversity International, whose job is to coordinate research, information management and development of international standards for use of DNA markers to identify timber species and origin is also part of the steering committee. The genetic reference database generated by the project will be transferred to Bioversity International and will be made accessible to everyone.

ANNEX 1. PROFILES OF THE EXECUTING AND COLLABORATING AGENCIES

The description provided by each partner (Table 4) involved in the project implementation is presented here.

1. The University of Adelaide

The Australian Centre for Evolutionary Biology & Biodiversity (ACEBB) is a University of Adelaide designated research centre within the Environment Institute that brings together expertise from three key organizations: The University of Adelaide, the South Australian Museum and the Department for Environment and Natural Resources (DENR) Science Resource Centre, housing the State Herbarium and Biological Survey for South Australia.

The Mission of the ACEBB is to be a leading centre for research and training in evolutionary biology and biodiversity science, with an emphasis on fauna and flora of Australia

- Year of establishment -2000
- Fields of expertise - ACEBB is focusing its research effort around four key themes:

Species discovery and phylogenetics

Building on ACEBB's key strength in biodiversity discovery, taxonomy, systematic and phylogenetics, we are developing new molecular methods to understanding the evolutionary relationship species and their rapid identification, including DNA barcoding. In addition methods to incorporate evolutionary history into conservation assessments of species are being developed (e.g. phylogenetic diversity and endemism).

Evolutionary and landscape adaptation

Strengths in this area include; macroevolution, life history trait analysis, adaptational evolution, biogeographic history, phylogeography and recent landscape genetic and ecological changes due to contemporary pressures. Through this research ACEBB scientists are able to advance our understanding of evolutionary adaptations in Australian systems due to historical impacts (long term climatic change, geological change) and contemporary landscape influences (fragmentation, invasive species, climate change).

Biodiversity and ecosystem analysis and monitoring

This theme aims to improve our understanding of the dynamics of species and ecosystems and how they change over time in response to climate change, fragmentation and invasive species through analysis and modeling. Part of the research involves establishing large scale remote monitoring programs in terrestrial and marine environments to track the trajectory of biodiversity and ecosystems over time, and includes the development of novel monitoring techniques, such as DNA barcoding, environmental genomics, image capture and analysis and remote data feedback.

Biodiversity management and conservation decision-making

At the applied end of science, we are using the unique capabilities of ACEBB to combine genetic and adaptation understanding into biodiversity and ecosystem analysis and modeling for conservation decision-making. This is a new and expanding area of ACEBB's focus. Novel technical skills in environmental forensics and assessment that use DNA barcoding and phylogeographic data are also being developed (e.g. tracking illegal logging).

2. Centre for Forest Biotechnology and Tree Improvement (CFBTI) in Forest Research and Development Agency (FORDA)

Centre for Forest Biotechnology and Tree Improvement (CFBTI) is one of research centres under FORDA (Forest Research and Development Agency), its specific tasks are to plan, implement and monitor the research and development pertinent to forest biotechnology and tree improvement. The total number of staff is 140 personnel, including 44 research scientists and 20 technicians.

The origin of CFBTI dated back to 1992 when the Ministry of Forestry received grant assistance from JICA for the construction of building and research facilities in Yogyakarta. Following the completion of

the building, JICA continue the support through technical assistance project, commonly known as JICA Forest Tree Improvement Project which last for 10 years. Since 2004 JICA has terminated the project and CFBTI has continued to carry out its research activities.

Over the years CFBTI has had bilateral research collaboration with CSIRO Forestry and Forest Products in Canberra on various aspects of tree improvement, and University of Tasmania/CSIRO Sustainable Ecosystem on Management of root diseases in acacia plantation in Indonesia (2006-2009) funded by ACIAR. In fact, collaborative research with Australian research institutions dated back to 2001 with over 5 research projects.

The Centre has several laboratories in the field of tissue culture, seed technology, reproductive biology, and DNA. The DNA laboratory is fully equipped capable of conducting any PCR-based markers analysis. The laboratory is equipped with PCR machine, DNA sequencing and other essential instruments. DNA technique has been applied in the field of tree improvement, conservation of forest genetic resources, genetic identification of superior trees, identification of pathogen etc.

The Centre research program is structured into three main topics, namely 1). tree improvement through breeding and selection; 2). conservation of forest genetic resources; and 3). biotechnology which deals with the use of biotechnology, especially DNA markers for breeding, conservation, bio-security and forensic botany. Part of the biotechnology topic is propagation by tissue culture. To carry out the research program, the Centre has 44 researchers, of whom 10 with PhD and 15 with MSc qualification.

3. The Thunen Institute

The Thünen Institute (TI) is one of four German federal research institutes under the auspices of the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV). The TI was created on January 1, 2008 from the German Federal Research Centre for Fisheries, the German Federal Research Centre for Forestry and Forest Products and part of the German Federal Agricultural Research Centre.
The TI drafts scientific basics as decision-making helps for the policy of the German federal government and thus serves, with its application oriented and practice related research, the development of the society of tomorrow.
The TI pursues interdisciplinary research in the following areas:

- Economics (micro and macroeconomics of agriculture, forestry, lumber, food and fish production),
- Technology,
- Material use of renewable natural resources,
- Climate,
- Biodiversity,
- Organic Farming.

For more details see: http://www.vti.bund.de/en/

The TI will mainly contribute to the project through its Institute of Forest Genetics
The TI Institute of Forest Genetics carries out research on genetics of indigenous and exotic tree and shrub species. The studies help to elaborate recommendations for national and international laws, conventions and strategies in the area of forest reproductive material, biological diversity, control of origin for timber and forest reproductive material, conservation of forest genetic resources, genetic engineering, adaptation to climate change and optimization of biomass production. For more than ten years the Institute has been working in close co-operation with the University of Hamburg on the development and implementation of DNA-fingerprinting methods in different timber tracking projects in the tropics.

4. World Resources Institute

Founded in 1982, the World Resources Institute (WRI) is an environmental think tank that goes beyond research to find practical ways to protect the earth and improve people's lives. Its mission is to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations.

WRI organizes its work around four key goals:
People & Ecosystems: Reverse rapid degradation of ecosystems and assure their capacity to provide humans with needed goods and services.
Access: Guarantee public access to information and decisions regarding natural resources and the environment.
Climate Protection: Protect the global climate system from further harm due to emissions of greenhouse gases and help humanity and the natural world adapt to unavoidable climate change.
Markets & Enterprise: Harness markets and enterprise to expand economic opportunity and protect the environment.

WRI has a unique set of experiences, skills, and relationships it will utilize to jointly execute:
Forest monitoring. With its own geographic information system (GIS) and laboratory, WRI has more than a decade of experience converting remote sensing data (e.g., satellite images) into information to help improve forest management and protection. WRI launched Global Forest Watch in the mid-1990s; an initiative that mapped the world's remaining primary forests, identified threats, and provided information to decision-makers and stakeholders on how to address these threats. Since then, WRI has mapped the forests of a number of countries including Brazil, Canada, Indonesia, Russia, Cameroon, and the Democratic Republic of Congo. This information is being used by government agencies, major wood buyers, NGOs, and other forest stakeholders.

Forest supply chain management. With the World Business Council for Sustainable Development, WRI recently co-authored Sustainable Procurement of Wood and Paper-Based Products, a guide that helps companies increase the sustainability of their forest product supply chains and that provides an objective assessment of the various forest certification schemes around the world.

In-country capacity building. For more than a decade, WRI has built the capacity of government agencies and NGOs (in Brazil, Russia, Indonesia, Cameroon, and other forested countries) to better monitor and manage their forests. WRI experience includes preparing publications and guides, conducting training seminars, managing international exchange programs, and providing technical information and guidance.

Network of relationships. WRI has strong relationships with government agencies and NGOs in many countries in which Leveraging Lacey will be active including the United States, Indonesia, Peru, and nations of the Congo Basin. For instance, WRI recently developed a modern forest monitoring system (the Forest Resource Information System) for the Indonesian Ministry of Forestry. In addition, WRI will leverage its growing staff presence in China.

ANNEX 2. TASKS AND RESPONSIBILITIES OF KEY EXPERTS PROVIDED BY THE EXECUTING AGENCY

1. CV Project coordinator: Andrew Lowe

Name: ***Professor Andrew Lowe***

Present Address:

Professor Andrew Lowe
Chair in Plant Conservation Biology
Australian Centre for Evolutionary Biology and Biodiversity
University of Adelaide
North Terrace, 5005
Australia
Telephone: +61 8 8313 1149
Email: andrew.lowe@adelaide.edu.au
http://www.adelaide.edu.au/directory/andrew.lowe

Education

1992–1996 Ph.D Plant Evolutionary Genetics: University of St Andrews, UK
'The origin and maintenance of a new *Senecio* hybrid in England'

1987-1991 BSc (Hons) Applied Biology: University of Bath, UK
Placements in UK Agriculture Institutes and Purdue University, USA

Career Details

2006-ongoing. Professor of Plant Conservation Biology, University of Adelaide, Australia
At the University, I lead a team of 50 academics, postdocs, postgraduate students and technical and professional staff focused on tackling a range of ecological and evolutionary genetic issues.

2006-onging. Head of Science, Department of Environment, Water & Natural Resources
Developed strategic direction and external linkages for the section (75 people), and broadly across the agency (>1,000 employees). Driven an agency-wide appreciation of science.

2008-ongoing. Director of Australian Centre for Evolutionary Biology and Biodiversity (ACEBB), the Environment Institute, University of Adelaide
Integrate evolutionary and biodiversity science in the University and in collaboration with the South Australian Museum and State Herbarium, and redirected strategic and funding focus

2010-onoging. Associate Science Director, Terrestrial Ecosystem Research Network
Provide scientific and strategic direction for this national capability ($55M), to develop the human, infrastructure, data and synthesis capabilities for ecosystem science in Australia.

2010-ongoing. Chief Scientific Officer, DoubleHelix tracking Technologies
Provide strategic scientific direction to a start-up company that is developing DNA tracking and source identification tools for timber products to help fight illegal logging

2008-2010 Facility Director for ecoinformatics and national scientific research network facilities of the Terrestrial Ecosystem Research Network (TERN)
Set up functioning data and field monitoring facilities during start-up phase of TERN ($20M)

2003-2006 Lecturer, University of Queensland, Australia
Lecturer in plant ecology. Research focus on population and evolutionary genetic questions of Australasian interest, and in ecological and evolutionary functional genomics.

1998-2003 Senior/Higher Scientific Officer, Centre for Ecology & Hydrology, UK
Managed and supervised staff and resources of the Ecological Genetics Lab. Attracted more than €5 million of funding, and setup a commercial service to undertake genotyping of tree species

1998 Postdoctoral Scientist, Long Ashton /John Innes Research Stations, UK
Developed molecular marker and database tools for genetic mapping and crop improvement

1997 Postdoctoral Scientist, CEH/ Scottish Crop Research Institute, UK
Developed conservation genetic priorities for African multipurpose trees using molecular markers

1996 Consultant, International Livestock Research Institute, Kenya & Ethiopia
Characterised the genetic variation in a germplasm collection of African forage grasses

1991-1992 Science Officer, Society for Environmental Exploration, UK & Tanzania
Coordinated biodiversity work of 18 volunteers in Tanzanian Coastal Forests

Research and Teaching

- Awarded Executive Dean's prize for mid-career researcher (within 15 years of PhD) in the Faculty of Science, 2010
- Finalist for South Australian Scientist of the Year (in Research Collaboration category), 2010
- Collaborated with over 275 researchers (as evidenced by joint publications, funded projects or student supervision), from 86 institutes and 30 countries
- Since 2003, have lead 26 research grants, worth more than $34M (equivalent), and has been a partner on a further 22 grants, with a total combined income of over $100M.
- Scientific coordinator of several large research programmes (>$1M; TERN, TREND, EU), and a partner in national and international programmes (TERN, NCCARF and EU)
- Currently manage 50 scientific, technical and professional staff, including 16 academics/postdocs and 11 postgraduate students. In total, 29 postdocs/research associates have been through my lab, with 15 PhD, 4MSc and 10 BSc Honours students successfully completing
- Received high evaluations for teaching whilst at the University of Queensland (top 25% of teachers, the highest category). Upon taking over coordination of the first year ecology and environment course (approx 350 students), increased student satisfaction rating by 26%

International, National and State Service

- Associate Science Director (2011-ongoing) and previously Adelaide node and Facility Director (Reference Site Network and Ecoinformatics), and member of Host Synthesis Consortium, for Terrestrial Ecosystem Research Network (TERN; 2009-2011).
- Founding member of steering committee for Global Timber Tracking Network, established by Bioversity International (2012-onwards)
- Member of International Global Genome Biodiversity Network (2012-onwards)
- Australian co-representative on International Barcode of Life (IBOL) Science Steering Group (2009-ongoing)
- Chair and founding member of the Australian Barcode of Life Network, a national strategy group to provide leadership and integration (2007-ongoing, Chair since 2011)
- Coordinator of International Union of Forest Research Organisations (UFRO) working party on Population, ecological and conservation genetics (Unit 2.04.01) with Sally Aitken (Canada) and Wickneswari Ratnam (Malaysia), (2003-2011)

Publications and Presentations

- Published more than 150 papers and book chapters, many in high impact publications (including Science, Ecology Letters, Trends in Ecology and Evolution, Trends in Plant Science, Systematic Biology, Proceedings of the Royal Society B, Molecular Ecology, Evolution)
- Lead author of a book Ecological Genetics; Design, Analysis and Application, published in 2004, which received an outstanding review in Trends in Ecology and Evolution. It is now in its third reprint (selling more than 5000 copies) with publisher Blackwells
- Awarded Institute of Chartered Foresters' 2004 Silvicultural prize for Lowe et al 2004 Forestry 77: 335-347 ' an original and much valued contribution to the genetics of oak'

- In my career I have given over 100 public and scientific presentations and organized over 30 scientific conferences/meetings/workshops. For example, since 2008 I have given 40 invited and funded plenaries/presentations at international and national meetings, and 22 public, departmental and policy presentations. I regularly contribute to public media (over 100 featured items), and produce a blog (www.biodiversityrevolution.com.au)
- In Dec 2011, I was host and co-chair (with David Schindel, Secretary of the Consortium of the Barcode of Life, Smithsonian Institute) of the fourth International Barcode of Life Conference held at the University of Adelaide. The conference was the largest and most successful meeting yet (>400 delegates), resulting in media reports reaching 34 countries in 15 languages, with coverage by major wire services in the United States, Latin America, Europe and Asia; and over 307 online publications. Special issues of Systematic Entomology and Molecular Ecology Resources covered conference research

Grants (last 10 years)

Large collaborative or international funding

Clancy T, Phinn, Lowe AJ, Deed J (2013-2014) Terrestrial Ecosystem Research Network. DIISRTE Collaborative Research Infrastructure Scheme (CRIS, $2.8M)

Lowe AJ, Walker C, Chinnick P, Turner D (2012-1014) Harmonisation and Retrieval of Ecological Data – SHaRED. National eResearch Collaboration Tools and Resources Project, RT020 (NeCTAR, $900K)

Lowe AJ, Walker C, Chinnick P, Turner D (2012-1014) From soils to satellites: Data integration across domains. Australian National Data Service (ANDS, $500K)

Degen B, Koch G, Hardy O, Lowe A, Doucet J-L, Höltken A, Cavers S, Boner M, Kelly S, Horacek M, Yéné Yéné G, Zahnen J, Opuni Frimpong E, Ngomanda A, Odee D (2012-1016) Development and implementation of a species identification and timber tracking system in Africa with DNA fingerprints and stable isotopes. International Tropical Timber Organisation (ITTO, US$ 1.7M)

Lowe AJ, Lindenmayer D, Liddell M (2011-2014) Long-term Australian Multi-scale Plot System (LAMPS), incorporating Ausplots, LTERs and Supersites. Terrestrial Ecosystem Research Network (TERN), EIF-DIISR ($12M)

Lowe AJ, Hayman P, Bradshaw CJ, Brook B, Cooper A, Gurgel F, Ophel-Keller K, Tanner J, Foulkes J, Hamden R (2010-2013) Transect for Environmental monitoring and Decision making (TREND): Adaptive management of productive and native systems for climate change. Premier's Science and Research Fund (PSRF $1.35M)

Lowe AJ, Foulkes J *et al* (2010-2012) National Scientific Reference Site Network – Australian Rangeland Ecosystems. Component of South Australian consortium application (coordinators Meyer W and Lowe AJ) for Terrestrial Ecosystem Research Network (TERN). NCRIS-DEST ($3M)

Lowe AJ, Pillman S, Coddington P, Jenkins C *et al* (2010-2012) Eco-informatics – integrating and visualizing ecosystems information. Component of South Australian consortium application (coordinators Meyer W and Lowe AJ) for Terrestrial Ecosystem Research Network (TERN). NCRIS-DEST ($4.5M)

Williams, S, Hughes L, Stafford–Smith M, Possingham H, Hoffman A, Brook B, Lowe A, Pressey B, Williams D, Garnett S, Kitching R, Thomas C, Moritz C (2009-2013) Terrestrial Biodiversity - Adaptation Research Network - National Climate Change Adaptation Research Facility (NCCARF $1.6 M)

Meyer W, Stringer R, Lewis M, Brook B, Bryan B, Connor J, Hayman P, Fisher A, Johnson J, Lowe A, Williams S (2009-2012) Climate Change, Communities and Environment: Building Research Capability to Identify Climate Change Vulnerability and Adaptation Options for South Australian Landscapes. Premier's Science and Research Fund (PSRF $1.26M)

Kremer A, Koelewijn HP, Berenyi M, Degen B, Vendramin GG, Boerjan W, Bradshaw R, Finkeldey R, Lenee P, Amaral W, Lowe A, Brandl R, Gugerli F, Paule L, Muller-Starck G, Alia R, Morgante M, Frascaria-Lacoste N, Bhalerao R, Burczyk J, Savolainen O, Taylor G, Matyas C, Lascoux M, Reineke A, (2006-2010) EVOLution of TREEs as drivers of terrestrial biodiversity, EVOLTREE. EU (€14.7 M).

Lowe AJ, Boshier D, Kremer A, Degen B, Finegan B, Vendremin G, Gribel R, Margis R, Navarrete H, Dick C, Parolin P (2006-2010) Developing best practice for seed sourcing for planting and natural regeneration in the neotropics, SEEDSOURCE. EU (€2.6 M).

Lowe AJ, Finegan B, Kremer A, Degen B, Gribel R, Margis R, Gheysen G (2002-2005) Sustainable Management of Neo-Tropical Tree Genetic Resources: Combining molecular and modelling methods to understand the structure and dynamics of gene diversity, GENEO-TROPECO. EU (€1.2 M; £225K to my group).

Lowe AJ, Indira EP, Sudarsono, Volkaert H, Van Der Straeten D, Wellendorf H (2002-2004) Developing know-how for the improvement and sustainable management of teak genetic resources, TEAKDIV. EU (€1.25 M; £200K to my group).

Nationally competitive funding

Austin A, Lowe AJ Donnellan SC, Cooper A, Gardner MG, Cooper SJ, Weinstein P, Beheregaray LB, Waycott M, Bull CM, Wilkinson MJ, Stevens MI, Mitchell JG, Watson-Haigh NS (2012) Next generation enhancement of the South Australian regional facility for molecular ecology and evolution. ARC LIEF LE130100065 ($370K). Partner/Collaborating Eligible Organisation(s)- The Flinders University of South Australia, South Australian Museum, University of South Australia, Botanic Gardens of Adelaide and State Herbarium of SA, Australian Wine Research Institute.

Lowe AJ, Degen B (2012-2014) Developing DNA tracking methods to identify illegally logged timber products from Africa. ARC Linkage LP120100648 ($273K)

Crayn D, Costion C, Bransgrove K, Schulte K, Abell-Davis S, Metcalfe D, Rossetto M, Lowe AJ (2012-2014) What is at risk? Identifying rainforest refugia and hotspots of plant genetic diversity in the Wet Tropics and Cape York Peninsula. National Environmental Research Program: Tropical Ecosystems Hub ($344K)

Lowe AJ, Brook BW, Bradshaw CJA (2011-2014) Developing best practice approaches for restoring forest ecosystems that are resilient to climate change. ARC Linkage LP110200805 ($404K)

Lowe AJ, Rossetto M, Summerell B (2011-2014). Species and gene turnover across environmental gradients – a landscape approach to quantify biodiversity and resilience for climate adaptation. ARC Linkage, LP110100721 ($410K)

Lowe AJ, Bradshaw C, van den Hengel A, Brook B, Cooper A (2011-2014) Multi-model predictions of ecosystem flux under climate change based on novel genetic and image analysis methods. ARC Super Science Fellowships, FS1102 00051 ($556K)

Breed M, Ottewell K, Lowe AJ (2010-2012) Developing best practice approaches for restoring River Murray forest ecosystems that are resilient to climate change. Native Vegetation Research Grant ($45K)

Thomas D, Chew FT, Lowe AJ (2009-2011) DNA Verified^{TM} Timber Origin. Proof of Concept stage, Technology Enterprise Commercialisation Scheme, Singaporean Government (SING$250K)

Lowe AJ, Keppel G (2007-2009) Genetic dynamics of lowland rainforest trees on islands in the tropical Southwest Pacific. Australian and Pacific Science Foundation ($24.5K).

Richardson DM, Wilson JR, Lowe AJ, Hedderson TAJ, Hoffman JH, Sheppard AW, Witt ABR, Foxcroft LC (2007-2010) Research for integrated management of invasive alien species; Using genetic techniques to improve understanding and management of invasive alien plant species in South Africa. Working for Water Programme, South African Government (South African R 1.4 M ~ $200K).

Lowe AJ, Clarke AR, Schenk PM, Rieseberg LH, Abbott RJ (2006-2009) Why do some exotics become invasive? Using ecological and genomic approaches to test alternative hypotheses in an Australian weed, fireweed. ARC Discovery DP0664967 ($561K).

Lowe AJ, Rossetto M, Crayne D, Pole M, Lambert D, Hollingsworth P (2006-2009) Developing biogeographic know-how: Improving species divergence and dispersal estimations to examine geological and climatic evolutionary drivers. ARC Discovery DP0665859 ($282K).

Bacles C, Lowe AJ, Kremer A (2005-2007) Ecological Genomics of Sub-tropical Eucalypt Woodlands: Comparing the Structure and Dynamics of Neutral and Adaptive Genes across a Sharp Environmental Cline in Queensland Eucalyptus. ADaPtE. EU Marie Currie Outgoing Fellowship (€300K).

Government agency, Non-government agency, research centre or commercial contract

Lowe AJ (2011) Study on the Genetic Differentiation of Remnant Populations of Atriplex sp. Yeelirrie Station. BHP Billiton ($160K)

Lowe AJ (2009-2010) DNA barcoding of Australia's trees. Australian Biological Resources Study, DEWHA, Australian Government ($80K)

Lowe AJ, Bickerton D (2007-2009) Genetic delimitation and health assessment of threatened flora. Department for Environment and Heritage SA ($100K)

Lowe AJ (2005) Phylogeography and genetic identity of cats claw in its native and introduced ranges. Department of Natural Resources, Mines and Water QLD ($50 K).

Lowe AJ (2005) Combining phylogeographic connectivity and habitat modeling to establish the response of Wet Tropic montane vegetation to climate change. Rainforest CRC ($25K).

Schmidt S, Lowe AJ (2005-2006) Spontaneous Evolution Technologies. ($160 K).

Publications in international journals *(last 10 years)*

2013

1. Breed MF, Ottewell KM, Gardner MG, Marklund MHK, Dormontt EE, Lowe AJ. Mating patterns and pollinator mobility are critical traits in forest fragmentation genetics. *Heredity*. Accepted.
2. Hereward JP, Walter GH, Lowe AJ, DeBarro PJ, Riginos C (2013) Gene flow in the green mirid, *Creontiades dilutus* (Hemiptera: Miridae), across arid and agricultural environments with different host plant species. *Ecology and Evolution*. doi: 10.1002/ece3.510
3. McCallum KP, Guerin GR, Breed MF, Lowe AJ. Combining population genetics, species distribution modelling and field assessments to understand a species' vulnerability to climate change. *Austral Ecology*. Accepted.
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2. Key people from other collaborating institutes

Title and name	Occupation	Institution	Expertise relevant for the project	Country	Responsibility
Dr Anto Rimbawanto	Manager	Centre for Forest Biotechnology and Tree Improvement in FORDA	Genetic fingerprinting Education and training Sampling	Indonesia	Oversee work of the Project secretariat, scientist and field coordinator in Indonesia
Prof Bernd Degen	Director	Thunen Institute – Institute of Forest Genetics	Genetic fingerprinting	Germany	Oversee work of technician in Thunen Institute
Mr Adam Grant	Timber supply chain management	World Resources Institute	Forest governance and policy analysis	USA	Assist CFBTI in FORDA in evaluation of existing log tracking systems and identifying the required conditions in Indonesia for implementation of DNA markers in timber tracking

ANNEX 3. TERMS OF REFERENCE OF PERSONNEL AND CONSULTANTS AND SUB-CONTRACTS FUNDED BY ITTO

Terms of reference for the scientific project coordinator at University of Adelaide

- Setup the contracts between the executive agency and ITTO and between the executive agency and the collaborative agencies
- Supervise the implementation of the work plan and work
- Supervise the monitoring and evaluation of the project progress and budget development
- Organize the steering committee meeting, project meetings, ITTO monitoring visits
- Organize the project reports: project inception report, progress report and technical reports
- Obtain feedback on project implementation from stakeholders
- Organize the dissemination of project results

Terms of reference for the technical project coordinator at University of Adelaide

A technical coordinator will be appointed at the University of Adelaide as a full time position for day-to-day project management. He /she will work under the direct supervision of the scientific project coordinator to:

- implement of the work plan and work
- monitor the project progress and budget development => enter the information into the ITTO online monitoring system
- help to organize the steering committee meeting, project meetings, ITTO monitoring visits
- write the project reports: project inception report, progress report and technical reports
- keep in contact with the stakeholders
- work on the dissemination of project results
- create and update the project home page
- prepare and send out project homepage

Terms of reference for UoA and CFBTI in FORDA as collaborating agencies for species identification based on DNA barcoding

- sequencing of target genes for 100 samples
- searching for SNPs (single nucleotide polymorphisms), fragment length differences in the chloroplast genome among 50 species
- new primer design for short PCR amplification products (< 350 bp) that include the SNPs
- selection of restriction enzymes that distinguish between the SNP haplotypes
- verification of the DNA barcoding for 50 wood probes in frame of the blind test

Terms of reference for CFBTI in FORDA as collaborating agencies for sampling

- Sampling of cambium or leaves from 400 red meranti trees from 40 sampling locations (10 individuals sampled at each location) in the natural distribution area in Indonesia
- Sampling of cambium or leaves from 400 light red meranti trees from 40 sampling locations (10 individuals sampled at each location) in the natural distribution area in Indonesia
- Sampling of wood samples along the chain of custody for the blind tests

Terms of reference for UA, TI, CFBTI in FORDA for the development of the genetic reference data base

- Optimization of DNA extraction protocols for wood (UA)
- Development of gene markers (chloroplast and nuclear microsatellites, SNPs) with high variation and clear spatial pattern for trees (UoA)
- DNA fingerprinting of 800 meranti trees (UoA, TI, UGM)
- Blind testing of 50 samples from unknown origin based on DNA fingerprinting (AU)

Terms of reference for UA and DX as collaborating agencies for pilot studies on the DNA-fingerprinting tree by tree along the chain of custody

- Sampling of cambium or leaves and wood probes
- DNA fingerprinting (SNPs) of 100 trees (UA)
- Training of local staff (DX)

ANNEX 4: Responses to reviewer comments/recommendations

Reviewer Comments/Recommendations*	Amendment(s) made**	Page #***
1.3.1It has been added that samples will be collected in Kalimantan, however it is still not clear whether it will be across Kalimantan or limited to selected areas.	*Section 1.3.1 (Geographic Location) was modified as follows: "The project team will collect samples from across Kalimantan to target all species. The exact locationsfor collecting samples will be determined when the project is up and running"*	*9*
2.1.1 Although the organizationsal setup appears very solid and now involves the Indonesian Government, the tasks of each partner are not clear in this chapter. Some information is provided in the workplan for UoA and FORDA and also under Chapter 4, but complete information needs to be provided under this chapter.	*Reviewed text on the role of FORDA now reads: "FORDA is a key provider of forest research in Indonesia and has a major stake in the development of DNA tracking technologies for chain of custody compliance. As a part of the Ministry of Forestry, FORDA is in an ideal position to influence the policy agenda in Indonesia. The involvement of FORDA in particular and the Ministry of Forestry more generally will be at a strategic level on the Steering Committee and at an operational level as a key delivery agent for the project. Crucially, FORDA will also ensure the ongoing sustainability of the outcomes from this project by acting as the champion and delivery agent of DNA testing inside the Indonesian government."*	15
2.1.4 Under 'Indicators' for the 'Specific objective' Output 2 it still reads ' • By 2015, a DNA fingerprints timber tracking system is ready for use for THREE timber species' - shouldn't this be TWO species? *Impact indicator (by 2016, certification standards have integrated DNA as additional audits) should be amended as it is almost impossible for such integration. Perhaps it may be amended with the wording of "recognized" instead of "integrated".*	*In Section 2.1.4.,* *Under 'Indicators' for the 'Specific objective' Output 2 it now reads ' By 2015, a DNA fingerprints timber tracking system is ready for use for TWO timber species'* *Impact indicator now reads 'By 2016, certification standards have recognised DNA as additional audits'*	22
3.4.3 "ITTO Programme Support Costs (12%) should be recalculated based on the total amount of subtotal 2 in the ITTO budget table. *ITTO Monitoring and Review must be increased to US$ 6,000/year.* *As already commented earlier, ITTO projects require annual PROJECT audits, plus a final audit - which have to follow the ITTO rules. If such expenses are not budgeted, then the EA is expected to cover the audits. If the latter is the case, then such expenses can be included and considered as EA contribution. Otherwise appropriate amounts should be included in the budget.*	*Budget has been changed to reflect an increase in budget for ITTO Monitoring and Review to US$6,000 pa* *The ITTO Programme Support Costs (12%) have been recalculated based on total amount of sub-total 2 in the ITTO budget table.* *NOTE: No savings have been made elsewhere in the budget to bring the budget back to match the original proposal. This can be done quickly if required, but was not done in this case because the change in the budget was less than 1% of the total.*	49,51
3.5.1. Insufficient information on role of local partner may present a risk to the sustainability of the project.	*Given that the information on the role of the local partner has been clarified and improved, we no longer regard it as a significant risk. A dot point under the assumptions notes: "The local partner CFBTI/FORDA will play a key role in the project delivery and governance and will continue to promote the use of DNA-based*	54

Reviewer Comments/Recommendations*	Amendment(s) made**	Page #***
	compliance within Indonesia" *In the table on page 56, under the risk:Strong support from partners and stakeholders, added under mitigation "Involvement of MoF through CFBTI in FORDA in the delivery of project. Include decisions makers from Indonesia agencies on Steering Committee for project".*	55
3.5.2 Further elaborate on FORDA/CFBTI's continued role/research to ensure the strengthening of the sustainability after project completion	*Added to the third paragraph under Sustainability: "The organization already undertake timber log tracking work for other species such as Merbau. FORDA will lead these particular components and will participate in all aspects of the project governance and delivery. They will ensure the ongoing sustainability of the outcomes from this project by acting as the champion and delivery agent of DNA testing inside the Indonesian government after the project has been completed. "*	56
4.1.1 Under FORDA, CFBTI should appear as the key collaborator for this project. This should be harmonized throughout the proposal including on the Cover Page.	*This has been harmonised throughout the document, including the cover page.*	*multiple*
Proposal can be further strengthened by clarity provided on specific roles of local partner.	*See points addressed above*	*multiple*

Please expand table as needed

* *In this column please insert the individual reviewer comments/recommendations*
** *In this column please describe which change(s) you made (see examples)*
*** *In this column please insert the page number where changes have been made*